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EDUREFORM

Focus on

Re-thinking education in the age of AI

EDITORS
STEFANO GRECO
LETIZIA CINGANOTTO

AN INTERNATIONAL AND OPEN ACCESS JOURNAL
BY THE ITALIAN E-LEARNING ASSOCIATION

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EDITORIAL

Re-thinking Education in the Age of AI

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Why to re-think education?

Previous industrial revolutions have transformed the socio-economic structures of society, dissociating human productive processes from animal power, creating the pre-conditions for mass production, and bringing digital devices into the houses of billions of people. The technological innovation associated with the industrial revolutions led to profound sociological, economic and educational changes, having an extensive intergenerational impact.

As observed in the past, the Fourth Industrial Revolution will gradually change the role of humans in the economy and society. The mainstreaming of artificial intelligence (AI) and the progress in the field of robotics will create new technologies fusing physical, digital and biological worlds. In discontinuity with the previous industrial revolutions, the impact would not be confined to a specific productive sector, but conversely, it will also affect the service industry. This transformation will challenge the relevance of the contemporary normative theories related to society and the economy. The Fourth Industrial Revolution will encompass the life and employability of future generations, creating new opportunities and novel dividing lines. In 2015, a report jointly issued by Citi and Oxford University, estimated that 57% of jobs are at risk of automation, while a study from PwC (2018) predicted that by 2035, almost 50% of the low-skilled workers would be replaced by machines and software. As the economists Erik Brynjolfsson and Andrew McAfee (2014) pointed out, technological advancement in AI and robotics could yield greater inequality, generating an extensive reorganization of the labor market. The reshuffling of the labor market will primarily affect the employability of individuals from disadvantaged socio-economic backgrounds. As

explained by Martin Ford (2015), the jobs most at risk are those in which the tasks allocated are related to routinary, repetitive and predictable actions. In this scenario, even in low-income countries, workers would not be in a position to compete with the robots and software.

In the wake of the Fourth Industrial Revolution, policymakers and educators need to re-think education vis-a-vis the mutation occurring in society and the labor market. Educators, psychologists – and experts in social sciences – should play a pivotal role in assisting policymakers in transforming socio-ecomomic challenges into opportunities. Therefore, reshaping education through the use of learning technologies in all possible developments (e.g., innovative pedagogies, webtools, open educational resources, platforms, AI, robotics) is the need of the hour. A multilingual approach to education (Council of Europe, 2022) should also be considered within this framework, taking into account the strategic significance associated with linguistic and digital competencies by the European Commission (2018) and the importance of a pluriliteracies approach to education (Coyle and Meyer, 2021; Cinganotto and Cuccurullo, 2019).

The contribution of the special issue to the scientific discussion

The special issue *Re-thinking Education in the Age of AI* aims to provide an interdisciplinary and holistic contribution to the discussion over the readaptation of education to the ongoing technological advancements. The publication has been supported by the Erasmus+ EDUREFORM project, co-financed by the European Union. The articles address different pedagogical and scientific aspects related to education, technology and socio-economic mutation.

The special issue opens with an article from ***David Marsh***, which brings to light the juxtaposition between education and technological advancement. Adopting a realistic approach, the author illustrates the challenges that policymakers and practitioners will face to embed artificial intelligence in the existing curricula. The following contribution from ***Nick Saville*** provides a pragmatic reflection on the use of AI in language education. While acknowledging the inefficacy of banning AI from the classroom, the article ponders the strategies practitioners could use to enhance students' performances. Through case analysis and participant observation methodologies, the article presented by ***Stefano Greco*** researches the ability of public programs and international cooperation initiatives to transform the education sector. With this goal, the socio-economic challenges of the Fourth Industrial Revolution have been applied to the critical analysis of the Erasmus+ programme in India. Based on the training mobility organized in the framework of the EDUREFORM project, the study conducted by ***Letizia Cinganotto*** aims to assess the reactions of Indian pre-service teachers to innovative teaching practices. The study conducted in Italy reports the results of the experimental teaching activities, identifying possible paths toward the promotion of multilingual and intercultural pedagogies in India. Focusing on linguistic comprehension and deep learning, the interdisciplinary research conducted by ***Gunta Rozina***, ***Indra Karapetjana*** and ***Marina Losevica*** relates the transformations arising from the Fourth Industrial Revolution with the learners' cognitive abilities. The contribution is based on the critical contextualization of case studies where linguistic obstacles impair the students' learning processes.

The following article, co-authored by ***Madhavi Shamkuwar***, ***Priya Jindal***, ***Rahul More***, ***Pandurang Patil*** and ***Pravin Mahamuni***, broadens the discussion, presenting a systematic literature review on the expansion of AI in the research domain. The aim is to comprehend the contributions of the scientific literature in defining how AI can be integrated into higher education curricula to enhance learners' performance. A connected study presented by ***Kalyani Pande***, ***Vaibhav Jadhav*** and ***Mahesh Mali*** investigates the attitude of Indian secondary students toward AI. The research explores how the students perceive the inclusion of new technologies in the learning sessions with a specific focus on the role of the teachers in the classrooms. A similar study has been conducted by ***Chaitali Sarangi***, ***Tanushri Mohanta***, ***Moumita Pradhan*** and ***Nibedita Guru*** to assess the impact of COVID-19 on the learning methodologies deployed by teachers. Based on the qualitative and quantitative interviews engaging Indian teachers and students from different schools, the research investigates how technological developments have penetrated the learning practices following the coronavirus pandemic. Providing a supplementary insight on education and technology, the work of ***Shama P. Ansari*** and ***Ashutosh Biswal*** scrutinizes the attitude of future Indian in-service teachers towards online learning. The experiential investigation is based on the exposure of the target group to MOOCs, collecting integrated qualitative feedback regarding the attitude of future Indian teachers towards online learning. Continuing the examination of digital technologies and pedagogical practices, the article by ***Debanjali Roy*** and ***Tanmoy Putatunda*** analyzes the integration of AI tools in English literature classrooms. By referring to classroom experiences, the study demonstrates how AI can be instrumental in developing collaborative learning practices.

The special issue also provides space for pedagogical strategies training critical, analytical and creative skills among the learners. The study proposed by ***Nidhi Waldia***, ***Vaibhav Jadhav*** and ***Mahesh Mali*** examines microlearning strategies as a pedagogical solution to the Education 4.0 challenges. Following this objective, the research assesses Indian teachers' preparedness to

utilize microlearning in the classroom. The following article from ***Meenal Arora*** proposes video-making as a further pedagogical tool to revise education practices vis-à-vis the challenge of the Fourth Industrial Revolution. The study engaged Indian pre-service teachers to comprehend the relationship between the creation of videos and the student's learning process. Chasing a similar path, ***Pooja Singh*** and ***Jyotika Guleria*** investigate the attitude of Indian undergraduate students towards sketchnoting pedagogy. The study aims to assess if sketchnoting could be a valuable tool for teachers to enhance learners' skills. Conducting a survey based on the observation of Indian pre-service teachers, ***A.V. Jayalakshmi*** and ***Ashutosh Biswal*** examine the impact of the open book environment in higher education. More specifically, the research assesses how a learning environment characterized by open book assessment influences the learners' critical, creative and analytical skills. Continuing to examine innovative teaching practices, ***Manisha*** and ***Shubham Gargrish*** comprehensively review augmented reality (AR) use in education. The final aim of the study is to inform educators interested in incorporating AR technology in educational settings.

The special issue pays specific attention to studies providing an interdisciplinary perspective on the impact of the new technologies on the learning environment. The digital divide is at the center of the contribution offered by ***Vidyanand S. Khandagale***. Through the collection of quantitative and qualitative data, the paper identifies the strategies deployed in the Indian scenario to mitigate the detrimental socio-economic impact of the digital divide. The last article of the special issue developed by ***Roopali Kansal*** and ***Payal Bassi*** provides a holistic perspective on the modernization of the education sector. The paper illustrates the role that architecture can play in reshaping learning spaces to the needs of education 4.0, emphasizing the importance of enlarging the focus of the discussion towards different subject areas.

Education and Fourth Industrial Revolution: The way forward

Adapting the education system to the mutation of the labor market and society remains a rebus. Policymakers and practitioners are not yet fully aware of the challenges ahead. The proclamations from the tycoons of Silicon Valley in favor of public schemes for guaranteed income reveal their concern regarding the impact of AI and robotics on human employability. As occurred during the previous industrial revolution, the upcoming technological developments will substantially restructure the agricultural, manufacturing and service sectors. Policymakers should deeply re-think education to mitigate the detrimental socio-economic effects of the Fourth Industrial Revolution. In the first place, practitioners and scholars should be aware of the nature and the magnitude of the challenges ahead. Awareness campaigns would be instrumental in enlarging the pool of experts interested in transforming education, bringing forward experimental teaching practices to train learners' analytical, creative, and critical skills. New digital devices would hardly excel in those skills, representing an essential asset for workers willing to escape the technological unemployment trap. For this reason, curricula should avoid aiming at mere memorization, and educators should be aware of the importance of developing out-of-the-box skills among their students. Until today, these skills are often considered an inborn peculiarity of the learners. Contrary to the vernacular beliefs, out-of-box skills can be trained. The advent of the Fourth Industrial Revolution brought into the agenda of the policymakers the dilemma of how the education system could effectively train analytical, creative and critical skills among the learners. The way forward entangles a paradigm shift, moving away from the empty motto 'think out of the box!'. With the support of scholars and educators, policymakers need to define how the schooling system can support deep learning among students. As mentioned earlier, society must be aware of the challenges ahead to achieve this goal. Without this step, there is the concrete risk of underestimating the socio-economic consequences of the Fourth Industrial Revolution, leaving society unprepared for the labour market's transformation (and its socio-economic consequences).

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INVITED PAPER

AI and the contemporary educational landscape: a personal view

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1. Introduction

This article is about the juxtaposition of two phenomena. Education which often develops slowly, and AI which is showing exponential growth.

Whereas scientific understanding of how to best educate people, young and old, has advanced significantly in the past 30 years, using this knowledge to innovate educational practice is often slow. There are different reasons discussed as to why this is the case. Some concern disruption of longer-term systemic development by often short-term political interests. Others are linked to the influence of educational industrial interests that want to maximize market share and maintain the commercial status quo mainly through publishing and testing.

One classic example of disjuncture between what is understood to be beneficial for learning and what happens in practice relates to how we teach and learn additional languages. In a 1629 publication, The Door of Languages Unlocked, John Amos Comenius proposed a view that language cannot be successfully taught without relation to content. Yet now some 400 years later, language teaching in many parts of the world remains dominated by teacher-centric traditional approaches focused on language structures, devoid of content other than grammar. A complementary approach close to what Comenius was proposing, Content and Language Integrated Learning (CLIL), is steadily being realized in practice globally, but it has already been some 30 years since its launch in 1994.

The term AI was launched in 1956. Since then, we have seen steady development and application of what is termed Artificial Narrow Intelligence (ANI) throughout societies. Since November 2022, there has been widespread discussion on the implications of publicised applications, particularly on generative AI. During 2023 this discussion spread through educational communities with varying degrees of often polarized argumentation. Some of this discussion, in and outside education, has been on the threats and potential of emergent Artificial General Intelligence (AGI) which would involve applications being able to operate at high levels of human intelligence.

One form of generative AI launched by Open AI in 2022 is ChatGPT. There are many others such as Bard,

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Bing, Chatsonic, Jasper, Perplexity, and Youchat. Some of these chatbots are not new. For example, one chat robot, Eliza, was developed by Joseph Weizenbaum at MIT in 1966 as a psychiatrist conversational interface. But since 2023 much discussion in educational circles has focused on the ChatGPT version 3 launched in November 2022, subsequent versions, and what can be done when different types of generative AI are combined.

To get a sense of how rapid generative AI is developing it is worth looking at the changes in different versions from a single provider, Open AI. ChatGPT-1, launched in 2018, was designed according to 117 million parameters. A parameter is a measurement of the complexity and capacity to learn from input data. ChatGPT-3 involved 175 billion parameters, and in March 2023 ChatGPT-4 involved 100 trillion parameters.

During early 2023 discussion within education was heavily reactive, focusing on potential problems and threats. One of these has been on how to prevent students from using generative AI to engage in unethical behaviour such as cheating and plagiarizing. Later in 2023 this discussion shifted towards re-conceptualizing academic integrity, and looking to see how AI, present and future, could be harnessed to enhance education. A key interest was on how the emergence of generative AI could provide opportunities to adapt assessment practices (Cochrane & Ryan 2023) and reimagine possibly outdated assessment strategies (QAA, 2023). Another was on how it could become a new tool to help teachers with their workload and enable them to function even more effectively.

By the time you read this article both AI development and educational discourse on its use may have evolved considerably. However, it can be suggested that such discussion is likely to revolve around one key constant. This constant involves analysing the potential of AI, not just in terms of functional features of teaching and introducing rules, regulations and possibly firewalls to prevent misuse through unethical student behaviours, but in relation to more holistic views on life, learning and wellbeing in school, out of school, and in future life.

The rapid development and crucially, accessibility of AI, is one aspect of the multi-dimensional changes that we can see within the diverse ecosystems in which education exists globally. Discussion about the role of generative AI and education, now and in the future, is not productive if it only focuses on what happens within the confines of educational institutions. The recurring constant in this discussion is that this is not just about technology, but about humanity.

2. Scoping the Landscape of Digital Natives

School are microcosms of their respective surrounding societies, and because these societies differ significantly, generalizations about good and less good teaching practices may be superficial. But since around 2010 we have witnessed important developments in relation to learners and learning across the world. One of these is an emerging global cultural new order driven by access to technologies in which young people's lifestyles are markedly different to earlier generations.

The 2020-2023 COVID-19 pandemic accelerated access to new technologies by citizens, but the trends have been evident for many years particularly with respect to access, age, use and time-on-screen. Impact on the lives, cognition and aspirations of young people has been given considerable attention. See, for example, James et al. (2017); Twenge (2017); Firth et al. (2019); Dienlin and Johannes (2020); Haidt (2021); Haidt, Rausch, & Twenge, (ongoing).

Self-reported student hours spent online and access to the Internet at home for schoolwork have been reported as steadily rising (PISA, 2018). At the same time studies, for example in the Anglosphere, indicate that since around 2012 some societies have reported rapid increases in levels of anxiety and depression amongst young people, especially females. For example, the biannual report (CDC, 2023) of the USA Centers for Disease Control and Prevention reports that whereas adolescent females reporting persistent sadness or hopelessness was 36% in 2011, by 2021 this had risen to 57%. Those who had seriously considered suicide was reported as 19% in 2011, and 30% in 2021. Male adolescent levels are also reported as rising but the increases are smaller, and the rates not at the same levels as with females. One cannot assume that digital lifestyles are the main cause of such changes as there may be others relating to contemporary life. However, this is one cohort of the young people now in education, and when we think about AI in education, issues like this on mental wellbeing need to be part of the picture.

In a meta study on social media as the major cause of what is commonly termed the mental illness epidemic amongst young women in specific societies, principally the USA, UK, and Canada, Haidt (2023) comments 'the arrival of smartphones rewired social life for an entire generation. What did we think would happen to them?'

Studies have been published which claim to show little to no evidence that social media has a detrimental effect on the lives of young people. One well-publicized example is by Orben and Przybylisti (2019) who studied over 17 000 adolescents in the UK, USA, and Ireland. This report has been widely cited to argue that there are few to no adverse effects from forms of online engagement. But using the same data set Kelly et al. (2018) found significant evidence of causal relationships between social media use and the mental health of adolescents.

There are huge global enterprises operating social media networks (Facebook, YouTube, Whatsapp, Instagram, WeChat, Tik Tok, Snapchat) that have considerable commercial vested interests in arguing against links between use and harm. This means that studies which argue one way or another need to be scrutinized in relation to how they have been funded, and what data has been used for analysis. For example, has the study focused on a single platform that young people may have access to but rarely use for frequent and valued communications and entertainment. Does a study of young people's behaviour which uses data from, for example, Facebook, differ to one on use of others such as Instagram or TikTok, where Facebook might be used for connection with family and relatives, but others are used for the 'real action'.

Haidt (2023) specifically refers to a period when health statistics revealing cause for concern started to reveal upward trends. He writes

> *"Instagram was founded in 2010. The iPhone 4 was released then too – the first smartphone with a front-facing camera. In 2012 Facebook bought Instagram, and that's the year the user base exploded" (Haidt, 2023, p. 35).*

Haidt reports that the

> *"magnitude of association between social media use and depressive symptoms was larger for girls than for boys…. Greater social media use related to online harassment, poor sleep, low self-esteem, and poor body image, in turn these related to higher depressive symptom scores. Multiple potential intervening pathways were apparent, for example: greater hours social media use related to body weight dissatisfaction (≥ 5 h 31% more likely to be dissatisfied), which in turn linked to depressive symptom scores directly (body dissatisfaction 15% higher depressive symptom scores) and indirectly via self-esteem" (Haidt, 2019, p. 59).*

Reporting on health and digital use is of key importance when we examine the role of generative AI in education. Put simply, it may be that digital connectivity does not lead to supportive human connectedness. And this is what we need to consider when facing, as now, a new wave of AI technological developments that may or may not enhance teaching and learning throughout education. The ecosystems surrounding schools and therefore teachers and students, their work, their lives online and offline, are undergoing profound change due to the interconnected environmental, societal, geopolitical, and economic polycrises affecting the world.

The educational landscape is changing because the wider environment is changing and AI is one feature that is inter-connected with others. AI has the potential to be a change agent which could be harnessed in education as a force for good, but it is only one reality to which education needs to adapt. This means focusing on not only what happens in school, or with homework assignments, but also out-of-school lifestyles.

> *"Digital technologies have become an integral part of our lives. Many common activities that once required physical contact, such as talking to family and friends, or consulting a doctor, are now carried out online. The digital space is no virtual second life, but it is an intrinsic part of one's life" (OECD, 2022, p. 10).*

Talk in education about increasingly technology-driven life, what it can bring to people and what it can take away, is increasingly on not just functions but the roles of key players, namely students and teachers. Both are now subject to adaptation and change, and not only because of AI. The role of the teacher as a person, a human interface, who strives to realize the best potential of all young people in their care, and the role of the student as an 'active learner' are both heightened. Mitigating the negative challenges resulting from technology-based lifestyles, and other environmental and geopolitical polycrises now affecting the world can be supported by AI but needs to be driven by students and teachers alike, often in new teaching and learning sub-cultures.

3. Shaping Tomorrow: Building Knowledge, Competences and Future-readiness

We can see that young people are acquiring new and crucial skills from their experience of living with integrated technologies from a very early age. This influences how they process and use information. A significant study by Firth et al. (2019) argues that use of the Internet can result in acute and sustained changes in cognition, specifically attentional capacities, memory processes, and social cognition.

We can see that these technologically astute young people are increasingly generating their own contexts for and habits of learning, and that in many countries the speed of this is outpacing how we are responding in education (PISA, 2018).

We can see that convergent and multi-dimensional advanced technologies are creating innovative environments which provide new opportunities for combining the learning of subjects in the curriculum with competence-building for the future. Discussion on AI is particularly significant when we consider the simultaneous building of knowledge, competence, and future-readiness throughout education.

One characteristic of new and adapted curricula is to include life-centric intended learning outcomes that

blend both knowledge and competences. AI has been identified as a possible tool to break away from the inefficiency of generic prescriptive curricula (one size fits all) and provide opportunities for AI-enabled personalised learning that can meet the individual needs of all learners, and supporting their wellbeing, mental health, and resilience.

Building knowledge and competence-based intended learning outcomes into curricula is innovative in some countries, but building capacity to realize these through pedagogical practices is the key to achieving successful curricula transformation. Developing high-impact pedagogy, the science of teaching, can take decades to cascade throughout an educational system. But now AI could play a key role in accelerating both the diversification of learning methods and opening up of new learning opportunities, especially for those who have specific learning needs, neurodiverse learning preferences, or are otherwise marginalized, through what is termed personalized, individualized, and differentiated learning. It also introduces opportunities for adults to engage in lifelong learning, especially for reskilling during periods of employment transition.

There is an educational adage relevant to functional innovative curricula, namely that the curriculum is a tool, not a rule. It is the teacher who is expected to apply a curriculum, and sometimes course curricula are heavy in detail and time-consuming to implement. This, alongside possibly high levels of time required for administration, can make the work of a teacher very demanding. TALIS (2018) reports on professional stress resulting from time spent on continuous grading and reporting and how this reduces time available for enabling student achievement. AI can be used by teachers, and educational entities, to reduce administrative time-on-task and therefore provide space, if not personal energy, to operationalize new curricula through pedagogies. For example, Spain which has recently updated curricula (LOMLOE, 2021) which repeals earlier versions (2006 and 2013) has faced resistance from teachers not because of the learning goals, but the extra administrative workload involved, amongst other challenges (Gortazer, 2020).

The broader goals of a curriculum that serves to enhance the capacity to learn and prepare for actively engaging in lifelong learning after formal education typically focus on learner agency, engagement, efficacy, cognition, and competences. Developing student agency (taking responsibility and making choices); engagement (being involved in constructing teaching and learning processes); efficacy (self-belief in having capacity to reach goals); cognition (analytical systems thinking); and competences (applying knowledge and know-how to solve problems and achieve goals) are widely viewed as essentials in leading-edge curricula. The question is now if and how AI could be used to enable students to navigate development of these in and outside school, and how it could transform outdated teaching and learning environments.

Statements of intent on improving education such as the 2019 Alice Springs (Mparntwe) Education Declaration can now be seen throughout the world.

> *"The Declaration includes some significant changes to ensure Australia's education system continues to provide the best opportunities for young Australians in a rapidly changing world… Education has the power to transform lives. It supports young people to realise their potential by providing skills they need to participate in the economy and in society and contributing to every aspect of their wellbeing" (Australian Education Council, 2019, p. 2).*

Now there are increasing numbers of guidelines on generative AI educational policy and descriptions of how it can lead to change available such as through Miao at al. (2021) and Sabzalieva and Valentini (2023) for UNESCO, Tuomi (2018) for European Union, the UK's QAA (2023) and Russell Group (2023), and through international crowdsourcing such as Nerantzi et al. (2023).

National and regional changes to curricula focused on developing skills for future-ready adult life in the Information Age involves recognizing that AI will play a significant role in student's future lives, and that learning to use it should start from an early age. This does not mean taking up classroom time with students on digital devices because that limited time needs to focus on student-teacher interface. But it does mean developing competences that encompass all aspects of the digital world into teaching and learning processes. One example is the introduction of 'futures readiness' into Finnish education from 2016 to 2019 for students from age 7 years upwards (FNAE, 2014).

Futures readiness involves developing student agency; engagement; efficacy; cognition; and competences. Some competencies and related skills relate to managing safety and security in virtual and other digital spaces; awareness of the forces that can be used and unleashed in cyberspace; communication ethics; navigating internet superhighways; and being empowered to use forms of AI for good. Just as the slide rule (1850s) and calculator (1960s) provided new tools to enhance the learning of mathematics and engineering, so AI can be used to improve educational access and equity. But the key foundation for realizing all of these depends not on tools and machine learning but on the knowledge, skills and understanding of AI by the teacher whose principal task is to "engage in a practice of human improvement" (Hattie, 2023, p. 215).

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INVITED PAPER

The future of language learning in the era of ChatGPT

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1. Introduction

Originating in the 1950s, Artificial Intelligence (AI) refers to the capability of machines to emulate human-like intelligence by executing tasks humans can do, such as understanding language, and problem-solving. However, in recent years AI has become a buzzword in the media and it needs to be demystified and explained more clearly if we are to take advantage of it in educational contexts. Practitioners must now navigate potential pitfalls and risks, including ethical considerations, and come to terms with the implications.

2. The era of ChatGPT

"The Age of AI has begun", Bill Gates claimed in his blog on 21 March 2023, and like Gates, many commentators now think that AI will be as revolutionary as the internet in the 1980s and the invention of smart phones that ushered in the 4th Industrial Revolution about 15 years ago (the era of Data and Devices). However, the speed of change and potential for disruption, has taken many by surprise. In less than two months following its release in November 2022, Open AI's ChatGPT gained over 100 million users, and for the first time the global public became familiar with the jargon that accompanies this kind of *generative AI* (GenAI): large language models (LLMs), machine learning (ML), natural language processing (NLP), black box algorithms, amongst others.

As the influence of these latest AI models widens and developments continue at a breakneck pace, established ways of thinking and current practices will be disrupted in many sectors of society, including language education. The challenge for educationalists is to come to terms with the key concepts and jargon and to

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understand better the risks and benefits that educational uses of AI might bring in their own teaching, learning and assessment contexts.

In the first months after its release there were mixed reactions to ChatGPT from politicians and policy makers, and in some cases there were attempts to ban its use in educational and other societal contexts. This was not an unprecedented early response to disruptive technologies, and there have been several other examples in the past where the new tech was banned from the classroom when it first came out. Perhaps the most memorable was the pocket calculator which was first released in 1972 by Hewlett-Packard. Some educationalists believed that this handy device would have a negative effect on children's learning of arithmetic, and initially calculators were not allowed into schools in some jurisdictions. However, once the devices became popular and students had access to them at home, it became clear that they were being used, despite the policy e.g., to do homework. Moreover, it was realised quite quickly that the *potential benefits* of using calculators outweighed the risks. Similarly, there was concern over Wikipedia in the early 2000s based on fears that students might use it to avoid conducting their own research in libraries. In both cases, teaching and learning practices adapted to accommodate the new tech. So, a more realistic option is not to ban ChatGPT and similar types of AI, but to seek to understand them better and to explore ways to use them with caution.

In considering the future of language learning in light of the recent AI developments, a number of questions can be posed related to the role that humans will play in combination with machines:

- In what ways will practitioners – teachers, assessment specialists etc. – need to adapt their roles and current practices to benefit from the opportunities that AI-based systems can offer?
- What practical steps can be taken to ensure that AI-based systems are used to make improvements over current practices?
- How can policy makers and practitioners working together address the risks associated with the latest AI models?

In using artificial intelligence (AI) for educational purposes, teaching and learning must remain the central concern for policy-makers and practitioners. As a first step in answering these questions, it worth remembering that existing challenges in delivering educational goals supported by educational technologies (EdTech) are the starting point. Hitherto the take up take been slow and difficult to integrate into existing practices on a large scale. This is partly due the wide range of, sometimes competing, objectives that formal education has to deliver.

In language education, the priorities for language educators, both at policy level and in schools, are still related to the following: *delivering the curriculum; setting and raising standards; improving teaching and learning outcomes;* and *innovating and managing change.* Added to this list most recently are concerns for *diversity* and *sustainability*, in light of global crises related to migration and climate change. The real world impacts of language education in schools, relate to important societal goals, such as the need for higher levels of plurilingual communication skills and intercultural competence, as well as transferable competences that enhance employability (cf. 21st century skills).

Taken together, this means that the emerging technologies need to enhance the communicative approach to language teaching and ensure that the social and educational values that are associated with it remain the priority. The well-being of learners must continue to be emphasised alongside the cognitive and meta-cognitive aspects of their development.

EdTech has been around for many years, and traditional models of AI already play an important role in language assessment, for example, in carrying out the automated assessment of writing tasks and compositions. However, it has proved difficult to scale up digital technology and to integrate it widely into school contexts. This in turn has limited the use of AI for educational purposes as it depends on the digital tech, and especially the collection and use of digital data. But the last three years have provided a watershed moment brought about by the following two events: a) the pandemic (2020-22) that forced us all to adopt new practices using the available digital tech (e.g. video conferencing); b) the wider familiarity with AI across all sectors of society since the arrival of ChatGTP in 2022.

With this in mind, the questions posed above can be answered by considering the following three points:

- Hybridity as a design principle;
- Understanding AI in order to retain focus on educational values;
- Ethical considerations.

I believe that by addressing these together, we can ensure that the *Technology Tail* does not wag *the Educational Dog,* and that we can open up exciting new possibilities that have so far been impractical on a wide scale: e.g., personalised learning experiences; interactive learning environments that enhance accessibility and improve learner engagement; streamlined assessment processes that offer real-time feedback for diagnostic and formative purposes; etc.

3. Hybridity

Hybridity (or hybridisation) became an established concept during the pandemic (2020-22) and a range of blended solutions were deployed as a necessary response to the emergency conditions: e.g., physical plus online classes; synchronous and asynchronous sessions; etc. This was not entirely new. *Cloud-based learning* had been around for nearly 10 years, supplementing in-class learning, and the *flipped classroom* concept was already established. So the existing tech that was available for *blended solution* became widely used in the mainstream in response to the pandemic conditions. For example, we all became familiar with the use of Zoom and similar applications for many 'authentic' communicative purposes, including for teaching and learning. As a result, innovative uses of video conferencing rapidly emerged for specific educational purposes, such as in the assessment of spoken language. With schools closed, traditional examination providers also had to make use of the available tech to deliver their tests online, outside of the school context. In many cases they also took advantage of AI-systems to support this, e.g. to provide remote proctoring or for the automation of the marking of speaking and writing.

By building on the concept of *hybridity as a design principle,* (rather than an emergency measure), we can exploit the interplay between humans and machines more effectively, taking advantages of machines to do things faster and more efficiently, but retaining the 'human touch' to ensure that educational values remain the top priority - and with the goal of bringing about long-needed improvements in the areas that have been highlighted above.

But before this vision can be put in practice at scale, the concerns recently raised in using ChatGPT have to be addressed. This takes us to the second point: what do we need to learn about AI in order to use it effectively, and what measures do we need to take to prepare for its deployment in our own educational contexts?

4. Understanding AI: what is ChatGPT?

Traditional EdTech and AI models have paved the way for a new era of context-aware, dynamic language education. Educators now have the opportunity to harness the potential of EdTech *plus EdAI* to develop innovative pedagogical practices to support plurilingual learners in an increasingly interconnected, multilingual world. To do so, it is important to provide clearer and more accessible information about the technology itself in language that is designed for non-specialists.

The technical complexity of AI is challenging but an understanding of some basic concepts and related terminology is certainly achievable, and is necessary to inform choices and decisions we need to make about AI-systems. It is also important to grasp the differences between traditional AI and the latest innovations represented by ChatGPT and other generative AI systems. The following four points are particularly important, and their implications need to be clearly understood:

- Collection and use of Data, including concerns for privacy;
- Bias;
- Malpractice (cheating etc.);
- Transparency and Explainability (cf. the "black box" problem).

A good starting point is to find out about two related AI concepts that are central to the development of AI systems that are already being used in educational contexts: *Machine Learning* (ML) and *Natural Language Processing* (NLP).

ML is a subset of AI that uses statistical techniques to enable machines to improve what they do through experience – hence the concept of the machine doing the learning. ML systems are trained using large amounts of data, e.g., written or spoken language. Some significant challenges and risks of AI-based systems from the social perspective are related to the collection and uses of that data.

NLP is concerned with interactions between computers and human language, and how computers are programmed to process and analyse large amounts of natural (i.e., human) language data of all kinds. NLP is central to many applications of ML relevant to language learning and assessment systems, including speech recognition, text-to-speech synthesis, and machine translation.

In building an ML model, *training data* is the foundation for the model's learning and decision-making process. The data provides *input* that "feeds" the model, and the output is the prediction based on the data. The goal is to achieve *a mapping from inputs to outputs*, so that the AI can *accurately predict* the output for new, unseen inputs. The quality and quantity of the training data is therefore crucial; the larger the data set, the more patterns and relationships can be learned from the data. It is important that the training data is diverse, representative and unbiased to avoid biases in the data and in the predictions (see below re: ethical considerations).

The choice of algorithm is also an important consideration. An algorithm is a finite sequence of instructions to perform a computation, and a variety of them are used in AI for specific types of ML. How the algorithms work and how they can be explained to those who use the AI systems are important considerations, especially as some algorithms are inherently more difficult to explain than others. Those that cannot be easily understood and interpreted are known as 'Black Box' algorithms. They are based on artificial neural networks are inspired by the structure and function of the human brain (see also *deep neural networks* - DNNs).

Until recently, ML was largely limited to *predictive models*, used to observe, and classify patterns in content. For example, a traditional machine learning problem was to use texts of written language (such as essays) as input and then to predict the level of proficiency (e.g. the CEFR level). In other words, to address the problem of accurately scoring and classifying the texts according to the features of the writing.

ChatGPT is an example of a *generative model of AI* where GPT stands for *generative pretrained transformer*. *Generative models* can generate human-like text through seemingly natural interactions with users and can perform many different kinds that can be fine-tuned by users to meet their specific needs.

Generative AI systems are based on Large Language Models (LLMs), and unlike traditional AI systems, LLMs learn from vast amounts of text data in an unsupervised way and can create new, human-like content to fulfil the requests of the user that is prompting it. This generative capability makes these AI systems versatile tools in language teaching and learning. A critical dimension is the way the system is prompted and will be aspect of AI that teachers will have to come to terms with.

5. Ethical concerns - Building Trust in AI systems

As discussed, banning new technologies is not a sensible or practical approach and is out of touch with the realities of technological evolution. There is no inherent reason to prevent the use of ChatGPT in schools or universities, but there are factors that might make it less appropriate or less effective in certain contexts. Cambridge University's pro-vice-chancellor for education, Prof Bhaskar Vira, believes that ChatGPT is simply "a new tool" that is now available (Varsity, Feb 2023). The response is not whether it should be used, but how.

There are many emerging suggestions for AI uses in language education. Here are a few on using it as an 'assistant' to the human teacher in providing language practice with feedback:

- Chatbots can be used as virtual tutors or language partners to help students practice speaking and writing in a foreign language.
- AI can be used to develop adaptive tests that can adjust the difficulty level of questions based on the learner's performance.
- AI speech recognition technology can be used to assess pronunciation and provide real-time feedback to learners.
- AI can be used to analyse student writing, providing feedback on grammar, vocabulary, and coherence.
- AI can be used to analyse students' writing and speech to determine their emotional state and provide feedback on how to improve their communicative skills.
- AI machine translation can be used to help learners understand written and spoken content in a foreign language.

However, there are also pitfalls and risks that need to be acknowledged and understood in order to build trust and protect the best interests of learners.

Known risks are associated with the *collection and use of personal data*, including concerns for the security and privacy of learners. In this respect, bias is a long-standing concern in machine-learning as the AI models depend on the data they are trained on; if the training data is biased, the model's output will also be biased. The danger is that the AI perpetuates underlying inequalities and prejudices through the outputs of the system. One of the main concerns in generative AI is related to the *origin* of the data and the ownership of it in the large language models. And despite the size of the data used to build the models, they are still prone to lapses and factual errors in the output (known as *hallucinations*).

Other concerns related to deployment of AI in assessment include the loss of the 'human touch', an over dependence on technology that offers no improvements in outcomes, and the Black Box problem referred to above. Moreover, ChatGPT has created opportunities for *cheating and malpractice* (plagiarism) in computer-delivered examinations which potentially undermine the integrity of existing assessment systems.

Perspectives should now be sought on these issues from a wide range of stakeholders to ensure that AI systems are designed and used in keeping with the overarching educational goals and values (notes above regarding language education). They should complement the roles that humans play in a hybrid way – rather than

replace them – and a responsible approach should seek to bridge both the technical and social aspects.

Systems that allow for the integration of human intelligence, knowledge, and decision-making with AI system are sometimes referred to as a 'human-in-the-loop' approach. By bringing together AI specialists with domain experts, practitioners and decision-making bodies (policy makers, regulators etc.) it should be possible ensure that AI systems are designed with societal goals in mind (society-in-the-loop) and that the following aspects are attended to so that systems are:

- *Interpretable* by developing understandings of how the technology works.
- *Explainable* by providing accessible explanations so users can understand why/how an outcome was reached.
- *Transparent* by providing information about the data and algorithms used.
- *Justifiable* by providing valid arguments in support of outcomes.
- *Contestable* by providing information enabling stakeholders to challenge an outcome.
- *Sustainable* by developing awareness of the environmental impact of AI and how it can be managed.

Emerging regulations and legislation can also contribute to this debate. Already under the EU's *General Data Protection Regulation* (GDPR), 'data subjects' can request *human review* when automated decision-making is used, and in 2023, the EU 's AI Act is an important step towards regulating AI from a statutory perspective. More widely, governments are engaged with the leading tech companies in establishing Known risks in using AI in language assessment are associated with the *collection and use of personal data*, including concerns for the security and privacy of learners, and the potential for bias in outcomes. Other risks may occur when AI systems are not validated for specific uses, or the outcomes cannot be adequately explained to the users.

Ethical AI is emerging as a field in its own right and ethical frameworks are being developed in various educational contexts (e.g., for assessment) and these are providing useful information for leaders and practitioners. The *Institute for Ethical AI in Education* (2021), for example, promotes a learner-centric approach that seeks to empower educational leaders to make ethically informed decisions about AI on behalf of their learners (see http://www.buckingham.ac.uk/wp-content/uploads/2021/03/The-Institute-for-Ethical-AI-in-Education-The-Ethical-Framework-for-AI-in-Education.pdf) and the World Economic Forum has proposed a very practical 'toolkit' in considering 'Artificial Intelligence for Children' (2022) (see https://www3.weforum.org/docs/WEF_Artificial_Intelligence_for_Children_2022.pdf).

Conclusion

In conclusion, careful thought needs to be given to ways of working that enable a multidisciplinary approach that balances the benefits of AI with its potential risks. This will involve political leaders and policy-makers working collaboratively with educational practitioners and experts from a range of academic disciplines. In language education specifically, a better understanding of the technical and ethical issues will facilitate innovations that value a hybrid approach, bringing together the combined strengths of humans and machines working together to deliver better language teaching and learning outcomes.

See also:

- OECD. AI Principles Overview (2019).https://oecd.ai/en/ai-principles
- Office of Educational Technology (2023). Artificial Intelligence and the Future of Teaching and Learning. https://tech.ed.gov/ai-future-of-teaching-and-learning/
- *World Ethical Data Foundation (2023). https://worldethicaldata.org/*

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The impact of the EU Development Policy in Indian Higher Education: the EDUREFOM Project and the socio-economic impact of the Fourth Industrial Revolution as a case study

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Abstract

The fourth industrial revolution is expected to deeply affect the Indian socio-economic trends. Higher education is gradually acquiring significance in the agenda of development and cooperation policies. In the last decade, the European Union has supported Indian higher education institutions to enhance their role in the development of the country. The Erasmus+ has been revised to intertwine the internal and external dimensions, embedding goals related to social, political and economic spheres. To pursue this goal, under the Erasmus+ Capacity Building in Higher Education action, the EU has allowed Indian universities to ideate and develop projects addressing local needs and global challenges. Through case study and participant observation, the article assesses the EU's action in India for cooperation development initiatives engaging the Indian higher education sector. The research findings have been instrumental in delivering targeted recommendations to European policymakers to enhance the impact of the EU developmental cooperation policy in India and the EU-India relations tout court.

KEYWORDS: EU Development Policy, EU-India Relations, Capacity Building, Higher Education Studies, Fourth Industrial Revolution.

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1. Introduction

While in the past international and national development investments had primary education as the exclusive target, the acknowledgement of the socio-economic mutation led by globalization has provided a new emphasis on higher education institutions. The United Nations (2015) and the World Bank (2022; 2023) have recently recognized the role that academia can play in creating new competencies and skills in developing countries. Moreover, international cooperation among higher education institutions also represents soft diplomatic tools to enhance bilateral relations among countries (Wojciuk 2018; Wojciuk et al., 2015). Globally, European Union is the largest contributor to development assistance delivered through different instruments and programs (OECD, 2022). The extension of the scope of the Erasmus+ programme has entangled the financial support towards higher education in low and middle-income countries. As a peculiar soft power and cultural diplomacy action, the EU has considerably invested in developing Indian academia through the Erasmus+ Capacity Building in Higher Education initiative.

Following the release of technologies exploiting the potential of artificial intelligence, the world is acknowledging the challenges of the fourth industrial revolution. In the near future, several tasks in all sectors will be performed by machines. The automation of labor is likely to affect the political communities that are unable to invest resources in the technological transition. For this reason, the socio-economic impact of the fourth industrial revolution is gradually acquiring centrality in the agenda of development aid programs.

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Considering the books and articles published, the developmental role acquired by the EU in Indian academia has been underestimated in the scientific literature focusing on EU-India relations. Reflecting the belief that the Erasmus+ programme is still merely related to individual mobility grants, scholars have not yet investigated the developmental action of the EU in India. To fill the gap detected, this research aims to assess the action of the EU in India for developmental initiatives engaging the Indian higher education sector. More accurately, this work aims (i) to assess how the European initiatives have supported the Indian authority to modernize the education sector vis-à-vis the labour market transformation connected with the fourth industrial revolution; (ii) to comprehend if the required institutional infrastructure has been established by the European and Indian authorities to enhance the impact of the funds invested by the European Commission; and finally (iii) to generalize the impact of the Erasmus+ cooperation development initiatives on the bilateral relations.

The research is based (i) on the theoretical understanding of the EU's developmental action in the Indian academia and the socio-economic challenges of the fourth industrial revolution; and (ii) the observational engagement in the Erasmus+ capacity-building project EDUREFORM. Following the presentation of the methods and data utilized, the analysis and the conclusion of the study address the objective and aims of the research.

2. The action of the EU Development Cooperation in the Indian Higher Education sector

In the EU, developmental aid programs can be represented as a patchwork composed of national initiatives and joint supranational actions. As a result, the European development agenda tends to be fragmented and guided by multiple actors operating both at the national and transnational levels (Greco 2022, p. 214). Analyzing the *Global Gateway* – flagship policy of the EU in the field of Development Cooperation policy – education is included among the top five priorities for developing middle- and low-income countries. Investments in education are perceived as critical for supporting developing countries in building equitable and inclusive societies (European Commission 2021, p. 7). More precisely, the financial instruments from the EU budget should be dedicated to assisting developing countries in (i) training a higher number of students, (ii) supporting digital education and life-long learning initiatives, (iii) supporting women and vulnerable strata of the population, (iv) strengthening the networks engaging European academia and higher education institutions from developing countries (European Commission 2021, p. 7-8).

Narrowing the focus to the EU development cooperation aids designed for Indian academia, the Erasmus+ Capacity Building in Higher Education represent the initiative that better embodies the goals of the European Commission. Capacity-building projects aim to modernize, democratize and internationalize Indian universities (European Commission, 2018). The key novelty is represented by the possibility for the Indian universities to apply as lead applicants on behalf of an Indo-European alliance of academic and non-academic stakeholders. This innovation aims to address the shortcomings of local ownership hampering the effectiveness of action undertaken by European experts in the Indian scenario. The concepts of capacity building and local ownership emphasise the importance of promoting initiatives designed and coordinated by experts from targeted countries. To engage Indian experts in developing the domestic higher education environment, during the multiannual financial framework 2014-2020, the European Commission has allocated more than 246 million euros to co-finance 290 capacity-building projects in South Asian and South East Asian universities (Greco, 2022). Financed with the EU Development Cooperation Instruments and the European Development Fund, the Capacity Building in Higher Education is bifurcated into structural and joint projects (European Commission, 2020). The former envisages the participation of Indian ministerial authorities with the final goal of producing structural techno-political changes. Differently, joint projects are meant to finance tangible improvements in the Indian universities engaged in the project consortium. Projects can involve Indian and European institutions; or as a further element of internationalization, the project can also be implemented by a coalition of Indian and Asian universities. Lastly, capacity-building projects are characterized by separate macro-aims. The different strands aim to support (i) the curriculum development, (ii) the modernization of the governance, management and functioning of the universities, and (iii) the creation of bridges between the academia, the productive sector and/or the society (European Commission 2020, p. 167).

3. The socio-economic impact of robotics and artificial intelligence

The fourth industrial revolution will gradually re-modulate the labour market. As occurred with the previous industrial revolutions, artificial intelligence and robotics will generate a global socio-economic restructuration. Unlike the previous industrial revolutions, the advancement in the field of robotics and artificial intelligence will occur faster, generating deeper economic, social and cultural transformations. The introduction of new machines and software in the marketplace will sweep away jobs based on repetitive tasks conducted by low and middle-skilled workers

(Graetz & Michaels, 2015; Schwab, 2017). Drawing a general picture, the future labour market will be dominated by skilled professionals and workers able to complement, program and organize the operations of the machines (Spitz-Oener, 2006). Young people with low education levels, limited capability to analyze processes, and weak in critical thinking will be more likely to face technological unemployment (Zervoudi, 2020). Irrespective of the human capability to adapt to socio-economic mutations, the inclusion of artificial intelligence and robotics in the labour market could revive the reflections of economist John Maynard Keynes (1931/2010) envisaging the unsustainable growth of unemployment caused by technological advancement. Multiple studies (e.g., Frey & Osborn, 2017; OECD, 2017) confirm the broad impact of the fourth industrial revolution on the labour market. According to an analysis conducted by the McKinsey Global Institute (2017), half of the work activities could be automated, expecting already in 2030, 400 million displaced workers and between 3-14 per cent of the global workforce coerced to switch their occupational profiles.

Interestingly, the robotization of the labour market is likely to follow a nonlinear path. For instance, during the first stages, automation and production restructuration are likely to primarily occur in advanced economies due to the elevated cost of the new technologies. Nonetheless, in the middle term, the cost reduction – and the recovery of the investments for developing artificial intelligence and robotics devices – will allow entrepreneurs in developing countries to automate their companies. In the short term, a supplementary nonlinear path relates to the typology of workers penalized by the introduction of artificial intelligence and robotics on the work floor. As robotization of workplaces will primarily target monotonous and one-dimensional jobs, people with lower and average educational levels are much more likely to be replaced by machines (Frey & Osborn, 2017; McKinsey, 2017; Schwab, 2017). As illustrated by Martin Ford (2015; 2021), the fourth industrial revolution could accelerate the polarization between low-skills/low-salary and high-skills/high-salary workers, exacerbating socio-economic inequalities and facilitating the radicalization of pre-existing social cleavages.

In this study, the central focus is shifted to the impact of robotics and artificial intelligence on the socio-economic performance of the most vulnerable workers in low- and middle-income countries. Considering that developing countries are usually characterized by a low average age and intensive productive activities – employing a labour force with limited education and skills – the socio-economic impact of the Industry 4.0 could be sternest in low and middle-income countries. According to a report issued by the Swiss financial institute UBS (2016), robotics and artificial intelligence are expected to heavily jeopardize the competitiveness of South American and South Asian economies currently exploiting the competitive advantage of low-cost domestic labour. International institutions and post-industrial nations should support the governments of low and middle-income countries to develop strategies and financial instruments to prepare their societies for the fourth industrial revolution. Countries failing to implement long-term policies will endanger their economic sectors, jeopardizing competitiveness, and decreasing their capability of redistributing wealth (Zervoudi, 2020). The action plans should establish long-term strategies contextualized to the local realities and developmental needs (Manda & Ben Dhaou, 2019). As underlined by the World Economic Forum (2016:3), the ability to prepare the society and the national economies is a critical task that governments, civil society and entrepreneurs should handle. The final goal is to seize the opportunities of the fourth industrial revolution, mitigating the undesirable expected consequences. Failing to adopt national strategies would ultimately lead to increased unemployment and socio-economic inequalities. High level of technological unemployment would increase the domestic political and social instability, (i) magnifying the migratory trends from the Global South to the developed countries, and (ii) undermining the progress observed in the fight against poverty and social inclusion. Education and educational institutions should play a central role in supporting the transition of middle and low-income countries toward Industry 4.0. As we saw, education and skills are the main discerning variables in the study of technological employment. Tackling the uneven distribution of skills becomes the key to mitigating the socio-economic impact of the fourth industrial revolution (OECD, 2017). From this perspective, education is the solution to protect vulnerable people in low and middle-income countries.

4. The EDUREFORM project

EDUREFORM *Mitigate the Impact of Fourth Industrial Revolution on Indian Society*: *Education Reform for Future and In-Service School Teachers* is a multi-stakeholders project developing pilot activities in technological unemployment prevention. Selected under the action Erasmus+ Capacity Building in Higher Education, the project is implemented over four years by a team based in Indian-European universities, secondary schools and enterprise specialized in skill development.

Coordinated by Chitkara University, EDUREFROM is composed by an interinstitutional team of experts working at Chitkara University Punjab (India), Shivaji University (India), The Maharaja Sayajirao University of Baroda (India), The Savitribai Phule Pune University (India), Jamk University of Applied Sciences (Finland), IUL University (Italy), University of Hamburg (Germany), Chitkara International School (India),

Liceo Artistico Coreutico Musicale Candiani-Bausch (Italy), CSX Solutions India Private Limited (India). EDUREFORM aims to promote best practices capable of mitigating the detrimental effect of the fourth industrial revolution in Indian society. In the Indian education system, the EDUREFORM team identified the tendency to follow rote learning. An extensive consultation of the academic literature concluded that technological unemployment would be lower for job profiles requiring critical, analytical, creative and intercultural skills. As a result, the EDUREFORM experts identified the need to train the Indian students in skills closely related to cognition, flexibility, multidimensional analysis and management of complex situations.

To meet the needs, a series of innovative teaching and assessment pedagogies has been detected – and included in the targeted study programs – by the EDUREFORM interinstitutional team. Rather than creating new study programs addressing teacher education, the mission of the project is to retune the existing curricula vis-à-vis the challenges of the fourth industrial revolution. To pursue this goal, the pedagogical tools introduced by the project are meant to empower future Indian in-service teachers to train out-of-the-box thinking skills among Indian secondary school students. In order to enhance the short-term impact of the project, the EDUREFORM team has piloted a 3-day vocational training program targeting Indian in-service teachers. Offered free of charge and regularly organized in different geographical locations, the EDUREFORM vocational training is a lifelong learning initiative designed to encourage the adoption of innovative teaching techniques in Indian secondary schools. The innovative teaching and learning pedagogies have also been disseminated through creating an open-access online course and handbook. Considering the importance of increasing societal awareness of technological unemployment, EDUREFORM regularly delivers public events and campaigns. Organized in different locations, workshops, webinars and international conferences represent the ideal platforms to disseminate the aim of the project, engage new actors in the implementation of EDUREFORM, and promote the intellectual outputs of the project. The final mission is to encourage educators, educational institutions, civil society, and policymakers to take pragmatic actions to enhance human development, exploiting the comparative advantage that humans retain in handling complex tasks.

5. Methods and Materials: Case Study, Participant Observation and Erasmus+ capacity-building projects in India

The case study relates to the scrutiny of phenomena for which a deeper understanding is required. Although the research protocol can acquire different structures and connotations, the case analysis is always related to a phenomenon having a time and space specificity (Johansson, 2005, p. 33). Combining different research methodologies, it involves the analysis and contextualization of specific cases characterized by interconnected operative paths (Gillham, 2001; Yin, 2009). When the boundaries between the research subject and the surrounding context are not self-evident, the case study allows the development of an in-depth empirical comprehension of the phenomenon within its real-life setting (Yin 2009, p. 18). Different methodological approaches are triangulated through a meta-analytical process to provide a multidimensional understanding of the studied phenomenon. In this process of triangularization, different methods and theoretical backgrounds are applied to the data analysis (Denzin, 2009). The final aim is to break down (and then contextualize) the case analyzed to draw generalized conclusions. In this explicative process, generalization is understood as a proposition based on interconnected inferences generated by the observation of reality (Schwandt 1997, p. 57). The key task of the researchers is to develop causal explanations among the dependent variables (Sharp, 1998).

In the framework of this research, participant observation is the methodological tool enabling the analysis of the case study and its generalization. For almost a decade, the author of the study has coordinated several Erasmus+ capacity-building projects, ideated and implemented in India. This experience has allowed the author to interact with academic and institutional stakeholders, developing an insider understanding of the dynamics generated by the execution of these projects.

The analysis is restricted to the projects financed with the multiannual financial framework 2014-2020. To assess the impact of the EU development investments in favour of the Indian higher education sector, the observational investigation is based on the analysis of the role played by the capacity-building projects in promoting (i) people-to-people relations, (ii) visibility of the EU in India, and (iii) the bilateral relations between India and EU. In this normative scheme, the improvement of the bilateral relations is considered consequential to the positive impact of the capacity-building projects on the people-to-people relations and the visibility of the EU in India.

6. Results: People-to-people relations, visibility of the EU initiatives and India-EU bilateral relations

6.1 People-to-people relations

While generalizing the impact of the Erasmus+ capacity-building project, it is essential to distinguish the dynamics generated by the EDUREFORM project (and the Erasmus+ capacity-building action tout court)

between peers from the Indian and European academia, the beneficiaries and the EU officials, and the relations between officials representing the Indian and the European authorities. This distinction is required since the findings change according to the actors considered.

The opportunity for Indian universities to apply as coordinators has been highly beneficial to improve the local ownership of the projects. In the past, capacity-building projects were mainly designed by experts based in developed countries, having a brief understanding of the grassroots needs of the Indian academia. The increased local ownership had a constructive impact on the relationship between the Indian and European experts working together to achieve the project goals. More specifically, projects ideated and designed by Indian experts have enhanced the developmental role allocated to European experts. Rather than being perceived as foreign agents imposing a development model, the European experts are considered peers willing to support the modernization of Indian higher education. Hence, the enhanced local ownership has been instrumental in favouring the creation of deep people-to-people dynamics between Indian and European academic staff.

Different considerations should be drafted for the relations generated by the Erasmus+ capacity-building projects among Indian academic staff and EU officials, and equally, among Indian and European civil servants. To comprehend these dynamics, a brief excursus in the institutional governance of the capacity-building projects implemented in India is required. The European Education and Culture Executive Agency (EACEA) manages the capacity-building action. The EACEA is an executive agency of the European Commission deputed to the on-ground implementation of the Erasmus+ programme. In the case of the Erasmus+ capacity-building projects, the agency executes what has been designed within the European Commission by the Directorate-General (DG) Education, Youth, Sport and Culture in consultation with the DG for International Partnerships. In this organizational setting, the EU Delegation to India is expected to act as a bridge between the implementers of the projects and the EU officials based in Brussels. The communication between the projects' beneficiaries and the EU is handled by the EACEA. These interactions are limited due to the number of tasks assigned to the EU officials working at the EACEA. Each EACEA project officer has to parallelly supervise a multitude of capacity-building projects, and as a result, the communication is fragmented and confined to the technical aspects. There are no structured channels for the Indian and European project implementers to interact with the staff of the European Commission and the EU Delegation based in Delhi. Similarly, the European investment in Indian higher education has not been combined with the establishment of a high-level dialogue where European and Indian civil servants could jointly monitor and assess the impact of the capacity-building activities. Therefore, the funds invested by the EU in the Indian academia have generated a limited impact on the people-to-people interactions among the project implementers and the EU officials, and equally, between the Indian and European civil servants working on higher education. In addition, the absence of a structured communication channel between the project implementers and the European Union jeopardizes the transferability of the intellectual outputs of the projects. For instance, in the case of EDUREFORM, the weak peer-to-peer relations between the project implementers and the European Commission – combined with the extemporary interactions between Indian and European civil servants working on education – resulted in the lack of institutional awareness regarding the intellectual outputs of the project.

6.2 Visibility of the EU initiatives

Moving the analysis to the visibility generated by the capacity-building projects, the findings trace an interesting outlook of the operations of the EU in India. In the first place, considering the relevance acquired by digital and social media (Seib, 2012), the analysis begins with the findings from the website and social media accounts of the EU Delegation to India. Although the digital communication of the EU in India represents a positive example of diplomacy 2.0, the Erasmus+ capacity-building projects have been excluded from the communication strategy of the EU representation in Delhi. For instance, on the EU Delegation website, there are no traces of the financed capacity-building projects. Similarly, the Facebook account of the EU Delegation dedicated to the activities of the EU in India has never posted regarding the capacity-building projects supporting Indian academia. The digital promotion is limited to the mobility of students under the Erasmus+ Mundus action and to the research grants disbursed under the Horizon programme.

The visibility deficit of the Erasmus+ Capacity Building in Higher Education on the communication channels of the EU Delegation has three possible interconnected explanations. First, it has to be specified that the EU Delegation to India subcontracts to third-party tasks related to public diplomacy. The mission of the subcontractor is to promote the EU in the Indian media and society, increasing awareness regarding the activities of the EU in India. In the case of Erasmus+, the subcontractor has conducted activities highlighting the mobility of the students, marginalizing the capacity-building investments and their impact on Indian higher education. In the second place, the lack of visibility of the Erasmus+ capacity-building project can be attributed to the weak coordination between different EU actors. As emphasized in earlier studies (e.g., Gebhard, 2017), achieving coordination, coherence, and consistency among European institutions – or

within a single European institution – is a demanding task. In the case of capacity-building projects, most of the work is conducted by the EACEA. Considering the executive and technical nature of the agency, the EACEA does not have the know-how and the human resources to provide visibility to projects. To fulfil this task, the European Commission – in particular the DG Education, Youth, Sport and the DG for International Partnerships – along with the European External Action Service (EEAS) should create a structured cooperation to develop standard practices to promote and exploit the funds in favour of the Indian higher education sector. The third element that could partially explain the visibility deficit is related to the priorities adopted during the selection of the project proposals. The priorities selected by the European Commission could represent an indirect obstacle to the visibility (and impact) of the projects. The methodology adopted by the European Commission to select the project's priorities is based on a vague top-down approach. The inclusion of multiple priorities has resulted in the bottom-up emergence of projects targeting a vast array of problems related to multiple spheres. Providing a practical example, in the year when the proposal for EDUREFORM was submitted, applicant universities could propose their topic by choosing among seventeen macro-disciplines, four macro-issues on the governance of the higher education institutions, and five macro areas related to the cooperation between academia and society. In addition, returning to reflect on inter-institutional coherence, the European Commission created common priorities for all the academic institutions based in South and South-East Asia. In other words, Indian universities share the same priorities with Chinese, Thai, Indonesian and Burmese higher education institutions. As the EU strategies with Asian countries significantly vary, similarly the challenges faced by Asian universities considerably differ among countries.

As a result, the projects approved in India are scattered over a multitude of topics and challenges, and more significantly, the issues addressed by the projects are not always in line with the top priorities of the EEAS and European Council in India. Probably for these reasons, the EU Delegation to India, the institutional actor better placed to provide visibility to the capacity-building projects, might have marginalized the representation of the EU developmental action in higher education.

6.3 EU-India bilateral relations

As previously mentioned, the impact of the Erasmus+ capacity-building projects on the EU-India bilateral relations is subordinate to the people-to-people relations and the visibility generated by the EU investments in the Indian higher education sector. At this moment, the European Union is the only sovereign donor offering the chance to Indian universities to obtain financial support for projects designed and implemented in India. Nonetheless, the relationship between Indian and European policymakers in the field of education did not record an improvement in terms of interactions and synergies. For instance, during the last years, the EU and India did not conduct any high-level meetings in the field of education. In other words, the interactions between the Indian Ministry of Education and the DG Education, Youth, Sport have been rather limited. The Erasmus+ Capacity Building in Higher Education action failed to engage the Indian ministerial authorities in implementing a *structural project*, directly involving Indian governmental stakeholders in delivering structural reform. On the other hand, the Indian Education Minister and the European Commissioner for Innovation, Research, Culture, Education and Youth did not establish a formal dialogue on the EU-India cooperation in the field of education.

These factual findings underline the importance of investing additional resources in reinforcing the people-to-people relations between institutional Indian and European stakeholders, while setting down within the EU an inter-institutional strategy to maximize the impact and visibility of the capacity-building projects.

7. Discussion and Conclusions: Learnings from the implementation of Erasmus+ capacity-building projects in India

Through the Erasmus+ programme, the EU has supported Indian higher education in developing innovative initiatives by modernizing study programs, the management of the universities and financing initiatives designed to narrow the gap between academia and society. The socio-economic impact of the fourth industrial revolution will reshape the labour market and societies. In this process, developed political communities are expected to support low and middle-income countries in mitigating technological unemployment. Reflecting upon the contribution of the EU to assist Indian policymakers and higher education institutions in mitigating the socio-economic impact of the fourth industrial revolution, the study has detected scope of improvements in the selections of the priorities that implementers of the projects should pursue. The vague top-down priorities selected by the European Commission resulted in an investment portfolio where the development aids are scattered among too many issues. As a result, the funds invested by the EU to support the Indian academia for the transition toward the Industry 4.0 are not proportional to the socio-economic magnitude and the global relevance of the issue. Rather than creating common priorities for societies facing different developmental challenges, the priorities should be developed for single countries. For instance, in India, where unemployment is a phenomenon that entangles inequality and migration, the EU should have a strategic interest in financing

preventive measures to mitigate the socio-economic impact of the fourth industrial revolution.

Moving to the following aim of the study, the case study analysis has showcased the necessity to improve the institutional infrastructure behind the implementation of the Erasmus+ capacity-building. Enhanced internal coordination between the different European institutions, and a superior engagement of the Indian policymakers, would be beneficial to increase the impact and the visibility of the activities financed by the EU in close cooperation with the Indian stakeholders. A strategic role could be allocated to the EU Delegation to India. Due to the in-depth knowledge and awareness of Indian society, the EU officials based in Delhi are better placed to act as a bridge and intel unit for the project implementers, the European institutions, and the Indian authorities. Currently, the EACEA is the pivotal institutional actor deployed for managing the capacity-building projects financed in India. Considering the technical and executive nature of the EACEA, the agency lacks the mandate to handle political tasks. To fill the existing governance gap, the EU officials based in Delhi could act as process managers, empowering the different actors directly and indirectly involved in the projects to improve the performance of funds invested.

Enhancing the people-to-people relations and visibility will likely generate a virtuous circle in EU-India bilateral relations. The European Union and its member states are the major developmental partners of the Indian higher education sector. Unfortunately, until today, European investments have not yet been capitalized in an advanced partnership between the EU and India in the field of education. Improving the intra-EU coordination and providing a political control booth to the Erasmus+ Capacity Building in Higher Education, could be an effective solution to engage Indian policymakers and to exploit the intellectual outputs and the networks developed in India in the framework of the capacity-building projects.

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Perceptions and reactions of Indian student teachers engaged in a CLIL Teacher Training Mobility Programme in Italy

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Abstract

This article presents the main findings of a teacher training mobility program on Content and Language Integrated Learning (CLIL) conducted as part of the EDUREFORM Erasmus project. The project, led by a consortium of Indian and European partners, aims to promote innovation and critical thinking skills in the Indian school and university curricula. As one of the project's outputs, Indian student teachers attending a professional graduate programme in teacher education participated in a training programme hosted by Italian schools. The programme focused on CLIL and its main pillars, particularly the Cognitive Discourse Functions construct and thinking skills.

The article examines the reflections and thoughts of Indian students regarding their observation and micro-teaching experiences in Italian schools. Their reactions indicate a highly positive attitude towards CLIL, suggesting that it could provide added value to Indian educational institutions. CLIL facilitates interaction, encourages questioning, and utilizes a variety of interactive methodologies, such as debates, which can enhance deep content learning, especially when combined with learning technologies. Furthermore, CLIL is seen as a catalyst for multilingual and intercultural pedagogies, particularly in today's increasingly multiethnic and multicultural classrooms.

The study also reveals that CLIL lessons are perceived as effective tools for fostering critical thinking skills, with numerous Cognitive Discourse Functions being highlighted and identified. Indian students advocate for the integration of CLIL across the Indian school and university curricula, drawing inspiration from the remarkable success of CLIL in Europe.

KEYWORDS: CLIL, Thinking Skills, Cognitive Discourse Functions, Multilingual and Intercultural Pedagogies.

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1. Introduction

This article focuses on a training mobility programme undertaken by four Indian student teachers enrolled in a professional graduate programme in teacher education. The mobility programme was organized and planned by the author of this article and hosted by Italian schools as part of the EDUREFORM project. The student teachers received scholarships from one of the universities that is a consortium member of the European project.

The EDUREFORM project, titled "Mitigate the Impact of the Fourth Industrial Revolution on Indian Society: Education Reform for Future and In-Service School Teachers", is co-funded by the European Commission. Its objective is to promote creative, critical, and analytical thinking in classrooms through pre-service and in-service teacher training. The ultimate aim of EDUREFORM is to raise awareness and empower future and in-service secondary school teachers in India to mitigate the anticipated societal impact of the Fourth Industrial Revolution.

The project has short-term and long-term objectives. The short-term objectives include empowering future and in-service teachers, creating conditions to mitigate the negative impact of the Fourth Industrial Revolution on the Indian labor force, and piloting activities in Indian secondary schools to enhance students'

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analytical, critical, and creative skills. The long-term objectives involve mitigating the impact of the Fourth Industrial Revolution on the Indian labor market by promoting critical and analytical skills among secondary school students, incorporating teaching practices that foster critical, creative, and analytical thinking among Indian secondary school students, and establishing new Indian-European joint initiatives while following up on EDUREFORM's capacity building actions.

The EDUREFORM consortium consists of 11 partners from Europe and India, including Chitkara University, the consortium leader, Shivaji University, The Maharaja Sayajirao University of Baroda, Chitkara International School, CXS Solutions Indian Private Limited, University of Latvia, JAMK University of Applied Sciences, University of Hamburg, IUL Telematic University in Italy, Liceo Artistico, Musicale e Coreutico, and Savitribai Phule Pune University.

Within this project, one of the outcomes involved a training mobility programme where Indian students attending a professional graduate programme in teacher education were hosted by Italian schools. During this programme, the student teachers observed CLIL (Content and Language Integrated Learning) lessons in Italy and engaged in micro-teaching activities using the CLIL methodology. CLIL is an innovative and interdisciplinary technique aimed at fostering critical thinking skills, creativity, and intercultural dialogue.

This article will provide an overview of CLIL's main conceptual frameworks and highlight the reactions and comments of the Indian students regarding their observations of CLIL lessons and their own CLIL micro-teaching activities during the mobility program in Italy. These discussions align with the main goals of the EDUREFORM project.

2. Methodology

The study aimed to address the following research questions:

1. What are the Indian student teachers' perceptions and impressions of CLIL lessons in Italian schools?
2. What are their ideas about the features, potential and impact of the CLIL methodology?
3. From the perspective of Indian student teachers, can the CLIL methodology contribute to the development of students' critical thinking skills?

A qualitative methodology was employed for this research, utilizing interviews, and learning journals as data collection instruments. The Indian students were instructed to maintain updated learning journals, essentially serving as their daily diaries. These journals provided a platform for the students to record their observations, reflections, and insights. The qualitative data obtained from the interviews and learning journals were analyzed using the Framework Analysis approach (Ritchie & Lewis, 2003). This methodology is well-suited for conducting thematic analysis of textual data, enabling the identification and organization of data into meaningful themes and categories.

The primary focus of the analysis was to explore the Indian students' perceptions and ideas concerning the potential of CLIL and its role in developing students' critical thinking skills, fostering creativity, and promoting intercultural dialogue.

3. Overview on CLIL

CLIL methodology (Coyle et al., 2010; Mehisto et al., 2008; Graziano et al., 2021) is a dynamic and dually focused pedagogy that integrates language and context to facilitate the creation and negotiation of subject knowledge and content. Unlike mere conversations in a foreign language, CLIL emphasizes collaborative group work aimed at carrying out authentic tasks (Task-Based Learning) (Willis & Willis, 2007; Nunan, 2004) or projects (Project-Based Learning) (Thomas, 2000; Cinganotto, 2021a) as tangible and visible outcomes of the learning process.

CLIL has received significant international encouragement (Council of Europe, 2019) as an effective strategy for increasing exposure to the target language while simultaneously conveying subject content. It serves as an excellent means to promote multilingualism, particularly because different vehicular languages can be used within CLIL instruction.

One of the most popular CLIL conceptual frameworks is the 4Cs framework (Coyle, 2005):

- Content: This refers to the subject matter that is involved and conveyed through CLIL instruction.
- Communication: It encompasses the verbal, non-verbal, and multimodal interactions among students and between students and teachers within the CLIL context.
- Culture: This aspect focuses on the cultural background and context that influences and shapes CLIL interactions.
- Cognition: It emphasizes the development of critical thinking skills in students through the assignments and tasks they engage in within the CLIL framework.

Regarding the last "C", the cognitive dimension is concerned, it is important to underline the connection between thinking skills and the verbal expressions of intentions and functions, as highlighted by Dalton-Puffer (2007; 2013) in the Cognitive Discourse Functions (CDFs) conceptual framework, summarized in the Table 1.

CDFs allow teachers to effectively plan and guide students to actively engage with subject content through various approaches. These functions activate thinking skills and are primarily expressed through verbs, requiring specific language resources for their execution (Morton, 2020). Verbs such as "classify", "define", and "describe" express different communicative intentions and functions, as depicted in Table 1.

By assigning students authentic CLIL tasks in STEM subjects or humanities, their critical thinking skills are stimulated. This dimension plays a pivotal role in the EDUREFORM project, which aims to incorporate tools for developing critical thinking skills across the curriculum.

Type	Communication intention	Label
1	I tell you how we can cut up the world according to certain ideas	CLASSIFY
2	I tell you about the extension of this object of specialist knowledge	DEFINE
3	I tell you details of what can be seen (also metaphorically)	DESCRIBE
4	I tell you what my position is vis a vis X	EVALUATE
5	I give you reasons for and tell you causes of X	EXPLAIN
6	I tell you something that is potential	EXPLORE
7	I tell you about something that is external to our immediate context on which I have a legitimate knowledge claim	REPORT

Table 1 - Cognitive Discourse Functions (Dalton-Puffer, 2013, p. 234).

The implementation of CLIL in Italy (Cinganotto, 2016) has gained recognition as a notable best practice in Europe, as acknowledged by the "Council Recommendation on the comprehensive approach to the teaching and learning of languages" (Council of Europe, 2019). CLIL was formally introduced by law (DPR 88-89 dated 2010) in all upper secondary schools. Furthermore, recent developments have expanded the adoption of CLIL to lower secondary schools, primary schools, and even pre-primary schools (Ministerial Decree dated 2022).

During the pandemic, a study conducted by Cinganotto et al. (2022) in collaboration with the European Commission and the Italian Ministry of Education and Merit revealed that Italian teachers persisted in teaching CLIL despite the challenges posed by emergency remote teaching. In fact, the extensive utilization of platforms, web tools, and digital resources enabled teachers to design and implement highly creative, dynamic, and successful CLIL approaches.

4. Language diversity and CLIL in India

India has a population of approximately 1.3 billion people and stands as a unique example of ethnic, socio-cultural, and religious diversity, alongside its rich linguistic variety. Hindi and English are the two most widely spoken languages in the country, both recognized as co-official languages: Hindi holds greater prevalence, especially in rural areas, while English is common in urban settings, higher-level business, universities, and government contexts. Proficiency in English is perceived as a significant political and economic advantage, often limited to the middle and upper classes who can afford private schools where English is properly taught. India is renowned for its "melting pot" of regional languages, with the 2011 Census Report indicating the presence of 121 languages and 270 home languages spoken throughout the nation. All these languages are viewed as crucial for preserving cultural and social identities. Consequently, while there is a strong need to foster multilingualism in India, English has become a vital lingua franca in the globalized world. However, instruction in English is sometimes considered elitist, leading to discrepancies where children in urban areas receive extensive English education alongside their regional languages and mother tongues, while children in rural areas have limited exposure to English, reducing their opportunities for higher education and employment. The absence of a common school system, a high number of private schools, and disparities in resources contribute to a situation where only a limited number of students attend elite schools with an English-only model of instruction.

In 2014, the National Council of Education, Research and Training (NCERT) proposed that all states in India define class-wise learning indicators and implement a common curricular expectation. The recommendation was for English class activities to be based on English textbooks, encouraging a teaching-learning process that allows children to use their first language when necessary. The aim was to eliminate regional disparities and enable teachers to plan their pedagogic process accordingly.

The National Education Policy of 2019 designed an India-centered education system aimed at building an equitable knowledge society by providing high-quality education for all. According to the "three-language formula" (Hindi, English, the regional language), children should be exposed to three languages from preschool. The formula allows flexibility, enabling students to change one or more of the three languages in Grade 6 or Grade 7. Additionally, Sanskrit and other classical languages and literatures, such as Tamil,

Telugu, Kannada, Malayalam, Odia, Pali, Persian, and Prakrit, would also be offered at various levels of school and higher education.

English serves as the primary lingua franca in India, functioning as a means of communication and exchange among different states. Therefore, a dual model of instruction across all schools (both private and government) with a common curriculum could serve as a potential solution to ensure an inclusive pedagogic process. This approach could transform English into a tool for multilingualism, making the implementation of CLIL methodology more feasible. Presently, CLIL settings can be identified in Indian schools where the medium of instruction is English and immersion programmes are embraced, though CLIL is still in its early stages in India.

One of the Indian students' comments emphasizes the importance of considering the issues related to the Indian linguistic diversity while adopting CLIL pedagogy:

> *"To express the Indian perspective about CLIL pedagogy, considering this diversity in every term is crucial. Reason being, it is a baggage each learner carries, forming the learning process as an outcome of this diversification. Further, the considerable aspect about the structure of Indian education system, where the instructional medium is segregated".*

The awareness of Indian linguistic diversity and the concept of a "melting pot" is evident in the comment, highlighting the close link between the learning process and diversification.

Some studies (Vency & Ramganesh, 2013) have demonstrated the potential and added value of CLIL in the Indian curricula, as it can facilitate and enhance students' learning outcomes. Given the success of CLIL in Europe, its implementation in the Indian school curricula would be beneficial.

Before the EDUREFORM project, another highly successful Erasmus project on CLIL was funded and implemented: the "CLIL@India" project (https://www.clilatindia.in/), completed in 2019. The consortium consisted of seven Indian and European universities engaged in developing a new model of bilingual education by introducing CLIL as an innovative pedagogical practice within the Indian education system to preserve the nation's multilingualism, serving as a supplement to the "three-language formula". The partnership with Università Degli Studi di Milano, Universidad de Castilla-La Mancha and Latvijas Universitāte, brought in the best of Content and Language Integrated Learning approach from Europe, facilitating the exchange and sharing of ideas and best practices between European and Indian academicians, resulting in the creation of innovative professional profiles with in-depth skills in CLIL both in the academia and society.

Pilot projects were conducted in Indian schools with the aim of transferring and adapting CLIL methodology to the Indian context. In schools where the medium of instruction is the regional language, English was taught through the CLIL approach, while in schools where English is the medium of instruction, the regional language was targeted using CLIL.

5. The Indian student teachers' profile

The Indian students who participated in the CLIL mobility programme were from various Indian cities and universities, all of which were consortium members of the EDUREFORM project. The selection criteria for the programme, designed by the author and organized by IUL Telematic University, were as follows:

- Graduated students in STEM subjects or humanities.
- Graduated students enrolled in a professional graduate programme in teacher education.
- Graduated students with a basic knowledge of CLIL methodology.
- Availability to agree to and follow the CLIL plan designed by IUL Telematic University, represented by the author.
- Availability to attend an online course on CLIL delivered by the author prior to the mobility.

The CLIL plan included a toolkit of learning materials for self-study, grids for lesson observation, tools for lesson planning, and guidelines for the learning journal.

During the online meetings and the pre-mobility online course, the students displayed great enthusiasm and a high level of motivation to enhance their understanding of CLIL and improve their teaching skills, capitalizing on the opportunities provided by this international project.

6. CLIL lesson observation: primary and lower secondary school

The EDUREFORM training mobility plan to Italy included visits to various schools, including a primary school and a lower secondary school, to observe and learn about CLIL implementation. The schools visited were located in Latina, Italy, and included IC "Da Vinci-Rodari" and IC "Frezzotti-Corradini" (comprehensive schools), Liceo Classico "Dante Alighieri", and "Istituto San Benedetto" (a vocational school and boarding school), where the teachers were hosted.

The visit to the "Da Vinci-Rodari" primary school was a memorable day for the students, as their comments illustrate:

"This was a special day for us as today we visited a primary school where children aged 3 to 10 were present. They were very welcoming and interacted with us. Some of them were very shy and teachers helped translate things. They were very comfortable with the teachers and followed the instructions very well. I went through the books and notebooks of all the classes and noticed that there was a huge difference from the Indian books, and they were almost one year ahead of the Indian curriculum. After going through a lot of books I also noticed that the way of teaching and framing the books was also very different from the Indian books and in some ways, better than the Indian books. Italian teachers used a lot of tools to teach students about different concepts and student enjoyed studying with tools".

The comparison between Italian and Indian primary schools is quite intriguing: Italian methods appear to be more active, interactive, and playful, according to the students. They also observed that the Italian curriculum is one year ahead of the Indian curriculum, as reflected in the following comments:

"The school was based on learning by doing. For the pre-primary level, teaching was done through stories and play. Small children were able to understand English. From the age of three they start teaching students about colors, numbers, family, festivals with loads of creativity".

"The walls of the school were filled with informative art. And it was done by the students. These are drawings of families drawn by the students".

"Students were given such printed materials to practice writing. And such activities are used for learning to make it interesting. And we went to the class where a beat dance on mathematical activity was also done by the students. This was a wonderful activity which for sure engages students' psychomotor domain".

The Indian students were impressed by the students' command of English at such a young age. They also appreciated the practical, hands-on approach and the extensive use of tools and visual materials, which were well-aligned with the children's cognitive development.

At IC "Frezzotti-Corradini", a lower secondary school, the Indian students were pleasantly surprised by a debating activity organized between two classes on the topic of "e-books vs. printed books". One of the comments highlighted the following:

"Two classes were performing, and one was evaluating them. And other classes from the schools were also observing them and listening to them. These students were brilliant and this activity of arranging the debate at this age is a very thoughtful experience. Where the students would learn at an early age about public speaking and their presentation skills will surely get developed. And the debate teacher was hosting the debate and other teachers were observing".

Debate, as a teaching and learning tool for CLIL (Cinganotto, 2019; 2021b), was also a topic covered in one of the modules of the EDUREFORM MOOC (https://www.edureform.eu/mooc/) produced by IUL University. The Indian partners were fascinated by the potential of debate for language learning and CLIL, as it can enhance communication skills, public speaking skills, creativity, and critical thinking, aligning with the main goals of the EDUREFORM project.

The Indian teachers also appreciated the "DADA" organization and setting implemented in the lower secondary school. Each subject had its own laboratory, and students rotated from one classroom to another, as one comment highlighted:

"Environment was conducive to a more functional teaching approach for the subjects being studied. Here they shared their experience of using a locker in school, where students carried the lesson material for two hours and after that they went to the locker to get the material for the next class. By doing so students didn't get bored by sitting in place and their productivity improved. Also, it helped them to develop organizational skills at an early age".

7. CLIL lesson observation: upper secondary school

The Indian student teachers primarily spent their time observing lessons at two upper secondary schools: the Istituto "San Benedetto" and the Liceo Classico "Dante Alighieri" with an IGCSE (International General Certificate of Secondary Education) curriculum, where they had the opportunity to observe IGCSE lessons in Math, Chemistry, and Latin, all taught in English by native speakers.

Here are some of the comments and observations collected from their learning journeys and interviews:

"The next class we attended was Mathematics in English, and we were able to understand everything. The class had a student-centered approach with a friendly atmosphere. The topic for the class was linear equations, and students

were asked to expand and simplify given questions. Some aspects of binomial and polynomial equations were also covered by involving the students. For evaluation, the teacher had the learners solve questions from the Cambridge question paper. I appreciate this method because Mathematics is a practical subject that requires practice."

The Indian teachers noted the practical and interactive approach used in STEM subjects. They also observed strategies for developing thinking skills, as evident from the statement "students were asked to expand and simplify given questions".

Similarities were found between the Indian Chemistry lesson and the Italian one:

"The first class of the day was Chemistry in English, where the teacher taught about elements of the periodic table. The class was interactive, with students actively participating by drawing the structure of the elements. This class was similar to the Indian approach, as it involved discussions on the properties, uses, and functions of the elements. The teacher used diagrams to explain electronic configuration and the concepts of electrons, protons, and neutrons. After the topic discussion, the teacher evaluated the content using questions from previous year question papers. This was an important and effective method as it provided learners with an idea of exam preparation and boosted their confidence".

The main strategies highlighted were discussions, interactions, the use of visuals and diagrams as scaffolding techniques, and mock tests.

One student emphasized the competitive dimension and game-based approach in the Chemistry class, as mentioned below:

"The second class was Chemistry, where we conducted an experiment to determine the concentration of HCl in a solution. The experiment was done as a competition between different groups of students, including our own group. We achieved third place in the experiment, with a concentration value close to the actual value. The teacher recorded all the data and showed it to the students for further improvement."

It is noteworthy that consideration was given to recording data for "further improvement", which fosters critical thinking skills, self-awareness, and metacognition.

"I performed the titration experiment with my group of students. The class was interactive, and the teachers were very helpful and cooperative towards the students. Our group also received the second prize for having the least deviation from the expected values".

Competition and prizes were highly appreciated by the Indian students as additional incentives in the class.

The Indian student teachers also observed some History lessons and noted the use of the deductive method:

"The next class was History, where the teacher employed the deductive method. The discussion focused on socialism, communalism, and nationalism. There were around 18 students in the class, and the environment was learner-friendly".

"The first lecture was on Italian history, and after some time, the teacher asked us about Indian history, showing a keen interest. In response, I started a lecture on Indian history, starting from the Mughal period and discussing up to the country's independence. They were surprised to learn about the facts I presented and wanted to know more about Indian history".

It is interesting to note how the presence of Indian student teachers in the class acted as a catalyst for intercultural dialogue and exchange. Italian students were curious to learn more about Indian history and culture.

The observation of the Latin class in English was particularly impressive for the Indian students and led to broader reflections on the history of the world, the meaning of life, and its foundations:

"We attended the Latin class, where we learned about the general history of the Roman Empire through a video presentation. The video helped us visualize and imagine the structure of the city. It demonstrated that history is the same everywhere, with survival and a dignified life as the basis of human existence. The teacher used the video to interpret its contents, linking it with the present and providing direction to the learners. She had a command over the language and was clear in her explanations. To evaluate the class, a Quizlet activity was used, where the learners had to answer questions briefly. The textbook used was in English, and some Latin words were incorporated into the lesson, along with information on historical events".

Videos, images, and learning technologies like Quizlet were mentioned as examples of scaffolding techniques used to make the lesson interactive and engaging.

"Sometimes, the teacher had to explain new concepts in Italian. Later, as a means to assess students' understanding and competence, an activity was given where students had to write down what they understood from the class in English and then read it aloud. This allowed the observation of their reading, writing, and speaking skills in English. It was a group activity, and all the students performed well".

The use of *translanguaging* (García, Wei, 2014; Cinganotto, Turchetta, 2020) was also highlighted, where Italian was used as a scaffolding technique to facilitate understanding of content in English. Additionally, code-switching and code-mixing among Italian, Latin, and English were addressed as unusual but noteworthy aspects.

8. CLIL microteaching

Under the supervision of the author and the host teachers, the students were guided to plan and carry out their own lesson plan in their respective subjects, implementing micro-teaching interventions.

An example of a lesson plan in Math is reported below. The Indian student teacher planned it carefully, after meeting the students and having discussed with them about their possible pre-requisites.

8.1. The lesson plan

TOPIC: Probability

GLOBAL GOAL: To familiarize the students with the concept of probability and set theory

AGE OF STUDENTS: 13

LEVEL: 2nd year

TIMING: minutes 30

Aims
The concept will be taught with the help of the English language and numerous illustrations.
TEACHING OBJECTIVES (What I plan to teach)
• Students will understand the concept of probability. • Students will develop an interest in set theory.
Content • Definition of event, random experiment, sample space, set, etc. • Properties of union, intersection, and De Morgan's Law.

Cognition	**Culture**
• Students will understand set theory.	• Students will gain knowledge about set theory in an international context.

Communication

Key vocabulary:
Set
Equations
Intersection
Union
Overlapping
Complement
Null set

LEARNING OUTCOMES

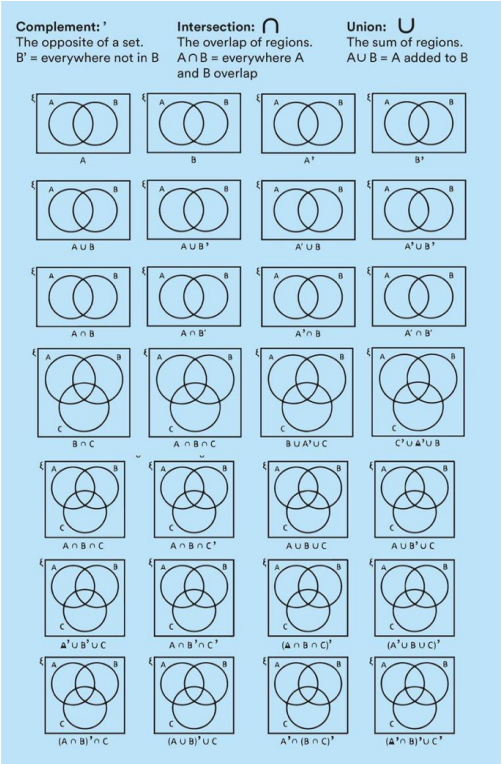
By the end of the lesson(s) learners will be able to:

- Define the terms used in probability.
- Write down the properties of union and intersection.
- Establish relationships between different Venn diagrams.

By the end of the unit learners will be able to: Apply different equations to solve Venn diagrams and describe their properties.

Assessment Method tools

Assessment will be conducted by frequently asking questions in class and providing diagrams for students to solve equations.



8.2. Reflections on micro-teaching

The interview with the Indian student teacher regarding the reactions and feedback on the Math lesson clearly highlights the benefits of CLIL in terms of cognitive skills. The student reports observing progress in delivering concepts, emphasizing the role of questions in fostering thinking skills and communication in the foreign language, as advocated by CLIL.

> *"I chose the topic of probability to teach to the 2nd-year students. After assessing their prior knowledge on the topic, I started from the basics and introduced different concepts. The students responded well to the initial concepts, and when I gave them some questions, most of them were able to find the answers easily. Encouraged by their response, I proceeded with more concepts and presented them with a few tricky questions. Although it took them some time, they eventually solved the questions. I noticed that the students were listening attentively, which indicated their interest and enthusiasm for the lesson. The fact that they grasped the concepts easily demonstrates their potential to learn even more advanced concepts."*

This reflection highlights the student teacher's effective instructional approach, starting from the basics and gradually introducing more complex concepts. It also emphasizes the students' active engagement and ability to comprehend and apply the learned material. The student teacher's observation of the students' attentiveness and enthusiasm further supports the positive impact of CLIL on student motivation and learning outcomes.

9. Interviews with the Indian student teachers

The interviews with the Indian student teachers revealed their positive attitudes and reactions towards CLIL. They mentioned various benefits, encompassing all four Cs, as summarized by the following comments:

> *"Students and teachers will be well versed in using the 4 C's".*

> *"Exchange of culture with language integrated into subject knowledge".*

> *"We prepare global students. Students studied with CLIL are ready for the world which uses English as its global language".*

> *"It would help with the introduction of a new language other than the mother tongue, which would aid students who go for further studies to other countries as well as help in corporate jobs".*

The Indian student teachers highlighted interesting aspects about the CLIL lessons they observed:

> *"Students were excited to learn with a new aspect".*

> *"The activity planned for the topic was productive".*

> *"I noticed that students are able to understand in the English language, and with a little more effort, there is a high scope of improvement, and conditions can be to global level".*

> *"Students were highly interested in learning English and were working hard to try and converse in the English language".*

The Indian student teachers identified favorable conditions in the CLIL environment for language improvement, content acquisition, and engagement.

In particular, regarding communication and interaction, the Indian student teachers observed a strong command of the English language and recognized the high potential of CLIL as an effective strategy to improve it, as reflected in the following comments:

> *"Students interact well in English. During the teaching-learning process, content is covered with perfection. Some students make errors related to language, including spelling, writing, and sentence framing".*

The reflections on CLIL methodology refer to the innovative techniques adopted, the use of learning technologies, and the creation of good conditions for safe, student-centric, and comfortable learning environments. This allows students to feel free to express themselves in English without fear of making mistakes.

> *"It is a mix of traditional methods with the addition of ICT. They use smart boards, but they can enhance their skills in using them meticulously".*

> *"The teacher-student relationship is more friendly here. The school environment is very positive, and the major learning is how building a positive environment is helpful for learner to grow well".*

> *"The school is student-centric, and students actively participate in class activities. They do*

not have any fear of expressing themselves, which is essential aspect of the teaching and learning process".

Positive remarks were also expressed about one of the 4 Cs, "Culture": CLIL with Indian students represented a natural environment for intercultural dialogue and exchange, as shown below:

"Students were enthusiastic to learn different cultures and were also eager to share their own culture through ppt slides and hosting parties (sharing food)".

The Indian student teachers were also interviewed about another of the 4 Cs, "Cognition." They were aware of the Cognitive Discourse Functions (CDFs) conceptual construct presented during the online CLIL course before the mobility. Their reflections were very interesting:

"During the class observations, multiple discourse functions were used by the teachers. At the beginning of the sessions, there was a time structure that could be classified under the "classify" category. The act of "defining" the topic to be taught was almost always present in every class. The "describing" function, where the teacher helps the learners identify, specify, and name relevant information, was also observed. "Evaluation" at the end of the sessions was conducted, although the specific methods varied from class to class. It was noted that learners were encouraged to explore beyond the topic and share their perspectives. In terms of student participation, there was a collective use of discourse functions when answering questions or engaging in activities. Some of the discourse functions prominently used by the students were "explain," "classify," "describe," and "define." During the lesson I conducted, I used "explain," "classify," and "define" to warm up and introduce the topic based on the specific needs of the lesson. As the session progressed, "describe" and "explore" were employed to encourage learner participation and assess their learning progress. Finally, at the end of the session, evaluation was conducted to determine the level of understanding.

In summary, during the teaching and learning process, all seven Cognitive Discourse Functions (CDFs) are naturally employed to ensure the effectiveness and accuracy of the process.

"When discussing cognitive discourse, we refer to the processes involved in learning academic content, such as describing, defining, explaining, or evaluating. These processes are understood using linguistic patterns employed in the classroom. The verbs associated with these aspects are already included in the objectives of various academic subjects, describing specific cognitive operations like defining, evaluating, and explaining. It is important to note that these operations or functions have specific linguistic realizations that can be taught to students."

When considering the use of learning technologies in a CLIL class, one of the students suggested the inclusion of new Cognitive Discourse Functions (CDFs) such as Comprehend, Analyze, and Frame. These CDFs relate to aspects commonly used for metacognition, where learners analyze their own learning, assess their understanding, and activate self-monitoring strategies. The proposed CDFs highlight the importance of engaging learners in higher order thinking skills and promoting self-reflection and self-regulation in the learning process. By incorporating these CDFs, CLIL instruction can further enhance students' metacognitive abilities and facilitate deeper understanding and application of the subject matter.

"Metacognition is an essential component of the learning process, and incorporating cognitive discourses is crucial for its development. When learners share their experiences, they often use words, verbs, or phrases such as "feel," "analyze," "understand," and "experience." These words and verbs align with the cognitive discourses and reflect the learners' engagement in metacognitive processes. As a teacher, using these verbs naturally during a lesson helps guide learners towards achieving the desired outcomes. By integrating metacognitive strategies and promoting self-reflection, educators can empower students to take ownership of their learning, monitor their understanding, and make meaningful connections to the subject matter."

Another important aspect mentioned in relation to CLIL is the activation of critical thinking skills. One comment emphasizes the significance of critical thinking in CLIL:

"CLIL provides an opportunity for students to develop critical thinking skills through the integration of content and language. Students are encouraged to analyze, evaluate, and apply their knowledge in various contexts, fostering a deeper understanding of the subject matter."

By engaging in CLIL activities, students are challenged to think critically, solve problems, and make

connections between different concepts. This promotes higher order thinking skills and enhances their ability to think independently and critically evaluate information. Overall, CLIL not only facilitates language learning but also nurtures metacognition and critical thinking skills, preparing students for academic success and lifelong learning.

> *"More tasks that involve expressing oneself in the target language while using subject content, along with self-reflection and metacognition by the learner, are considered essential".*

Critical thinking skills are also highlighted in relation to CLIL, as mentioned in another remark:

> *"Teachers also implemented various activities in the class, such as solving application-based questions or completing worksheets in groups or individually."*

A very positive comment by one of the student teachers highlighted the valuable contribution of CLIL to the Italian school curricula, which could serve as an inspiring case study for the further implementation of CLIL in India.

> *"You have done such great work for future generations. Shaping new minds is a great task that not everyone can do or even think about. And yes, congratulations for envisioning it and implementing it with CLIL!"*

9. Results and Discussions

According to the Framework Analysis, comments, notes on learning journals, and interviews with the Indian student teachers were triangulated to collect their reactions and thoughts into certain categories, identifying their attitudes towards CLIL lessons and CLIL potential. The main reflections and opinions of the Indian student teachers on CLIL are collected and summarized below.

They believe that CLIL can increase students' exposure to English, creating favorable conditions to improve their language competences. A good level of English was generally observed among Italian students, who appeared eager to communicate and express themselves during CLIL lessons.

CLIL teachers are described as employing interactive methodologies and incorporating learning technologies in a friendly environment.

CLIL classrooms are noted to be ICT-friendly, with interactive whiteboards and devices being common in the host schools, even at the primary and lower secondary levels. The learning environments are described as dynamic, interactive, and flexible, following the "DADA model," which can facilitate the learning process. According to the students, CLIL classes were highly effective when teachers utilized ICT tools such as presentations, videos, and audio stimuli to enhance learning and content retention in English. Engaging in debates in English was also identified as an effective strategy in CLIL.

CLIL is seen as a facilitator of intercultural dialogue and an enhancer of multilingual pedagogies.

The Indian student teachers were impressed by the diverse range of languages taught in CLIL classrooms, which included English, Latin, Greek, and Spanish. They appreciated the use of various techniques, such as *translanguaging*, to incorporate these languages, each bringing its own cultural dimensions and values. The presence of Indian students in the class was seen as a catalyst for intercultural dialogue and global exchange, and it also contributed to the enrichment of home languages, particularly for students with a migration background, such as Indian students living in Italy and attending Italian hosting schools.

Additionally, CLIL was recognized as a means to foster critical thinking skills.

The Indian student teachers emphasized the potential of CLIL in developing critical thinking skills. They observed that in the CLIL lessons they witnessed, planned, and conducted, all seven CDFs outlined in the Dalton-Puffer conceptual framework were evident. They specifically noted the presence of metacognition and self-regulation strategies, which contribute to fostering critical thinking in CLIL classrooms.

Conclusions

The study conducted as part of the EDUREFORM project focused on a sample of Indian student teachers who were hosted by Italian schools. During their three-week training mobility on CLIL, the student teachers had the opportunity to observe, plan, and conduct CLIL lessons. It is important to note that the study has certain limitations, such as the small sample size and the short duration of the mobility programme. As a result, the study does not aim to provide a comprehensive analysis but rather offers insights based on the research questions outlined in paragraph 2:

1. What are the Indian student teachers' perceptions and impressions of CLIL lessons in Italian schools?
2. What are their ideas about the features, potential and impact of the CLIL methodology?
3. From the perspective of Indian student teachers, can the CLIL methodology contribute to the development of students' critical thinking skills?

The reactions and thoughts of the Indian student teachers, gathered through learning diaries and interviews, are positive and highly rewarding. They

firmly believe in the potential of CLIL in terms of increased exposure to the target language, the utilization of innovative and interactive teaching methodologies, the promotion of multilingual pedagogies, and the facilitation of intercultural dialogue. According to their perspective, CLIL can play a significant role in developing critical thinking skills by nurturing all the CDFs, including metacognition and meta-reflection on their learning. They believe that CLIL could be further implemented in India, also considering its success in Italy and Europe.

However, it is important to encourage more studies on CLIL in India in the future to further explore the current state of CLIL implementation on the Indian continent. This research should focus on identifying the main challenges and limitations hindering the widespread adoption of CLIL, as well as proposing potential interventions and actions for improvement.

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On importance of young learners' cognitive abilities: the Fourth Industrial Revolution's perspective

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Abstract

In compliance with the priorities determined by the Fourth Industrial Revolution, the present article attempts to address selected aspects that pertain to the role of young learners' cognitive abilities, which are brain-work related skills that individuals develop. This study is interdisciplinary in nature and is backed up by selected theoretical contributions that pertain to meaning construction in language use in intersection with the analysis of slight cognitive level impairment instances, which might result in learners' language perception and production difficulties, where slight cognitive impairment is understood not as illness but as a signal of speaking or comprehension problems, behavioural and mood changes, or memory and concentration fade. Several factors can cause manifestation of slight cognitive impairment in the processes of language perception and production. To investigate why several traits of this impairment type might develop in learners, the authors of this article have studied selected instances that refer to spoken language disorders in a sample group of young learners who were brought up in Latvian repatriate families and who repatriated to Latvia from western countries in the period between 2021 and 2022. As a result, the study has drawn its conclusion: within the framework of the tasks set by the Fourth Industrial Revolution, young learners' cognitive ability manifestation enhances their role in society and depends on: a) objective factors, for example, background knowledge of spoken language production principles, b) subjective factors, for example, language procession adequacy, which in certain groups of learners might be lowered due to some factors deriving from slight cognitive impairment.

KEYWORDS: Fourth Industrial Revolution, Cognitive Abilities, Cognitive Impairment, Spoken Language Disorders.

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1. Introduction

It is generally known that the 21st century foresees fundamental changes which should be introduced to enhance the role of the newly acquired learners' abilities, including digital competences, to promote their involvement, social inclusion, and participation not only in national-level commitments, but also in global political, environmental, and economic activities, such as employment, leadership, management and alike. In fact, this century is described as a century of digital governance, known as the *Trusted Web* (Cofta, 2010), where advanced cognitive abilities and digital competences promote successful performance in a broad array of professional sectors of work. Several writings on the Fourth Industrial Revolution (e.g., Schwab, 2016) note that fundamental changes in society mean much more than mere technology-driven transformations. They characterize new opportunities and are concerned with social inclusion of a broad spectrum of people from different layers of society, different ability groups and statuses including.

Klaus Schwab, the founder of the World Economic Forum, introduced the term the *Fourth Industrial Revolution* in 2016 and characterized it as "a revolution that will fundamentally alter the way we live, work and relate to one another" (Schwab, 2016, p. 7).

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The Fourth Industrial Revolution has been introducing enormous and far-reaching economic, social, and cultural changes in society, and it has exerted profound impact on people's livelihoods. At the same time, Schwab (2016, p. 16) voiced concern about inequality if people are not empowered to deal with rapid technological changes, which impose enormous demands on people's education, which in turn "pose serious challenges to education systems" (Bikse et al., 2022). Thus, the education sector has an important task to ensure that children have well-developed digital competences.

However, one should not downplay the role of young learners' cognitive abilities to face the current and future technological challenges. Therefore, the present study investigated the likely effect of the Fourth Industrial Revolution on language and cognitive development of children by studying the cases of repatriate young learners in Latvia, a country with the population of 1,875,757 in 2023. The choice of the target population has been determined by the diaspora policy which emphasizes the importance of return migration (Plan for Work with the Diaspora for 2021-2023, 2021).

In Latvia context, the present time tendencies demonstrate two distinct groups of repatriates. The first group comprises those who left the country in the late 1990's and at the beginning of the new millennium, which was a period marking a considerable number of Latvia citizens immigrating to such countries as England, Ireland, Norway, and Belgium to satisfy their social, employment, and financial needs. The second group comprises those who have completed their service in a variety of advisory, banking, counselling, and diplomatic positions in such countries as Belgium, France, and Luxemburg and have returned to their former communities in Latvia.

In the diaspora policy document *Plan for Work with the Diaspora for 2021-2023*, it is stated that at the beginning of 2020, the size of the diaspora was approximately 373,000 people, "including persons of Latvian origin and their descendants in the USA, Australia, Canada and some European countries. In the period from 2013 to 2019, the total number of immigrants in Latvia was 68,536 people, of whom 38,857 were remigrates (on average in one year - 9,791 immigrants, of whom 5,551 were remigrates)" (Central Statistical Bureau, Republic of Latvia, n.d.).

Pre-school and school-age learners who were brought up in Latvian-origin families but resided in foreign countries are often faced with integration problems in the educational environment of Latvia due to spoken language perception and production problems, which young learners from repatriate families experience when communicating in educational settings. Therefore, the present analysis is interested in looking beyond mere developmental processes and enhancement of technology-driven skills: its research focus is on examining selected underlying reasons that express its authors' presuppositions on how individuals referred to as lower-ability learners, i.e., those who need external assistance to develop as individual learners, can contribute to society, and, thus, can be stimulated and involved in its complex developmental processes. Considering the importance of an inclusive educational environment to satisfy the goals addressed by society, this study has posed its research question:

What reasons underly repatriate young learners' spoken language perception and production difficulties in language use in social environment?

2. Materials and Methods

2.1. Materials: theoretical background

It was an American descriptivist E. Sapir who supported the idea that the social context and people who perform in this context, in a way, encourage and promote the creation of linguistic production. E. Sapir held the view that the linguistic representation and language perception can be promoted if two aspects are considered: the physical aspect, namely, the geographical area, and the societal one, namely, the language being a social phenomenon. E. Sapir stated that "if the characteristic physical environment of people is to a large extent reflected in its language, this is true to an even greater extent of its social environment" (quoted in Fill & Muhlhauser, 2007, p. 17).

Research interest in meaning creation is not a recent one. Drawing on the American structuralists' contributions (e.g., Chomsky, 1965, p. 15-18), the central focus point that determines meaning creation in a language is a set of grammar rules, which govern a language at semantic, syntactic, and phonological levels. These levels create meanings or "senses" of the language (*ibid*.). As regards language acquisition processes, the structuralists stated that language acquisition is an in-born capacity of a human being, where a language relates to an established mental phenomenon; thus, language perception and its production should be viewed as interrelated activities with no relation to its social function of use.

Research findings acquired by the linguistic philosophers at Oxford University (e.g., Austin, 1962) stated that meanings of sentences relate to specified linguistic functions of a language (e.g., to express a request, to argue) and the use of linguistic functions, known later as speech acts, fulfil the language users' communicative needs. Appropriate and relevant use of language demonstrates that an individual has perceived and understood the expressed linguistic implications. The functional perspective on language use was associated with the view (e.g., Halliday, 1973, p. 38-39) that language use depends on the interface of semantic rules and general conditions that determine the

communicative language use in each context. In other words, a semantic meaning of utterance can be explored if it is viewed in relation to the communicative situation of use. Leech (1983, p. 10-13) marked that linguistic communication is concerned with both the use of formal language systems and conventional implicatures that can be derived from word meanings in the context of their use. Thus, communicative language use depends on internal language aspects, i.e., grammar rules, and on external language aspects that depend on the social functions of language use.

In addition, it should be noted that several layers of society exist, namely, those who perceive and produce language with a marked eloquence and those who suffer from spoken language disorders that might have occurred in different periods of life, early childhood including. For the study purposes, the present article has established its working definition for the concept *spoken language disorders:* these are slight impairments in language acquisition and in its contextual application due to language comprehension deficit and marked limitations in spoken language production when conventional rules of sound construction, morphology, sentence construction and meaning construction in a language should be observed.

To analyse the instances of spoken language disorders, this study was concerned with the latest contributions of clinical pragmatics, which, being a relatively "recent science" (Cummings, 2005), examines specific cognitive conditions that underlie language disorders, inter alia, the perception and production of a spoken and written language across one's lifespan, the analysis of how language knowledge is acquired and how the communicative needs of a person are met. It is generally accepted that language production and comprehension is not only related to the neuroanatomical structures of the brain that are responsible for language abilities of a person, but they are also related to the linguistic disciplines that determine how language knowledge is acquired and how the communicative needs of an individual are satisfied. However, if an individual suffers from, e.g., clinical speech pathologies, text (discourse) construction disorders, or from cognitive deficits, he/she can hardly cope with making sense of a statement. For example, individuals having developed phonological disorders or those with special language impairments can hardly identify meanings created by a sound system, or they can identify semantic mappings in a text (e.g., semantic fields) with difficulty. Coping with paradigmatic meaning relationship (e.g., use of idiomatic or metaphoric language) is a difficult task as well because such language use, as a rule, requires advanced cognitive skill involvement. Besides, a range of verbal and non-verbal behaviours, known as communicative appropriateness (Penn et al, 1988, p. 3-17), enable an individual to assess the language skills demonstrated by another language user. This means that not only the use of formal language features but also the language strategies employed ensure a communicative event (Cummings, 2014, p. 23).

Thus, it can be claimed that spoken language perception and production incorporates a variety of linguistic abilities at the levels of sound construction and perception, morphology, sentence meaning construction and speaker's meaning construction.

2.2. Methods

From a research approach perspective, this study deriving from the "focus on meaning and understanding the phenomenon" (Glatthorn, 2018, p. 34-35) was a qualitative study because "the study bearing features of empirical nature […] is concerned with exploring and describing a phenomenon" and thus, it is referred to a case study type because "a case study […] investigates a contemporary phenomenon within its real context" (ivi, p. 37).

From the perspective of research methodology design and to analyse why repatriate young learners experience spoken language perception and production difficulties in language use when it is applied in social environment, the authors of this study made use of:

- two types of *secondary sources:* a) theoretical contributions on cognitive abilities, cognitive functions and language verbal functioning (e.g., Regan 2018), on cognitive disorders (e.g., Cummings 2015; Cummings 2005), and on communicative situations of language use (e.g., Leech 1983), b) Latvia-related research findings obtained at Riga Stradins University (Latvia) on considering such aspects as communication patterns held between a physiotherapist and a patient (Rozenbergs et al, 2018), attention deficit disorders and cognitive impairment cases (Devjatnikova et al, 2020), and
- *primary sources*: a representative sample of 12 young learners between 5 and 10 years of age, who with their families repatriated to Latvia from several countries in the period between 2021 and 2022, formed the research population. The study analysed anonymised health-care reports drawn up by healthcare personnel and communication specialists. The cases under analysis were marked as Case 1 and Case 2. Case 1 characterized the young learners who were not referred to the *State Support Programme* upon repatriation to Latvia and, thus, did not receive the state's support for integration and/or social inclusion. Case 2 characterized the instances when the repatriates' children were referred to the *State Support Programme*, which functioned within the framework of a European Social Fund project and was conducted by researchers from the Faculty of Medicine, University of Latvia, one of them being a co-author of this article. As a result, several specialists, such as speech pathologists, psychiatrists, psychotherapists, and social workers contributed to

the social inclusion of young learners and to their involvement in educational, social, and emotional processes or contexts.

Considering the research methodology characterized above, it should be noted that this was a small-scale study. On the one hand, it was conducted to gain some deeper understanding of linguistic and cognitive level disorders that might develop in children who were brought up in the repatriate families when young learners started using the national language when attending schools in Latvia. On the other hand, the study reconsidered some of the factors that could pose obstacles for handling spoken language production and perception disorders in contextual language use.

3. Research Discussion and Results

3.1. Discussion

The analysis was conducted to find out how young learners dealt with meaning construction in communicative situations of language use, how they stated their communicative intentions, how they established conventional communication routines, and what cognitive conditions gave reasons for spoken language disorders that resulted from language perception difficulties. Besides, the roles of learners' parents and peers were considered as well when the study analysed how young learners' self-perceptions were shaped and how their self-presentations, i.e., spoken language perception and production was enhanced.

Case 1

Case study 1 reported on the analysis of young learners' spoken language performance and on social behaviour exposure of pre-school age, 5 to 7 years old, individuals, born in England in mixed nationality families where the Latvian language being the national language in Latvia was not used as a language of communication in the respective families. Having held interviews both with the learners and their parents, the communication specialists indicated several problems that caused spoken language perception and production difficulties, such as:

a) inability to use language appropriately to communicate ideas in a context,
b) inability to use various language strategies in a relevant manner,
c) inability to make smooth interactions to demonstrate the communicative intentions of language users,
d) incapability to formulate learners' communicative intentions in the communicative contexts,
e) language impairment instances ranging from stuttering and speech anxiety to poor language comprehension.

Further, to fulfil the language functions for the purposes of meeting the communicative needs in the situational context, young learners were able to ask questions to express their ultimate wishes or wants; however, they were hardly able to use verbal expressions to communicate their thoughts or feelings. In addition, they could hardly communicate factual knowledge which they had experienced; thus, difficulties in describing their observations in a descriptive and emotional way rather than in an evaluative manner were observed.

In sum, the above-stated testified that the spoken language perception processes of Case 1 participants were mostly based on the perception of sensory information (e.g., I/we saw, heard this), rather than on describing their beliefs (e.g., I/we think that this is true/false information), or values (e.g., I/we think that this behaviour is good, bad, wrong). The speech pathologist's observations indicated both young learners' spoken language production disorders and psychological disorders, such as a) learners were unable to display their emotions when they characterized the meaning of words or ideas, b) learners' physical performance and behaviour in the observation period were strongly influenced by cultural assumptions of their parents: the preferences and values regarding to what is acceptable or unacceptable in the communicative situations and contexts often differed.

Case 2

Case study 2 reported on the analysis of 8-10 years old school age learners' spoken language abilities and social behaviour exposures. These individuals were born in England, Ireland, Germany, and Island in mixed nationality families where the Latvian language was the mother tongue of one of the parents, but the national language of the respective country was used as a lingua franca in interaction. The learners of this group were referred to the *State Support Programme,* which was developed to promote integration and social inclusion of repatriates' children into Latvia's speech community.

Having held interviews both with the children and their parents, the communication specialists indicated several problems, such as:

a) communication difficulties where major limitations concerned language use in appropriate contexts,
b) meaning inferencing difficulties,
c) word order and sentence constructing difficulties at a semantic level.

Further, the above-mentioned conditions developed the basis for spoken language perception disorders because individuals faced difficulties with interpreting the literal and/or non-literal meanings. In the situations as referred to above, the young learners, for example, experienced problems with understanding time concepts, temporal relations between concepts, misuse

of language functions (e.g., greeting, thanking, apologizing, expressing promise).

As a result, Case 2 analysis demonstrated that spoken language perception disorders resulted in miscommunication because the participants:

a) failed to perceive the implied meaning of a statement,
b) were hardly able to share information with the other interlocutors,
c) failed to perceive the illocutionary force of an utterance, for example:

A: (speech therapist's question): *How was your trip to Riga?*

B: (respondent's answer*): Everyone was healthy in Riga.*

Results

As "meaningful communication does not naturally follow from conversational competence […], many speakers are inhibited by self-consciousness, lack of self-esteem, fear, and other over-riding emotions" (Apps, 2019, p. 15). That is why, sufficient and far-reaching attention should be paid not only to those young language learners who participate in spoken language production without any hesitation, but also to those who face challenges or experience language perception-production difficulties in language use in a social environment or speech community. Without any doubt, fluent spoken language abilities are based, inter alia, on:

a) cognitive abilities (e.g., Dickens, 2018), i.e., on such multidimensional skills as understanding concepts, handling unfamiliar situations, being knowledgeable about a wide range of topics,
b) cognitive functions (e.g., Regan, 2018) that refer to learning, memory, attention, and executive functions that refer to perception, thinking, reasoning, and awareness,
c) verbal fluency (e.g., Regan, 2018) that is displayed through the ability of decision making, memorization of word lists, explaining actions to be carried out.

To involve most of society individuals into far-reaching transformations anticipated by the Fourth Industrial Revolution, to promote the social inclusion of those society members who might suffer from cognitive impairment, spoken language disorders including, conciliatory and sympathetic attitude and careful and meticulous attention should be directed at them. To facilitate the linguistic behaviour of young learners who suffer from spoken language disorders, a broad array of linguistic strategies can be employed:

a) training learners' language functions: for example, producing appropriate responses which can be expressed through the language functions of clarification or through enhancing the fluency of interaction, which can be expressed through repetition, periphrasis, developing sociolinguistic sensitivity, which can be trained through the acquisition of language politeness forms, e.g., addressing, parting, and greeting,
b) developing linguistic strategies in a semantic context, which can be carried out through the language function of topic initiation, text construction, and text cohesion,
c) establishing fluency of interaction, which can be trained through teaching linguistic structures of repetition or simpler versions of periphrasis,
d) distinguishing features of non-verbal communication, which can be conducted through, e.g., showing how different facial expressions can be interpreted.

Consequently, it might be assumed that a variety of linguistic strategies can be employed if they are used in cases of slight cognitive impairment. They can be efficient tools to shape, e.g., the linguistic conduct of individuals. Besides, the linguistic interventions can be examined not only through functional language use but also through social language use. In case of spoken language disorders established in an early pre-school period, special emphasis should be laid on developing and expanding a text/message comprehension and production abilities, e.g., through implementing story telling activities.

To sum up, the development of young learners' cognitive abilities can be seen as an enhancing factor that plays one of the key roles in promoting learners' communicative skills. Thus, it might be considered as one of the basic therapeutic strategies that plays a crucial role in treating young learners with slight cognitive impairment. Not only educators, but also medical personnel, e.g., speech therapists and physiotherapists have a great opportunity to exert an overall positive and increasing impact on developing individuals' meaningful communication.

Conclusions

Spoken language perception and production incorporates a variety of linguistic abilities at the level of sound construction and perception, at the level of morphology, sentence meaning construction and speaker meaning construction. Spoken language production difficulties are often caused by language perception inadequacy, which, in its turn, is backed up by cognitive level problems, such as inability to memorize, perceive, understand, and produce language. It has been discovered that several problems are essential for spoken language perception and production, which young learners from repatriate families experience when language is used for communicative purposes in educational settings: a) appropriate language use in relevant contexts, b) difficulties with inferencing the speaker meaning, and c) sentence constructing challenges. Spoken language

production and comprehension is not only related to the functions of neuroanatomical parts of the brain that form cognitive abilities of an individual but also to the linguistic disciplines that demonstrate how language knowledge is acquired and how the communicative needs of an individual are met.

As a result, from the Fourth Industrial Revolution's perspective, the development of young learners' cognitive abilities can be seen as an enhancing factor that plays one of the most crucial roles both in promoting learners' communicative skill acquisition and in enhancing social inclusion of young learners with slight cognitive impairment in relevant speech communities. The implementation of the tasks pertaining to the Fourth Industrial Revolution cannot be successful without considering the importance of young learners' cognitive abilities such as the development of meticulous attention, ability to concentrate, problem solving skills, and planning skills being one the most important cognitive capabilities for establishing effective and meaningful communication, which facilitates the acquisition of communicative competence. Therefore, appropriate language applied in relevant interactional situations determines language users' linguistic behaviour in a variety of related aspects of linguistic representations.

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Artificial intelligence and higher education: a systematic visualizations based review

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Abstract

Artificial intelligence (AI) is evolving quickly, and its applications are attracting attention on a global scale. They have the potential to revolutionize many dimensions of human life, including education. AI has reformed various teaching methodologies, assessment methods and by enhancing their competitiveness and adaptability. In the current era, after the pandemic most preferably the AI and Education have interwoven and is continued to grab the attention of Academicians, Tutors, Instructors, the government, and students so that the research keeps AI and education intermingled for the benefit of society at large. The goal of our work is to present a visualization in form of the research trends and bibliometric analysis of research on the implementation of AI in HE during the 20 years. The study involves various parameters to include and exclude the research articles, we assessed 314 publications written by scientists in 67 different countries over the course of the last 20 years and included in the Scopus database. The study used word analysis and a variety of bibliometric markers to look at emerging patterns. In order to visualize the prominent research trends by locating keywords utilized inside AI in HE, VOSviewer was used. The findings display the annual publication rate of AI publications, as well as their regional distribution, subject- and keyword-level analyses, and research trends. Computer science and engineering disciplines dominate the interdisciplinary research in AI. AI research in HE is expanding; in the last five years have produced 78%, compared to 22% over the first 15 years. China and the United States are at the forefront of AI development, which is dominated by nations with significant research expenditures. There is hardly any research coming from poor nations. This work illustrates the limitations of AI in education research as well as its current and future possibilities.

KEYWORDS: Artificial Intelligence, Higher Education, VoSviewer, Bibliometric Analysis.

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1. Introduction

Artificial Intelligence in Education (AIED) offers the potential to raise standards, boost productivity, and give all students more equitable access to education. The use of artificial intelligence (AI) in education will have a big impact on how education is offered in the future. A multitude of applications and evaluation platforms that help with skill development already use AI in education. The AIED educational solutions will bridge the

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knowledge and teaching gaps and augment the educational system and academicians to work more efficiently. AI imparts customization of the teaching-learning system and streamlines academic administrative processes, providing teachers the time and freedom to concentrate on the cognitive capacities of the human being which would else are sacrificed in the stereotypical educational system. The finest use of artificial intelligence (AI) in education is when professors and robots work together to get the best outcomes for students. Another cutting-edge technology called artificial intelligence and machine learning is starting to change how educational tools and institutions work and what the future of education might entail, while educators, psychologists, and parents continue to debate the appropriate amount of screen time for children. As per the US Education Sector report on AIED in the time frame of 2017-2021, artificial intelligence in education will have an exponential rise by 47.5%. Even if the majority of experts believe that teachers' significant contribution is irreplaceable, there will be many changes to the teaching profession and the best practices in education.

2. Literature Review

This section covers a literature review to provide a review and brief of the existing research. It involves reviewing and evaluating scholarly articles, books, and other published works relevant to the topic at hand. The primary purpose of a literature review conducted is to provide a systematic overview with the help of the related work carried out earlier by various researchers and visualize it through various trends.

The section is composed of two subsections highlighting different aspects of the research review. The first sub-section generates a visualization of the research carried out and the second sub-section presents the combined journey of implementing AI in education.

2.1 Systematic Literature Review

To begin a literature study, similar publications are found, and a thorough scrutiny of the existing literature is conducted. The authors of this article are having studied the history of AIED and its involvement in multiple article types. A search query with Education and artificial intelligence OR AI for the span of 10 years was being generated which resulted into the list of documents generated.

To search the query IEEE Xplore was chosen, it has a total of 5917890 items to facilitate the user query. Millions of articles from the top technological journals, conference proceedings, and standards are available in IEEE Xplore, a digital library run by the Institute of Electrical and Electronics Engineers (IEEE) and its collaborators. It gives users access to full-text publications in a variety of relevant disciplines, including electrical engineering, computer science, and telecommunications. The search query was pertaining to 'education' or 'e-learning' or 'e-learning' and 'artificial intelligence' or 'AI' for the time span from 2012-2022 found in the publication title. A total of 2893, articles were being generated, out of which 2000 articles considered to be of more 'relevance' were being considered.

According to an analysis of the IEEE Explore research database, the notion was actually started booming in the year 2017 (Chen et al., 2022; Luan et al., 2020). The concept has gained momentum from the year 2000 and is popular in last few years; this same is visualized using the data set generated from IEEE explore Intelligence tool Figure 1. To show the adoption of artificial intelligence technology in the education sector the following line chart illustrates and is drawn using Tableau tool. The Tableau version considered is 2022.4.

In an attempt to find popular publication terms with respect to the current study, the top 25 publication topics were being considered and are being visualized. The few popular terms are: computer-aided instruction, educational courses, educational institutions, teaching, further education, computer science education, engineering education, Internet, distance learning, educational administrative data processing, virtual reality, software engineering, computer games, human factors, innovation management, learning artificial intelligence.

In an attempt to find popular states/Countries with respect to the current study, the top 25 publication topics were being considered and are being visualized. The top 5 countries' terms are Madrid, Spain; Uppsala, Sweden; Dubai, United Arab Emirates; Porto, Portugal; Vienna, Austria.

2.2 Related work

AI is one of the disruptive technology it focuses on smart machines, which are capable of observing their environment and acting in ways that will increase their chances of success (Shabbir & Anwer, 2018). The phrase "artificial intelligence" enabled system is computers with a tremendous amount of processing capacity, adaptive behavior to function more 'human like' behavior adapting the situation and taking decisions with cognitive abilities (Chen et al., 2020). In simple terminology, Artificial intelligence develops learning abilities through computer-created software and applications. Artificial intelligence to design and development of effective programs, methods, and algorithms to perform which else require human intelligence (Mitchell, 2019). In order words it is the act of simulating human intelligence by developing various functions, protocols, and standards is called artificial intelligence. AI-powered education comes along with its strengths, opportunities, and challenges since its initiation (Limna et al., 2021).

Over the last three decades and especially after the pandemic the growth of AI-based tools as more of virtual reality, virtual classroom environment, virtual

educators, and a mechanical evaluation system; the changes are tremendous (Roll & Wylie, 2016). The AIED depends highly on computational and information-processing tools (Ouyang & Jiao, 2021). AI in education opens up new possibilities, difficulties, and opportunities for educational methods (Alam, 2021). Several artificial intelligence concepts have been developed as a result of robotics research, and certain technologies can be applied to this field of study to create models of world states and explain how they change (Hwang, 2014). AIED education is student-centric providing students with a customized learning experience and assisting them as per their learning levels, priorities, and cognitive skills (Hwang et al., 2020). AI in education also aims to use AI to support the instructional process, which is crucial and where instructors' acceptance of AI is crucial. The instructors require computer-aided assistance for the collaborating education and provide predictive analysis through using data mining by generating various data patterns on the outcomes. But because AI is still a relatively new idea to instructors, they frequently have trouble responding quickly and effectively to insights from AI-enabled applications. As a result, they are less willing to adopt AI and are less open to it. Therefore, it seems crucial to increase instructors' acceptance of AI systems (Chen et al., 2022).To handle the new opportunities and opportunities provided by disruptive technologies such as big data, AI, machine learning, and soft computing; the various stakeholders' government, academicians, educators, policymakers, and professionals must collaborate and form an AI-based education eco-system. In this 21st century, where technology is available at the fingertip, all the aforementioned stakeholders must identify the KSA – Knowledge-Skills-Attitude component so that they get ready to be assimilated by the industry (Luan et al., 2020). These components are developed by using integrated learning systems, open education, effective and efficient grading systems, and immersive education tools (Yufeia et al., 2020; Owoc et al., 2019).

3. Bibliometric analysis

One of the most commonly used metrics in the bibliometric analysis is the citation count, which measures the number of times a paper has been cited by other researchers. This metric is often used as an indicator of the impact and influence of a particular paper or research output. Apart from citation count, h-index, i-index and journal's impact factor plays an important role to determine the quality of the research article publication and the publication journal too. The bibliometric analysis creates the clusters of the keywords, interrelation of authors, citation coupling, and interrelation of the publication country thus providing a 360-degree visualization of the dataset. This visualization is augmented by the analysis report showcasing the relevance, and occurrence count. It also creates the visualization in three forms Network, Overlay, and Density visualization to provide diverse and alternate views of the data pattern thus generated. Bibliometric analysis has become an important tool for research evaluation, funding allocation, and policymaking, but it is important to note that it has limitations and should not be used as the sole criterion for evaluating the quality or significance of the research.

3.1 Research themes and related literature

The most significant words 'keywords' as specified by the author in the research article are considered from the 'title/abstract fields' of papers on the literature related to education and AI with the least occurrence of 432 (70% of the minimum occurrences of the terms) from 30538 terms distributed in four clusters as shown in Figure 2:

1. The Cluster-1 (red) features 80 items and was organized alphabetically by the following topic: artificial intelligence, blockchain, big data, college, IoT, information technology, management, and platform.
2. The Cluster-2 (green) featured 67 items and was organized alphabetically by the following topics.: assignment, curriculum, engineering, educator, literature, gamification, project, programming, science,
3. The Cluster-3 (blue) featured 60 items and was organized alphabetically by the following topics: algorithm, device, engineering, experiment, project, science, simulation, video exercise, test,
4. The Cluster-4 (light green-yellow) featured 52 items and was organized alphabetically by the following topics: adoption covid, class face, influence, learning, pandemic, questionnaire, and response.

The study thus affirms that the clusters thus created concentrate majorly on technology usage articles, pandemic impact articles, and teaching-learning-evaluation process-related articles.

3.2 The Citation map

The authors were also keen to know the citations of the AIED term, so a citation ma was being created using the CitationGecko website as shown in Figure 4.

4. Discussion

A few of the uses of AI that are being employed fast in educational contexts are customized learning applications, automatic evaluations, social media platforms, and predictive analytics tools (Akgun & Greenhon, 2021). (AI) tools have the promise of helping both educators and learners by providing instruction in blended classrooms, providing students and teachers with periodic reviews, guidance, and suggestions on their cognitive skills, and providing teachers the freedom of being available and accountable 24*7. This will help students as they study, analyze, communicate,

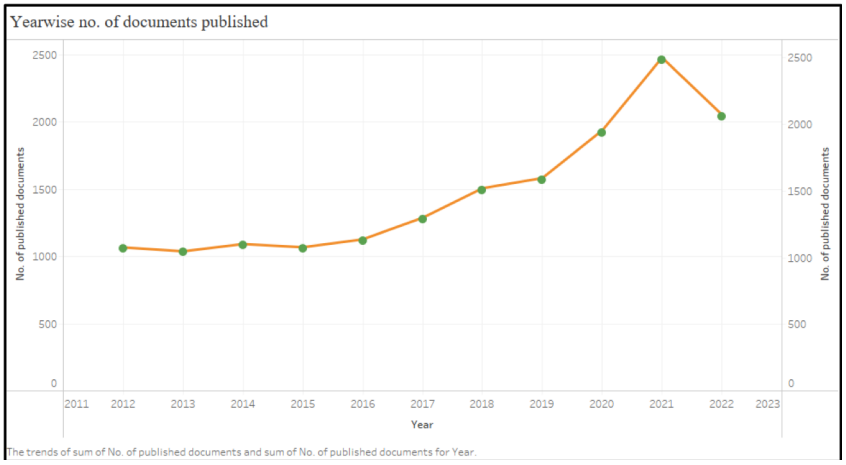

Figure 1 - Year wise publications w.r.t research query (education and AI) IEEE explore from 2012-2022.

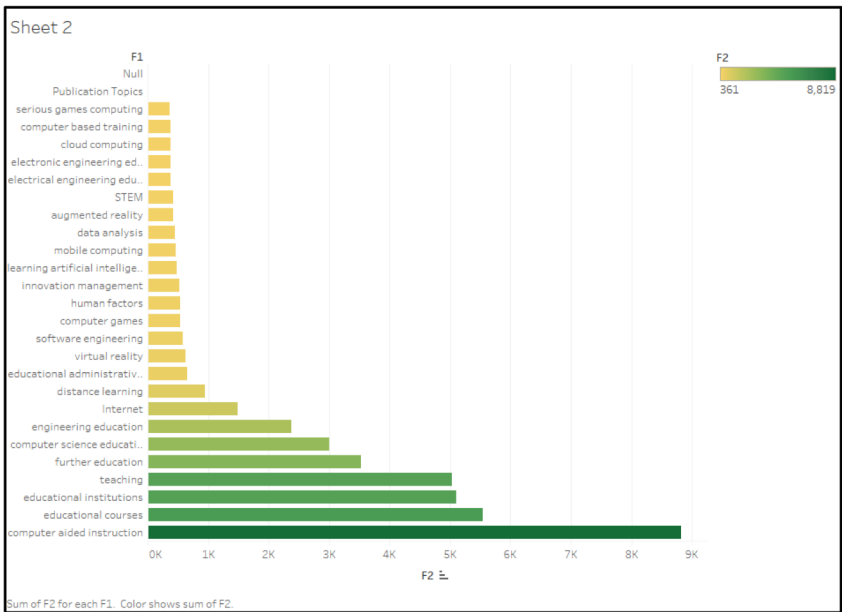

Figure 2 - Top 25 Publication topics w.r.t research query (education and AI) IEEE explore from 2012-2022.

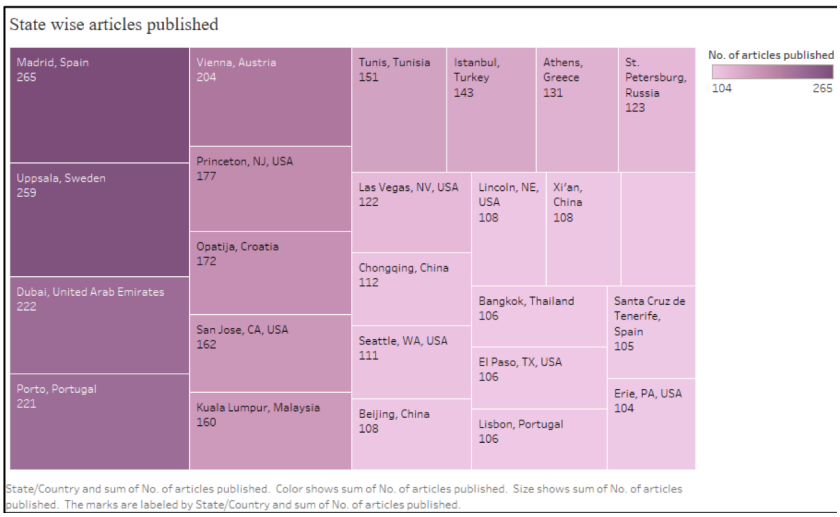

Figure 3 - Top 25 Countries w.r.t research query (education and AI) IEEE explore from 2012-2022.

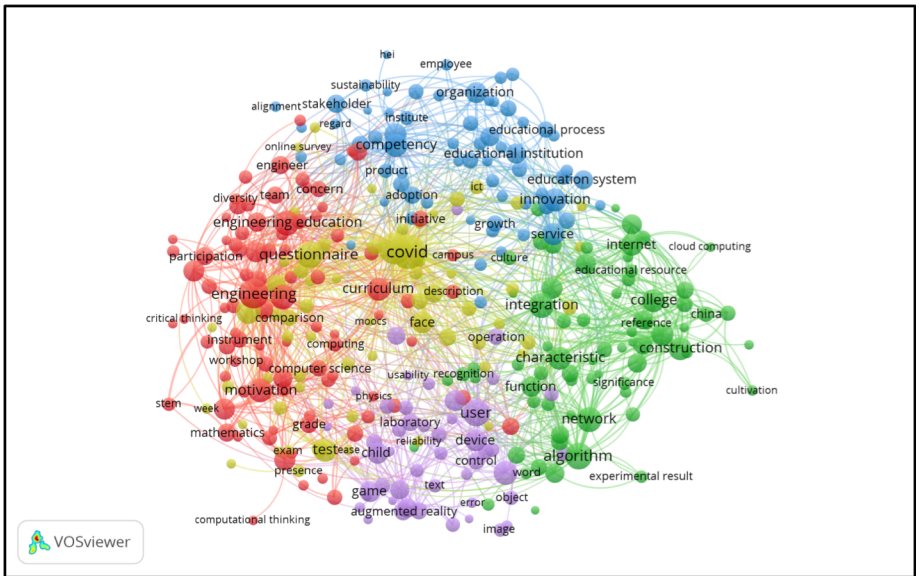

Figure 4 - Network visualization map of terms found in document title and abstract fields. The minimum number of times the phrases were used was 20. The Visualisation showcases four clusters in bibliometric analysis generated through VOSviewer.

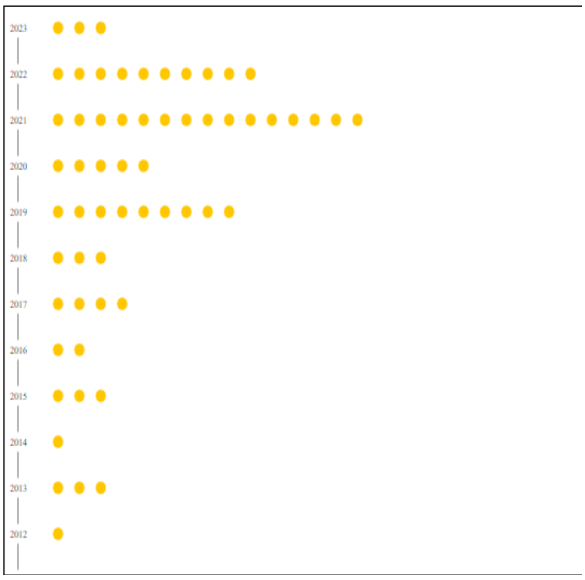

Figure 5 - Citation map.

and assemble information and represent it as part of their collaborative knowledge-building processes, and so on (Miao et al., 2021; Kim et al., 2019). Social networking sites use platforms like Facebook to link up students and teachers. The use of social media in the classroom can encourage students to actively learn, collaborate, and interact with networks outside of the classroom. Due to the varied AI systems and smart applications such as chatbots are found on social media platforms, e-learning portals, and institutes' websites (Tiwari, et al., 2022). Customized learning settings, also known as adaptive learning environments or intelligent tutoring environments, are common and helpful ways that artificial intelligence (AI) can help teachers and students. These intelligent tutoring environments allow students access to a variety of e-learning materials based on their areas of interest and technical operating systems. One of the most exciting uses of AI in education is adaptive learning. While the one-size-fits-all nature of the traditional classroom education approach persists, adaptive learning systems powered by AI are intended to maximize learning effectiveness. Notwithstanding these benefits, there are still valid worries. Privacy is one main issue. The two major concerns bought to the plate as an invasion of privacy and the unpredictability of ridesharing technology. The system of organizing, collecting, controlling, storing, using, archiving, and destroying data is the subject of data governance (Pabby & Kumar, 2017). A specialized program defined policies and processes, as well as communication from organizational leadership and

management, all work together to establish data governance. Generally speaking, the regulations must offer all required tools for upholding the general standards, which include audibility, security, completeness, accuracy, integrity, and accessibility. The effective use of big data analytics and AI depends on the application of the traits linked to each technology. It is possible for this person to apply substantial data analysis to support analysis and decision-making because they have the knowledge and analytical skills necessary (Tong-On et al, 2021). A recent study provides research on imparting AI in education. First, it is significant to know the implications of covid-19 coronavirus on the overall education system including the processes and persons as shown in the bigger 'bubble' at the central part of Figure 3. Future educators, governments, universities, policymakers, and other stakeholders need to understand the dynamics of education with the changing global scenario including the covid outbreak.

5. Conclusion

The development of AI technology has a lengthy history and is ongoing. Since the advent of computing and information processing technologies, AI has found widespread application in education because it presents new opportunities, problems, and possibilities for educational practises. Both good and negative effects of AI technology on teaching and learning are seen in the educational sector. AI in education has opened up new possibilities for designing learning environments and activities that make better use of technology. The use of AI technology in education is crucial for a number of reasons, including sautonomous grading, adaptive learning, and teacher feedback. Depending on their individual topic areas and learning demands, AI applications provide students with access to a variety of educational resources. When integrated with other intelligent systems, AI technology has the potential to assist and improve distant learning.

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Artificial Intelligence: exploring the attitude of secondary students

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Abstract

This paper aims to find the attitude of secondary students towards artificial intelligence. Intelligence is blessing received to mankind through which we have got the ability to learn new things, experience surrounding, and solve complex problems by making our life at a pace (Ewert, 2018). Likewise artificial intelligence (AI) is one of such abilities given to machines by humans for performing all possible tasks which humans can perform (Kengam, 2020). Rapidly growing technology has continuously changed the way of human existence by inclusion of robotics, automation leading to magical transformation. This technological transformation has not left the education field untouched. By the Google survey this paper analyzes the understanding of secondary students towards the artificial intelligence and its possible effect in the field of education. From the qualitative and quantitative data collected researcher found the high attitude in Pune city.

KEYWORDS: Artificial Intelligence, Attitude, 4th Industrial Revolution, Transformation, Evaluation, Microlearning.

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1. Introduction

Imparting knowledge is not limited to schools only. This process of knowledge building, including teaching and learning, has the addition of technological advancement. This advancement brought an effective instrument called artificial intelligence. And it is dominating the education sector also (Raja, 2018). Talking about innovation and revolution has brought magical, unexpected, surprising changes in numerous arenas (Khoza, 2020). In terms of transformation, from 1 Industrial Revolution, which started from 1790-1840, till the beginning of 4 Industrial Revolution, which came up with growing mechanical learning, automation, and technological advancement (Khoza, 2020) in every possible field made our life easy with artificial intelligence. Intelligence is the basis of human existence (Colom et al., 2010). Which is the guiding light for solving any problem, finding a solution, and inventing things to make human life better and more comfortable? Intelligence is present and shapes and helps humans gain new perspectives and adapt to emerging situations. With the blessing of human intelligence, humans gave birth to manufactured artificial intelligence (Colom et al., 2010). And John McCarthy is known as the father of Artificial Intelligence (AI). He coined this term in 1950. Artificial intelligence is part of every possible stream though it is part of the Science and Engineering arena. Artificial Intelligence reveals the characteristics we identify with human intelligence, like behavior, problem-solving, giving quick solutions, and creating innovative things to enhance productivity (Hemlatha et al., 2020). Robotic work is done immediately. It would be correct to call AI an interdisciplinary field (Dusan, 2020). It is entrenched in every field, even in the field of education. For example: Inclusion of mathematics through engineering, science through scientific discoveries in medicine, agriculture, psychology, neuroscience, economics, statistics for finding the inference, etc. (Tecuci, 2012). It continually keeps inculcating innovative concepts and techniques and upgrading with added inputs. AI solves most problems through knowledge (Hemlatha et al., 2020).

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1.1. Artificial Intelligence and Education

Comparing the education system with earlier learning, there has been a major observable shift in the use of AI due to the beginning of the 4 Industrial Revolution. Per Horizon report of 2018, specialists have anticipated the ongoing increase in the use of AI by 43% from 2018 to 2022 (Kengam, 2020). Also, as per the conference held in the 21st century on an international level based on Artificial Intelligence, AIED is an emerging arena in educational technology (Kengam, 2020). This could be observed in daily life without further confusion by monitoring the emergence of online learning-teaching platforms like; Digital Classroom, YouTube, MOOC courses, distance learning platforms, etc.

The presence and widespread of AI, kept us connected to education in the hard times of life and death. Schooling in earlier days was not flexible, but it became possible due to artificial intelligence (Pantelimon et al., 2021) Because of these significant functions of AI which are flexibility, diverse leaning, micro learning, multiple intelligence, knowledge boost etc. (Figure 1).

This significance of artificial intelligence makes it so, essential and making optimum use of it for effective & productive outcomes are crucial task (Hemlatha et al., 2020). However, qualities of AI are not limited to these. There are uncountable ways of making a fruitful outcome using it. Likewise, it also has a negative side. The use of AI and rapid automation can have unexpected outcomes if not used well. Targeting the field of education, AI can make learners and teachers dependable (Kumar, 2018), which can become a problem if balance is not maintained. Also, availability of too much information available at online platforms in terms of online classes leads to chaos rather than a focused outlook. That is why the way students perceive AI in an educational context becomes more important.

1.2. Attitude and Education

Attitude refers to people's judgment about events, ideas, and ways of perceiving things. It could be positive or negative. Attitudes are based on personal experience and belief systems (Das et al., 2010). Titchener of Structuralist schools believes that behind every action of a person, there are deep thoughts that could be temporary or permanent. The word 'attitude' has an Italian origin, 'attitudine' having traces in Latin' aptus' which means "fitness".

Cognitive	Affective	Psychomotor
Ability to understand developed through thinking, experiences and senses.	It involves our feelings, attitude and emotions.	It includes physical movement and coordination of motor skills.

Table 1 - Three Domains by Bloom.

According to Wood and Wood (1980) attitude has three components. Bloom gives the domains in Table 1, and attitude plays a crucial role in adaptation. Considering artificial intelligence has positive and negative effects (Peter, 2019). When we consider it for bringing effective changes by adding to lacking parts, attitude plays a significant role in any consideration. In terms of education, knowing the learner's attitude is necessary for making optimum use of artificial intelligence to reach the need of time. This study is for exploring the attitude through quantitative and qualitative analysis attempts to find the attitude of students at the school level. This would act as the guiding force to have an idea about the mindset of the students.

2. Methods and Materials

This study aims to explore School Students' attitudes toward Artificial Intelligence. An online digital survey collected the data. The researcher uses the descriptive

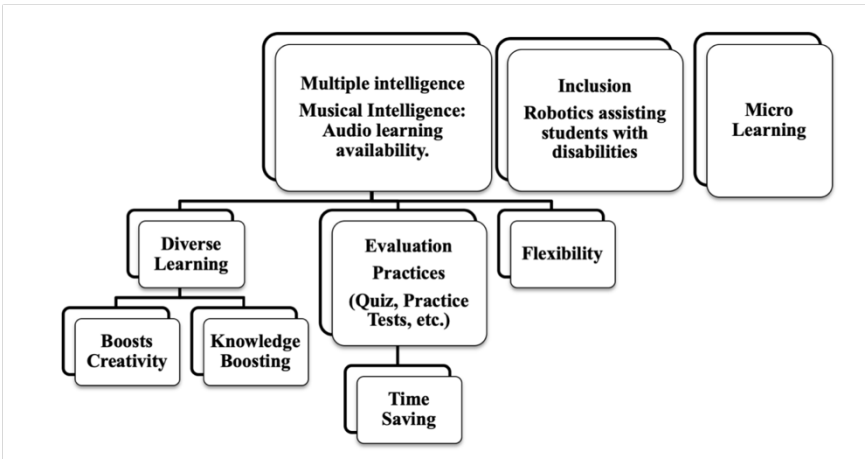

Figure 1 - Significant Functions of Artificial Intelligence.

survey method during this research by taking a sample of secondary school students from the Central Board of Secondary Education in Pune City. Moreover, the survey instrument used by the researcher is a scale for exploring the "attitude of school students towards artificial intelligence". The scale is formed based on a three-point Likert scale. The Likert scale was formed to calculate the attitude scientifically in 1932 (Ankur, Saket & Satish 2015). The questionnaire has, in total, twenty questions. From which eighteen are closed-ended, and two are open-ended. Closed-ended questions are for quantitative data, and open-ended questions are for qualitative data. The target population for the research was Secondary School students.

Moreover, from the instrument made to collect data, one hundred and twenty responses have been considered for the data analysis. The sample was selected using the random sampling method. The data collected from all respondents is divided based on the component for transparency and clarity. Furthermore, these components are divided into four categories based on the learners' experience towards artificial intelligence, micro learning, subjective performance of artificial intelligence, and evaluation.

Table 2 has data collected from the respondent by calculating mean and standard deviation and its interpretation.

2.1. Methodology and Data Analysis

For this research, the researcher used a descriptive digital survey using the random sampling method. After analyzing the data collected from the respondent, the data appeared slightly high. This clearly indicates the need for more awareness (Asmatahasin et al., 2020) people have in terms of learning through artificial intelligence, even though microlearning in terms of education has the significant significance of artificial intelligence because it makes learning available in micro chunks, which makes learning complex terms quickly.(Asmatahasin et al., 2020) Still, students' attitude is on the slightly high, which becomes questionable, and there is a need for practical learning related to AI usage. Regarding attitude towards the subject, the wise performance of artificial intelligence is noted as high. Artificial intelligence makes learning enjoyable and more interesting with ICT tools in the classroom regarding Science, Geography etc. (Reggien et al., 2021). Which is, sure, enjoyable for the students? For this component received, attitude is moderate. It makes the efficiency of artificial intelligence questionable. And this brings us to the reality that artificial intelligence's evaluation methods have limitations (Hasan, 2023), e.g., summative, formative, and other kinds of evaluation need critical analytical skills, which is the disadvantage of machine learning because it works on artificial intelligence. So in terms of evaluation, there is a need for improvement. After qualitative analysis, researchers have found that school students' attitude toward AI is high. However, the presence of teachers to make learning impactful (Felix, 2020) and technology is no alternative for teachers. Moreover, proper educational adoption of technology will create a better tomorrow.

Sr. No	Components of Attitude	Mean	Standard Deviation	Interpretation
01	Learners Experience Towards the AI	17.50	2.42	High
02	Micro Learning with AI	13.48	1.70	High
03	Subject Wise Performance of AI	10.17	1.57	High
04	Evaluation with AI	5.18	1.02	High
05	Overall Attitude towards AI	46.35	5.44	High

Table 2 - Component of attitude of school students towards the artificial intelligence.

3. Results

This study follows a mixed research methodology. The present study does qualitative and quantitative data analysis. The attitude towards artificial intelligence seemed high through the table and the above interpretation. However, necessary improvements are compulsory in terms of educational adaptation for learning with the help of artificial intelligence, microlearning, the subjective performance of artificial intelligence, and evaluation. From qualitative analysis, we can state that the options students have are available in case of learning through the online platform. It gives them intelligence-wise learning experience and the facility to learn anywhere, anytime, at their convenience.

Nevertheless, from the data collected, it is observed that even in the impactful times of technology, the teacher's role is sometimes questionable. Respondents have very clearly stated that the teacher is the most crucial part of the learning process by stating the disadvantage of online learning. Furthermore, the way teacher adds life to the class by adding emotional connecting elements to the teaching and learning process. Respondents realize artificial intelligence and its functioning, with clarity about it having a secondary role and the teacher

having the primary role. While stating the disadvantage of AI, respondents pointed out the lack of seriousness and effectiveness of learning virtually by giving importance to offline learning, where there should be the inclusion of ICT & AI, with the highly intellectual teacher who would facilitate the process of learning by the application of human intelligence.

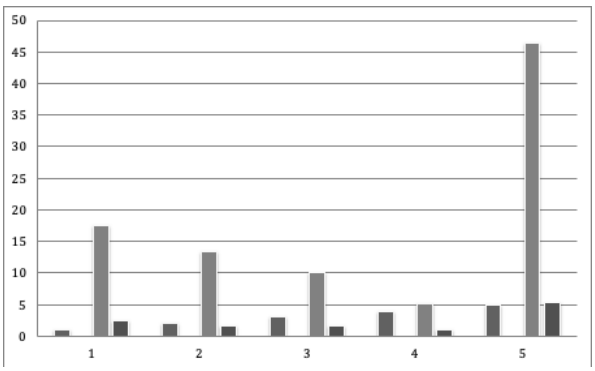

Figure 2 - Representation of Received data from Components of AI.

It would be right to state that a wrong attitude toward the educational adaptation of artificial intelligence will create distraction and confusion about what to use and where to receive knowledge for productive outcomes (Tang, Chang & Hwong 2020). However, we cannot stop the fast widespread of the 4 Industrial Revolution, but we can use AI by making optimum use of it. Furthermore, this study helps to gain insight into school students' perspectives and attitudes toward artificial intelligence.

4. Discussion

Artificial intelligence increasingly paves the way to the future, especially in improvising and revolutionizing the structure of the education system. A medical study assessed the attitude toward artificial intelligence (Asmatabasin *et al.*, 2020). A lack of awareness about the educational usage of artificial intelligence is found from the study amongst the respondents in terms of social media, newspapers, and magazines. Basic knowledge about artificial intelligence was found in the past study. It is similar in the present study when questions based on 'attitude of artificial intelligence in terms of micro learning'. The calculated mean of the component is measured at 13.48, which shows a borderline attitude. Another research related to the expectation and concerns of artificial intelligence has fundamental arguments from the received data while testing attitudes towards the knowledge of artificial intelligence shown agreeable 53%. Furthermore, non-agreeable of 47%, which is an indicator of lack of awareness and proper knowledge (Sheela, 2022)? Similar to these lines, the calculated mean from the present study, 17.50 is the mean where the range availability was till 21. Moreover, the gap between it shows that the attitude was borderline high. The study stating positive attitude towards artificial intelligence by (Reggien et al., 2021) found which brings advantages AI holds of fastening work related to healthcare; data collection is in alignment with the present study in terms of 'Subject wise performance of AI'. Where the attitude towards from respondents is noted as high and the calculated mean is 10.17 in terms of numbers. In addition to the above result, a study conducted based on an online survey of knowledge and attitude by (Soad et al., 2022) finds disagreement among the respondent regarding replacing AI doctors with robots. Likewise, in the present study, during qualitative analysis, the question on the AI replacing teachers and their role in the era of technology. Respondents clearly stated the need for teachers in the technological era. The other opinion expressed by (Yadrovs Kaia *et al.*, 2023) stated similarity with the present research for the component of 'overall attitude of learner towards AI' noted borderline high attitude with a calculated mean of 46.35 mean. This stated the scope for much-needed development for creating awareness amongst the school students.

5. Conclusion

The usage of artificial intelligence in the field of education makes assessing the attitude of students essential. Because students' perception of artificial intelligence helps further improve learning and understanding the educational topic. This study provides the attitudes of secondary school students through the gathered data concerning the given components. Moreover, the assessed attitude helps gain insight into the learner's way of perceiving artificial intelligence in education (Schepman, 2022). However, with some benefits, this study comes with limitations. First, the study is limited to school students. Second, the study is limited to the tested components which are calculated by collecting one-twenty samples at the school level. Third, the limitation of the study is the response given by the respondents, which are collected from India from Maharashtra state from Pune. After analyzing respondents' responses, it can be concluded that even with the dominance of artificial intelligence, students have numerous options for every difficulty. Still, respondents have clarity about the importance of teachers in the classroom and their impact on their life. Learning through a virtual platform is seen as an option rather than an alternative that could be chosen according to the student's condition. Additionally, respondents have a positive attitude towards using artificial intelligence (Selamat, 2021) because it makes learning lively and meets learners' different levels of intelligence. Nevertheless, there is need for improvement in evaluation and knowledge about

making the optimum outcome with the given components.

Ethical Approval

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee.

Conflict Of Interest

The Authors declare that they have no conflict of interest.

Authors' Contributions

All authors have equally contributed to collecting the data, analyzing the data, reviewing the literature, writing and revising and approving the final draft of the paper.

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An analytical study on integration of pedagogy and technology in secondary science classes of India during COVID-19

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Abstract

This study examines the importance of integration of pedagogy and technology in secondary science classroom of India in light of the COVID-19 pandemic. The researchers in this study focused on four types schools. Twenty-two teachers and eighty students have taken part in this research. Looking to the COVID-19 situation data is generated through telephonic contacts, e- mails and Google meets. Researchers used a mixed method and followed qualitative as well as quantitative data analysis. According to teachers from all four kinds of schools, technology is a necessary instrument for advancing education in the COVID-19 period. According to the study, factors influencing effective pedagogy and technology integration include necessary infrastructure, technical support, teacher training, supportive school management, skilled and motivated teachers etc. Integration of ICT with pedagogy makes learning engaging and entertaining. It encourages inquiry-based learning, cooperative learning, creative and critical thinking among students. It provides opportunity for students to receive materials in multiple formats like videos audio recordings, text materials etc. Though it facilitates individualized student paced learning, satisfying needs of diverse learners, but still not every sort of school uses the same technology. Poor attendance, face to face interaction, poor interconnectivity, health problems for teachers and students, are some of the obstacles encountered during online classes. In the light of 4th generation industrial revolution education system is going to be changed to adapt technological interventions in education. So, the educators and teachers need to be fully prepared to accept, learn and adapt the upcoming technological advancements.

KEYWORDS: Pedagogy, Technology, ICT, COVID-19, Secondary Science Class.

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1. Introduction

This paper explores the importance of integrating pedagogy and technology in education through Information and Communication Technology (ICT) at the secondary level. It suggests that investments of ICT in classrooms are becoming more effective day by day. The world is experiencing the fourth industrial revolution and everyone from school children to adults working in diverse sectors are comfortable with ICT tools and gadgets. Still there is a need to offer the necessary infrastructure, technical assistance, teacher training and supportive school administration for the integration of ICT into pedagogy. Thus, the process of integrating pedagogy and technology particularly in secondary science classes is a complex process. It is influenced by a number of variables such as the skills, motivation of teachers to adapt technology, their leadership qualities, supportive school environment etc. In the present era, the world is experiencing numerous environmental, economic and social problems, along with natural disasters such as earthquakes, cyclones, floods, health risks like COVID-19 etc. Due to all these obstacles, the school education system at times comes to a standstill. During difficult times, technology is a necessary instrument for overcoming the aforementioned obstacles and ensuring the continuation of good education. Integration of ICT with pedagogy simultaneously makes learning dynamic and engaging.

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It also fosters cooperative and inquiry-based learning. It gives pupils with various opportunities for critical and creative thinking. With the help of various multimedia tools students can construct and demonstrate a number of in-class projects. In addition, India is a big country with many social, geographical and economic regional variances in its educational system. There are several sorts of schools that vary with regard to school organization, culture, facilities, medium of instruction etc. In the current study, the researchers classified four categories of schools in India, including Type-4 schools with complete digital facilities. These are the privately run English medium schools following the Central Board of Secondary Education (CBSE) curriculum. Type-3 schools are those schools which are Government run English medium, Kendriya Vidyalayas (KVs). These schools are managed by central government and follow CBSE curriculum. They have average digital facilities. The next type of schools chosen for this research is Type-2 schools with modest digital amenities. These are state board vernacular Odia medium private schools. These schools follow state board curriculum. Type-1 schools do not have any digital facilities. These are state government run Odia medium schools. The researchers investigated teachers' perspectives on the integration of pedagogy and technology in all kinds of schools, as well as students' perspectives on the integration of pedagogy and technology in secondary science classrooms. The use of technical resources varies by types of schools. This research also examines the elements that influence the integration of pedagogy and technology as well as the advantages and problems of such integration. Here to represent the school education system of India, researchers have purposefully selected four different types of schools. These four different types of schools not only vary according to their digital facilities, but also in their school culture, curriculum and medium of instruction. This kind of selection of schools provides opportunities to investigate various factors influencing use of technology to continue education during COVID-19 pandemic. Choosing teachers and students as participants from different types of schools also promotes to find out their perception on integration technology in pedagogy.

2. Review of literature

To effectively execute reform-based scientific education in the 21st century, instructors need to employ technology as a tool in their pedagogical toolbox. In the current situation the globe is experiencing many environmental, economic and social difficulties such as natural disasters like earthquakes, cyclones, floods, health hazards as COVID-19 and economic upheavals in society. These problems greatly influence human life and school education is not an exception to it. To address all of the aforementioned issues, integration of technology and pedagogy is unavoidable. The sudden emergence of the COVID-19 pandemic, lockdowns, shut downs and social distancing norms need an urgent shift in school education to an online style of instruction (Das, 2021). Still various educational organizations are not in a situation to fully support online learning as they were following only the traditional method of teaching (Dhawan, 2020). ICT is considered as a "major tool for building knowledge societies" (UNESCO, 2003, 1). At the same time online learning has its own challenges and drawbacks (Gilbert, 2015). It provides innovation and support curricular reforms to meet the need of global citizens. The online training framework in India has been perceived as another support in the ongoing time (Kiran&Popuri, 2013). Various studies have been conducted to find out teachers' role, their belief and practice in implementation of ICT integrated curriculum (Nachmias et al. 2008; Somekh 2008; Webb 2002). Use of technology by the teacher is mostly dependent on their perception, belief and the benefits they get from technology integrated class. Thus, it is important to find out teachers' perception and their view regarding integration of technology with pedagogy. According to some studies ICT use strengthens traditional practices, some teachers find it difficult to adapt to change and bring innovation in teaching and learning with the help of technology (Cuban, Kirkpatrick, and Peck 2001). Integration of ICT with pedagogy is a complex process and several internal and external factors play important role in successful integration of ICT with pedagogy (Davis et al., 2009; Ertmer, 2005; Law et al., 2005; Nachmias et al., 2004; Tearle, 2003). One of the major hurdles to successfully implement ICT comes from the traditional culture of schools (Pelgrum, 2001; Wilson, Notar & Yunker 2003; Williams, 2005). Some studies point out educational innovations attempted through ICT may lead to development and advancement in student's learning (Wong & Li, 2008).

In this study, the researcher highlights teachers' and students' perspectives on the use of ICT in teaching and learning processes in various kinds of schools in India. In this COVID time students mostly depend on digital resources to continue learning through the Internet, Television or Radio. Teachers have to integrate technology with pedagogy to continue teaching for which they may not have got proper training. There are several learners in different schools who come under marginalized groups, they don't have access to digital learning resources. So, these students, teachers as well as the entire school systems are lagging behind. Some of the challenges faced during online class are poor attendance, lack of personal touch and lack of interaction due to connectivity issues etc. in some cases where students are not fully getting opportunities for proper integration of pedagogy and technology in classes, they develop negative attitude towards the education system (Senthikumar & Pandian, 2021). On the other hand, there are several schools in different

cities in India which are fully equipped with digitalization and could successfully carryout education during COVID-19. Similarly, there are schools which are in hybrid mode of digitalization and traditional teaching. The objective of the present work is to focus on four important aspects of integration of pedagogy and technology in secondary science classes during COVID-19 outbreak. Firstly, it explores the perception and view of teachers from all the four different types of schools, regarding integration of pedagogy and technology. Secondly it attempts to find out students view and experience regarding integration of pedagogy and technology during COVID-19. The third point of focus of this study is to find out the factors influencing successful digitalization and integration of pedagogy and technology in secondary science classes. The fourth point of study is the benefits and challenges before all the above mentioned four types of schools for integration of pedagogy and technology in secondary science classes.

3. Methodology

The present study is exploratory in nature. Here researchers followed mixed method of research. Data is being generated by qualitative as well as quantitative method. Various self-made tools were designed to collect data. Looking to the COVID situation, data were mostly generated through telephonic contact, emails, WhatsApp chats and zoom meetings with the participants.

3.1. Participants

Here purposive selection of participants is being carried out to study the influence of integration of pedagogy and technology in secondary science classes. Data are generated from 22 science teachers available in about 8 schools of the city of Odisha, India. Students from respective classes participated in the research study. In the present study researcher purposefully selected four different kinds of schools. Two number of schools from each type of school are selected for the present study. The Type-1 schools do not have any digital facilities. These are state government run Odia medium vernacular schools. The next type of schools chosen for this research is Type-2 schools with modest digital amenities. These are state board vernacular Odia medium private schools. These schools follow state board curriculum. Type-3 schools are Central Government run English medium, Kendriya Vidyalayas (KVs). These schools also follow CBSE curriculum. They have average digital facilities. Type-4 schools with complete digital capabilities. These are the privately run English medium schools following Central Board of Secondary Education (CBSE) curriculum. Here researchers investigated teachers' perspectives on the integration of pedagogy and technology in all kinds of schools, as well as students' perspectives on the integration of pedagogy and technology in secondary science classrooms. The use of technical resources varies according to the type of schools. A total of five teachers from Type-1 schools, six teachers from Type-2 schools, five teachers from Type-3 schools and six teachers from Type-4 schools are selected. Ten students from each school are selected for focus group discussion.

3.2. Tools

The various tools used in the present study to generate qualitative data are Semi structured Interview with science teachers (Through telephonic contacts and Google meets). Open ended questionnaire to teachers for reflective writing (Through e-mails and WhatsApp

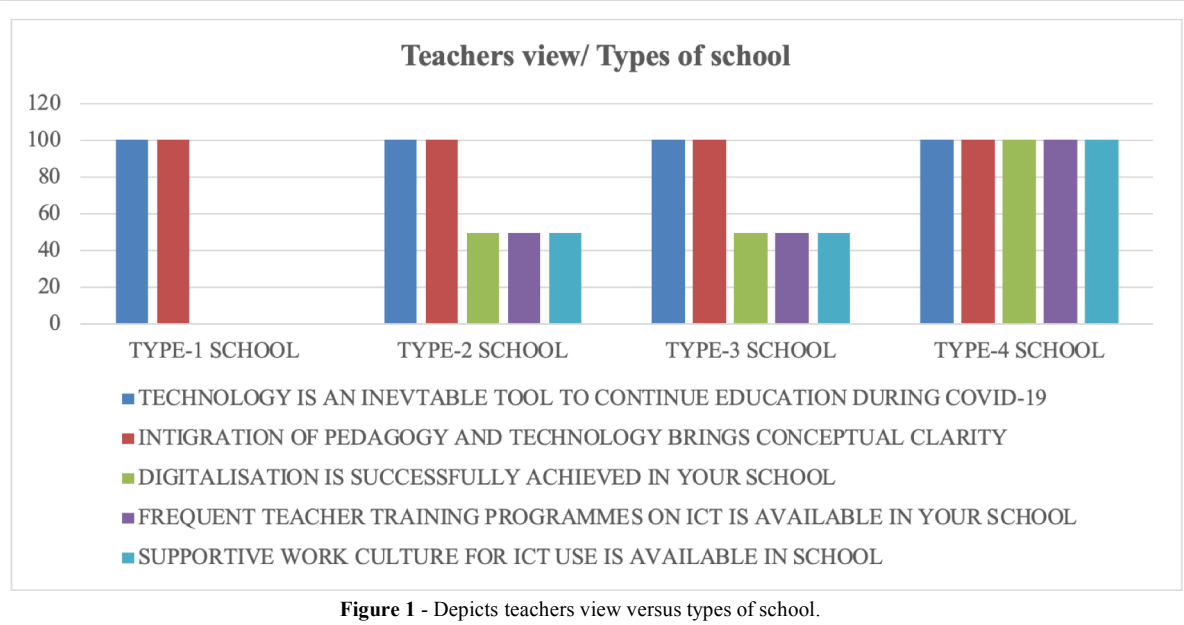

Figure 1 - Depicts teachers view versus types of school.

Teachers view	Types of school			
	Type -1	Type-2	Type-3	Type-4
Technology is an inevitable tool to continue education during COVID-19	Agree	Agree	Agree	Agree
Integration of pedagogy and technology brings conceptual clarity in abstract concepts in science	Agree	Agree	Agree	Agree
Digitalisation is successfully achieved in your school	Not yet	Not fully attained	Not fully attained	Completely digitalised classroom facility is available
Frequent teacher training programmes are available for use of ICT as a tool	No such program is available	Available but not sufficient	Available but not sufficient	Completely digitalised classroom facility is available
Supportive work culture for integration of technology and pedagogy	Mostly not found	Available but not sufficient	Available but not sufficient	Yes, available Fully cooperative and supportive staff, management and positive work culture is found

Table 1 - Representing teacher's view regarding integration of pedagogy and technology in secondary science classes in all the four types of schools.

Students view	Types of school			
	Type-1	Type-2	Type-3	Type-4
Could you attend online classes during first lockdown?	No	No	No	Yes
What are the teaching learning facilities available during COVID-19?	You tube videos, National TV channels, Radio, Telephonic messages from teachers	You tube videos, National TV channels, Radio, Telephonic messages from teachers	You tube videos, National TV channels, Radio, Telephonic messages from teachers	Regular online classes by teachers in zoom meeting
Are you satisfied with digital facilities available for learning during COVID-19?	No	No	No	Yes
Do you have conceptual clarity in science lessons?	Develop conceptual clarity by self-learning	Video lessons help for conceptual clarity but immediate clearing of doubt is not possible	Video lessons help for conceptual clarity but immediate clearing of doubt is not possible	Yes, as the classes are supported with video lessons, interaction with teachers, group discussion with classmates, immediate clearing of doubt is possible, it brings conceptual clarity.

Table 2 - Showing students view regarding integration of pedagogy and technology during COVID-19.

or telephonic messages). Focus group discussion with students (In WhatsApp groups, Google meet and telephonic contacts). Open ended questionnaire to students (Through emails and telephonic group chats). Looking to the objective of the present study, researchers developed self-made tools. The questionnaire for semi structured interview, open ended questionnaire and focus group discussion are first developed by the researchers as per the four objectives considered in the study. These questions are then

verified by one school head master, one senior science teacher having more than ten years of experience. At the same time questions for all the above tools are analyzed by professors in department of psychology and education of the state university. Once the tools are prepared, these are administered in the initial level for a pilot study taking four teachers and ten students. After pilot study some questions of repetitive nature are removed. These tools are used to collect qualitative data.

3.3. Process of data analysis

Qualitative data are generated by using the above-mentioned tools and are analyzed by using qualitative interpretative data analysis methods. Researchers followed open coding method for data analysis. Data generated from different tools are gathered and analyzed for specific tools in a particular school. For example, the data generated from open ended questionnaire were collected which are present in the form of text messages, e-mails, WhatsApp chats. The data collected in these formats are segregated for each

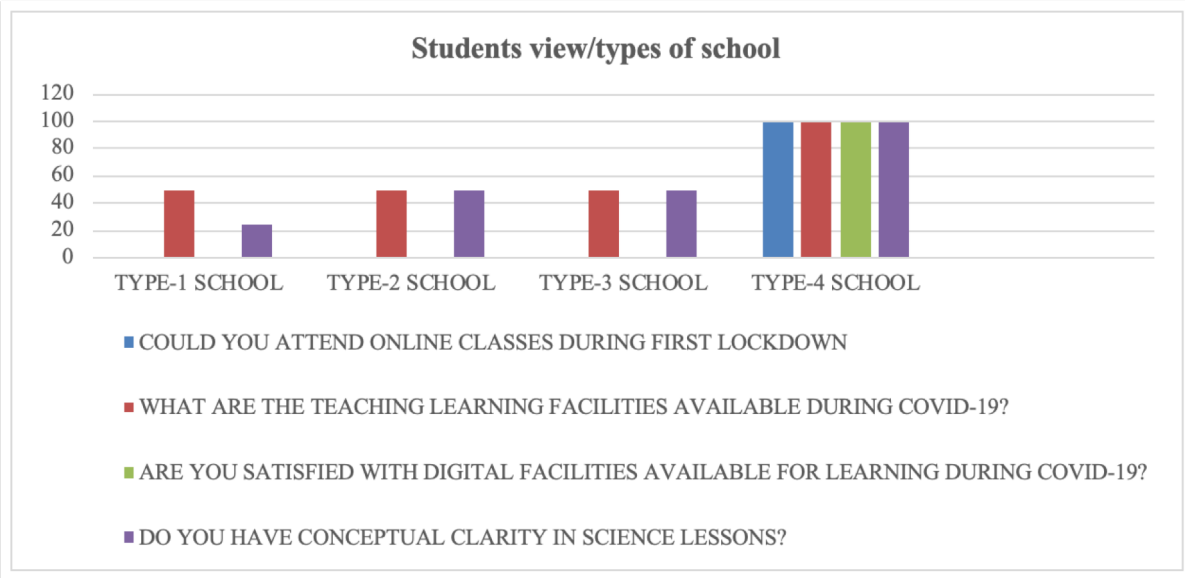

Figure 2 - Depicts students view versus types of schools.

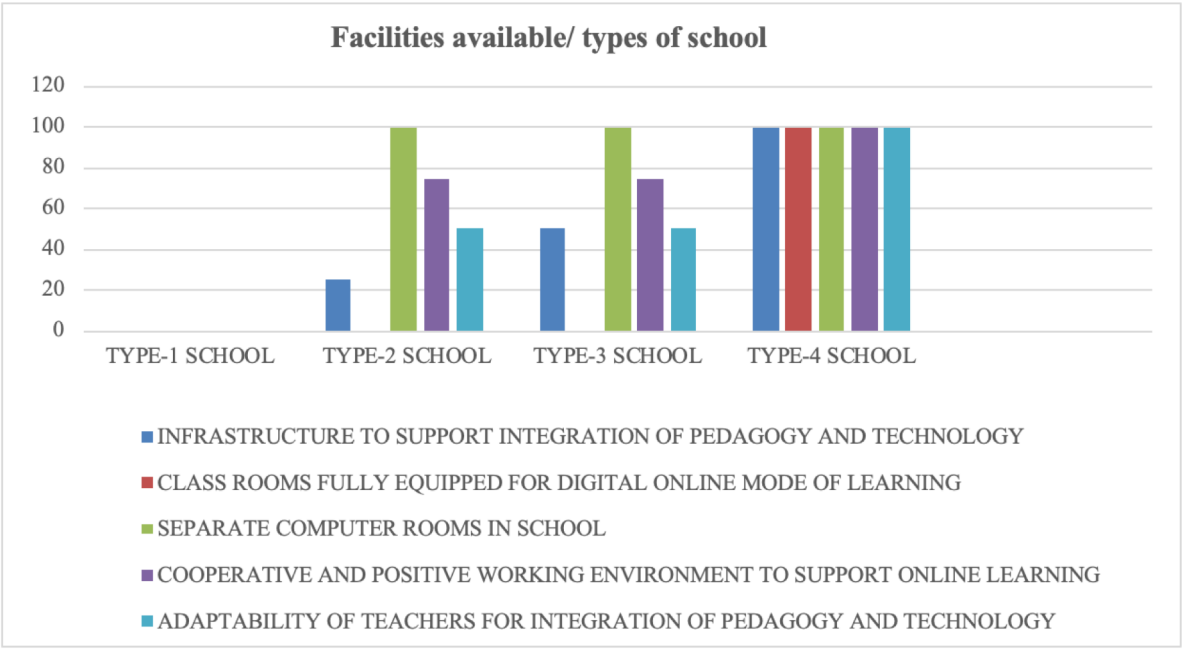

Figure 3 - Depicts the facilities available versus types of school.

Factors influencing integration of pedagogy and technology in secondary science classes	**Types of schools**			
	Type-1	**Type-2**	**Type-3**	**Type-4**
Infrastructure to support integration of pedagogy and technology	Not available	Underdeveloped	Available but not fully developed	Fully developed
Class rooms fully equipped for digital online mode of learning	Not available	Not available	Not available	Available
Separate computer rooms in school	Not available	Available	Available	Available
Cooperative and positive working environment to support online learning	Not available	Available	Available	Very good work culture and cooperative environment for integrating technology with pedagogy
Adaptability of teachers for integration of pedagogy and technology	Lacking	Improving	Improving	Very good technically trained teachers available.

Table 3 - Showing factors influencing integration of pedagogy with technology during COVID-19.

Opportunities/ Challenges	**Types of school**			
	Type-1	**Type-2**	**Type-3**	**Type-4**
Opportunities during online learning	Continued education with alternate mode of learning like television portals, radio, YouTube videos and telephonic contact with teachers	Continued education with alternate mode of learning like television portals, radio, YouTube videos and telephonic contact with teachers	Continued education with alternate mode of learning like television portals, radio, YouTube videos and telephonic contact with teachers	Continued education in a safe environment from home, opportunity for multiple presentation, explanation and exploration for both students and teachers well-equipped and trained for digital and distance mode of interactive learning
Challenges faced due to online learning	Lagging behind in course completion, lacking conceptual clarity in students, lack of parent's involvement, lack of personal touch, connectivity issue	Lagging behind in course completion, lacking conceptual clarity in students, lack of parent's involvement	students, lack of parent's involvement, lack of personal touch, connectivity issue Rising health issues in teachers and students due to increased screen	Rising health issues in teachers and students due to increased screen time, increasing work pressure for teachers, missing outdoor games for students

Table 4 - Represents opportunities and challenges faced by the schools for integration of pedagogy and technology during COVID-19.

question and for each type of school. Open manual coding is being carried out by the researchers. Theme is being generated from the codes and major themes for each question for each school type is being collected. From the central theme appropriate response to the question is being found out. The same process is being followed for semi structured interview and focus group discussion. The collected data are also segregated as per the objective of the study and a quantitative analysis of percentage calculation for a specific response is being generated. These quantitative data are than plotted in the form of Bar graph. The graphical presentation and qualitative data generated are triangulated to reach to major findings. This process is followed as per the objective of the research work.

3.4. Delimitation of the Study

In the present study researchers are confined to Science Teachers working in secondary schools in certain cities in the Indian state of Odisha, such as Bhubaneswar and Cuttack. This study has also taken view of students available in secondary schools in the same city.

4. Data analysis and interpretation

The first objective of the research study is to find out teachers' perception regarding integration of pedagogy and technology in secondary science classes. Analysis of qualitative data revealed that all the teachers in the four different types of schools taken in this study is having the view that technology is an inevitable tool to continue education during COVID-19 pandemic. Teachers from Type-4 schools mentioned ICT makes their classrooms better places to teach and learn. Teachers from all the four types of school agree that ICT tools help to bring conceptual clarity in understanding difficult scientific concepts. At the same time teachers from Type-1 schools mention they could not use ICT tools during first lock down as they lack infrastructural facilities and a readiness to start online classes. They also mentioned supportive school organizations, infrastructures, teacher training and a variety of instructional materials for educators, parents and students are necessary for effective ICT usage in the classroom. Teachers from both Type-2 and Type-3 schools agree that they have teacher training programs for conducting online classes using ICT tools. But these training are not sufficient to carry out the same. For Type-1 schools teacher training programs are not available. Teachers from Type-4 school mentioned they have supportive work culture for integration of pedagogy and technology. So, they could immediately start online classes within few days of first lock down. Teachers from Type-1 schools mentioned they don't have supportive school culture, environment and infrastructure to start online classes. The perception of teachers in different types of school is being mentioned in Table 1. The major perception of teachers regarding implementation of online class in the four different types of schools are presented in a graphical form in Figure 1. The figure depicts that in all the four types of schools all the teachers agree that technology is an inevitable tool to continue education during COVID-19 and integration of pedagogy and technology brings conceptual clarity in science lessons. Regarding digitalization facilities in school Type-1 school teachers have zero response. It means there is no successful digitalization in their school. There is fifty percent response regarding availability of digital facilities in Type-2 and Type-3 schools. When it is verified with data plotted in Table 1 it is found that teachers in these two types of school mention digitalization is available but not sufficient. At the same time Type-4 schools have hundred percent response regarding digital facilities.

Similarly, there is no satisfactory response regarding teacher training programme and supportive school culture in Type-1 schools. This is also in confirmation with qualitative data generated. Type-2 and Type-3 schools show fifty percent response and Type-4 school show hundred percent response for frequent teacher training and supportive work culture.

As per the second objective of the study qualitative data being generated regarding students view on integration of technology in their classes. These data have also been shown in Table 2 and plotted in Figure 2 in a graphical presentation. These data show Type-1, Type-2, and Type-3 school students could not attend to their classes during the first lock down of COVID-19. Only Type-4 school students mention that they could attend to online classes during first lock down. Figure 2 also mention the same response. Type-4 school show hundred percent response. Students in the first three categories of schools reported that they were unable to carry out their education during the first lockdown at COVID-19. While the fourth group of students mentioned that they are having resources to attend frequent online classes through Zoom or Google Meet. According to students in the first three categories of schools, YouTube videos, national Television channels, radio and telephonic messages from teachers are sources to facilitate teaching and learning during COVID-19, whereas students in Type-4 schools stated that they attend regular online classes from home. The research also shows that pupils in the first three categories of schools are dissatisfied with the existing digital facilities, but students in the fourth group are happy. During the initial lock down, pupils from Type-1 school said that they were unable to attain any conceptual clarity in science lessons. While students from Type-2 and Type-3 said that video lessons helped them with conceptual clarity, but immediate clarification of some doubts was not attainable. At the same time, students from Type-4 School said that their courses were accompanied by video lessons as well as interaction and discussion with teachers and classmates through an online platform. They were able to resolve their doubts and gain conceptual clarity.

To meet the third objective of the present research researchers analyzed the qualitative as well as quantitative data to find out the factors influencing integration of pedagogy and technology in all the four types of schools. Table 3 shows various factors influencing integration of pedagogy and technology in four different types of schools. The data shows infrastructural facility to support integration of pedagogy and technology is only available with Type-4 schools. It is under developed in Type-2 and Type-3 schools and not at all available in Type-1 schools. In the first three types of school classrooms are not equipped for online mode of learning. But Type-4 schools, classrooms support online learning. Separate computer laboratories are not available in Type-1 school but available in rest of the three types of schools. Cooperative supportive environment to facilitate online learning not available in Type-1 school, available in Type-2 and Type-3 schools and very well developed and cooperative work culture exist in Type-4 schools. Adaptability of teachers to online mode of learning is lacking in Type-1 schools, gradually improving in

Type-2 and Type- 3 schools and very well developed in Type-4 schools.

Figure 3 depicts that all the five factors found to positively influence integration of pedagogy and technology in secondary science classrooms are not available in Type-1 schools. For Type-2 school infrastructural facility poorly developed, digitalized classroom, not available, cooperative environment and adaptability of teachers is developing but less than Type-4 schools. For Type-3 schools' infrastructural facility is more than Type-2 school but less than Type-4 schools, separate computer labs available, cooperative environment and teachers' adaptability better than Type-2 schools. All the five factors identified to promote online mode of learning during COVID-19 are available.

According to the research, the first two categories of schools do not have any infrastructure to enable the combination of pedagogy and technology. The third type of schools has infrastructure support but cannot be efficiently exploited for teaching and learning objectives. The fourth group of schools has enough infrastructure to support digital learning. In addition, during the initial lockdown, online learning was carried out on a daily basis. The findings also suggest that owing to a lack of infrastructure in the first three categories of schools, instructors' flexibility and acceptability of integrating technology with pedagogy is limited. Nonetheless, instructors in the fourth group are well acclimated and comfortable with technology and may easily conduct online lessons during the first period of COVID-19 lockdown.

As per the fourth objective, various opportunities and challenges are there for all the four types of schools to continue with online mode of education during COVID-19 pandemic. As mentioned in Table 4 the opportunities for Type-1 schools are they could continue education with alternate modes like Television portals, YouTube videos, Radio and Telephonic contact with teachers. For Type-4 schools they could continue education Continued education in a safe environment from home, got an opportunity for multiple presentation, explanation and exploration for both students and teachers. Some of the challenges faced by Type-1 schools are they lag behind in course completion, students learn by self-study with little guidance from teachers. There are similar challenges for Type-2 and Type-3 schools. Some of the major challenges before Type-4 schools are, increased screen time for both teachers and students, lack of out-door activities for students and increased work pressure on teachers, lack of face-to-face interaction and in campus activity.

These results show that the first three types of schools may continue instruction via the use of mass media technology, but interactive lessons cannot be held owing to a lack of comprehensive digitalization equipment in schools. Nonetheless, the fourth group of institutions is prepared to confront the obstacles posed by COVID-19 circumstances and continue with online interactive sessions.

Figure 4 presents a graphical presentation of opportunities and challenges for all the four types of schools. Here Type-4 schools show maximum opportunities well as challenges. Opportunities are facilities available to continue education but challenges are heath issues arises due to long exposure to screen time, increasing work pressure on teachers leading to stress.

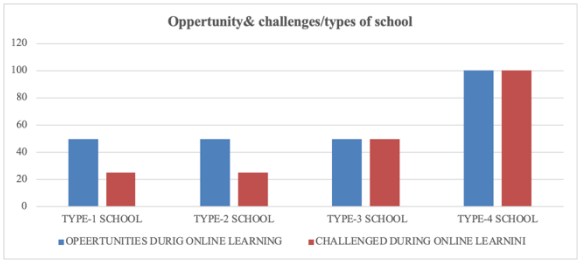

Figure 4 - Depicts opportunities and challenges of online mode of learning versus types of schools.

5. Major findings

The purpose of the research is to find out how successfully technological integration have been implemented in Indian secondary science classes, during the first phase of lock down in COVID-19 pandemic. Here researchers chosen four different types of schools that vary in their digital facilities, medium of teaching, school organization etc. The finding of the study reveals that all the teachers from all the four different kinds of school are having the perception that technology in today's time is an inevitable tool and highly essential to continue education. As some schools due to lack of technological support during COVID-19 pandemic could not continue their education for an indefinite period of time. Teachers from all types of schools also mentioned that technological support brings conceptual clarity in difficult concepts. The second major finding is that according to students view due to lack of technology integration they were bound to go for self-study, they could not attend online classes in majority of schools. So, students from all the types of school mention that technology is highly essential for them to continue education. As per the third objective the factors influencing successful integration of technology are, trained teachers, supportive infrastructure in schools, cooperative and positive working environment and adaptability of teachers to technology integration. The fourth major finding is that some alternate resources like Radio, Television, Telephonic contacts etc. are available for first three types of schools to continue education during COVID-19. At the same time Type-4 schools have complete digitalization facility to continue online safe education. The challenges before Type-1, Type-2 and Type-3

schools are lack of technological resources, trained teachers to continue education. Whereas for Type- 4 schools the challenges are to manage screen time for students and teachers, health hazards due to increased stress, and work overload, missing outdoor games, campus activities and face to face interactions.

6. Conclusions

At present time the world is going through 4th generation industrial revolution. The 4th generation industrial revolution signifies a flood of tools, technologies, gadgets supported with and run by Artificial Intelligence (AI). Use of such technologies in various fields largely replace human labour. The field of education is not an exception to be influenced and guided by fourth generation industrial revolution. Online assessments, blended mode of learning, asynchronous career advancement programs are a few examples to mention use of technology in the field of education. Technology is also greatly influencing school education system. On the outbreak of COVID-19 pandemic school education system has gone through a tough test of time to prove its preparedness to adapt technology and face challenges of the upcoming time. The present work selected four different types of school from Indian system and analyzed their preparedness to continue education with the help of technological tools during the time of pandemic COVID-19.The findings of the study reveal that, out of the four different types of schools chosen for the study, Type-4 schools which are English medium privately managed schools, following CBSE curriculum are completely digitally equipped to immediately start online blended mode of learning during first lock down in COVID-19. They possess infrastructural facilities, trained teachers, and a cooperative school environment to support online learning. As a result, students and teachers of these schools can safely learn and teach from home during COVID-19. The other two types of school like Type-3 and Type-2 schools, which are Government managed English medium Kendriya Vidyalayas (KVs) and privately managed Odia medium schools are not sufficiently supported with technological facilities and trained teachers to immediately carry out online mode of learning. But these schools are not totally devoid of technological facilities. During COVID-19 they could evolve themselves to continue technology supported learning. But there are another Types of schools like Type-1 school which are state government run vernacular schools and these schools are totally devoid of technological support to continue education. Students from these types of schools are worst sufferers of first lockdown during COVID-19. Their education came to a complete stand still during this time. The only source of learning for them are Television, Radio, YouTube etc. This scenario clearly depicts a sharp digital divide in Indian society. The Indian education system is not completely far away from adapting technological advances in classrooms. At the same time, it is not fully prepared to provide technological support to education at all levels. Now in the light of 4th generation industrial revolution education system is going to be changed to adapt technological interventions in education. So, the educators and teachers need to be fully prepared to accept, learn and adapt the upcoming technological advancements.

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Unpacking the MOOC experience: insights from Indian Postgraduate Students in Education

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Abstract

Anyone anywhere in the world can participate in Massive Open Online Course (MOOC) and gain knowledge and experience. As we all have a major role to play in making the world a better place, Massive Open Online Courses must be made available to as many people as possible. Students have access to a wide range of educational opportunities through the use of MOOCs, which can assist them in their pursuit of lifelong learning. MOOCs, are available to everyone interested in learning at no or minimum cost. The content presented in MOOCs is intended to be understandable by a diverse group of students. The course is typically completed at the students' speed, and there are no requirements for on-campus registration. They are viewable from any device so long as it has a constant internet connection. The researcher in the present study conducted an interview research on the M.Ed.(Master of Education) students who were enrolled in a MOOC developed by the researcher on the subject of Research Methodology. In India M.Ed. students are post graduate students in Education who enrol in this M.Ed. programme after graduation in Education i.e., B.Ed. After the MOOC got over, those enrolled in that MOOC were interviewed. The collected data was analysed using thematic analysis. The study revealed favourable attitude towards digital education among M.Ed. students. Moreover, the students' optimistic outlook on the future growth of MOOC implies its significance for developers seeking to design similar courses, as well as for educators integrating such courses into their instructional strategies. The findings of this research hold considerable value for both academics and industries, contributing to the advancement of online learning and its potential implications for the future.

KEYWORDS: MOOC, Online learning, Master of Education (M.Ed.), Interview, Thematic Analysis.

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1. Introduction

The Massive Open Online Course(MOOC) has the capacity to significantly expand access to education at all levels. Regarding education generally and higher education specifically, no one disputes its inventive potential. To develop and execute Open Educational Resources, the Indian government created MOOC guidelines in 2017. The guidelines for MOOC stress the importance of storing the online courses created under the policy on an indigenous website called Study Web of Active Learning for Young Aspiring Minds (SWAYAM), where students can access the educational materials created by the subject matter experts without cost. This innovative platform provides education to students from school to university level. It seeks to remove the digital divide and provide quality education to everyone. According to the new Education policy in India, universities now have the chance to team up with other organizations in the field, both at national and international levels and create their own MOOC. This has increased the scope of education to include both knowledge-based and skill-based courses.

MOOCs provide an excellent method for placing high-quality education in the hands of every student, be it from any field and course. It is high time for the system of teacher education to line up with current trends and also incorporate modern teaching methods in their day-

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to-day teaching practice. According to Goel & Goel (2013),

> *"Open Distance Learning through MOOCs has great potential to be infused in teacher education in both pre-service and in-service level which seems to be a neglected area. Teacher Education in India has a slow pace in getting access to modernization and has not yet integrated the technological innovations for transacting education."*

Adopting MOOCs into Teacher Education can bring about the necessary change and influence teaching and learning practices at all levels of teacher education. With this in mind, the Ministry of Human Resource Development (MHRD), Government of India, introduced the Annual Refresher Programme In Teaching (ARPIT) on 13 November 2018 for online professional development of in-service teachers using the MOOC platform SWAYAM. Teacher Education is a professional course where competent teachers and teacher educators are being produced who need to know a variety of information and be updated with the knowledge explosion. The goal of teacher education in India is to empower aspiring teachers with the knowledge, skills, and expertise they need to educate and support their students effectively. It is intended to prepare instructors to understand their student's needs and to employ research-based teaching practises to assist them in achieving academic achievement. The researcher in the present study conducted an interview research on M.Ed. students to find out their experiences. The developed MOOC enabled students to get acquainted with a new method of teaching-learning, compelling them to use various authentic open educational resources available on the online platform, enabling self-paced and flexible learning among them, and introducing them to an alternative mode of learning.

1.1 Unravelling MOOC

According to the British online dictionary, a MOOC is a term for a free online course that is taken by a significant number of students. According to McAuley et al. (2010) and Vardi (2012), "MOOCs are web-based courses taught by academics or professionals that may accommodate an unlimited number of students simultaneously." MOOCs are a continuation of the trend in innovation, experimentation, and the use of technology that was initiated by distance learning and online education to provide comprehensive learning opportunities (Siemens, 2013). According to Chakravarty (2016), " MOOCs help to pursue our area of interest while doing a job or studying, people from different geographical locations can come together, learn and connect online. Sitting at home, students will be able to learn from the best university and best educators. MOOCs can help in self-paced learning as there is no time scheduling for these courses." In India, where gender discrimination leads to lesser-educated girls, MOOCs can be very beneficial. MOOCs help people in professional development and also sharpen their skills. It helps fulfil the learning thirst, offering the chance to physician to join a dance MOOC or a musician from undertaking a human resource course.

A study conducted by Pandit, (2016) reveals that, "in a country like India, where most people are residing in remote areas and do not have adequate access to skill enhancement and quality learning, MOOC can play a pivotal role". As per a study conducted by Kaur (2019), the major advantages of MOCs in higher education are scalability, free education and removal of other constraints of boundaries. MOOCs force professors to improve their lectures, develop futuristic designs to ensure students keep up, bring people together from different parts of the world, and provide many business opportunities for making platforms and collaborating with universities like Coursera and Edx.

Hence, MOOCs are a welcome step that brings immense benefits to various stakeholders of the Indian education system. India has the second most people sign up for MOOCs after the USA (Shah, 2018). MOOCs will likely have a significant effect on India's education system by raising standards and making it easier to get a good education in all fields with the click of a button.

1.2 Significance of MOOC

MOOCs are open and accessible to all with a stable internet connection. There is no kind of biases concerning caste creed, gender and age. So learning through MOOC is considered to be inclusive. Learners can select any course of their choice irrespective of their previous background. There are no restrictions on boundaries as students from Indian universities can enrol in a course from Cambridge University, UK. The courses are also usually free and provide financial assistance in paid courses. The discussion forums in MOOCs provide an opportunity to interact with students of different backgrounds and communities. The course provides students with self-paced learning and learning at their own convenient time. People who are doing a job and lack time to study in physically mode can enrol in such courses and get the benefits of online learning. Moreover, MOOCs also provide opportunities to achieve the sustainable goal of providing inclusive and quality education to all and lifelong learning opportunities. Vezne (2020) looked into Teacher Candidate Satisfaction with Massive Open Online Courses in Turkey. Findings suggested that MOOCs help teacher candidates learn and grow as people, and that they are happy with them. King et al. (2018) found the experiences of a group of Timorese English language teachers experience in MOOC and pointed out the benefits involved, like encouraging teachers to discover new ways, improve their teaching

techniques, and enhance participants' English. Adams (2014) explored undergraduate students' experience of time using MOOCs and found that the end of lectures in MOOCs created an aura of sorrow among learners. The study found that students take different time to complete the course, some wishing days and some wishing months, but all had meaningful time spent studying the online courses. Latha (2019) included 500 Indian Learners who have completed at least one MOOC course through Coursera, Edx, or Udacity MOOC platforms and found that students in post-graduation have a higher inclination toward studying through MOOCs, where the internal rewards drive the behavior. Sukhbaatar et al. (2018) also explored undergraduates' and high school students' perceptions of MOOCs and found that students consider MOOCs a learning resource and a worthy source of knowledge. Koukis & Jimoyiannis (2018) explored 326 language teacher views on MOOCs in secondary education schools and found that MOOCs promote professional development among teachers and a high inclination towards adopting such platforms in the future. Aljaraideh (2019) took a sample of 130 faculty members from all faculties at Jerash University and found their perceptions about MOOCs. The study concluded that teachers perceive MOOCs to provide students with better learning opportunities and recommended that higher education institutes introduce MOOCs in their daily learning. Verma (2021) found the perception of participants and instructors towards the effectiveness of the SWAYAM platform through a web-based survey and concluded that although Swayam is an affordable solution to increase the enrolment ratio, it still has certain challenges like long videos and lack of audio clarity. Salas et al.(2022) studied 122 teachers from the National Autonomous University of Mexico's perception of MOOCs during the pandemic and found that MOOC is a viable solution to transform education.

In India, where in the year 2000, only 5 millions of citizens had internet access,, the number has now increased to 755.8 million (Internet World Stats, 2021). This huge increase in internet access, especially in the developing world, has also made online content and interaction available to people worldwide (Ahuja, 2018). In 2006, NCERT wrote a position paper saying that non-traditional ways of learning, like distance and open learning, on-demand education, and other flexible ways of learning, should be tried out. Today's young people need flexible systems, curricula that look to the future, and a focus on careers in the twenty-first century. There is an urgent need to persuade the educational system, which should make teaching and learning more meaningful for teachers and their students. MOOC is the solution to most of these problems, and it can give many people access to education. MOOCs can give students better and more varied lessons than one teacher might be able to develop on their own (Daniel 2012).

Efforts need to be taken to maximize the engagement among learners, monitor their learning, and make learning interesting so that the dropout rate can be minimized. This study provided Master of Education (M.Ed.) students not only a new platform for learning but also promoted them to adopt such practices in the future. It provided a path for future teacher educators to get acquainted with an innovative teaching-learning platform, promote professional development, create awareness for MOOCs, and equip them with 21st-century technical skills. This study aim to analyse the experiences of M.Ed. students who had enrolled in the MOOC developed by the researcher.

2. Materials and Methods

The following section will discuss the research design, participants, tools used, and data analysis techniques.

2.1. Research Design

The present study is qualitative in nature, and the interview method was adopted. The M.Ed. students were enrolled in a MOOC developed using WordPress. The course was divided into three specialization courses on research methodology. Each course lasted three weeks and was self-paced but with a fixed start and end date. Students were also provided a manual to guide them in enrolling and surfing the course. At the end of the course, an interview was conducted to know their experience towards the MOOC.

2.2. Participants

The participants in the present study were students enrolled in the two-year M.Ed. (Master of Education) programme. These are postgraduate students in Education who enrol in this programme after graduation in Education (i.e., B.Ed.) to become teacher educators. In 2021-2023, fifty-one students were enrolled in the M.Ed. programme in the Department of Education, Faculty of Education and Psychology, The Maharaja Sayajirao University of Baroda, Gujarat, India. All those fifty-one M.Ed. students were enrolled in the MOOC prepared by the researcher. Out of these fifty-one students, twelve were randomly selected to participate in the interview.

2.3. Instruments

Data was collected through an interview schedule which was semi-structured. The interview schedule had twenty five mixed questions, including both open-ended and close-ended questions. The main aim of conducting the interview was to know experience of the students in learning through MOOCs, the challenges faced by the students during the implementation of the MOOC, and also their suggestions for future developers of a MOOC and prospective learners in MOOCs. The interview was conducted via phone, and

each interview, lasting for approximatively 30 minutes. Every M.Ed. student has explained the purpose of conducting the interview, and permission was taken to record their voice for analysis purposes. The M.Ed. students were asked to be honest during the interview. The interview began with some general questions about their educational qualification and experience, and later open-ended questions related to challenges and experience. Suggestions and feedback were taken into account. Probing was done wherever the researcher felt that the M.Ed. students is stuck. The recordings were saved for analysis at a later stage.

2.4 Data analysis

The interviews taken by the researcher were recorded with the prior intimation and later transcribed manually for qualitative analysis using thematic analysis. Braun and Clarke's (2013) framework for thematic data analysis was used to do thematic analysis. This analysis was done in six steps: getting to know the data, making initial codes, looking for themes, going over themes, naming and defining themes, and making a report.

3. Results

When the thematic analysis of interview data was done, it gave rise to seven main themes. This included learner background, advantages, challenges faced, benefits, replacement over the traditional classroom mode, recommendations and suggestions for the future.

	Themes
Massive Open Online Course (MOOC)	• Learner background
	• Advantages
	• Challenges faced
	• Benefits
	• Interesting features
	• Replacement over traditional classroom mode
	• Recommendations & suggestions

Table 1 - Themes that emerged from the Interview.

Theme 1: Learner background

Of the twelve M.Ed. students interviewed, eleven were female M.Ed. students and one was male. Most of the M.Ed. students had teaching experience, and only four M.Ed. students had no experience in teaching. Out of twelve M.Ed. students, only four had bachelor's degrees, while eight M.Ed. students had a master's degree. Most M.Ed. students never had experienced MOOC in the past, although two M.Ed. students did try their hands on MOOC and two were familiar with online courses on Diksha, but not MOOC. Seven out of twelve M.Ed. students did have a modest knowledge of research methodology, and five M.Ed. students had never studied research methodology in the past.

Theme 2: Advantages

It was essential to know the experiences of M.Ed. students on learning through the MOOCs developed by the researcher. Most M.Ed. students felt that it was an interesting medium to learn research methodology. Some described MOOC as an important course for anywhere and anytime learning. Others felt that this course made them aware of a new platform to learn research methodology. The feature that makes this platform important for M.Ed. students is that there are shorter videos, an option to revise videos, and no burden of carrying books. One M.Ed. student said that her pre-existent fear of online learning was removed by this course. One interviewee commented:

> *"When you introduced us on the first day of the course, I was very afraid of it Because this is a new technology. I thought I would not be able to do it. Never did I do an online course. But eventually, I got interested in the course. The language was very easy. Now I have learned in college about MOOC, I have become aware of such a course, so I will make such a course in science and social science for school students"*

Theme 3: Challenges faced

It was important to know the challenges faced by the M.Ed. students on the platform where they enrolled to learn through MOOCs. Some felt that there were no major challenges faced while others listed some challenges like forgetting passwords while enrolling and confusion between registering for the course and logging in. In all the cases, respondents reported that the manual helped them to avoid confusion. One interviewee opined that fonts in a few videos needed to be bigger than it was.

Theme 4: Benefits

When M.Ed. students were inquired about the benefits of MOOC the interviewees, on the whole, demonstrated that MOOCs are flexible and self-paced. On top of that it also gives a scope to revise all the concepts, while learning as all materials are available in one place. One interviewee quoted that:

> *"I think we can learn at our own pace and revise whenever we want. When we learn through videos so we visualize. It's a good way to learn. The test is there, activities, games are so interesting. It's not boring and it's fun to learn through MOOCs".*

Theme 5: Interesting features

The next section of the interview pertained to the most and least interesting features of the MOOC. Majority of the M.Ed. students responded that the video-embedded pop-ups in between the videos excited them the most

while learning in MOOC. For a small number of M.Ed. students, the activities in each module made them enjoy the course content. On the other hand, when they were inquired about the least interesting feature, some interviewees argued that fixed duration of the courses and additional resources after every video were too much to grab and felt unnecessary sometimes.

Theme 6: Replacement over Traditional classroom mode

Later when the M.Ed. students were asked whether MOOCs would ever replace the traditional classroom, there was a mixed reaction. While some opined that it might happen in the future and the future is digital, others felt that instructors' absence makes it a weak medium to learn. Some respondents expressed that both the mode hold equal significance, and emphasized that the instructors presence and support is paramount for any course, regardless of the mode. One interviewee also responded that blended mode would be preferred where MOOC can be used as a learning resource. When asked about the future of MOOC for M.Ed. students and whether it will decline or bloom, the majority of the learners opined that it will bloom in the future as it is flexible and suitable for independent learners.

Theme 7: Recommendation and Suggestions

When the M.Ed. students were asked what their recommendations are for future learners of MOOC, a small number of those interviewed suggested that learners should make a plan and set their deadlines in advance. Some felt that learning through MOOC initially gives a culture shock as it is a unique medium to learn a course without any instructor, but later they will enjoy it. There were some suggestions that M.Ed. students should make notes while studying and read all the additional resources provided. One interviewee reported that:

> *"I will tell them that focus and watch all videos and also make notes because after all its technology, and if in future the platform is lost or deleted, what will students do, so make notes, that stay forever".*

On the same line, when M.Ed. students were asked what they recommend for course developers, some suggested that more real-life examples in videos be added, and technical terms explanation should be more. A few of them suggested the instructors have their presence in the videos for M.Ed. students to know who the instructors are. One of the interviewees suggested including such a course at the school level with more game features.

In the final part of the interview, when M.Ed. students were asked about what should be added to the MOOC in the future to make it more engrossing, few M.Ed. students reported that there should be doubt-solving sessions after every MOOC. Whilst a minority mentioned that more discussion forums be added after every module. One M.Ed. student shared a few features, like Nearpod, the option to download videos, and a course map.

Discussion and Conclusion

The M.Ed. students are postgraduate students who are mature learners. Such students do not require the transmission of knowledge from the teacher, they only necessitate proper guidance and direction to get access to relevant knowledge related to the subject. This is in line with the study of Latha (2019) wherein post graduates students have a higher inclination towards MOOC. Confirming the finding from previuos studies (Koukis & Jimoyiannis, 2018; Salas et al., 2022), M.Ed. students are positive towards future growth of MOOC. It can be an effective learning medium for M.Ed. students, especially those who fear online learning. The MOOCs can be designed with shorter videos, an option to revise videos, and additional student resources. It can also encourage students to create MOOCs, which can be useful for future teachers. According to National Education Policy (2020), Teacher Education is an indispensable sector for making future teachers that will shape the future of the next generation. They should not only be well-versed in Indian values but also a master of the latest advances in education and pedagogy. The teacher and teacher educators in the future will be dealing with digital natives. These students will be well versed with the latest technology and will prefer learning through the latest technology. Hence teacher education institutes should promote the development of more such MOOCs and their implementation that can allow students to learn anywhere and anytime. The developed MOOC can be used as a resource for online learning, can complement traditional learning, and can also be used in higher education institutes where there is a lack of teacher educators to teach the subject of research methodology.

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From Textbooks to Chatbots: Integrating AI in English literature classrooms of India

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Abstract

With technological transformations and advancements in the field of Artificial Intelligence and its pervasive infiltration into multifarious facets of human existence, there has been a radical reconceptualization of technological intervention and human agency fostering epistemological modifications in the domain of education. Triggered by the gradual evolution of Web 2.0 to Web 3.0 and the envisioned prospects of Web 4.0, higher education institutions worldwide have discerned the pressing need for pedagogical transformation to cater to the imperatives of a perpetually evolving world. In the Indian context, the New Education Policy (NEP) 2020, a curricular framework formulated by the Government of India for all levels of education, has underscored the significance of interdisciplinary curricula, harnessing technological innovations to promote collaborative and activity-based learning.

In this context, the teaching- learning of English literature is at a pivotal crossroad and demands a reevaluation of existing curricula and pedagogical practices to align with the course's current needs.

The present research investigates the incorporation of AI tools in the English literature classroom at the undergraduate level in India, and scrutinizes their potential to enhance interactivity, efficacy, and collaboration among learners through case studies and interviews of practitioners. This article argues that the facilitator's efficient pedagogical design can transmute Artificial Intelligence into a collaborating agent in the teaching-learning process and mitigate the epistemological and ethical questions that it potentially entails.

KEYWORDS: Artificial Intelligence, English Literature Pedagogy, Undergraduate Studies, India, ChatGPT.

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1. Introduction

Referring to English education in India as the crucible in which the "war of position" (Gramsci cited in Mukherjee, 2016, p. 10) has been fought, Alok Mukherjee delineates the history of controversies that have sketched the terrains of curriculum development in English in this multilingual and multicultural nation (Mukherjee, 2016, p. 10). Shaped by the legacy of colonialism and post-colonial deliberations, the evolution of the English curriculum in India has resulted in a contentious arena of power politics. While the British model of English teaching, encompassing both language and literature, dominated the pedagogical landscape of the nation during the colonial period, in the post-Independence era, there were endeavours to negotiate the tensions of universalizing the curriculum without compromising its essential 'identity', thereby resulting in the "several commissions and omissions" (Krishnaswamy & Sriraman, 1995, p. 37) that inform English teaching in India.

The liberalization of the economy during the 1990s brought about a profound transformation in the socio-economic landscape of the country, marked by the advent of the global market. This confluence of the influences of globalization and the subsequent proliferation of digital technology ushered in the propensity to revise, reformulate and reconstruct the pedagogic practices of English education in India.

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Recognizing the need to update the existing curriculum to global standards, the Indian education system envisaged technology-enabled teaching practices as the future of learning; an idea that was endorsed both by educators who comprehended the contextual significance of a constructivist classroom built around digital tools and academic administrators who foresaw in digital learning the scope for upgrading the national status in the global context (Roy, 2022, p. 47-48). The already nuanced nature of teaching English literature was further problematized by the radical transformation in the educational context ushered in by the closing down of academic institutions in the wake of the global pandemic in the year 2020. Amid the shift to online platforms due to the COVID-19 pandemic, digital media played a crucial role in the process of designing curriculum, as educators had to not only acquire the requisite technical knowledge to conduct virtual classes but also had to seek ways to replicate the interactive, activity-based learning experiences of traditional physical classrooms in the online environment. In India, the lockdown of educational institutions for two years exposed the inadequacies of digital technology, which is intricately tied to the country's economic and political forces, and highlighted the resilience and determination of educators to adapt and improve classroom pedagogy in response to the radical shift in the learning context. In addition to the technological obstacles confronting English literature educators in tertiary educational institutions such as colleges and universities, the intrinsic nature of the subject presented a significant hurdle in being facilitated over the digital domain.

George Levine argues,

> *"Teaching literature is a subject, and a difficult one. Doing it well requires scholarly and critical sophistication, but it also requires a clear idea of what literature is, of what is entailed in reading and criticizing it." (Levine cited in Chambers and Gregory, 2006, p. 4).*

One of the foremost concerns of formulating a higher education English literature classroom pedagogy was to equip learners with not only the digital competence of attending the classes but more significantly, attaining the learning outcomes so envisioned for the courses. However, numerous studies have already addressed the methods through which educators have tackled these challenges through pedagogical innovations, both on a global scale and within the context of India. Hence the focus of this study is not on the implementation of Web 2.0 technologies in classroom instruction; instead, it seeks to examine how the advent of artificial intelligence (AI), the most recent addition to the technological landscape in education, has impacted the field of teaching English literature in Higher Educational Institutes (HEIs) of India. Against the backdrop of ongoing global discussions surrounding ChatGPT and the ethical concerns related to AI use in education, this study involves the findings of the researchers who had been involved in experimenting with AI technology in their classroom practices to foster activity-based collaborative learning environments.

2. AI and English Literature Classrooms

> *"Artificial intelligence (AI) is the combination of intelligence, that is, machines capable of demonstrating human intelligence and of making decisions with human skills" (Sun et al., 2020, p. 2).*

The field of artificial intelligence (AI) in computer science involves creating computer systems and algorithms capable of executing tasks that generally necessitate human intelligence, such as speech recognition, decision-making, natural language comprehension, and visual perception. "Based on the integration of AI technologies into learning sciences" educational AI or (EAI) involves the implementation of AI technologies in education, as well as the development of educational frameworks and the restructuring of significant educational elements or processes (Zhang K, Zhang J cited in Yu Yu Lu, 2021, p. 3). One of the most recent fields of research and innovation, EAI (Educational Artificial Intelligence) aims to utilize AI technologies to comprehend the process of learning and assess the influence of external elements, such as socioeconomic conditions, physical surroundings, and advancements in science and technology, on learning, to enhance the efficacy of learning (Yan Z, Tang X, Qin X, et al. cited in Yu Yu Lu, 2021, p. 3). While researchers and educators in conventional educational practices typically focus on designing learning environments, analyzing learners, identifying appropriate learning content, selecting suitable instructional strategies and tools, providing instructional evaluation and feedback, and utilizing evaluation outcomes for management and decision-making, with the foraging of AI in the educational domain, the complexity of these aspects has increased due to the changing needs of learners. "Built on pervasive computing technology and perceptual computing technology", Artificial Technology (AI) enables the perceptual function of learning environments to meet the diverse needs of learners and offer personalized services in a ubiquitous learning context thereby reconfiguring the educational context by creating: (1) intelligent learning environments; (2) intelligent support to the learning process; (3) intelligent learning assessment; (4) intelligent teacher assistant; and (5) intelligent educational management and services (Yu Yu Lu, 2021, p.5).

The integration of artificial intelligence (AI) in English literature teaching presents the potential to enhance traditional modes of instruction and revolutionize the learning experience. By leveraging the capabilities of AI, English literature teachers can offer personalized learning experiences, facilitate student engagement, and promote critical thinking and analysis. The implementation of AI technology in the domain of English literature pedagogy offers a wide array of potential applications, one of which is 'text analysis', a method by which literary works can be scrutinized using AI techniques to obtain profound insights into their structural attributes, thematic components, and symbolic representations. By such implementation, teachers can help students to better comprehend and analyze literary texts. AI can also be used to create personalized learning experiences by analyzing student data and adapting teaching methods to cater to the specific needs of individual students, ultimately enhancing learning outcomes and fostering learners' engagement. Additionally, AI can assist students with writing by providing grammar and spell-checking, and even suggesting improvements based on an analysis of their writing style. AI can also be used to inspire and assist students in creative writing exercises by providing writing prompts or generating ideas for stories based on a student's interests. Finally, AI can offer virtual tutoring and support for students who need extra help outside of the classroom, which can be a valuable resource for students who struggle with a particular concept or who need additional assistance with their writing. Besides providing individual learning assistance, AI-powered tools and resources can be harnessed to enable seamless communication and collaboration between learners in collaborative learning environments. The use of AI in cooperative learning can be realized through various means, including virtual collaboration tools that enable students to collaborate in real-time irrespective of their geographical location, personalized learning experiences that provide tailored feedback and support to individual learners, intelligent tutoring systems that can adapt to the unique learning needs and styles of learners, AI-powered chatbots that provide instant guidance and support to learners, and gamification strategies that enhance student engagement and motivation through the integration of competitive elements and feedback mechanisms. The integration of AI into cooperative learning experiences can thus catalyze increased learner engagement, achievement, and success.

However, the most significant potential of AI technology in classroom pedagogy for English literature courses is engendering a constructivist learning environment where learners create and construct knowledge through an interaction with the learning context, thereby "shifting the emphasis from the act of transference of knowledge to individual perception" (Roy, 2022, p. 48). The implementation of AI in the English literature instructional setting confers a plethora of benefits, for instance, AI can engender amplified student engagement by offering personalized learning experiences and interactive activities, thereby inducing a more dynamic pedagogical milieu. In addition, AI can enhance learning outcomes by scrutinizing student data and adapting teaching techniques to cater to individual learner requirements, bolstering academic performance. Another advantage of AI in the classroom is the automating of certain pedagogical tasks, such as grading, providing instructors with additional bandwidth to focus on other facets of their pedagogy. Furthermore, AI can foster and facilitate creative writing exercises by inspiring and aiding learners, which can cultivate divergent thinking and promote innovation. Finally, AI can furnish both instructors and learners with novel resources and tools that are otherwise unattainable, amplifying the learning experience and equipping learners with the potential to expand their acumen in the discipline.

3. Research Aim

The objective of this study is to investigate ways in which AI can be integrated into English literature classrooms in India and interrogate whether such ways are sustainable. The present study attempts to demonstrate how the technology of AI can be harnessed to construct activity-based collaborative learning practices for a subject like English literature in Higher Educational Institutions (HEIs) of India, evaluate the strengths and weaknesses of such technological immersion, and illustrate pedagogical innovation in tertiary level of studies by referring to authentic classroom examples.

4. Methodology

Concentrating on English literature instruction at the undergraduate level of English Language and Literature courses as underlined by the University Grants Commission (UGC) in its Choice Based Credit System (CBCS) model, this study seeks to probe the ways of integrating AI technology into the English literature classroom to foster a collaborative, activity-based learning environment, one that would contribute to attaining desired learning outcomes of the course, addressing learners' needs and motivation and ensuring the collaboration between the facilitator and the technology in a manner that does not seek to supplant the facilitator with technology but rather, serve as a partner in the instructional process. Besides this, the study also aims to investigate the assumptions of educational practitioners regarding designing classroom pedagogy for a course in English literature using AI and the sustainability of such practices.

To achieve these research objectives, data from undergraduate English literature classes conducted by the educator-researchers of this study and from interviews conducted among select educators facilitating courses on English literature at the undergraduate level in India have been consulted.

4.1. Case Studies

Case Study I

This case study involves the use of ChatGPT in a session on 18th Century British Literature where learners equipped with contextual information were expected to engage in autonomous knowledge creation by using the AI tool to generate customizable outputs based on the prompts (questions asked) provided by them. The skill focused was the learners' ability to ask the right kind of questions and utilise the technology to develop higher-level critical knowledge.

This learning outcome corresponds to the taxonomy designed by Benjamin Bloom (1956) aimed to identify the emphasis given to the acquisition of certain skills on the completion of activities, sessions, or courses (Bloom, 1956, p. 2-3). One of the most popular and widely debated AI tools at present, ChatGPT uses a natural language processing model to 'converse' with users on diverse topics and this conversational aspect of this AI tool foregrounds the rationale behind its implementation in classroom pedagogy.

In the session, learners with information about the socio-political and cultural context of the Age of Enlightenment were given critical issues concerning the Age and asked to use ChatGPT to elicit such information using prompts they deemed fit. They were also asked to regenerate the response provided by the AI if it did not answer the question appropriately. At the end of this activity, learners were asked to share the questions (the prompts) they fed to the system, the response so generated, and the modifications (along with the rationale behind them) they had to make in the initial questions to get their desired responses. Keeping in mind that the dataset that ChatGPT uses to respond dates back to 2021 (Southern, 2023), highlighting the limitations of the technology, this activity was cautiously guided by the facilitator and any misinformation or problematic assumptions were pointed out. Learners were also made aware of the importance of following authentic source materials in this context.

As exhibited in Figure 1, it can be observed that the particular learner equipped with the idea that the Western Enlightenment project is a philosophical and cultural movement grounded in rationality, asked a question about the role of emotion during the age in order to develop ideas about how certain cherished ideals of Enlightenment was challenged by the Romantic poets, which was the topic assigned to the learner. A close reading of the response generated by ChatGPT shows both its brilliance as an information provider highlighting its popularity among students worldwide and how individual insight is essential to generate appropriate responses.

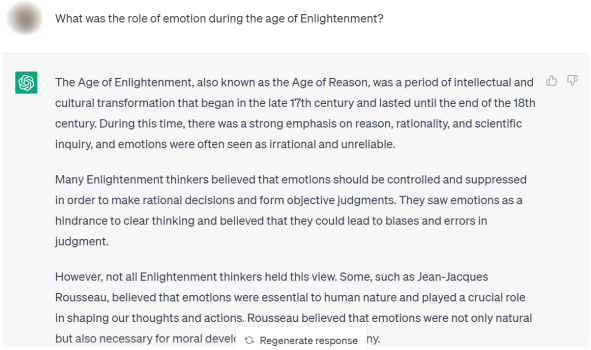

Figure 1 - Screenshot from a class assignment using ChatGPT.

When the responses received by learners after their interaction with ChatGPT were shared in class, it was found that not only were responses to questions asked alike (due to the Blockchain technology behind ChatGPT) but also the kind of prompts had a significant role in assisting the learner 'create' critical ideas autonomously. This underlines how a learner's ability to evaluate complex ideas and reject monolithic assumptions helps them formulate critical discourse and how such a knowledge-creation process can be complemented by and shaped within a technological domain. At the end of the session, learners expressed their delight in using this tool for a class assignment that was both enjoyable and challenging. As students of literature, they felt that ChatGPT can indeed be a useful tool to develop the habit of asking appropriate critical questions in order to create a holistic idea about the topics that are being addressed.

It can thus be estimated that this AI tool can be used to design class activities to contribute to the critical discourse expected of a graduate-level literature classroom simultaneously increasing learner's motivation and desire to participate in the class.

Case Study II

This case study involves the use of the tool Verse by Verse in a session on American Literature to analyse the differences and similarities in the styles and thematic concerns addressed by select poets through an interactive poetry writing activity fostered by AI technology. The skills targeted to be developed by the end of the session were creative expression and analysis of diverse writing styles of American poets.

Verse by Verse is an AI tool created by Google that takes inputs from both humans as well as machines and collaboratively creates verses mimicking the styles of canonical American poets. Users can choose up to three

poets or 'muses', and specify the poetic form, syllable count, and rhyme scheme. Once the user writes the first line of the poem, the AI offers hypothetical suggestions from the selected 'muses' which the user can either accept or write their verse.

In the session, learners were directed by the facilitator to select specific poets and poetic styles before they entered the first line of a poem (individual creative expression) in the text box provided on the Verse by Verse website. The first line of the poem selected by the learner was expected to reflect the learner's understanding of the style and content associated with the poet that s/he had chosen. After reading the poems so generated by the AI with the prompts given by the learner, s/he was tasked with analysing which of the poems aptly represented the defining trait of the poet so selected. Learners shared their explanations and rationale behind their choice with the class which demonstrated their skill of understanding the topic taught and their ability to evaluate it from critical standpoints.

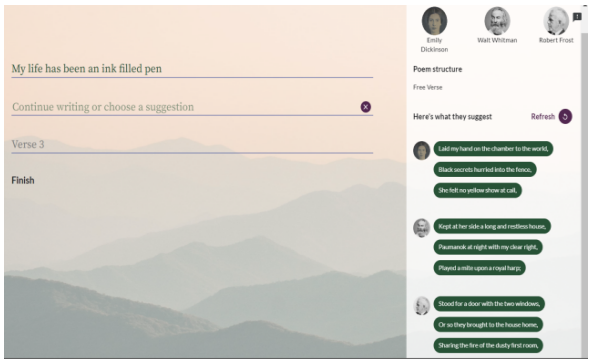

Figure 2 - Screenshot from a class assignment using Verse by Verse.

As exhibited in Figure 2, a learner had chosen Emily Dickinson, Walt Whitman, and Robert Frost and accordingly entered the first prompt based on which the AI generated three preferences, attempting to mimic the writing styles of the selected poets. The learner chose the poem reflecting Dickinson's style and noted that of the three options, it was closest in addressing ideas that would have been done by Dickinson herself. Through this activity and follow-up class discussions, learners demonstrated not only their creativity (a skill deemed integral to literature courses) but also their critical analytical skills in appreciating distinct poetic styles.

This activity, assigned to undergraduate students was positively received and underscores the utility of AI technology to contribute to developing creative and critical thinking faculties in individuals.

Case Study III

This case study involves using the tool StoryLive for a creative writing class activity where learners, having been introduced to the elements of plot, characters, language, and narrative design of storytelling, were expected to apply their understanding of those aspects in a creative context. The skills expected to be developed by the end of this activity were creative expression and the ability to apply theoretical knowledge in practical contexts.

StoryLive is an AI tool that can be used for text completion or text-to-image creation. Once the user enters a line or description in the text box, AI generates a narrative or image (at the user's discretion) based on such prompts.

Learners, divided into groups, were assigned the task of co-creating a narrative with AI using prompts. They were given options of various literary genres by the facilitators and they had to think of appropriate prompts (reflecting their creative thinking) for the AI to create a story that could fit the genre that they had selected. After the story was generated, each group had to analyse the characters and actions in their stories, discussing how all these factors together contribute to the development of the narrative.

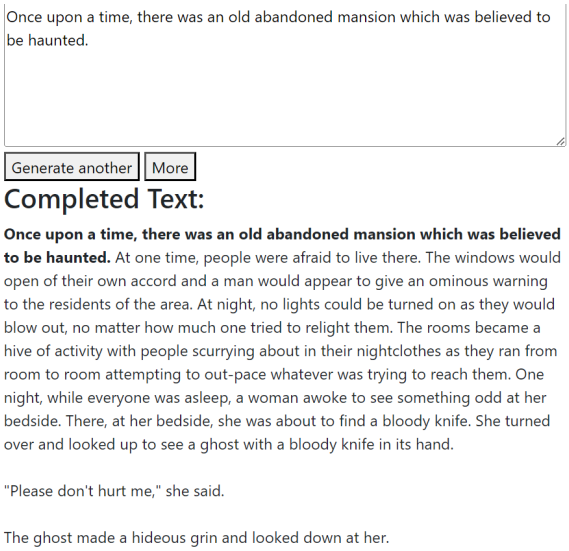

Figure 3 - Screenshot from a class assignment using StoryLive.

As exhibited in Figure 3, the group that had chosen 'horror' as their preferred genre of writing, had typed in: "Once upon a time there was an old abandoned mansion that was believed to be haunted" and accordingly, a narrative was created by AI. The facilitator ensured that this story was then shared with the class, with an intensive analysis of the characters, actions, and settings that contributed to the creation of the narrative. The learners here demonstrated their skill of application of knowledge after having been introduced to ideas covered by the course and also their skills in critical analysis of literature. Met with positive feedback from the learners who enjoyed using the technology in channelising their creative energies, this

case study thus illustrates how AI technology can be integrated into a literature pedagogy to co-create knowledge and kindle the creative spirit of the learners.

Case Study IV

This case study involves the use of AI Dungeon in a session on British Literature in the Middle Ages where learners, having a fair understanding of the socio-literary context of England in the Middle Ages, and having developed the skills to analyse literary texts and evaluate their contribution to the shaping of the literary consciousness of the age, were expected to formulate independent perspectives by situating the texts in the context of modern critical discourses. Learners, at the end of the class activity, were expected to develop the skills of creation and construction.

AI Dungeon is a free-to-use, text-based fantasy simulation that utilizes AI technology to generate limitless possibilities. Rather than being limited to pre-designed worlds created by game designers, AI Dungeon allows users to guide the AI in creating unique worlds, characters, and scenarios for the character so chosen or adopted by the user to engage with.

Directed by the facilitator, learners were asked to create a story using the framework of medieval chivalry combining it with their critical understanding of contemporary literary and philosophical discourses, gathered throughout the course. The learners logged into the AI Dungeon website where they chose their settings and characters from multiple options provided. Based upon the preferences, the AI-driven interface provided prompts of a narrative and asked the learners to enter their preferred action which in turn shaped the storyline.

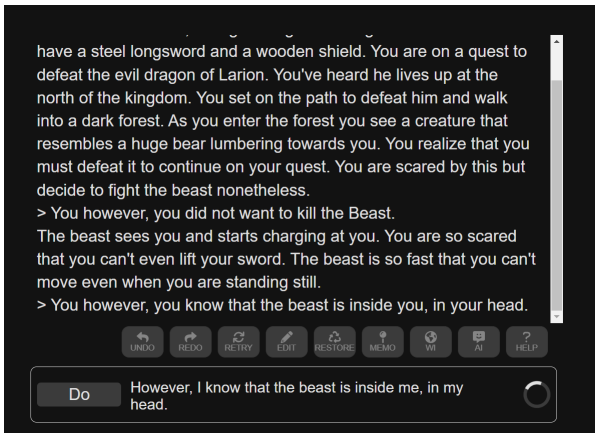

Figure 4 - Screenshot from a class assignment using AI Dungeon.

As exhibited in Figure 4, the learner had chosen the persona of Sir Lancelot (reflective of his knowledge of literary characters from the medieval age) and was co-creating a story with AI by simultaneously building ideas from the prompts so given and deviating from it. After completing the task, the learners shared their stories co-authored by the machine. The learner here harnessed technology to develop the skill of forming independent critical perspectives from existing literature where the traditional narrative of chivalry in medieval English literature was interpolated by the learner's knowledge of contemporary theoretical ideas which in turn generated new critical discourses.

Undergraduate students who were assigned this class task lauded the novelty of the assignment and have used it beyond class assignments from that point onward. This activity, designed on a constructivist model of learning, embodies the germination of future collaboration between the human and the machine in the creation of knowledge, one that would reorient the conventional epistemology of knowledge creation and dissemination.

4.2. Interviews

While conducting the study, select educators facilitating courses on English Literature at the Undergraduate level of studies following the UGC CBCS model were interviewed to analyze their assumptions and readiness in implementing AI in literature classrooms and discuss the risks associated with such technological integration. The respondents for this study have been involved in attempts at pedagogic innovations using digital tools in their curriculum and are aware of the potential of AI integration in classroom pedagogy. Selected from the cities of Kolkata and Bhubaneswar, capital cities of the states of West Bengal and Odisha respectively, almost all the respondents were optimistic that by the next decade, a radical transformation would reconstruct existing discourses of pedagogy in the fields of disciplines like literature, a transformation that has already been initiated by the extensive proliferation of digital tools in education during and in the aftermath of the pandemic. However, as agreed upon by the respondents, before implementing a pedagogy harnessing digital technology (Web 2.0 or Web 3.0), "a course designer needs to be aware of the 'end customer' so that he or she can tailor the course content, exactly as per the students' needs" (Koul & Bapat, 2020, p. 3922). The respondents selected for this study have mostly agreed that despite present debates and deliberations concerning the possibilities of AI technology replacing human agency in educational contexts, the need of the hour is to update the existing pedagogic practices by harnessing the technological potential as available and situate such transformation in clearly outlined theoretical implication. Such revision is significant specifically in the field of literature, noted a respondent, as traditionally teaching English literature has followed the teacher-centered, lecture presentation model where learners are expected to consider the educator as a repository of knowledge. In the words of

the same respondent, "technology holds the key to democratize English literature education in India", as she envisions digitization as a tool to reorient the hierarchies existing in the classroom context. Practising online collaborative tools like Google Jamboard and other online LMSs (Learning Management Systems) for her English literature classes at the undergraduate level since the pandemic, a respondent was optimistic that as technology evolves, the visions concerning designing pedagogies would also be revised. When asked about her opinion on the debate concerning the inclusion of ChatGPT and other AI tools in teaching practices, she noted how the present debate fails to consider the most significant aspect in implementing changes in pedagogy, the role of the facilitator. Most of the respondents observed how facilitators must play an active role in forging a learning environment where learners develop the skills required to create knowledge and AI chatbots and other tools would facilitate the process. The respondents also emphasized the recommendation of National Education Policy (NEP) 2020 according to which "pedagogy will have an increased emphasis on communication, discussion, debate, research, and opportunities for cross-disciplinary and interdisciplinary thinking" (Ministry of Human Resource Development, 2020, P. 37) and how AI might contribute significantly to foster a multidisciplinary learning context where technology would help address issues like increasing learners' motivation, learners' autonomy and the ability to construct knowledge.

5. Findings and Analysis

While the case studies containing authentic data from class activities so conducted aimed to provide practical illustrations of how AI technology can be integrated with the designing of pedagogy to promote a constructive learning environment, the interviews conducted among practitioners reveal the assumptions and estimations concerning such integration thereby providing insights into the questions regarding feasibility and sustainability of AI-enabled literature classrooms in India.

As observed in the comments made by the respondents, scopes of integration of AI in English literature classrooms have been identified and readiness has been observed to update their teaching approaches *vis à vis* technology. However, as noted by the respondents as well, although AI has enormous potential to improve literature education, it is vital to consider the ethical implications of its implementation in the classroom. Several ethical concerns must be taken into account, including data privacy, reliance on technology, impact on employment, bias, and access and equity. Besides data privacy and ethical concerns over data usage, respondents have also indicated ambiguities concerning the curious relationship between 'natural' creative expression and artificial machine intelligence and how such ambiguity is instrumental in creating a bias among educators teaching literature at the graduate level. It has been pointed out by some respondents, especially in the context of AI tools like ChatGPT that over-reliance on AI can lead to a lack of critical thinking abilities among learners. Hence, the facilitator has a major role to play in negotiating the challenges involved in designing class activities by and within AI tools. The outcomes of the course and/or activity must be designed in a way that it utilizes the power of technology to enhance their command over the subject, ameliorate their critical thinking abilities, reduce learning anxieties, and most importantly, engage them in autonomous construction of critical discourses.

Also, as observed by the respondents, the nature of the subject plays a major role in advancing this bias as well since the teaching of English literature at the tertial level follows a lineage of learners dependent on class lectures delivered by the educators. The conventional pedagogy of an undergraduate-level English literature course in India is discursive and activities usually consist of quizzes, debates, critical discussions, article and essay writing, creative writing, poster presentations, and audio-visual presentation where technology is used to screen media content and storage of class notes, reference materials, and assignments. Only in recent times, the Government of India has recognized the digital potential and taken initiatives to harness the power of technology in the educational context which has led to the re-evaluation of existing curricula and the proliferation of digital tools, e-learning pedagogies and sponsored educational portals and massive open online courses (MOOCs). Nevertheless, as highlighted by the respondents of the study, besides taking measures to integrate technology in classrooms, appropriate training must be imparted to facilitators who are entrusted with the responsibilities of practical applications of theoretical deliberations over existing curricula. Besides this, the cost of implementation of AI tools in a country permeated by a conspicuous socio-economic and digital divide has also been pointed out by the respondents, who, interestingly belong to privileged positions owing to their adeptness with online educational tools and LMSs (Web 2.0) as well as the technique of implementing AI technology in educational contexts, specifically literature classrooms.

Notwithstanding the challenges though, all the respondents were optimistic about the future of AI in the present society which is progressively integrating technology in complex ways. "Industry 4.0", as it is being labeled in common parlance, has already ushered in the integration of AI in almost every facet of human existence. Moreover, as opined unanimously by the respondents, in the following decade, as already initiated in the post-Covid phase, AI will trigger a metamorphosis in the educational sector by revising not

only the educational context and learning modes but also by refashioning the role of the teachers. Contrary to the belief that AI would supplant a teacher in the classroom, teachers and AI could potentially collaborate in pedagogic reconstructions, and English literature classrooms would also constitute an integral part of this phenomenon.

6. Conclusion

The objective of this study has been to explore and evaluate the incorporation of AI tools into the pedagogic process of courses like literature while remaining cognizant of their limitations and potential hazards. There is a dearth of literature concerning the use of AI tools in classroom practices, especially in the field of literature and the Indian context. Hence, this paper has attempted to fill this gap by generating critical discourses concerning such usages and providing peer educators of English literature with examples of how AI tools can be used to enhance classroom teaching and contribute to learners' autonomy.

The study aims to establish that as the world migrates towards Web 3.0 and Web 4.0, learning processes too should be realigned to cater to the demands of learners located within this rapidly changing world. The existing pedagogy of subjects with a lineage of traditional teacher-centered, lectured-based teaching practices must be recalibrated to accommodate the utilization of emergent technologies like AI tools in the classroom. The study delineates the ways in which artificial intelligence can serve as a collaborator in the teaching-learning process by facilitating interactive discussions, generating the learner's interest in the process, and fostering critical acumen and creative expression which are crucial for literary studies. As the above case studies and interviews have demonstrated, the role of the facilitator is crucial in integrating AI tools in pedagogic practices as the process demands not only awareness of epistemological and ethical challenges that are associated with the use of artificial intelligence for education but also expertise and training in the implementation of such technology in educational context and theoretical knowledge that constitutes the rationale behind such integration. The facilitator has to be aware of the needs of the learners as well as the intended outcomes of utilization of such technology to ensure the success of the pedagogic mutations in subjects like literature at the graduate level that tend to destabilize the dichotomy between creative explorations and critical contemplations.

As the Columbia Centre for Teaching and Learning notes in a statement:

> *...higher education, like all industries, will continue to feel the impacts of technological evolution and growth...classrooms will continue to remain flexible and responsive to this evolution. With digital innovation and developments, the capabilities (and limitations) of today's AI tools, including ChatGPT, will shift and evolve. For that reason, trying to completely ignore or shut out these tools, or even adopting an approach of complete disengagement will not serve instructors and their students in the long term. Instead, instructors have an opportunity to rethink and focus on the elements of their course over which they have the most control, including transparent course policies, explicit communication, partnerships with students, and course and assignment design. Leveraging these aspects of teaching and learning can better serve instructors and their students no matter the digital innovations of the future. ("Considerations for AI tools in the classroom")*

Thus, AI tools in the English literature classroom can potentially help the instructors to personalise learning, increase their effectiveness by making the class more engaging, and as envisaged by the curricular framework of NEP 2020, "make education more experiential, holistic, integrated, inquiry-driven, discovery-oriented, learner-centered, discussion-based, flexible, and, of course, enjoyable" (Ministry of Human Resource Development, 2020, p. 3).

Conflict of Interest

The authors in the present study have no conflict of interest.

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Microlearning strategies for teacher professional development in the era of fourth industrial revolution in India

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Abstract

The Fourth Industrial Revolution which is characterized by rapid breakthroughs in digital technology, automation, and artificial intelligence, is revolutionizing both the classroom and workplace learning settings. This change in the classroom and workplace setting is characterized by changing skill requirements, accelerating knowledge obsolescence, need for personalized and adaptive learning experiences, a culture of continuous learning, and on-demand performance support. The educational landscape is changing with the intervention of technology into our lives and new and innovative ways of learning are emerging. The key stakeholders in the education system are teachers and their professional development has utmost significance in helping education pick pace with societal changes. The various strategies of microlearning are useful for teachers to enhance their skills and mitigate the impact fourth industrial revolution is having in terms of quicker knowledge obsolescence and new job creation. Microlearning can provide considerable benefits in the Indian classroom context since traditional educational systems struggle to keep up with these changes. According to a Deloitte University Press research report, microlearning can improve learning retention rates because it provides learners with bite-sized, focused content that is easier to digest and retain than lengthy classroom lectures or training sessions. The interactive and self-directed learning approaches, such as microlearning, can lead to higher learning outcomes compared to traditional classroom teaching (Sitzmann, 2011). The paper provides a look into effective microlearning strategies that can help in dealing with the problems of the traditional classrooms in the current digital society.

KEYWORDS: Microlearning, Fourth Industrial Revolution, Continuous Learning, Professional Development.

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1. Introduction

The fourth industrial revolution has permeated has permeated into our lives bridging the gap between the physical, biological and the digital worlds and it is changing the way we live, learn and work (Schwab, 2017). The Fourth Industrial Revolution, characterized by rapid technological innovation, automation, and digitization, is revolutionizing many parts of our society, including the economy, labor, and daily life. The Fourth Industrial Revolution is altering the work market, and the scale of impending skill set disruption is so large that the existing subject knowledge of the current workforce will be outdated in just a few years (Leopold et al., 2016). The scale is disruption is such that 65% of children enrolled in current elementary schools will ultimately end up working in completely new job types that don't yet exist (Leopold et al., 2016). The Fourth Industrial Revolution's rapid rate of technological improvement is causing knowledge obsolescence, in which skills and knowledge become swiftly obsolete. The markets generated by the fourth industrial revolution demand knowledge workers who produce goods and services with their mind (Xu et al., 2018). The traditional classroom learning may fail to keep up with these shifting skill demands as it equips learners for a static world that has ceased to exist and so the traditional content-based curricula must be replaced with fast-paced processes of knowledge creation (Doucet et al., 2018). The role of teachers in fourth industrial revolution is crucial in preparing

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students for the workplace of the future by cultivating their curiosity, collaboration and critical thinking skills (Doucet et al., 2018). These rapid advancements necessitate a continuous evaluation of the instructional approaches that will equip students for an uncertain future (Matthews et al., 2021). Thus, continuous teacher professional development is necessary to help teachers in inculcating key critical skills among learners that they require to navigate their way through the fourth industrial revolution (Ajani, 2021). To do so, teachers require to continuous upskill themselves in both content and skill. Microcontent and microlearning, offer a potential solution to rapidly developing and multitask-oriented patterns of learning and working that have emerged as a result of fourth industrial revolution (Buchem & Hamelmann, 2010). Buchem and Hamelmann (2010) emphasize that microlearning supports self-directed professional development for the teachers as it enables them to remain up-to-date in today's knowledge society by reducing knowledge gaps and building confidence in performing tasks. Microlearning is the process of learning through short, digestible, well-organized units of the content (Sonawane & Jadhav, 2022).

The concept of microlearning is based on the principles of spaced learning (Ebbinghaus, 1964) and distributed learning (Youtz, 1941). The distributed learning (DL) outperforms massed learning (ML) in terms of mnemonic advantage (Cepeda et al., 2006; Janiszewski et al., 2003). In two tests performed by Litman and Davachi (2008) it was found that over a 24-hour period, DL does not improve immediate memory performance but rather lowers the pace of forgetting compared to ML. Donovan & Radosevich (1999) investigated the relationship between massed and spaced practice circumstances and task performance and found that spaced practice led to better task performance. Concerning the use of microlearning for teacher professional development it was found that all teachers who used microlearning showed sustained professional learning (Billings & Kasmer, 2015). Furthermore, Kohnke and Foung (2023) found that teachers felt the microlearning teacher professional development activities to be quick, relevant, and engaging and were helpful in gaining practical knowledge and confidence.

Besides, Carter and Youssef-Morgan (2022) found that it appears that micro-learning yields the steepest immediate post-intervention results in comparison to traditional and online face to face learning. Furthermore, the imminent effectiveness of microlearning for teacher professional development can't go unnoticed. Microlearning helps teachers upskill themselves with tools that are already familiar to them in terms of access, curation, development and content; microlearning helps teachers learn from subject matter experts in comfort of their homes and also helps them engage with larger teacher community; microlearning provides teachers with means of active learning quickly in less time using devices they have while keeping records of their progress (Allela et al., 2020).

Looking at the search results that came up with key words "teacher professional development and microlearning" on google scholar, it can be seen that the use of microlearning by teachers to upskill in themselves has increased.

Microlearning is compatible with modern communication and information transmission methods. Microlearning can aid learners with brief, targeted, and easily available learning modules that can be swiftly updated to reflect the most recent technological breakthroughs, allowing learners to gain relevant skills in a timely manner. The necessity for personalized and adaptive learning experiences for teacher professional development is emphasized by the Fourth Industrial Revolution. Formal teacher training, which frequently takes a one-size-fits-all approach, may struggle to satisfy learners' individualized learning needs. Microlearning can deliver personalized and self-paced learning experiences that respond to each learner's particular learning styles, preferences, and speed, hence increasing learning effectiveness and engagement (Sonawane & Jadhav, 2022).

The classroom learning and professional development are most important factors in the life of the teacher. A successful teacher is eager to implement new ways of professional development and is keen to engage is outcome-based learning (Sonawane & Jadhav, 2022). Microlearning can create a lifelong learning mindset by providing conveniently accessible and convenient learning opportunities that fit into employees' hectic work schedules. This mindset towards learning in the life of the teacher leads to the successful profession and they unintentionally engage in continuous professional development, or we can say lifelong learning is leads to professional development also. It encourages individuals to take responsibility for their learning journey and supports self-directed learning, resulting in a workplace culture of continuous learning. The Fourth Industrial Revolution emphasizes the importance of on-demand workplace performance support. Employees frequently require quick access to information and resources in order to complete their responsibilities effectively. Microlearning can be used as a performance support tool by offering just-in-time knowledge, task aids, and micro-modules that employees can use as needed to assist their workplace performance, resulting in increased productivity and performance.

Teachers' professional development is a multifaceted process that involves development of various areas. Clarke and Hollingsworth (2002) provide an interconnected model of teacher professional development namely personal, practice, outcome and external source of information. A high-quality professional development program impacts teachers

content knowledge, is extended over a period of time, is collaborative in nature and is a part of daily work, is ongoing, coherent and integrated with teachers teaching objectives and goals for professional development, is inquiry based and teacher-driven (Kedzior & Fifield, 2004). Microlearning characteristically being user-driver and on-demand can cater to all the characteristics of a high-quality professional development tool. Besides, it has been seen that in comparison to traditional groups, microlearning group showed around 18% better learning outcomes (Sirwan et al., 2018).

However, there is still very less information on how teachers can use microlearning strategies to upskill themselves and what are the challenges they face. Thus, the paper aims to assess the status of teachers' use of microlearning strategies for professional development. Furthermore, the paper aims to map the challenges of using microlearning for professional development and suggest techniques that can increase the effectiveness of using microlearning for professional development.

2. Methods and materials

2.1 Methods

In the present study, mix method was used. To know the status of us of microlearning by teachers for professional development, survey was used. The survey method helps gather information from a large number of users. It assesses the characteristics of whole population of people or situations. Survey represents one of the most common types of quantitative, social science research. In this survey research, the researcher selects a sample of respondent from population and administer questionnaire to them for knowing the actual status. At the same time, researcher used open ended questions for getting deeper understanding and getting the information related challenges of the usages of microlearning for their professional development.

2.2 Instruments

The status of teachers' use of microlearning strategies for professional development was quantitative data was collected using "Microlearning strategies for professional development scale" which gave insights into the status of teachers' TPACK knowledge, proficiency in teaching skills, accountability, learnership effectiveness, and attitude towards self-upgrading using 78 statement Likert scale. The TPACK knowledge encompasses content knowledge, pedagogical knowledge, and technological knowledge. Content knowledge (CK) refers to the subject-matter expertise of the teachers. A given subject's concepts, theories, supporting data, and organizational frameworks may all be included in content knowledge, as well as the best practices and established methods for imparting this knowledge to students. The pedagogical knowledge (PK) describes teachers' knowledge of the practices, processes, and methods regarding teaching and learning. As a generic form of knowledge, it encompasses the purposes, values, and aims of education, and may apply to more specific areas including the understanding of student learning styles, classroom management skills, lesson planning, and assessments. Furthermore, technological knowledge describes teachers' knowledge of, and ability to use, various technologies, technological tools, and associated resources. Technological knowledge concerns understanding edtech, considering its possibilities for a specific subject area or classroom, learning to recognize when it will assist or impede learning, and continually learning and adapting to new technology offerings.

The proficiency in teaching skills component of the scale checks the status of the teacher's contextual proficiency, conceptual proficiency, and transactional proficiency. Contextual proficiency involves making learning meaningful to students by connecting it to the real world. It draws upon students' diverse skills, interests, experiences, and cultures and integrates these into what and how students learn and how they are assessed. Besides, conceptual proficiency involves the ability to verbalize connections among concepts and representations, conceptual understanding need not be explicit. The transactional proficiency involves teachers' skills in teaching various reading comprehension strategies and how to use them with each other.

The Accountability component of the scale checks teachers' measure of their accountability towards teaching, students, and administration. Accountability towards teaching includes teacher commitment to work for the highest standard of teaching and their adjustment in work along with punctuality. Teachers' accountability towards students includes providing equal opportunity to the students, demonstrating empathy, concern, honesty, and truthfulness towards students. It also encompasses teachers' belief that all children can learn. Teachers' accountability towards administration consists of being accountable to government or management, involved in community projects and extension service and providing service to the community through the professional.

Status of leadership effectiveness of teachers includes two kinds of leadership that the teachers can demonstrate namely, academic, and administrative. If a teacher uses academic leadership, they use four styles which include "telling, selling, participating and delegating" (Hersey & Blanchard, 1969). If a teacher is a successful administrative leader, they are able to establish systems that protect and sustain operational functions to meet the needs of children and families.

The status of teachers' rigor towards self-upgrading includes the frequency with which they participate in an extension course, workshops, conferences, and

seminars. The participation in the extension course covers teachers participating in refresher courses on related subjects, courses that talk about recent development in their courses, undertaking higher studies formal as well as through informal mode, ability to use computers for teaching and learning, and efforts towards developing technical skills as well as using various audio-visual aids for effective teaching. Participation in workshops, conferences and seminars in related subjects also includes getting involved into research activities, the reading of journals, reference books, books related to the subject as well as related to the subjects.

Furthermore, the teachers' cohort was invited to respond to open ended questions to talk about the challenges they face while using microlearning for their professional development. The questionnaire had five questions that talked about challenges of using microlearning, and if challenges faced by microlearning were in regard to a specific subject or were they generic, and the role technology can play in overcoming the challenges of using microlearning for professional development. Furthermore, teachers were asked about the benefits and drawbacks of using microlearning strategies for professional development and what are the best practices that teachers recommend for designing and delivering effective microlearning lessons.

2.3 Population

The target population were 32 school teachers of Kerala state in the age group 35 to 50 years of age. This group represents a section of teachers who are at the crux of the teaching learning process and are significant mitigators of the fourth industrial revolution. The teachers were part of the EDUREFORM Teacher training program at Kochi and were invited to participate in the research by filling the google form. The questionnaires were filled using google forms for the ease of the participants.

2.4 Data analysis

To assess the status of use of microlearning strategies for professional development for the teachers, we used descriptive statistics. The status of teachers TPACK knowledge, proficiency in teaching skills, effective use of leadership, accountability and self-upgradation was established by calculating mean and standard deviation of group. Furthermore, the data was graphed and skewness and kurtosis of the data was found.

Furthermore, the thematic analysis of the qualitative data was conducted to understand the common concerns shared by the teachers in regard to challenges, subject-specific difficulties, benefits and drawbacks of using microlearning for professional development and solutions that they suggest.

3. Results

The data was divided into five components namely TPACK knowledge, proficiency in teaching skills, effective use of leadership, accountability and self-upgradation. The mean of and standard deviation for each component was calculated. It was found that of all the participants It was found that the TPACK knowledge, i.e., knowledge of subject matter, technology and pedagogical knowledge of the teachers was average. Similarly, their proficiency in teaching skills, effectiveness of leadership, and rigor towards self-upgradation was average. This shows that even though teachers have content knowledge, technology and pedagogical knowledge to use Microlearning for professional development, they are not able to use it to the fullest due to some barriers. Similarly, they seem to use microlearning in improving their proficiency in teaching skills, leadership and for self-upgradation, there is still scope for improvement. However, their accountability was low which shows that teachers feel less accountable towards their profession, students and administration in respect to using microlearning for professional development.

Sr. No.	Component	Mean	SD	Interpretation
1.	TPACK Knowledge	47.09	4.49	Average
2.	Proficiency in Teaching Skills	45.75	4.48	Average
3.	Accountability	37.31	4.95	Low
4.	Leadership Effectiveness	57.68	4.61	Average
5.	Self-Upgradation	38.43	4.79	Average
	Total	226.28	17.86	Average

Table 1 - Mean and SD of Microlearning regarding Professional Development.

However, the data reflects that although microlearning have been proven as an effective model for professional development (Zhang & West, 2020), overall, teachers have been using microlearning for professional development to a moderate level. Furthermore, the learning area in which teachers use microlearning least in the area of accountability. The overview of the survey shown that teachers are low in the accountability. The teacher accountability is important as it provides intrinsic motivation to teachers to indulge in self-directed learning. The various strategies of microlearning may be the way to enhance the accountability in their profession.

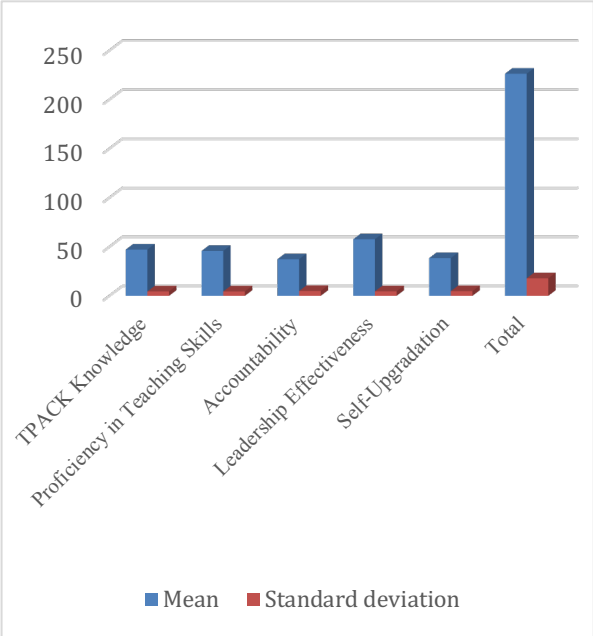

Figure 1 - Status of Microlearning for Professional Development.

In regard to challenges faced by teachers in using microlearning strategies for professional development, we found that teachers had problems paying attention to content being learned, they struggled in learning due to lack of face-to-face interaction with teacher and peer and lack of instant feedback with non-verbal cues from the learner while teaching and teacher while learning. The teachers also faced problems with managing time while using microlearning. There was a lack of motivation among teachers to use microlearning for their professional development. Besides, lack of digital literacy gadgets, and technical issues were also found to hinder the teachers' use of microlearning for professional development.

Furthermore, it was found that teachers find it difficult to use microlearning for subjects like mathematics [to learn/teach numerical], science [due to its practical component], dance, geography and history. Besides, they found it difficult to use microlearning to improve their skill of class management and interaction with the children.

Additionally, teachers found that if technology is used in microlearning it can make the concepts more digestible, can save time, improve attention, make it more attractive for students to pay attention, improve communication, create blended learning environments, and simulation to learn experiments.

Teachers found that using microlearning can have both benefits and drawbacks. The benefits listed by the teachers include that it makes learning user-centric, flexible, can be used to learn in portions, convenient, can be used to learn anything in world, low cost, can be done from anywhere even in the comfort of home, more exposure to different experts in the field, enhances self-discipline, can be used while not being a full-time student, and accessible. In terms, of drawbacks of using microlearning, teachers cited that it creates isolation and lack of confidence, increased screen time, more time-taking, can be distracting if the user is addicted to using gadgets for games and social media, can take more time than regular classes, can create health issues, and lack of socialization, cannot be used for practical learning, lack of individual attention, lack of peer interaction, lack of trust between teachers and students, can lead to addiction to gadgets, and student attention cannot be confirmed.

Regarding the best practices that teachers suggest for making microlearning more effective for professional development are better time management by instructors. Sessions should be more interactive and should include live creative work, the modules should have activities based on the topics covered, should collect feedback and improve, instructors should have recorded lessons and live sessions, the lesions should be well planned, should have YouTube videos, have group discussion forums for peer and collaborative learning, should be one source, should be flexible, instructor should check responses whenever possible, inclusion of activity based learning, learning should be visual with presentation and videos and should help interest in the subjects.

4. Discussion

Teacher professional development helps improve the education system and prepares them for the jobs of the future while enhancing students learning outcomes. The National Commission on Teachers (1983) pointed out the need for teacher trainers to be proficient in the use of skills they seek to develop among their trainees. In the era of 4th Industrial Revolution, the role of teacher is quite different, they should be constantly updating their Technological, Pedagogical, and Content Knowledge (TPACK) for their professional development. It means that teachers should have average knowledge and skills needed to effectively integrate technology into their teaching practices. In the age of Artificial Intelligence, the teachers should have a outlook of a learner so that can help their already techno-savvy students achieve necessary skills using multimedia and various educational gadgets. Teachers must be life-long learners and must strive to inculcate the need for life-long learning among their students. Teachers can mitigate the impact of fourth industrial revolution on the society with improved TPACK knowledge. Similarly, their proficiency in teaching skills is moderate. The Program of Action (1992) emphasizes that induction and continuing training programs for the teacher of District Institutes for Education and Training (DIETs)/ Colleges of Teachers Education (CTEs)/State Council of Educational

Research and Training (SCERTs) should be planned and implemented by National Council of Educational Research and Training (NCERT), The National Institute of Educational Planning and Administration (NIEPA) and other sister institutes. Therefore, the teaching skills with technology should be modified for the future learner. However, the accountability of teachers towards teaching, students and administration stands low which means that teachers do not feel accountable to use microlearning strategies to upgrade themselves due to obligation. Teachers are the brain and central nervous system of the education institutes establishment. Thus, the current teacher must use professional development tools that the current society has made handy.

Looking at the challenges teachers face in using microlearning for professional development, it is evident that one of the most common themes that was apparent in challenges teachers faced in using microlearning for professional development was time-management. This shows that the microlearning modules available for professional development are not following the thumb-rule being of 2-10 minutes in length. Besides, the teachers face the lack of face-to-face interaction and instant feedback from the instructor while learning. Moreover, teachers feel that microlearning modules should integrate simulation for practical subjects. These points emphasize that microlearning modules to be more effective for teacher use for professional development should be shorter, should have interactive features like annotation, discussion forums, should integrate URLs for sites that make simulation of practical subjects like mathematics and science possible, should also provide links to extra reference for teachers to refer if they want to. Moreover, even though discussion forums seem to be present in the microlearning environments, they are not active. So, for microlearning to be more motivating for teachers, the instructors of the course once in a while can host live online sessions and can interact in the discussion forums. Besides, the need to blend microlearning with in-person teacher professional development programs is also apparent from participant responses. Researchers suggest that microlearning, aligned with formal learning and embedded in online learning communities has the potential to support ongoing professional development (Buchem & Hamelmann, 2010). This will help teachers talk about their self-directed learning goals and issues that they face in achieving them and will help them seek support and guidance that they require. Additionally, teachers feel that feedback about the microlearning modules should be collected from them and the feedback should be integrated to make the modules better. This is an important component when thinking about the use of microlearning for professional development. Zhang and West (2020) emphasize that microlearning can be a powerful model for professional development if design is appropriate.

If the microlearning modules are improved on the basis of the feedback from the participants, they will be more relevant in terms of content and more contextual to the need of the participants they are targeted at. This will help improve the status of use of microlearning by teachers for professional development.

Besides, Hanshaw and Hanson (2019) have shown that microlearning can be developed into a more systematic tool for professional development by integrating it with social learning. This emphasizes the role of online communities and discussion forums in reinforcing teacher learning through microlearning by giving them platform to discuss and extend their learnings.

5. Conclusion

Professional development is generally associated with fixed guidelines of higher authority and deals with teacher effectiveness and attitude of teacher (Henwood & Flinton, 2012). Effective professional development is on-going process; it includes training, practice and feedback, and provides adequate time and follow-up support.

In the fourth industrial revolution, where knowledge creation happens at a very fast rate, teachers need to keep up with change teacher by constantly upskilling themselves. Besides, this continuous professional development of teachers will enable them to meet the learning needs of the current learner who due to high interaction with the digital systems have lowered their attention span (Microsoft, 2-15). To do so, teachers need to continually upgrade their content, pedagogy and technological knowledge with help of available resources online. Microlearning is an effective tool that can cater the need of the teacher for on-demand continuous professional development. However, the microlearning environments need to be improved to encourage teachers to use them. For this purpose, it is important to make microlearning environments that are available online conducive to the needs of the teachers. Integration of user feedback in to improve microlearning content and integration of social learning with microlearning are the ways ahead. Moreover, a successful microlearning program should involve teacher in learning activities that are similar to ones they will use with their students, and encourage the development of teacher's learning communities. The world is changing, old jobs are disappearing and new jobs are surfacing. Our students are walking into an uncertain future and to prepare them for future, we need to prepare their teachers for engaging in self-directed continuous professional development.

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Creating videos: A Pedagogic Tool for 21st Century Teachers of India

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Abstract

With smartphones and tablets becoming part of our lives, videos grabbing the learners' attention, and the resultant increased screen time, the idea was to test video creation as a learning tool for pre-service teachers. Creating videos related to current social, environmental, or economic issues requires in-depth research of the issue being investigated, interview of people connected directly with the subject, visiting required locations and having the first-hand experience or visiting a familiar place with a lens, and then synthesising the content into a meaningful short video. The action research study having four phases – reflection, planning, implementation, and feedback- shows that video creation engages the learners' head, heart, and hand, fostering critical thinking, creativity, and collaborative and communication skills necessary to tackle 21st-century challenges. The study was conducted on thirty pre-service teachers enrolled in two colleges offering B.Ed. Programme under the University of Delhi and resulted in the creation of four videos. The study also highlights how video creation contributes to quality education for 21st-century learners based on the Four Pillars of Education outlined in the Delors Report: learning to know, learning to do, learning to be, and learning to live together.

KEYWORDS: Action Research; Pedagogic Tool; Video Creation.

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1. Introduction

Today's youth has grown up in a world of technology, shaping the future landscape of education and work. The youth is more interested in interacting with the complex social, political, environmental, and economic issues affecting their lives by writing blogs, posting on social networking sites, and documenting through pictures and videos than through formal schooling. Learners today advocate for flexible, relevant, and meaningful learning tasks and strategies that allow them to direct their learning. Students have consistently used tools to support their learning. Traditional examples include books, pencils, blackboards, paper, rulers, and calculators. Digital technologies are also learning tools that support student learning in collaborative, communicative, and creative ways. Redecker and Punie (2013) say, "digital technologies will not only alter what students need to learn in the future but also *how* they learn." Today's education community is fascinated by the learning opportunities that mobile technologies offer. It helps increase access to resources, collaborate with others, and create online content through blogs or videos. With advancements in Information and Communication Technology (ICT) tools and declining prices of smartphones, mobile devices with a camera are increasingly becoming accessible and affordable by almost everyone.

> *"The continual growth of web-based multimedia and social media incorporating text, audio, photo and video capabilities provide increasing opportunities for educational institutions to integrate these technologies into teaching, learning and assessment" (McLoughlin and Lee, 2010).*

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Video creation provides an active learning experience that is "social, participatory, supported by rich media and within learner control" (UNESCO, 2015). Classrooms are not the only places where learning can occur; classrooms are, in fact, artificially created settings isolated from reality. The community and our surrounding natural settings offer powerful sites for learning if visited to achieve intended educational objectives. Mobile technologies and digital tools allow learners to become active content creators and not just passive consumers (Klamma et al., 2007; McLoughlin & Lee, 2010). YouTube, a popular video-sharing platform, has seen exponential growth in users creating and consuming content.

However, integrating technology in classrooms is successful only if the teacher is well aware of its benefits and the extent of its usage in their subject matter. Thus this research aims to train teachers in integrating technology to make it more relevant and meaningful for the learners of today and, at the same time, help shape what young people need to learn in order to 'act' or 'respond' to the socio-economic and environmental challenges of 21st century.

The objectives of the study are to explore video creation as a pedagogical tool for the 21st-century teachers, and to understand the benefits of video creation in terms of building crucial competencies required for advancing the agenda for sustainable development.

2. Learning Content of the 21st Century

With the complexity and uncertainty daunting our lives, preparing our children for the 21st century has become challenging as never before. Phenomena like globalisation, increasing acceptability of new technologies, blurring of boundaries, and changing markets compel us to ponder the learning content and methods students need to succeed in the twenty-first century. More and more researchers are focussing on learning experiences tailored to the needs of individuals and grounded in real life (Ala-Mukta et al., 2010; Learnovation, 2009). The learner of the 21st century likes to learn by exploring and expressing themselves through technology (Ben-David Kolikant, 2010). Leadbeater and Wong (2010) argue that "schools are not the only, nor necessarily the most important, place where children learn. Children learn first in their homes, families, and communities" (p. 15).

Moreover, 21st-century learners want freedom of choice in deciding on the content they want to learn and do not want their learning to be governed by traditional 'authoritative' sources. The learning approaches and methods are also moving away from teacher-dominated classrooms to more flexible, interactive, and self-driven forms of learning. The learners of today are "producing new insights and ideas motivated by a spirit of inquiry" (Lee & McLoughlin, 2007).

3. Pedagogies for the 21st Century

The 21st-century challenges demand 21st-century competencies from the learners, which cannot be acquired through the age-old lecture method, where the teacher is believed to have all the knowledge which is to be transmitted to learners whose role is to be a passive listener. Today's learners are active co-creators of knowledge and new ideas. Learners of today must be engaged in meaningful inquiry-based learning that holds relevance and value for them and the communities in which they live.

> *"Real-world experiences merged with sustained engagement and collaboration offer opportunities for learners to construct and organise knowledge; engage in detailed research, inquiry, writing, and analysis; and communicate effectively to audiences." (Barron & Darling-Hammond, 2008).*

It is believed that 21st-century Learning is based on three pedagogical pillars – personalisation, participation, and productivity (McLoughlin and Lee, 2008). "Twenty-first-century pedagogy must employ innovative and research-supported teaching strategies, learning technologies and real-world applications" (Saavedra and Opfer, 2012). It can be said that pedagogical approaches using technology for inquiry and problem-based learning will empower the learners with the required competencies to develop higher-order thinking skills.

4. Contribution to Quality Education for 21st Century Learners

The problem of quality and 21st-century learning outcomes is the most significant agenda for the world nowadays. The Sustainable Development Goal on education for 2030 aims to 'Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all'. Learning: The Treasure Within, famously called, Delors report recommended that the aims of education be created on "four pillars of learning" which further strengthens the belief that video creation as a pedagogical tool can promote quality education in the following ways:

Learning to Know: Video creation engages learners in informal and self-directed learning while understanding the concepts in the real context. It makes education meaningful and relevant by studying local and global issues in a cross-disciplinary manner, breaking the subject boundaries.

Learning to Do: Video creation enables learners to investigate local needs, perceptions, or conditions by exploring and reviewing the concepts in real settings. The learners interview those directly involved with the

issue, interact with the location, and create a piece of work after incorporating his/her creativity.

Learning to Be: Video creation not just provides an opportunity to develop cognitively but also socio-culturally. It not just prepares one for academics but also for failures, conflicts, and crises. It helps the learners take responsibility for their growth and see it as central to their creations. Thus, it can push learners beyond their comfort zones and make them innovators of tomorrow.

Learning to Live Together: Creating videos requires extensive teamwork and coordination to have the vision or idea of what to create, for what purpose, and how to bring the desired outcome. Not only does it require cooperation and collaboration among the team members but also stewardship and adaptability for working with other community members engaged in it, be it an interviewee or a contributor.

5. Methodology

Action Research was conducted with two-fold objectives: (1) To familiarise the young future teachers with the learning potential and use of readily available technology (like a smartphone), and (2) to encourage pre-service teachers or students of education to experiment with the video creation as a teaching-learning tool so that they can effectively assign and evaluate their students using video technology in their future classrooms. (Girod, Bell & Mishra, 2010; Kearney & Schuck, 2004, 2006; Hofer & Swan, 2005, 2006) The population of the study consists of social science pre-service teachers enrolled in the B.Ed. Programme in Delhi.

Furthermore, the sample for the study was purposively selected to include only social science pre-service teachers. A total of thirty pre-service social science teachers were chosen from two of the colleges offering B.Ed. Programme under the University of Delhi, India.

5.1. Phases of the Action Research

The study was conducted in a phased manner, following the below mentioned four phases:

1. ***Reflection:*** With smartphones and tablets becoming part of our lives, videos grabbing the learners' attention, and the resultant increased screen time, the idea was to test video creation as a learning tool. The students were divided into groups of five and asked to reflect on how they can use video creation as a pedagogic tool to teach social science concepts to their secondary school students. After discussing within the group, each group was asked to present at least one topic or concept which they think is embedded in or is part of our day-to-day activities.

   The reflection phase involved providing opportunities for learners to reflect on their ideas or understandings about a specific issue or topic of their interest. Work in groups to span over its multiple perspectives – social, environmental, ethical, political, legal, and economic, that they can show through their videos.
2. ***Planning:*** Deciding on the settings, audience, and narrative was all part of the planning phase. Aligning the roles and responsibilities of each team member to achieve the best results is also an essential element of planning.
3. ***Implementation:*** Finally, going in the field as a team, to execute the plan and experience the issue first-hand. In the process, learners also handle many unforeseen situations as they work with the community.
4. ***Feedback:*** Involves review of what was planned and what happened, and if something could have been done better to achieve the desired results. Feedback was crucial to empowering the teachers to take Video Creation to their classrooms.

6. Results

6.1. Video Creation as Pedagogic Tool for Teachers

Through this action research study, pre-service teachers felt confident that they could use video creation in their classrooms with school students. They believe their learners can do better than them as they are more creative in using such interactive technology. Further, teachers felt it would generate interest and enthusiasm in students to explore the heavy concepts creatively. Further, teachers also concluded that not every concept or topic of social science could be learned through video creation; for example, for learning history, story narration or role-play can be more effective.

The study resulted in creation of four videos on four topics: Development, Globalisation, Poverty and Consumer Awareness. Creating these videos helped the teachers broaden their understanding of these topics, and the created resource/assets, the videos, can be used with their secondary school students in the schools.

While making the videos, teachers became more aware and sensitive as they experienced poverty first-hand, and challenged their understandings. For making the video on the concept of Poverty, short clippings of different locations and underprivileged section of the society were shot. In the video, while showing a small tent in a slum where a family of six lives, a question flashes, "how do you manage to share a room with your sibling?". Thus, the video sensitises the learners about poverty's complex and multi-dimensional nature. Also, it elicits inequality and urges the viewers to help those in need, being the privileged community member.

Further, by interviewing people from varied occupations and from different socio-economic-cultural backgrounds, the video creators learn to critically evaluate the content, question norms, practices and opinions, and present a position in the discourse. For example, for the concept of development and consumer awareness, pre-service teachers asked pre-decided questions to different individuals, the responses of which varied among respondents. This task also required convincing others to participate in their survey and getting permission to record them as they responded to the questions.

Lastly, video creation broadens the perspective on the concept as it requires holistic understanding, which takes one beyond the textbook and into the real world. It also helps the learner understand the multi-dimensional nature of the concepts and their relationship with other concepts. For example, poverty and inequality are closely related concepts but are presented as separate textbook chapters.

6.2. Video Creation for Advancing Crucial Competencies

Gerhard de Haan gave a concept of *Gestaltungskompetenz* (shaping competence), which can lead people to participate actively in modifying and shaping the future of society by addressing the current social, economic, technological and ecological problems (de Haan, 2010, p. 318). In the year 2017, UNESCO, in their publication *Education for Sustainable Development Goals: Learning Objectives,* suggested the following eight competencies crucial to advance sustainable development; how each of the competencies can be advanced through video creation is explained in the Table 1.

Based on the highlighted competency building that video creation as a pedagogic tool can result in, it is suggested that pre-service teachers be trained to create videos and use them in their classrooms.

7. Conclusion

The notion that the school is the only source of learning does not hold, and this idea needs radical transformation by understanding the environments that enable one to learn. The 21st-century learners' self-directed and self-determined learning has immense potential in equipping them with various competencies. Video creation introduces them to real-world challenges and provides opportunities to interact with the community, collaborate with others, and solve unforeseen problems. The study showed that creating

S. No.	*Learning*	*Components of Video Creation*
1	Strategic Thinking Competency	Video creation requires breaking down material into its components, identifying the various parts, analysing the relationship between parts, and recognising the organisational principles involved.
2	Critical Thinking Competency	Video creation also demands evaluating the content critically, questioning norms, practices and opinions, and presenting a position in the discourse through video.
3	Self-Awareness Competency	Video creation involves comprehending the issue under study, which involves making meaning of the concepts or material based on first-hand experiences and understandings.
4	Citizenship Competency	Videos creation necessitates a visit to different locations, interaction with members of the community, working with peers, and developing inter-generational partnerships.
5	System's Thinking Competency	Video creation entails synthesising the various parts of the material together into a new whole. For example, writing a creative short story around the concept under study.
6	Collaboration Competency	The video creation process provokes learners to consider new uses of knowledge with their peers and cultivate new insights about the concept or issue. Collaboration is also required while interviewing those directly involved with the issue.
7	Anticipatory Competency	It is also vital for video creators to foresee the multiple possibilities or desirable impact of the video and create one's vision that one intends to create. For example, the objective can be generating awareness about the issue or changing people's attitudes or behaviour.
8	Problem Solving Competency	Video creation allows for authentic, real-world contexts, carrying out the planned activities from beginning to end, and solving problems as they arise, all of which constitute powerful learning strategies.

Table 1 - Competencies Advanced through Video Creation.

videos related to current social, environmental or economic issues require in-depth research of the issue being investigated, interviews with the people connected directly with the subject, visits to required locations and having first-hand experience or visiting content into a meaningful short video. This action familiar place with a new lens, and then synthesising the research study having four phases – reflection, planning, implementation, and feedback, revealed that video creation engages the head, heart, and hand of the learners and fosters critical thinking, creativity, collaborative and communication skills, and many others necessary to tackle the 21st-century challenges.

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Attitude of Undergraduate students towards Sketchnoting activity in classroom

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Abstract

Ensuring and further increasing student engagement in the classroom is a challenging task for the teachers. Teachers need to be creative with the tasks and activities they employ in the classroom so that students pay more attention to the topic being discussed. Greater the involvement of the students, better would be the chances that they learn. This study focused on studying the attitude of students towards sketchnoting activity in the classroom. College going students from Bachelor of Education (B.Ed.)., Bachelor of Arts (B.A., Applied Psychology) and Bachelor of Science (B.Sc., Clinical Psychology) courses were included in the sample.

KEYWORDS: Sketchnoting, Teaching, Notes, Visual, Engaging.

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1. Introduction

In the face of the fourth Industrial revolution, it is imperative that teachers come up with innovative and creative ways to teach in the classroom and focus on 21st century life skills and not just on basic content delivery. It is a great challenge for the teachers to ensure that the students are attentive in the classroom as with the strong impact of technology in today's world, students may find the usual classroom atmosphere uninteresting. Catching and sustaining students' attention in the classroom and further enhancing their creative, analytical and critical thinking skills is a challenging task for teachers. Teachers need to be on their toes to look for and experiment with various teaching tools and methodology. Sketchnoting is one such technique that teachers can utilize in the classroom to engage students. Sketchnoting is a technique that involves taking notes in the classroom using visual note taking. It is a fun and engaging method as it turns doodling into a tool that can help students focus better in the classroom and it also helps deepen their understanding of a concept. Sketchnoting assists the students in organizing ideas visually and it further can help the students remember concepts better.

Tidy, Burnham and Elkington (2022) discuss that the concept of sketchnoting was first introduced by Mike Rohde to capture information in a visual form using a combination of the visual stimulus and words. According to these researchers, in the Higher Education field, a sketchnote can prove useful to summarize key points from the delivered content in the form of a combination of words, simple pictures and graphics. Sketchnotes can help students record main points from a lecture, seminar, journal article or book in a visual manner that can be recalled easily later.

2. Aim of the Study

The aim of the present study was to find out the attitude of undergraduate students towards sketchnoting activity in classroom**.** The focus was to study whether students find the activity more engaging and whether they enjoy using it.

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3. Defining the Variable: Sketchnoting

Sketchnoting is defined as a creative form of notetaking that uses a mix of linguistic (words) and nonlinguistic (pictures) representation together (McGregor, 2018). Erb (2012) defines sketchnoting as a graphic method for putting thoughts on paper for taking notes or presenting a design process. Sketchnotes are visually rich as they are created by a mix of handwriting, drawings, hand-lettering, shapes, and visual elements (Schubert, 2022).

Dual coding theory by Paivio (1990) is used in sketchnoting by combining both words and images. According to Paivio, there are two ways one can expand on learned material: verbal associations and imagery. According to this theory, images and verbal information can be used to represent information.

Sketchnoting is being used as a tool in design and engineering classes as an alternative approach to traditional note taking. Hjeltness, Mina and Cyamani (2017) discussed how sketchnoting could be integrated in engineering classes to foster further creative confidence and critical thinking. The researchers have made an attempt to bring sketchnoting into freshman engineering classes with the aim to provide the students with an alternative to traditional note taking in order to foster learning and retention.

Sketchnotes can have an impact on students' learning in an English Language Arts (ELA) classroom. Dale, Crovitz and Bennet (2022) conducted a qualitative study to analyze if sketchnoting helped deepen students' understanding of concepts learned in ELA. Results from students' examination of their own sketchnotes, teachers' examination of the sketchnotes, and interviews were analyzed. The results of this study could help educators understand the benefits of sketchnoting in their classroom.

Tidy, Burnham and Elkington (2022) conducted research on students of a Forensic Science module at Teesside University. They were asked to make sketchnotes on what they learned after each lecture to create a visual revision aid for their upcoming examination. The resulting sketchnotes were shared each week. Students described the task as helpful, fun and creative with approximately half the class stating they would be using this as a future revision process for exams.

Some researchers are also working to develop apps and online games based on sketchnoting. For example, Atashpendar, Grevisse and Rothkugel (2019) have developed a note-taking app based on sketchnoting that helps students have a better learning experience. The app combines semantic annotation with drawing recognition. A web-based game called "Sketch & Learn" was designed by Fernandez and He (2019). It engages learners in playful sketching and helps them build a visual library and it also serves as a dedicated practice toward sketchnoting. From a pedagogical point of view, the game helps establish a playful learning environment and uses examples to help learners use sketchnoting. Preliminary testing results showed that the game promoted engagement from users, and elicited learning gain.

Gansemer-Topf, Paepcke-Hjeltness, Russel and Schiltz (2021) conducted a study on the students of an undergraduate ecology course and assessed the effectiveness of sketchnoting. They found that students' perceptions of using sketchnoting did not significantly change after being introduced to the tool, but over two-thirds of students found the tool valuable and recommended it to other students.

In the process of teaching students at the university it is important that innovative means and methods of developing visual thinking are utilized. One such method is sketchnoting. Vovk, Koikova and Nikeitseva (2022) conducted a study on first-year students and based on the analysis of the results it was revealed that sketchnoting has a positive effect on the level of development of visual thinking in the students.

Perry and Weimar (2017) discussed how sketchnoting is an activity that K12 students can use effortlessly. They posit that compared to adults, children are more comfortable drawing and being more creative.

4. Methodology and Data Collection

33 Undergraduate students from three courses – B.Ed. (Bachelor of Education), B.A. (Bachelor of Arts in Applied Psychology) and B.Sc. (Bachelor of Science in Clinical Psychology) formed the sample for this study.

A questionnaire was prepared to take the feedback from the students after they had used sketchnoting in the classroom. The experts' advice was sought for the questionnaire and the questions were framed and reframed. Out of 19 items, 4 items were rejected and only 15 were short listed for the final draft. Finalized questionnaire for students contained a total of 15 items out of which ten items (Item No. 1, 3, 4, 7 9, 10, 12, 13, 14, 15) were positive and remaining five items (Item No. 2, 5, 6, 8, 11) were negative statements. Likert five-point scale was used for recording item responses, which range from 'Strongly Agree' and 'Strongly Disagree' having 'Agree', 'Neutral' and 'Disagree' options in between.

5. Results and Discussion

The present study aimed at examining the attitude of students towards sketchnoting activity in the classroom. The results obtained showed that the students gave a positive feedback towards preparing sketchnotes in the classroom. Out of the 15 items included in the attitude

scale, feedback towards 14 items proved to be in favour of the sketchnoting activity. The students generally approached the new methodology with positivity. The study also helped provide students an alternative to traditional note taking in order to foster better learning and retention.

At the beginning of the lecture, the students were given a brief about the method of sketchnoting, thereafter they were encouraged to use the same to take notes in the classroom in that particular lecture. Figure 1 shows some evidences for the same. It must be noted that the students were keen on trying sketchnoting in the classroom and thoroughly enjoyed the activity.

The feedback obtained from the students showed positive attitude of the students towards sketchnoting in the classroom. The responses for 14 items were mostly positive and promising as far as the use of sketchnoting in the classroom to engage undergraduate students is concerned. 42.4% of the students claimed that they were more focused on the content while sketchnoting. This is understandable as sketchnoting is an activity that demands the students' sustained attention when they prepare the notes. 48.5 % students found this technique relaxing and claimed that they were able to engage themselves in the classroom well when using this technique. The act of drawing and doodling is very therapeutic and relaxing for many people and this would definitely help students feel relaxed while they work on their sketchnotes. Also, it gives the students a break from the mundane and helps them have fun in the class. 36.4% students disagreed that they skip main points while sketchnoting sometimes, which further helps add weightage to the fact that sketchnoting is an effective technique for notes-taking in the classroom. 51.5% students disagreed with the item that artistic skills are required for sketchnoting. Sketchnoting doesn't need artistic or creative skills. One doesn't have to be very good at drawing to prepare sketchnotes. One can also just use graphics and doodles while

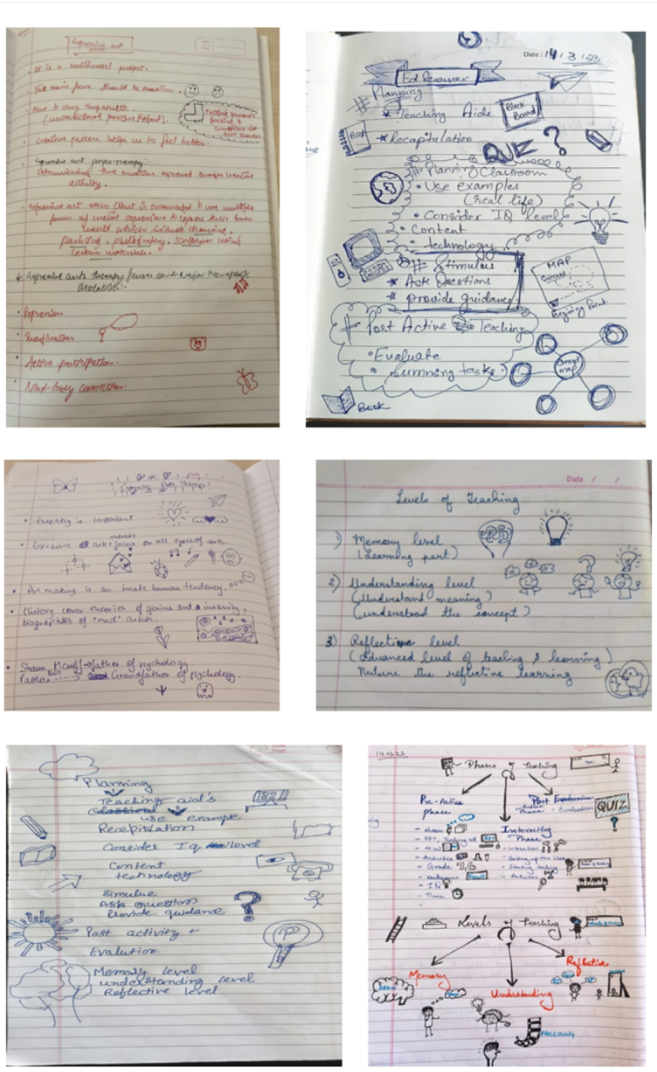

Figure 1 - Evidences of Sketchnoting Activity in the Classroom.

sketchnoting. 49.5% students agreed that this technique breaks monotony. It is a very interesting technique that adds an element of fun in the regular classroom atmosphere. A large percentage (60.6%) disagreed that they would not understand their drawings while revising the content, which helps validate the fact that sketchnotes are useful and one may refer to them later to revise. 43.8% students found this technique very useful, while 48.5% students found taking notes through this technique fun. This shows how sketchnotes can help students as they find it not just a fun technique but also useful. 42.4% students agreed with the item that they would not understand sketchnotes borrowed from their friends, and that makes sense as the pictures and graphics drawn may be somewhat unique and may hold special meaning for the person who drew them. 39.4% students believe that all teachers should use this technique in the classroom. This is helpful information as teachers need to constantly try and look for new and interesting techniques to engage students in the classroom, and sketchnoting is one such technique. 45.5% students would want to use the technique in future, further helping the case for introducing such innovative techniques in the classroom. 45.5% students claimed the sketchnoting helped them learn content better, thus adding more weightage to the utilization of this technique in the classroom so that students understand the content well. There was one item wherein the students rated sketchnoting negatively- "I found this technique tedious." 28.1% students claimed to find it tedious. However, this is in stark contrast with the responses given by the students in all the other items. The researchers posit that it could be because the students didn't understand the term "tedious" that well, as 48.5 % students had claimed that they found this technique relaxing.

6. Conclusion

Keeping in mind the fast-changing scenario of education and the fourth industrial revolution, educators need to be enterprising and they need to hone their creative skills much more in order to engage students in the classroom. Teachers must continue to come up with creative ways to teach. The present study focused on sketchnoting as one such creative way. The study can have various educational implications. In-service and pre-service teachers can be encouraged to use this technique in the classroom as the students are more focused when they use sketchnoting. It helps in better retention of the concepts and is really helpful in case of visual learners. Also, teachers are always struggling with catching and sustaining the students' attention in the classroom, and this technique could

S.No.	*Item*	*Percentage of Students under various Categories of Responses*				
		Strongly Agree	*Agree*	*Neutral*	*Disagree*	*Strongly Disagree*
1	This method helps learn content better	42.4	45.5	12.1	-	-
2	I would like to do more of it in future classes	45.5	45.5	6	3	-
3	I wish all teachers to encourage this technique in their classroom	42.4	39.4	15.2	3	-
4	I enjoy using this technique	45.5	48.5	6	-	-
5	I would not understand sketchnotes borrowed from my friends when I am unable to attend the lecture	12.1	42.4	27.3	12.1	-
6	It is fun taking notes through this technique	42.4	48.5	9.1	-	-
7	I found this technique really useful	37.5	48.3	15.6	3.1	-
8	Sometimes, I do not understand my drawings while revising the content	3.1	12.1	24.2	60.6	-
9	The technique breaks monotony/boredom	39.4	45.5	3	9.1	3
10	This technique requires artistic skills which I do not possess	3.1	12.1	24.2	51.5	9.1
11	I skip main points while sketchnoting sometimes	5	27.3	27.3	36.4	4
12	I am unable to engage myself in the classroom when using this technique	33.3	48.5	12.1	6.1	-
13	I found this technique relaxing	33.3	48.5	15.2	3	-
14	I am more focused on the content while sketchnoting	21.2	42.4	33.3	3.1	-
15	I found this technique very tedious	21.9	28.1	15.5	25	9.4

Table 1 - Percentage Score of Items on Five-point Scale.

help them towards this cause and help break monotony as well. Sketchnoting could also help reduce some stress when the students use this technique in preparation for the exams.

The present study was delimited to Chitkara University, Rajpura, Punjab. Similar studies can be conducted in different geographical locations. The sample size can be increased, and this study can be replicated for larger samples. The tool can be standardized as well for further research. A comparative study on the effect of sketchnoting on different types of learning styles can be conducted. How sketchnoting fosters retention can further be researched. A quantitative research study may be conducted to find out how sketchnoting boosts academic success.

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Open book environment for enhancing the thinking skills in the Indian pre-service social studies teachers

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Abstract

The initiation of Industrial revolution 4.0 has brought the intervention of technology in every field of life. Education is one such field of life where Industrial revolution 4.0 will bring artificial intelligence into forefront. In such a situation the teachers will have sole responsibility to nurture the higher order thinking skills like critical thinking, creative thinking, analytical thinking, problem solving, decision making and effective communication in the learners. In order to develop such higher order thinking skills in the learners, it is imperative that the teachers themselves are groomed to use those skills. This grooming is necessary in the novice teachers who are getting trained to teach in the schools. This study was conducted by the researchers to inculcate higher order thinking skills like critical thinking and analytical thinking skills through the use of open book environment in the classroom for the pre-service teachers. The study was conducted for 6 months on 16 pre-service teachers who opted to learn pedagogy of social studies in the academic year 2021-22. The findings of the study show that most of the pre-service teachers liked to study in the open book environment. The pre-service teachers also expressed that they improved their critical thinking and analytical thinking skills by learning in open book environment and appearing for open book examination. Thus, it can said that open book environment tool has much potential to develop higher order thinking skills in the pre-service teachers and such teachers would definitely become torch bearers to develop thinking skills in the school students.

KEYWORDS: Open Book Environment, Open Book Examination, Thinking Skills, Pre-Service Teachers, Social Studies.

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1. Introduction

Education should aim at all round development of the learners. According to the New Education Policy of India (NEP of India, 2020):

> *"The aim of education will not only be cognitive development, but also building character and creating holistic and well-rounded individuals equipped with the key 21st century skills. Ultimately, knowledge is a deep-seated treasure and education helps in its manifestation as the perfection which is already within an individual. All aspects of curriculum and pedagogy will be reoriented and revamped to attain these critical goals".*

The overhauling of the curriculum and its transaction needs a reorientation of the teachers and a parallel change in the teacher education curriculum too. Till now students were just considered as the passive takers of the information given by the teachers. But with the arrival of industrial revolution 4.0 in this 21st century, it has become significant to nurture the 21st century skills in the students, like analytical thinking, critical thinking, creative thinking, problem solving, reflective thinking, decision making and effective communication. Developing these skills can be possible well through social engagement. Cooperation, teamwork, and leadership are fundamental capacities for social engagement (National Curriculum Framework of India draft, NCF-2023). Using social engagement activities for teaching learning helps the

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students to develop awareness about their own potentialities also. Such individuals with self-awareness about one's own potentialities will be able to survive the challenges of 21st century society. The 21st century society needs individuals who would use the 21st century skills for enhancing their quality of life. Enhancing the 21st century skills is possible in the schools if the teachers are empowered to use strategies to enhance these skills in students. Thus, it is important that the pre-service and in-service teachers should be trained in using strategies and tools to enhance 21st century skills. Open book environment is one such tool which helps to enhance critical thinking, creative thinking and problem solving abilities in the learners. Open book environment provides opportunities to explore new learning resources, collaborative learning and reflect on the content learnt. This paper is a humble effort to see the impact of open book environment (OBEn) on the learning of pre-service social studies teachers.

1.1. Open Book Environment (OBEn)

Open book environment is a pedagogical tool which helps is curbing rote memorisation, reduction of anxiety and prolonged retention of the learning content. It also aims at developing in students higher order thinking skills like critical thinking, analytical thinking and creative thinking skills. Research studies show that students had lesser level of anxiety studying in an open book environment and then attending open book examination (OBE) (Gharib, Phillip & Dominican, 2013). It helps the students to construct new knowledge, modify the existing knowledge, processing the information rather than imbibing it readily, thinking and rethinking about the knowledge, and develops problem solving abilities. One of the components of OBEn is Open Book Examination (OBE). In order to conduct open book examination, open book environment (OBEn) during teaching learning process is needed. If students are given open book examination without teaching through OBEn then the achievement might suffer. Research studies shows that only students taught through OBEn and then attempting OBE score have good achievement otherwise they fall short of time for attempting all questions of OBE and also achievement is adversely affected (Jalal, Fadhil &Hasini ,2014; Karagianopoulou & Milienos, 2013).

In open book examination the students are allowed to refer to the prescribed books and learning materials while answering the questions in an exam. It reduces the anxiety of the students during exam. For conducting an open book exam, students should be taught through open book environment. It would help students to develop higher order thinking skills. In this paper the impact of OBEn and OBE has been shown in the pre-service teachers for the subject Pedagogy of Social studies. This subject was taught through OBEn and was assessed using OBE. The questions asked in the OBE were such where critical thinking and analytical thinking was to be used. Critical thinking is the intellectually disciplined process of actively and skilfully conceptualising, applying, analysing, synthesising, and/or evaluating information gathered from, or generated by, observation, experience, reflection, reasoning, or communication, as a guide to belief and action (Scriven & Paul, 1987). So critical thinking is the ability of an individual to seek information, analyse alternatives and making conclusions or forming opinions. Analytical thinking means breaking down the problem to be solved into parts, finding out the causes of the problem, finding out the solution to solve the problem and evaluate the implemented solution. Thus, it can be said that analytical thinking skills involves gathering information, identify the cause of the problem, breaking down the problem, identifying the logical and factual outcomes based on information, identifying actions to solve the problems. Research studies also show teaching through OBEn and taking an OBE after that, helps in improving the achievement and also helps in developing divergent thinking, logical thinking, content knowledge and comprehension ability (Das, 2015; Maity, 2016; Jana, 2019; Biswal, 2015).

1.2. Theoretical perspective of Open book Environment (OBEn)

The open book environment has drawn its foundation from the Jerome Bruner's discovery learning theory (1961), Multi Store Model of Atkinson and Shiffrin (1968), Badeley and Hitch's working memory model (1974) and Bloom's Revised taxonomy (2002) given by Krathwohl in 2002.

Bruner believed that every individual had a natural ability to discover knowledge by interacting with his or her own environment. The role of a teacher is just to scaffold or provide learner centred environment such that the student discovers the knowledge through various cognitive processes. In this process of learning the learner might manipulate certain objects, address the confusions and questions that arises in the mind, might perform some experiments and may draw some conclusions or analysis from the previous knowledge. The learner does inquiry-based learning using all the above processes or some of the above processes. The only thing needed is a proper environment and learning materials. According to Bruner (1961) language plays a vital role in interacting with the environment. Similarly in the open book environment the learner is provided with a question for which they have to find an answer. The process of finding answers to the questions is collaboratively done in group activity.

Richard Atkinson and Richard Shiffrin in 1968 gave the multi-store model of memory. According to this model, memory consisted of three stores: a sensory register, short-term memory (STM) and long-term memory (LTM). In each memory there is a difference in how the

information is processed (encoding), amount of information that can be stored (capacity), period for which the information can be stored (duration). Any information is first detected by the sense organs and becomes part of the sensory memory which is stored for half a second. If this information got through senses is attended again and again or recalled again and again it enters into STM where it can be stored for about 18 seconds. If the information is rehearsed or recalled/ revised again and again by giving a meaning to it, then the information gets stored in LTM. The control processes like attention, rehearsal, searching and retrieving helps the information stored in sensory and STM to be stored in LTM. In the OBEn the students are given group activities, information searching and retrieving while finding answers to given questions. The students in OBEn are also given concept maps for rehearsing the learnt content. Thus, it can be said that OBEn uses the principles of information storage given by Atkinson and Shiffrin (1974).

Working memory model given by Badeley and Hitch (1974) has three sections in which information is stored i.e. Central Executive system, Visuospatial Sketchpad, Phonological Loop and Episodic buffer (added in year 2000). The Visuospatial Sketchpad processes the visual and spatial information. The central executive system is responsible for monitoring and coordinating the operation of the Visuospatial Sketchpad and Phonological Loop and hence helps in paying selective attention to one task and ignore others. The written and spoken words are articulated and stored in Phonological Loop. The episodic buffer links information from other elements of working memory and stores it in order, with respect to time, prepares the information to be stored in episodic manner in LTM. The problem solving enabled in the OBEn helps the students to use all the aspects of working model memory to solve problems and store the learning in their LTM. OBEn also emphasises on developing higher order thinking skills given in revised Bloom's taxonomy like application, analysis, evaluation and creation (Krathwohl, 2002).

1.3. Importance of Open Book Environment for 21st century teachers

The advent of industrial revolution 4.0, every sector of the society will upsurge many changes. Artificial intelligence will become an inseparable part of the education sector. With these changes, it is important that the teachers aim at making the learners equipped with 21st century skills. It would be very important that the teachers inculcate in the students the analytical thinking, critical thinking, creative thinking, decision making, problem solving, people management, emotional intelligence, coordinating abilities, making effective judgement and cognitive flexibility (Biswal & Das, 2021). In order to develop these skills, it is important that teachers are trained to develop these skills during the training program. Providing open book environment will definitely help the teachers to develop analytic thinking skills, critical thinking skills, reflective thinking skills, decision making and problem-solving skills. If the pre-service teachers are empowered with such skills, they are bound to develop such skills in the school students when they would start teaching in school.

1.4. Open book environment during the study

A culture that encourages people to learn and work together is characterised by trust and respect for all, this is critical to a good school - this is possible in an environment that is open and caring, and where dialogue, collaboration, enquiry, and reflection are embedded practices (NCF draft, 2023). It can be said that a learner centred classroom culture or environment encourages the learners to learn well. Open book environment is one such pedagogy tool which helps in making a learner centred classroom. For the present study all the 16 pre-service teachers were given different learner centred activities under the open book environment. The students were given group activities, presentations, and most of the topics were taught using discussion method. Power point presentations and concept maps were used to teach the students different topics. The students were also given some field activities for which they had to collect data from the field and analyse it to write the report.

The reviewed research studies on the OBE and OBEn show the significant impact of OBEn on the improvement in achievement of the students in OBE. The studies of Das (2015), Biswal and Das (2016), Maity (2016), Biswal (2015), Jana (2019) proved the that there was reduced exam anxiety and enhancement in students' achievement and thinking levels when the OBEn was provided to the students. Das and Delwala (2019) through their study suggested that OBEn is a pre-requisite for the success in OBE. Most of the reviewed studies were conducted on the impact of OBEn on OBE in school students. But it is important to understand that teachers can provide OBEn only if they are trained to create an OBEn in the classrooms. This study was planned by the researchers with the intention to provide the OBEn to the pre-service teacher in the pedagogy of social studies class followed by OBE to assess their learning. The study also aimed at analysing the responses of the pre-service teachers in an OBE, observe the changes in their behaviour in the OBEn class and to gather the reaction of the pre-service teachers on OBEn and OBE.

1.5. Objectives of the study

Studying the impact of open book environment in terms of

I. the responses given in the open book examination
II. the classroom activities in the class with open book environment

III. the reaction of the pre-service teachers on open book environment and open book examination.

2. Research Methodology

This was a qualitative study. The sample of the study were all the 16 pre-service teachers who selected to study the pedagogy of social studies in semester II and semester III of the two years Bachelor of Education program (B.Ed. program) in the academic year 2021-22. The study was de-limited to pre-service teachers who opted to get trained in using pedagogy of social studies. The tools and techniques used for data collection were field diary, responses in the open book test paper and reaction scale on open book environment. Data gathered for 6 months is presented as findings of the study. The field diary was used to record the observations of the participation of the pre-service teachers in the open book environment during the teaching learning process in the pedagogy of social studies class. Total three open book exam questions were analysed by the researchers to draw out the findings of this paper. All the three questions were from the final open book examination that the pre-service teachers attempted at the end of 6 months. The Pre service teachers had to respond to three questions in the open book exam. Out of three questions, two questions needed analytical thinking abd one question needed critical thinking to be used while responding to them. Apart from analysing the responses to these three questions, a five point reaction scale was also implemented on all the 16 preservice teachers to gather feedback about the open book environment and open book examination administered on them. The reaction scale had 16 items. The first 11 items were related to teaching learning process and classroom activities in an OBEn classroom and the last five items were regarding the OBE. The response was collected on a five-point scale ranging from SA-Strongly Agree, A-Agree, U-Undecided, D-Disagree to SD-Strongly Disagree. The data gathered from the five-point reaction scale was analysed using intensity index. The data from the field diary and the responses in the answer books were analysed using content analysis.

3. Findings of the study

The findings are drawn based on the analysis of field diary, open book exam responses and the reaction of pre-service teachers.

Findings for Objective I

The first objective was to study the impact of open book environment in terms of the responses given in the open book examination. The findings of this objective were found using the content analysis of the answers of the pre-service teachers in an open book examination. The content analysis of the three questions showed the following results. The results are presented for each question.

The analysis of the responses for the question "select a topic from the social studies textbook of class IX, describe the best teaching strategy that can be used to teach the selected topic. Give justification for the teaching strategy chosen". In order to respond to this question, the pre-service teachers had to use analytical thinking. Most of the pre-service teachers selected a topic, explained the use of discussion method as the best strategy to teach the selected topic, made a plan to for teaching the topic and justified their choice of method. One pre-service teacher gave a unique response. In the response the pre-service teacher wrote a plan to teach class IX students the topic of economic development through round robin brainstorming strategy. The teacher felt that use of this strategy would help the learners to read about different perspectives of economic development; enhance abilities to discuss, debate and think out of the box to resolve issues economic development.

The pre-service teachers had to use critical thinking to respond to the question 'Peer teaching leads to better learning than teaching through visual aids. Justify'. According to majority of the respondents peer teaching was better than teaching through visual aids because peers are of same age group so they would give relevant examples to provide better understanding of the topic. There were two unique responses to the above question. One pre-service teacher responded that the visual teaching aids might be confusing if the student doesn't understand the teacher's perspective, in peer teaching local language or mother tongue can be used to explain which would make the learning easy. Another pre-service teacher took the reference of Edgar Dale who explained the cone of experiences in teaching aids. According to Edgar Dale one remembers 30percent of what one sees and 70 percent of what one discusses and 95 percent of what one teaches to others. Hence in peer teaching one who would teach would remember 95 percent of the taught content and the learner would remember 70 percent of the learnt content hence it's a win-win situation for both the friends.

Another question asked in OBE was 'Timelines are better for teaching history than chronological charts. Justify.' In order to respond to this question, the pre-service teachers had to think critically. Most of the respondents said that timelines could be shown progressively and regressively so they were better than chronological chart. One unique response to this question was that timelines mentioned the dates of the events and also showed the time that had lapsed between two events; comparative timelines could help compare the national events with international events of a particular era while chronological charts could not give that comparative view and the time lapse between

two historic events. So, timelines were better to teach history than chronological chart.

Findings for Objective II

The second objective was to study the impact of open book environment in terms of classroom activities. The field diary was written for 6 months during the period. There were four open book tests conducted in these 6 months. Two tests were for internal assessment and two tests were semester end assessment. It was observed that out of 16 students only three students interacted in the class in the beginning of the period. After teaching for 1 month in an OBEn class first open book test was conducted. It was observed that after the first OBE, about 10 students started participating by giving their perspectives and viewpoints on the topics discussed in the class. These students actively participated in the classroom discussions and presented points they discussed in their group. At the end of third month there was the second open book assessment. The achievement of students in the second assessment was quite better than the first assessment. The classroom interaction and the achievement in the pedagogy of social studies improved during these three months. After the second OBE, 15 students out of 16 made several attempts to interact in the classes, by sharing their viewpoints and ideas on certain aspects. They improved their communication skills while interacted with their peers during group activities. They also freely presented their critical thoughts and ideas in the classes. In the fifth month, pre-service teachers conducted activities in the school. The pre-service teachers were divided into three groups, two group had five pre-service teachers each, and one group had 6 pre-service teachers. The first group conducted interviews to find out the apathy of the parents, students and teachers regarding the subject social studies. The second group conducted interview of the school teachers teaching social studies in schools to find out the professional competencies they acquired. The third group conducted bingo games for the school students to develop gender sensitivity and to develop awareness about the luxuries that the school students got in their lives. All the activities for the school students and the

Sr. No	Items	Intensity index
1.	It was interesting to learn the subject pedagogy of social studies through open book environment	4.06
2.	Teaching pedagogy of social studies in open book environment helped me in better learning of it.	3.69
3.	I liked to work in the groups when the tasks were assigned to us.	3.56
4.	The home assignments given to me stimulated my thinking.	4.25
5.	The group activities given to us helped improve the communication skills with each other.	4.00
6.	Power Point Presentation used while teaching the Pedagogy of social studies in open book environment helped us learn better.	4.06
7.	The use of Power point presentations and the teacher's explanation in the open book environment enhanced our understanding of the topics taught.	4.00
8.	The type of examples given to us by the teacher while teaching pedagogy of social studies during an open book environment helped in better grasping of the content.	4.13
9.	I liked the freedom given to share my experiences while teaching Pedagogy of social studies open book environment.	4.44
10.	I liked the freedom given to ask questions and clarify the confusions while teaching Pedagogy of social studies through open book environment.	4.44
11.	Freedom given to me during teaching through open book environment helped me to increase my confidence level.	4.38
12.	Giving an open book examination has reduced my rote memorization and has improved my understanding of the topic.	3.81
13.	Attempting for open book examination improved by decision making ability	3.88
14.	I liked answering questions in the open book examination.	3.63
15.	Attempting an open book examination helped me reduce fear of examination.	3.69
16.	The open book examination is a better alternative to develop thinking skills than the conventional system of examination.	3.94

Table 1 - Intensity Index showing the reaction of respondents to different components.

interviews with parents, school students and teachers were planned and executed by the pre-service teachers. The researchers could observe that the communication skills, critical reflection skills and analytical thinking skills of almost all students improved during this period. Four students, who hardly paid attention in the classroom, started improving the attentiveness.

Findings for Objective III

The third objective was to study the impact of open book environment in terms of the reaction of the pre-service teachers on open book environment. The following five-point Likert type scale was analysed to find the intensity index for each of the 16 statements with the following findings.

The intensity index was found for the responses of the pre-service teachers on the OBEn and OBE. Majority of the pre-service teachers liked the freedom given in the OBEn classes to share their experiences and express their ideas and thoughts. The home assignments given stimulated the thinking of majority of the pre-service teachers. Majority of the pre-service teachers felt that the group activities in the OBEn classes improved the communication skills. Majority of the pre-service teachers felt that the coordination of power point presentations and the teacher's examples while explanation in the OBEn classes, helped in better grasping and enhancing the understanding of topics related to pedagogy of social studies. Most of the pre-service teachers felt that OBE reduced the rote memorisation and improved the understanding of the topics taught by the teacher. After attempting the OBE most of the pre-service teachers improved the decision-making ability. Most of the pre-service teachers liked to answer the questions in the OBE. Fear of examination was reduced due to OBE in most of the pre-service teachers. Most of the pre-service teachers felt that the open book examination was a better alternative to develop thinking skills than the conventional system of examination.

4. Conclusion

It can be said that in the age of Industrial revolution 4.0, which is bound to be ruled by digital machines, it is imperative that the learners are equipped with higher order learning skills. The policy makers also demand the learners to be made abreast with the new knowledge and technology and to empower them with the higher order thinking skills such that they become knowledge creators and not just knowledge seekers(NEP of India,2020). In this regard it is important that the next generation teachers be educated in the use of such higher order thinking skills. The present study aimed at enhancing the thinking skills of the pre-service teachers by the use of Open book environment and open book examination. The reaction scale show that most of the pre- service teachers felt that their decision making, grasping ability and thinking skills improved due to the open book environment and open book examination. While it is to be understood that open book environment in the classrooms is a pre-requisite if the learners have to perform well in an open book examination. Researches show that achievement of the students in open book exam has improved only when they were given open book environment for learning (Jalal, Fadhil, & Hasini, 2014; Karagianopoulou & Milienos, 2013). The findings from the analysis of the field diary of the researchers also prove that since the pre-service teachers in the OBEn classes, were given opportunity to do field work in group, do presentations, raise their ideas and thoughts, most of them have positively reacted to the improvement of their thinking skills. The unique responses for the questions asked for having analytical thinking and critical thinking in an open book exam also reveals that learning through open book environment helped the pre-service teachers in thinking differently while answering those questions in the examination. Thus, it can be said that exposing the pre-service teachers to the innovative tools like open book environment will help them create such an environment in their classrooms when they go to schools for teaching. This in turn will help the learners to develop critical thinking, creative thinking, analytical thinking, decision making and problem-solving abilities.

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Augmented Reality and education: a comprehensive review and analysis of methodological considerations in empirical studies

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Abstract

Augmented reality (AR) has been gaining attention in the field of education due to its potential to enhance learning experiences. However, the use of AR in education is still relatively new, and empirical studies examining its effectiveness are limited. This review paper provides a comprehensive analysis of the methodological considerations in empirical studies that have investigated the use of AR in education. In this paper, 23 articles out of 134 articles were gathered from publishers database including Scopus, Science Direct, Springer, Taylor Francis, and Web of Science outlaying the detailed analysis of knowledge-based tests and methodologies essential for studying AR in education. The review paper further highlights the challenges and limitations of conducting such studies and also examines the outcomes and implications of empirical studies to date, providing insights into the effectiveness of AR in STEM courses. The analysis revealed that engineering education is more extensively explored compared to architecture. Additionally, mobile-based devices and AR marker-based technology are more commonly used in current studies than other AR-based devices and technologies, while probability sampling technique and pretest and post-test evaluation technique are more frequently followed by authors. Thus, based on the findings, the paper concludes with recommendations for future research directions and methodological considerations to be taken into account in empirical studies of AR in education. This review aims to provide a valuable resource for researchers and educators interested in incorporating AR technology in educational settings.

KEYWORDS: AR in Education, Augmented Reality, Education, Learning Environment.

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1. Introduction

The importance of education for a nation's development cannot be overstated. Likewise, in order to achieve the status of a developed nation, citizens must actively participate and have access to education. However, the traditional method of learning may not be sufficient in the modern world. In addition, with the advancements in technology and society's modernization, new and effective learning methods have become a necessity (Kaufmann, 2003). In order to appeal to a large number of students, educational institutions need to transform in response to new trends. However, (Pierson,2001) argues that despite their prevalence, traditional educational approaches provide several obstacles for pupils, hindering their academic success. Additional challenges include constraints on the quantity of study materials, limited opportunities for personalized instruction, and scheduling constraints for sessions. E-learning and personalised online education provides students with more flexibility and accessibility, resulting in advantageous outcomes. These strategies enable students to learn at their own pace, provide them with access to a wide variety of study tools, and provide them with personalized attention; all of these things contribute to an improved learning experience for the students.

The timely and appropriate adoption and use of necessary information is crucial for optimizing efficiency in educational and professional settings, particularly in the face of a dynamic and diverse knowledge landscape (Singhal et al., 2012). Hence, immersive technologies serve as a means to overcome

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the gap between students and education. Furthermore, the use of immersive technology-based methodologies in the educational setting enhances learner engagement, attractiveness, motivation, realism, and significance (Nischelwitzer et al., 2007).

Likewise, immersive technologies are those that allow a user to see or interact with an artificial or simulated environment. It allows the user to have the experience of being immersed in the digital world. Through integrating the digital environment with individuals sound, vision and even contact, immersive technology has revolutionized the digital experience. Immersive technology is comprised of two principal technologies: virtual reality (VR) and augmented reality (AR).

VR technology enables individuals to fully engage within a simulated environment, which may include a wholly fictitious realm or an accurate representation of the real world. The experience may include auditory, visual, and touch modalities on some occasions. According to Elmqaddem (2019), the level of immersion experienced in virtual environments may be similar to that of the physical world. The present investigation assessed the academic achievement of nursing students throughout their childbirth education course, as reported by Chang et al. (2022). In addition to serving as a kind of VR, AR system allow users the capability to see three-dimensional images by overlaying virtual data over a real-time video feed. To use these technologies, it is necessary to own a headset, smart phone, or tablet.

AR embellishes the physical environment by putting digital data over it. AR does not completely recreate artificial surroundings to replace actual ones, unlike VR. When used in conjunction with an existing environment, AR may add audio, visuals, and video. Because AR doesn't really require a head- mounted display, it gives users greater freedom and opens up more marketing opportunities, even if VR is more immersive. AR creates a link between the physical world and the mind (Azuma, 1997).

AR emerged as a promising technology to bridge the gap between students and educational learning techniques because it provides interaction, which is sometimes required in the learning process. AR overlays the digital content on the real environment, helping students understand the concepts (Osadchyi et al., 2021). Unlike VR, AR does not create an entire virtual world to replace the real one (Pavithra et al., 2020). Furthermore, AR can improve the effectiveness and appeal of in-class learning for students in the real world (Du¨nser & Hornecker, 2007).

1.1 Augmented Reality in Education

Education is a fundamental aspect of personal and societal development. In the 21st century, STEM (Science, Technology, Engineering, and Mathematics) subjects have become increasingly important in shaping the global landscape. However, many students find STEM subjects to be challenging, which can hinder their academic progress and future career opportunities (Mystakidis et al., 2022). The ability to comprehend these subjects and perform well in them depends on various factors, including memory retention, comprehension of the subject matter, spatial ability, critical thinking, cognitive load, and more. Thus, it is essential to understand the underlying factors that influence students' learning and academic success in STEM subjects. This research paper aims to explore and analyze these factors to provide insights into enhancing students' STEM education. While augmented reality AR) technology is increasingly being adopted in various sectors of education, there is a need for further investigation into its effectiveness as a teaching and learning tool. Previous research studies have demonstrated that participants generally have positive attitudes towards AR systems in educational settings. However, there is still a lack of comprehensive research on the integration of AR technology in teaching and learning, and the potential benefits it can bring to both teachers and students. Specifically, there is a need to examine how the use of AR technology can improve the teaching of subjects that require visualization, compared to traditional methods of instruction. This highlights the need for additional research in this area to help educators better understand the potential of AR technology to enhance the learning experience for students.

As the demand for online education grows, AR offers a plethora of potential outcomes as well as several benefits for improving the learning and teaching environment. For instance, AR has the capacity to: (a) encourage, fascinate, and involve students in investigating course materials from various perspectives; (b) assist in the teaching of subjects where students could not realistically gain their own experience (for example, in subjects like geography, astronomy, etc.); (c) improve coordination between students and instructors; (d) nurture student insight and creative ability; (e) aid students in taking charge of their education at their own speed and along their own way; and (f) develop a genuine educational environment for learning that accommodates different styles of learning (Yuen et al., 2011).

The objective of this research is to recognize the prevailing developments of AR in education by assessing the responses to the below research questions:

1. Which subject area or target area is in trend for AR educational applications?
2. What is the most commonly utilized type of AR device in educational settings?
3. Which type of AR technology is most commonly used in educational applications?
4. Which type of sampling technique is most commonly used in educational applications?
5. What type of evaluation technique is adopted by AR applications?

2. Methodology

2.1 Identification of relevant papers

The database has an enormous number of articles, making it a challenging task to select the relevant ones. It is imperative to carefully choose articles that illustrate the application of AR technology in different fields of education and how it has been utilized to enhance various contexts. These articles must demonstrate the functions and advantages of the AR technology employed in order to provide a comprehensive understanding of its potential.

To ensure that the selection process is thorough and accurate, certain criteria/ guidelines must be followed. In this study, a meticulous approach is followed for

selecting articles, beginning with a list of specific points that we consider essential for article selection. The selection process must include articles that showcase how AR technology has been used in various fields, such as STEM education, medicine, and architecture. These articles must provide detailed explanations of the AR technology used and how it has improved the particular field. Additionally, they must describe the benefits of using AR technology and how it has impacted various contexts, including the efficiency and effectiveness of tasks.

Furthermore, the articles considered for the study must be recent and up-to-date, reflecting the latest advancements in AR technology in the field of education. They must also have a clear and concise structure, making it easy for readers to comprehend the information presented. The articles must be published in reputable journals and have undergone rigorous peer review processes to ensure their accuracy and reliability.

Overall, the selection of articles is a critical aspect of any research study. By following specific criteria and guidelines, we can ensure that the articles selected provide a comprehensive understanding of how AR technology has been utilized in various fields and its potential for the future.

1. Online databases such as Scopus, Science Direct, Springer, Taylor Francis, and Web of Science were used for searching the articles that discussed immersive technology (AR) in education.
2. The articles were gathered from Google Scholar, which was published between 2017 and 2023.
3. The keywords used for searching the articles were: “augmented reality in education”, “augmented reality”, “current technologies in education”, “learning environment augmented reality”, “augmented reality trends”.

PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) is the tool used for this literature review as this tool offers an organized and standardized approach for conducting and reporting systematic reviews. It employs data extraction, analysis, and review (filter, identify, and eligibility criteria) of the relevant literature. The selection criteria (Figure 1) for relevant articles.

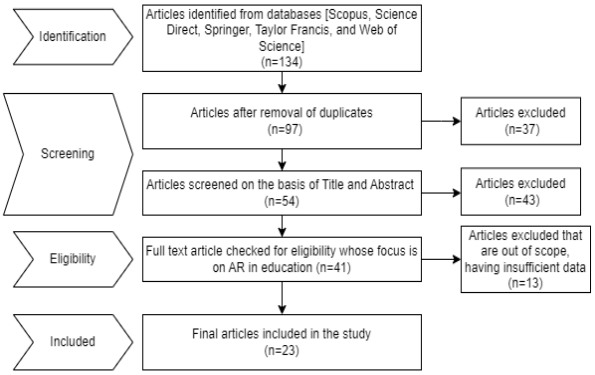

Figure 1 - PRISMA Flowchart for Study Selection.

2.2 Selection of relevant articles

The process of selecting articles for inclusion in a research study can be challenging, as there may be a large number of articles available from various sources. In this particular study, initially 134 articles were identified from different databases. However, not all of these articles were deemed relevant for inclusion in the study. After careful consideration and evaluation, 23 articles were finally selected that met the criteria and were included in the study. Specific inclusion and exclusion criteria were established (Table 1) to guide the selection process of relevant articles. Only articles that met the specific criteria were included in the study. The careful selection process ensured the study’s accuracy and credibility, and it allowed for meaningful conclusions to be drawn from the available evidence.

Inclusion Criteria	Exclusion Criteria
AR articles that discussed the development of an application wereincluded.	AR articles that are not related to education in AR were excluded.
Articles must be published between 2017 and 2023.	Not written in English.
Articles using AR technology in education were only included.	Articles using other technologies like Virtual Reality (VR), MixedReality (MR) were excluded.
Articles that evaluated parameters were included.	Articles that did not mentioned the type of AR technology were excluded.

Table 1 - Inclusion and Exclusion Criteria.

2.3 Data Visualization

By using data visualization techniques, data becomes more accessible and easier to interpret, which allows for better understanding of the implications of the results and drawing conclusions about the research findings. Overall, data visualization is a crucial aspect of the results and discussion section, as it helps to clarify and simplify the information presented, making it easier to comprehend and engage with the research.

3. Literature Review

The study examines the existing research on AR technology and its effectiveness in enhancing education. Through the discussion (Table 2, at the end of the paper), the study identifies potential AR applications in various sectors of education. The primary objective of this review is to evaluate the benefits of AR technology and how it can be used to improve teaching and learning outcomes.

4. Analysis and Discussions

In the Results and Discussion section, the data is presented using visual aids such as charts and graphs. These visualizations are a powerful tool for conveying information in a clear and concise manner, allowing readers to quickly and easily understand the data being presented.

RQ1: Which subject area or target area is in trend for AR educational applications?

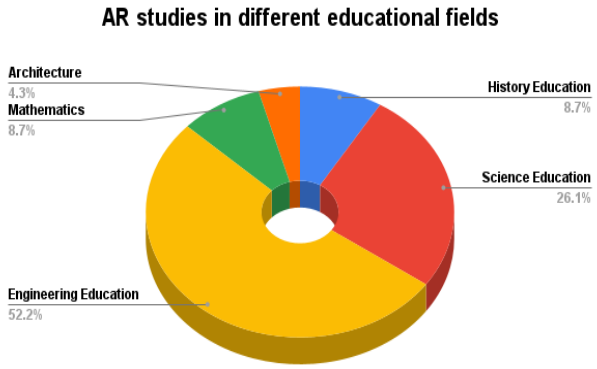

Figure 2 - AR articles in different educational fields.

The result (Figure 2) provides insights into the distribution of AR studies across various educational fields, including science, mathematics, history, architecture, and engineering education. The data shows that engineering education is the most popular area with 52.2%, while science education comes in second with 26.1%. Both history and mathematics education have an equal percentage of 8.7%. Architecture education has the lowest percentage at 4.3%, indicating that further exploration and research are necessary in this area.

RQ2: Which type of AR device is most commonly used in educational applications?

The result (Figure 3) depicts various types of AR devices utilized in the education sector. These devices create a simulated environment that enables users to interact with the application. Mobile-based devices 40% are the most preferred and commonly used devices due to their

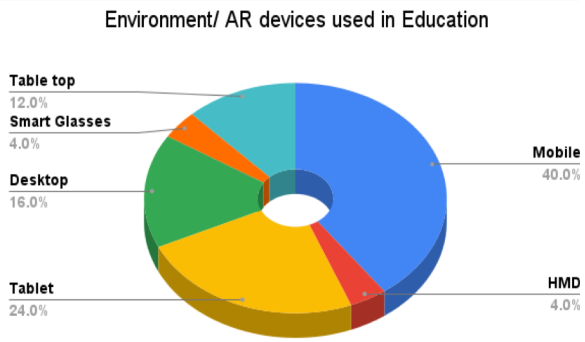

Figure 3 - AR devices used in different educational fields.

accessibility and ease of use. Tablet-based devices 24% rank second in usage frequency. Desktop devices account for 16%, and table-top devices account for 12% of the devices used. Smart-glasses 4% and HMD 4% are used the least due to the potential risk of eye strain that arises from focusing on a close-up screen for an extended period, leading to headaches, dry eyes, and blurred vision.

RQ3: Which type of AR technology is most commonly used in educational applications?

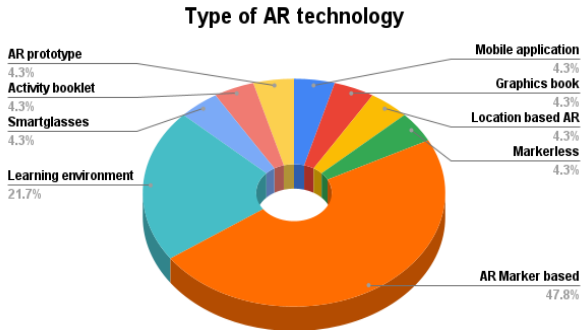

Figure 4 - Different types of AR technologies used in different educational fields.

The types of technologies used in the applications (Figure 4), with marker-based technology being the most used, accounting for 47.8% of the applications. This is due to the accuracy and reliability it provides, as the markers are easily recognizable by AR software, allowing for precise tracking of their position and orientation in 3D space. The learning environment is the second most used technology, with a percentage of 21.7%. Other technologies, such as activity booklets, graphics books, location-based AR, smart glasses, markerless AR, and AR prototypes, are used less frequently, each with a percentage of 4.3%. It indicates that there is a need for further exploration of these technologies, as they offer great flexibility and lower costs.

RQ4: Which type of sampling technique is most commonly used in educational applications?

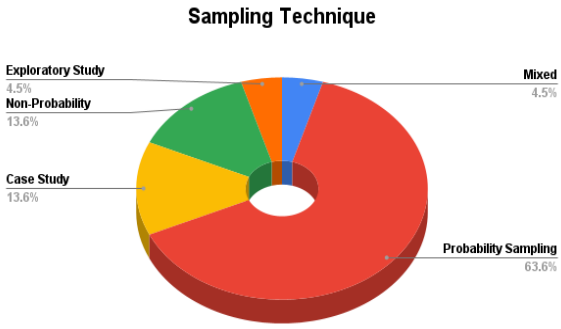

Figure 5 - Different types of Sampling techniques used in sample analysis in different educational fields.

The different types of sampling techniques used in research articles (Figure 5). Probability sampling is the most commonly used technique, with a percentage of 63.6%, as it involves selecting samples randomly and reduces bias. Non-probability sampling and case studies are used by 13.6% of the authors, while mixed and exploratory studies are performed by 4.5% of the authors each. The diagram provides valuable insights into the sampling techniques used in research articles.

RQ5: What type of evaluation technique is adopted by AR applications?

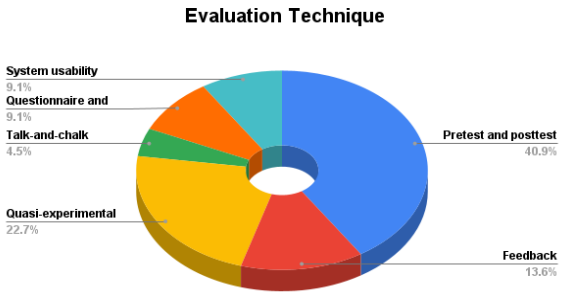

Figure 6 - Evaluation techniques used for sample analysis different educational fields.

The various evaluation techniques used in AR applications are illustrated (Figure 6). The pretest and post-test technique is the most commonly used, preferred by 40.9% of the authors. Another popular evaluation technique is the quasi-experimental pretest/post-test method, which is also used by 40.9% of the authors. Feedback questionnaires are used by 13.6% of the authors, while questionnaires and System Usability Survey (SUS) techniques are used by 9.1% of the population.

6. Conclusion & Future Scope

AR makes it easier for students to comprehend, evaluate, and recall information without tiring them out. Because it helps students enhance their memory, spatial ability, learning, and critical thinking, AR is quite popular among students. Augmented reality has the potential to enhance instructional materials and assist pupils in better comprehending difficult topics. Using AR, children may enjoy games while also studying, which prevents them from becoming bored.

According to the findings of this study, the application of technology that utilizes augmented reality can enhance classroom instruction in a range of subject areas. AR features and helpful apps can serve as motivation for students to learn and help them enhance their visualizing skills. Also, the features might assist instructors in making topics understandable to students. Participants and learners who demonstrated interest in integrating AR in their educational processes provided favorable feedback on the technology's application. Their affirmative feedback is significant because it demonstrates that students are eager to use augmented reality tools to actively participate in their academics. However, the research analysis reveals that the majority of the limitations are due to technical difficulties. These restrictions will be overcome, duplicated, and improved as more study on the use of AR in education is conducted. When the potential of these technologies is more extensively investigated, the useful qualities of AR can start being widely utilized in many educational fields, which will increase the effectiveness of the teaching and learning process.

Within this continuously developing domain, several unsolved issues and various aspects pertaining to the use of AR technology need additional investigation. There are some limitations associated with this approach. In the context of the study, it was seen that a significant proportion of individuals engaged in an AR learning activity had positive opinions on the efficacy of AR tools. However, it was noted that these participants did not perceive the AR tools to be as beneficial as their conventional textbooks. The use of AR technology for the purpose of information gathering posed a considerable challenge for them. Although the AR tool is user-friendly, it necessitates a certain amount of time for image transmission, word recognition, and subsequent text decryption. The frequency of replication research on AR is increasing. Nevertheless, Malaysia is gradually adopting this kind of technology, namely within the realm of education. To enhance pedagogical approaches within the national educational system and enhance the effectiveness of instructional practices, it is essential for a greater number of scholars in the realm of education to investigate the potential of AR. Further research should be conducted on the mobile augmented reality (MAR) system, a new technological

advancement that involves the integration of a smartphone application with the AR platform.

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Table 2 – Literature review.

Research Studies	Target	Topic	Parameter	Environment/ AR devices used	Type of AR technology	Sampling Technique	Sample Size	Evaluation Technique	Summary
Nagata et al. (2017)	History Education	Territorial information	Learning skills	Mobile	AR based mobile application	Mixed Sampling	143, Primary School Students	Pretest and posttest	Students productivity in the learning process were enhanced and interaction between students and learning materials were encouraged.
Hung et al. (2017)	Science Education	6 Bacteria	Learning performance and memory retention	HMD	AR based graphic book	Probability Sampling	72, Primary School Students	Pretest and posttest	The book provides youngsters with an empirical and hands-on method to discover and learn about bacteria.
Efstathiou et al. (2018)	History Education	Neolithic historical site	Conceptual knowledge and historical compassion	Tablet	Location based AR	Case study	53, Primary School Students	Pretest and posttest	When compared to a regular field trip, the AR technique proved more effective in developing students historical compassion and conceptual knowledge.
Reyes et al. (2018)	Engineering Education	Resistive Circuit Topology	Conceptual understanding	Mobile	AR based Markerless application	Non-Probability Sampling	60, Engineering Students	Feedback Questionnaire	The system aids the userin comprehending & contrasting the theoretical and experimental values of the parameters of a given circuit. Studentscan modify the existing topologies as well as propose new ones.
Omar et al. (2018)	Engineering Education	Fundamental of Engineering Drawing course	Student mental rotation and 3-dimensional development skills	Mobile and Tablet	AR Marker based application	Non-Probability Sampling	60, Engineering Students	Quasi-experimental pretest/ posttest	TPSVT:R and PSVT:D these two set of tests were used in pre and posttest and results show that student performance and visualization was improved.
Singh et al. (2019)	Engineering Education	Oscilloscope and Function Generator	Impact of AR intervention on student laboratory skills, cognitive load, and learning motivation	Desktop	AR based learning environment	Probability Sampling	60, Engineering Students	Pretest and posttest	ARLE is an effective tool in reducing the cognitive load of students while operating laboratory equipment.
Sagayam et al. (2019)	Engineering Education	3D Gearbox Model	Comprehension of the interaction of gears during a gear shift	Tablet	AR Marker based application	Probability Sampling	30, Engineering Students	Talk-and-chalk techniques compared with AR	A 3D model of a gearbox was developed, in which five separate sets of markers were developed for each gear. These markers ought to interact with the system more quickly upon recognition.

Omar et al. (2019)	Engineering Education	Orthographic Projection	Spatial Visualization Skills	Mobile	AR Marker based application	Non-Probability Sampling	60, Engineering Students	Pretest and posttest	Due to the significance of the PSVT:R, mental rotation abilities were assessed.
Thees et al. (2020)	Science Education	Heat Conduction	Extraneous cognitive processing	Smart Glasses	AR based smart glasses	Probability Sampling	74, Undergraduate Students	Quasi-experimental pretest/post test	AR technology was successfully used to transform basic laboratory environments from divided source to unified presentational format with live data visualizations. However, superfluous processing was reduced throughout the performance.
AlNajdi et al. (2020)	Engineering Education	Buzz-Boards	Learning Effectiveness	Tablet	AR-based learning environment	Probability Sampling	36, Engineering Students	Feedback Questionnaire	Results showed that the PVM with AR technique was more effective to the paper-based approach in terms of learning achievement, enjoyment of learning activities, and utility.
Sahin et al. (2020)	Science Education	"Solar System and Beyond" module	Academic achievements and Attitude	Desktop	AR-based activity booklet	Probability Sampling	100, Secondary School Students	Quasi-experimental pretest/post test	The research revealed a significant and moderate correlation between the academic achievement and attitudes of the experimental cohort of pupils.
Sharma et al. (2020)	Engineering Education	Ohm's law	Interaction and innovation	Desktop	AR Marker based application	Probability Sampling	40, Engineering Students	Feedback Questionnaire	Students find AR Ohm application to be more interactive and innovative, which leads them to an easier conception of the topic.
Russo et al. (2021)	Architecture, Engineering & Construction	Architecture	Democratization Process	Mobile	AR Marker based application	Not Specified	Not Specified	Not Specified	The whole AR process progression in architecture, from the conception stage to its application was underlined.
Faridi et al. (2021)	Science Education	Magnetic field, Electromagnetic waves, Maxwell's equations, Fleming's rules	Critical Thinking and Learning Gain	Mobile	AR-based learning environment	Probability Sampling	80, Engineering Students	Pretest and posttest	The AR experience enhanced students understanding of abstract physics concepts by aiding them in visualizing them.
Gargrish et al. (2021)	Mathematics Education	Vector addition, position vector, direction ratios, cross and dot	Memory retention abilities and learning	Table top	AR Marker based application	Probability Sampling	80, Polytechnic Students	Quasi-experimental pretest/post	Results revealed that memory retention capacities of students had improved even after 2 and 4 weeks of learning after using

		product						test	AR based GLA.
Arici et al. (2021)	Science Education	"Sun, earth and moon", "Solar system and eclipses" and "solar system and beyond"	Perceived learning, attitude, experience, and interest	Tablet	AR-based learning environment	Probability Sampling	40, Secondary School Students	Questionnaire and interview method	Space 4D application was developed and result shows that student interest and motivation towards the subjects have increased.
Kumar et al. (2021)	Engineering Education	Embedded System	System usability, learning experience	Table top	AR Marker based application	Exploratory Study	20, Professionals	System usability survey (SUS)	AR-based scaffolds were developed after their usability was tested with faculty members, and it was found that their total usability rating was 79.5%, which qualifies them for continued use with students for exploratory work.
Kaur et al. (2022)	Engineering Education	Stability Analysis of Linear Control System	Comparative difference between Mobile and Table top variant	Table top and mobile	AR Marker based application	Probability Sampling	60, Engineering Students	Questionnaire and interview method	Students potential for spatial visualization in real time is influenced which additionally, aids in improving concept comprehension in relation to a better understanding of the topics.
Portillo et al. (2022)	Science Education	Acid–base reactions, chemical elements and chemical bonds	Learning Outcome	Tablet	AR Marker based application	Probability Sampling	124, Secondary School Students	Pretest and posttest	The study determined the utility of an AR based learning activity for mastering fundamental chemical concepts as well as the appeal of immersion learning for students.
Dutta et al. (2022)	Engineering Education	K-maps	System Usability	Mobile	AR Marker based application	Probability Sampling	90, Engineering Students	System usability survey (SUS)	Students were divided into two groups: keypad-based MAR groups and marker-based MAR groups. The results suggested that the keypad-based MAR program had greater SUS and HARUS scores compared to the marker-based MAR application, indicating that it had better interaction with users.

Tuli et al. (2022)	Engineering Education	Electronics laboratory Manual	Student learning attitude and their attitude towards AR technology	Mobile	AR Marker based application	Probability Sampling	107, Engineering Students	Quasi-experimental pretest/ posttest	ARLM was developed, and results display an optimistic relationship between students academic achievement and their learning attitude towards the technology.
Shore et al. (2023)	Engineering Education	Building project	Involvement and imagination	Mobile	AR prototype	Case Study	60, Engineering Students	Pretest and posttest	The outcomes show that during a simulated design conference, students can perceive structures more quickly, precisely, and with more assurance with AR than they do with their traditional paper designs.

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A mixed method study of strategies adopted by postgraduate teachers to mitigate the impact of the digital divide

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Abstract

The digital divide, which refers to disparities in accessing and utilising digital technologies, has emerged as a noteworthy issue in education, especially in the context of postgraduate studies. The research, employing a mixed-method approach, investigates the methods employed by postgraduate educators to address the challenges posed by the digital divide in their teaching approaches. The study utilised a concurrent triangulation design, allowing for the simultaneous collection and analysis of qualitative and quantitative data. Initial data collection and analysis occurred in tandem with conducting in-depth interviews with postgraduate teachers, followed by thematic analysis. The data was collected and analysed from 25 postgraduate teachers who work in diverse educational settings. Findings revealed that postgraduate teachers adopted various pedagogical, technological, and socio-cultural strategies to address the challenges of the digital divide. Pedagogical strategies included using diverse instructional strategies, adapting teaching methods, and leveraging prior knowledge of students. Technological strategies encompassed utilising available digital resources online platforms and promoting digital literacy along with Free Open Source Software and Open Educational Resources among students. Socio-cultural strategies included building collaborative networks, creating inclusive classroom environments, and fostering a positive teacher-student relationship. The findings of this study contribute to the understanding of how postgraduate teachers address the digital divide in their teaching practices and highlight the importance of innovative strategies to ensure equitable access to digital technologies in education.

KEYWORDS: Digital Divide, Postgraduate Teachers, Pedagogical Strategies, Technological Strategies, Socio-Cultural Strategies.

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1. Introduction

Digital technologies in education have transformed teaching and learning practices, offering new opportunities for accessing information, engaging in collaborative learning, and fostering critical thinking skills. However, the digital divide, which refers to the gap in access to and use of digital technologies, has become a significant challenge in education, particularly in the context of postgraduate education. Postgraduate teachers play a crucial role in mitigating the impact of the digital divide, as they are responsible for preparing the next generation of professionals and researchers who will thrive in a digital society.

India is a rapidly developing country with significant technological and digitalisation strides. However, despite these advancements, the country has a significant digital divide, with many individuals and communities needing access to digital devices and reliable internet connections. This digital divide has become even more apparent in higher education in India, where students from lower-income households and rural areas face significant challenges in accessing and utilising digital resources.

The digital divide in higher education has been worsened by the COVID-19 pandemic, mainly due to the widespread adoption of online learning by universities and colleges. This shift has created a situation where students who lack access to digital devices or a stable internet connection are disproportionately disadvantaged, with their educational prospects significantly constrained. This digital divide has significant implications for the quality of higher education in India. With equal access to digital

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resources, students may be able to keep up with the latest developments in their field, and their job prospects may be limited. Furthermore, the digital divide can exacerbate existing social and economic inequalities in the country, creating a divide between those who have access to education and those who do not.

To address this issue, policymakers and the academic fraternity must work together to bridge the digital divide in higher education. This could involve increasing access to digital devices and internet connectivity, providing training and support for students and teachers in utilising digital resources effectively and implementing policies and programs that promote equal access to education for all. Ultimately, bridging the digital divide in higher education will ensure that all individuals in India have access to high-quality education and equal opportunities for success.

The digital divide can manifest in various forms, including lack of access to reliable internet connectivity, limited availability of digital resources, inadequate digital literacy skills, and socio-cultural barriers. These challenges can impact postgraduate teachers' ability to effectively integrate digital technologies into their teaching practices and create equitable learning opportunities for all students. Therefore, understanding the strategies postgraduate teachers adopt to mitigate the impact of the digital divide is essential for promoting inclusive and effective postgraduate education.

This mixed method study aims to explore the strategies postgraduate teachers adopt to mitigate the impact of the digital divide on their teaching practices. By examining the perspectives and experiences of postgraduate teachers, this study seeks to contribute to the existing literature on strategies for addressing the digital divide in postgraduate education and inform educational policymakers and practitioners on practical approaches for promoting equitable access to digital technologies in education. The present research represents an attempt to examine the impact of specific interventions aimed at addressing the digital divide, investigate the role of social and cultural factors in shaping access to and utilisation of digital technologies, and explore the implications of emerging technologies such as artificial intelligence and virtual reality on the digital divide. The research aimed to explore the strategies adopted by postgraduate teachers to mitigate the impact of the digital divide on their teaching practices in the context of the Indian postgraduate education affiliated with Shivaji University in various educational settings.

2. The digital divide and Education

The digital divide, the gap in access to and use of digital technologies has emerged as a significant issue in higher education, affecting students, faculty, and staff. Existing research has provided insights into the scope and impact of the digital divide in higher education and implications for practice and future research directions.

Access to digital technologies is uneven among higher education students, faculty, and staff. Students from low-income backgrounds, rural areas, underrepresented minority groups, and developing countries are more likely to face challenges accessing and using digital technologies (Van Dijk, 2012; Warschauer, 2003). Faculty and staff from marginalised groups may also face barriers to accessing and effectively utilising digital resources and tools for their professional activities (Bartolic, 2021; Howard et al., 2016).

Digital literacy skills, encompassing the ability to critically evaluate, navigate, and create digital content, are also significant factors in the digital divide in higher education. Individuals with lower digital literacy skills are more likely to need help using digital technologies for academic and professional purposes (Hargittai & Hinnant, 2008; Selwyn, 2006). This can affect their ability to participate fully in online learning, engage in digital research, and collaborate effectively using digital tools.

The impact of the digital divide on higher education outcomes is significant. Students who need access to digital resources and tools may need help completing assignments, participating in online discussions, accessing online course materials, and communicating with instructors and peers (Di Maggio et al., 2004; Johnson et al., 2014). Faculty and staff needing access to digital technologies may need help delivering online instruction, conducting digital research, and engaging in administrative tasks efficiently (Linder, 2016; Reinders et al., 2019).

Implications for practice include the need for higher education institutions to prioritise strategies to bridge the digital divide. This may involve providing financial support for students to acquire devices and internet connectivity, offering digital literacy training for students, faculty, and staff, and creating inclusive online environments that accommodate diverse learning needs (Fryer et al., 2020; Wimmer & Lewis, 2010). Institutions can also work towards reducing barriers related to cost, location, and identity to ensure that all academic community members have the opportunity to participate fully in the digital age.

In previous studies, researchers have highlighted disparities related to digital access and its various dimensions, including knowledge, economic factors, social resources, technology attributes like performance and reliability, and the realisation of utility (DiMaggio et al., 2004; Van Dijk, 2006; Van Deursen & Helsper 2015). While in technologically and economically advanced regions, access-related digital gaps are narrowing, inequalities persist that affect individuals' effective utilisation of digital resources (Lameijer et al., 2017; Hsieh et al. 2011; Bucea et al. 2020). As digitalisation becomes increasingly prevalent in work and daily life, concerns are growing regarding ongoing disparities within societies at the forefront of the digital revolution.

Simultaneously, in areas with limited resources, significant access challenges persist. For example, in the least developed countries, as classified by the United Nations, only 19 per cent of individuals had online access in 2019. In contrast, in developed countries, nearly 87 per cent of individuals can access the internet (International et al., 2019). Moreover, low-resource settings grapple with unique political, economic, and social conditions exacerbating digital disparities (Venkatesh et al., 2014; Srivastava and Shainesh 2015; Luo and Chea 2018). In summary, previous research has emphasised that the nature of digital inequalities varies based on the specific context, and it is crucial to explicitly consider the context when studying the digital divide (Barzilai-Nahon, 2006). This study researches the digital divide within settings characterised by advanced technological infrastructure and robust economies. The digital divide in higher education should be addressed immediately, continuing to explore the issue's complexities and investigate innovative solutions to bridge the gap. India has the most prominent young population, and the demographic dividend should not be a burden but rather an asset.

Research can examine the impact of specific interventions aimed at addressing the digital divide, investigate the role of social and cultural factors in shaping access to and utilisation of digital technologies, and explore the implications of emerging technologies, such as artificial intelligence and virtual reality, on the digital divide (Graham, 2018; Warschauer & Matuchniak, 2010). Additionally, research can focus on the experiences of underrepresented groups, including students of colour, first-generation students, and individuals with disabilities, to better understand their unique challenges and develop targeted strategies to promote equity and inclusion (Morris et al., 2019; Wang et al., 2018).

Furthermore, the digital divide can perpetuate existing social and economic inequalities, as those already marginalised may face additional barriers to accessing and utilising digital resources and tools in higher education (Cotten et al., 2014). Selwyn (2017) argued that students from low-income backgrounds and rural areas often need help accessing reliable internet connectivity and adequate devices, which can hinder their ability to engage in online learning. Similarly, research by Cruickshank and colleagues (2019) found that students from underrepresented minority groups may have limited access to digital technologies, which can impact their participation in online courses and academic success. Due to the pandemic, a similar situation has been traced in India. Teachers must be trained and educated in online learning and other digital tools. Furthermore, digital literacy skills, or the ability to effectively navigate and evaluate digital content, have also been found to vary among students, faculty, and staff in higher education. A study by Van Dijk (2019) highlighted that individuals with lower digital literacy skills may need help using digital technologies for academic purposes, affecting their ability to participate fully in online learning and engage in digital research.

The impact of the digital divide on higher education outcomes has also been well-documented. For example, a study by Johnson and Adams (2018) found that students who lack access to digital resources may face challenges completing assignments and accessing course materials, which can negatively impact their academic performance. Similarly, research by Anderson and colleagues (2020) showed that faculty and staff lacking access to digital technologies may need help delivering online instruction and conducting digital research, which can hinder their productivity and effectiveness.

Regarding implications for practice, higher education institutions can implement various strategies to bridge the digital divide. For instance, providing financial support for students to acquire devices and internet connectivity, offering digital literacy training programs, and creating inclusive online environments can help promote equitable access to digital resources and tools (Alexander et al., 2021). Institutions can also work towards reducing barriers related to cost, location, and identity to ensure that all members of the academic community have equal opportunities to participate in the digital age by adopting various Open Educational Resources (OER), Learning Objective Repositories (LOR) and Free Open Source Software (FOSS).

3. Government of India initiatives for digital divide and higher education

The Indian government has launched several initiatives to address the digital divide in higher education. One of these initiatives are, National Programme on Technology Enhanced Learning (NPTEL): NPTEL is a joint initiative of the Indian Institutes of Technology (IITs) and the Indian Institute of Science (IISc) that provides free online courses and resources to students in engineering, science, and technology. The programme aims to improve the quality of education by providing access to high-quality learning resources to all students, regardless of their geographical location or economic background. e-ShodhSindhu: The e-ShodhSindhu programme is a consortium of higher education institutions in India that provides access to electronic resources such as e-journals, e-books, and databases. The programme aims to provide equitable access to research resources to all students and researchers in India. National Digital Library of India (NDLI) is a digital library that provides access to e-books, e-journals, and other digital learning resources to students and researchers in India. The library has a vast collection of resources, including textbooks, academic journals, and other learning resources, making it an essential tool for students and researchers in India.

Study Webs of Active Learning for Young Aspiring Minds (SWAYAM) is an online learning platform that provides free courses and resources to students in India.

The programme aims to provide high-quality education to all students, particularly those in remote and rural areas who may need access to traditional classrooms. National Knowledge Network (NKN) is a high-speed network that connects all higher education institutions in India. The network provides access to high-speed internet, online collaboration tools, and other digital learning resources, making it an essential tool for students and faculty members in India.

This review discusses the digital divide in higher education, highlighting the uneven distribution of access to digital technologies and the significance of digital literacy skills. The impact of the digital divide on academic outcomes for students, faculty, and staff is significant. Strategies to bridge the digital divide include providing financial support for students to acquire devices and internet connectivity, offering digital literacy training, and creating inclusive online environments. Research can investigate the impact of specific interventions, the role of social and cultural factors, and emerging technologies. The review concludes by calling for the immediate need to address the digital divide in higher education and exploring innovative solutions to bridge the gap. The review also highlights India's most prominent young population and the need to turn it into an asset by not making the demographic dividend a burden. Hence, the researcher attempted to find the post graduate teachers' strategies to mitigate the impact of the digital divide in higher education.

4. Material and methods

This research employed a concurrent triangulation design to investigate how postgraduate educators address the challenges of the digital divide. The concurrent triangulation mixed method is a research approach that involves gathering and analysing qualitative and quantitative data, with the ultimate goal of combining the results to achieve a more comprehensive understanding of the research problem. This methodology enables an examination of various aspects of a research question, resulting in a more robust and all-encompassing analysis. In this design, researchers collect and analyse data using qualitative and quantitative methods, subsequently merging the findings through comparison, integration, or expansion approaches.

The concurrent triangulation mixed method seeks to enhance the credibility and dependability of research findings by offering multiple viewpoints on the research question. The study involved the distribution of questionnaires and conducting semi-structured interviews with 25 postgraduate educators representing diverse educational settings, including universities, colleges, and professional training institutes affiliated with Shivaji University, Kolhapur. Participants were purposefully selected based on their experience integrating digital technologies into their teaching methods and their encounters with digital divide-related challenges. The Data was collected through in-depth interviews, audio-recorded, and transcribed verbatim for analysis.

The semi-structured questions were formed and attached to Appendix 1.

5. Results: Mix method analysis of the digital divide mitigation among postgraduate teachers

5.1 Quantitative analysis findings

The surveyed data revealed that the most frequently employed strategies by postgraduate teachers to mitigate the impact of the digital divide were diverse instructional strategies (89%), followed by utilizing available digital resources (78%) and promoting digital literacy skills (81%).

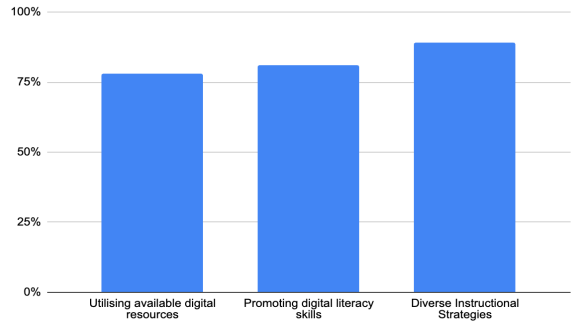

Figure 1 - Strategies adopted by Indian postgraduate teachers to mitigate the impact of the digital divide.

Concurrently, an in-depth interview was conducted and subjected to a thematic analysis. The data underwent coding and organisation into themes and sub-themes using a combined deductive and inductive approach. Deductive coding was rooted in the research questions and pertinent literature regarding the digital divide and strategies for its resolution. In contrast, inductive coding was applied to capture emerging themes evident in the data. Subsequently, the identified themes and sub-themes were subjected to analysis and interpretation to extract significant insights regarding the approaches employed by postgraduate educators to alleviate the effects of the digital divide.

5.2 Qualitative analysis findings: pedagogical strategies, technological strategies and Social Cultural strategies

The thematic examination of data obtained from in-depth interviews with postgraduate instructors unveiled a range of tactics employed to lessen the influence of the digital divide on their teaching methodologies.

A key sub-theme that emerged from analysing the pedagogical strategies was diverse instructional

strategies. The postgraduate teachers recognised the importance of tailoring their teaching approaches to suit their students' varied learning styles and abilities. They used online and offline methods, such as lectures, discussions, case studies, group activities, hybrid strategies, and uploading study material to facilitate learning. First, postgraduate teachers employed traditional teaching methods such as lectures to deliver course content to their students. These lectures were delivered in person or online via video conferencing, depending on the students' access to digital resources.

Additionally, the teachers conducted discussions on various topics to encourage students to think critically and engage in meaningful dialogue with their peers. To further support their students' learning, postgraduate teachers utilised case studies as a method of instruction. These case studies allowed the students to apply theoretical concepts to real-life scenarios, making the learning experience more practical and engaging. Furthermore, group activities were used to encourage collaboration and teamwork among students. Group activities such as presentations, debates, and simulations enabled students to learn from each other and develop their problem-solving and communication skills. The postgraduate teachers also employed hybrid strategies to cater to their students' different learning styles and preferences. These strategies combined various teaching approaches, such as lectures, discussions, and group activities, to provide a more holistic and integrated learning experience. This approach allowed students to engage with the course material in various ways, increasing their retention and understanding of the content. Finally, postgraduate teachers uploaded study material to online platforms, making it accessible to all students regardless of their physical location or access to digital resources. This ensured that students who could not attend in-person classes or had limited digital access could still access the course material and participate in the learning process.

In the digital age, postgraduate teachers face new challenges in teaching practices. The digital divide is a significant barrier that impacts students' access to technology and digital resources, hindering their learning experience. Therefore, postgraduate teachers have to adapt their teaching methods to suit the available digital resources and the technological abilities of their students. They recognised that traditional teaching methods might not be effective in the digital age. Therefore, they adapted their teaching methods to engage students in meaningful learning experiences. They utilised various approaches, such as flipped classrooms, blended learning, and hybrid models, to enhance their teaching practices. One of the strategies that postgraduate teachers employed was the flipped classroom model. Before the class, this model provides students with study materials, such as pre-recorded lectures, presentations, and readings. This enables students to prepare for the class and engage in meaningful discussions and activities during the class. Postgraduate teachers also utilise the blended learning approach, which combines online and offline learning methods. In this approach, students participate in online activities, discussions, in-person lectures, and group activities. This method allows for flexibility in learning and caters to different learning styles and abilities.

Moreover, postgraduate teachers adopted the hybrid model of teaching. This model combines both online and offline methods of teaching. It enables students to access the study material online and attend classes in person, which caters to the diverse needs and abilities of students. This model is constructive for students needing access to reliable internet or digital resources. Postgraduate teachers also use free learner engagement tools like Kahoot, Quizlet, Mentimeter, Edupuzzle, and Edmodo to enhance their teaching practices. These tools enable postgraduate teachers to create interactive quizzes, flashcards, and polls, which engage students in the learning process and provide instant feedback on their progress. Overall, postgraduate teachers recognise the importance of their students. They utilised various approaches, such as flipped classrooms, blended learning, hybrid models, and free learner engagement tools to engage students in meaningful learning experiences.

Postgraduate teachers understand that their students come from diverse backgrounds and have varied experiences and prior knowledge. They recognised that leveraging students' prior knowledge is essential in bridging the digital divide and providing effective teaching and learning experiences. To achieve this, they employed various strategies that encouraged students to share their experiences and perspectives and integrated them into the learning process.

One of the strategies postgraduate teachers used was incorporating student-led discussions and presentations into their teaching. They encouraged students to share their experiences related to the course material, which helped provide a more diverse range of perspectives and viewpoints. This approach also created a more interactive learning environment that allowed students to participate in the learning process actively.

Another strategy that postgraduate teachers employed was to use case studies and real-life scenarios relevant to their students' experiences and backgrounds. By doing this, they could leverage their students' prior knowledge and make the learning process more meaningful and engaging. This approach also helped to create a more inclusive classroom environment where all students felt valued and respected. They also provided opportunities for students to reflect on their experiences and perspectives through journals, blogs, and other forms of self-expression. This approach helped students develop a deeper understanding of the course material and connect it to their own experiences, which enhanced their learning. Overall, postgraduate teachers recognise that leveraging students' prior knowledge and experiences is essential in bridging the digital divide and providing effective teaching and learning experiences. They created a more inclusive and student-centred

approach to teaching by incorporating diverse perspectives and experiences into the learning process.

Switching to technological strategies, postgraduate teachers recognised the significance of utilising available digital resources and platforms to mitigate the impact of the digital divide. They adopted various technological strategies to promote digital access, literacy, and student engagement.

Utilisation of available digital resources was a critical strategy adopted by postgraduate teachers to mitigate the impact of the digital divide on their teaching practices. With digital resources, postgraduate teachers could provide students with access to relevant and up-to-date information, regardless of their location or access to physical resources.

To do this, postgraduate teachers used various digital resources, such as open educational resources, online databases, university websites and digital libraries. These resources were easily accessible and often free, making them ideal for students with limited financial resources. By providing students access to these resources, postgraduate teachers could ensure that all students have equal access to high-quality educational content.

In addition to open educational resources, postgraduate teachers used educational apps, software, and tools to enhance teaching and learning experiences. These resources included tools for creating interactive multimedia content, such as videos, podcasts, and infographics. They also included tools for facilitating online discussions through discussion forums, conducting quizzes, and providing feedback on student work. By utilising these digital resources, postgraduate teachers were able to create engaging and dynamic learning environments that catered to the diverse needs and abilities of their students. They also fostered a sense of collaboration and community among students, regardless of their physical location. In general, the utilisation of accessible digital resources played a pivotal role in postgraduate educators' efforts to alleviate the effects of the digital divide on their teaching methods. By using these digital tools, postgraduate teachers could provide students with access to relevant and up-to-date information, regardless of their geographic location or the availability of physical learning materials. By utilising these digital resources, postgraduate teachers were able to create engaging and dynamic learning environments that catered to the diverse needs and abilities of their students. They also fostered a sense of collaboration and community among students, regardless of their physical location. Overall, utilising available digital resources was a critical strategy for postgraduate teachers to mitigate the impact of the digital divide on their teaching practices.

Postgraduate teachers have used open-source tools to create virtual learning environments that foster student interaction, collaboration, and engagement. These online platforms include learning management systems like Moodle, virtual classrooms, and social media. Additionally, postgraduate teachers have utilised email, chat, and discussion forums to communicate with their students and provide support. These open-source tools offer a range of features that enable postgraduate teachers to create engaging and interactive learning experiences, such as uploading course materials, facilitating real-time discussions, and providing student feedback. These tools have been incredibly beneficial in remote learning settings, where students and teachers cannot meet in person. To ensure access to students without unlimited high-speed internet, teachers adopted the Jitsi video conferencing app and wikieducator. Overall, open-source tools have played a critical role in helping postgraduate teachers create effective virtual learning environments that support student learning and success.

Promoting digital literacy and orienting and educating about Free Open Source Software and Open Educational Resources was an essential aspect of mitigating the impact of the digital divide, and postgraduate teachers recognised this need. They provided guidance and training on digital skills, such as using digital tools and software and navigating online platforms. They taught students to use various digital tools and resources, such as online databases, libraries, and open educational resources. They encouraged students to use these resources to find relevant, up-to-date information for their assignments and projects. postgraduate teachers emphasise the critical evaluation of online information. They taught students how to identify credible sources of information, distinguish between reliable and unreliable information, and evaluate the accuracy and bias of online sources. The teacher-led efforts and practices have helped students develop a discerning approach to online research and prevented them from falling prey to fake news and misinformation. Postgraduate teachers encouraged students to develop digital portfolios like Mahara and engage in online research and communication. They taught students how to create and maintain digital portfolios that showcase their skills, achievements, and learning experiences. This teacher initiative explored the students' development of digital literacy skills and built an online presence that could enhance their employability prospects. Overall, promoting digital literacy among students was an essential strategy adopted by postgraduate teachers to bridge the digital divide. By providing guidance and training on digital skills, critical evaluation of online information, responsible use of digital technologies, and encouraging students to engage in online research and communication, postgraduate teachers were able to equip their students with the necessary skills and knowledge to succeed in a digital world. Teachers orient and train the students about creative commons, copyright and intellectual property rights.

Postgraduate teachers understood the importance of building collaborative networks to enhance their digital integration in teaching. They recognised the value of working with colleagues, educational institutions, and other stakeholders to share resources, experiences, and

best practices related to digital integration. To this end, they engaged in various collaborative initiatives to improve students' digital literacy and promote digital technologies' use in teaching and learning. One of the critical ways postgraduate teachers built collaborative networks was by working closely with colleagues within their institutions. They collaborated with other faculty members and educational technology specialists to develop digital learning resources, design practical learning activities, and provide training and support to students. They also shared their experiences and best practices through workshops, seminars, and other professional development opportunities. Postgraduate teachers also recognised the value of collaborating with other institutions and organisations to share resources and expertise. They partnered with other universities, research institutions, and educational organisations to share resources, collaborate on research projects, and promote best practices in digital integration. Collaborating with others allows postgraduate teachers to access a broader range of digital resources, share their expertise, and learn from others. In addition to collaborating with other educational institutions, postgraduate teachers also worked with community organisations and technology partners to provide access to digital resources and infrastructure for students in remote or disadvantaged areas. They recognised the importance of addressing the digital divide and worked to provide access to digital technologies for all students, regardless of their location or socio-economic status. They organised free online workshops and webinars to promote using open-source software, Open Educational Resources (OER), and other digital tools that students in remote or disadvantaged areas could use. Overall, postgraduate teachers recognised that building collaborative networks was essential to improving digital integration in teaching. By working with colleagues, educational institutions, community organisations, and technology partners, they could share resources, expertise, and best practices that helped promote digital literacy among students and enhance the use of digital technologies in teaching and learning.

Postgraduate teachers emphasise the need to create inclusive classroom environments that value diversity, respect different cultural backgrounds, and accommodate individual learning needs. They encouraged open discussions, peer learning, and student-led initiatives that fostered students' sense of belonging and inclusivity, regardless of their digital access and abilities. Building a positive teacher-student relationship is crucial for successful learning outcomes; postgraduate teachers recognise this.

Moving to the social-cultural strategy, teachers understood that fostering a positive relationship with their students is vital to bridging the digital divide, especially when students may feel isolated due to their lack of digital access or abilities. To achieve this, postgraduate teachers provided individualised support to their students through one-on-one sessions and regular feedback through offline and Online modes. They tried to understand each student's unique needs and strengths, using this knowledge to guide their teaching approach. Postgraduate teachers also emphasised the importance of open communication and active listening. They created a safe and supportive learning environment where students felt comfortable sharing their thoughts and concerns. They encouraged students to express their opinions and ideas and incorporated their feedback into the learning process. Overall, postgraduate teachers recognised that building a positive teacher-student relationship is vital to bridging the digital divide. They created a supportive learning environment where students felt valued and motivated to learn by providing individualised support, fostering open communication, and promoting well-being.

6. Discussion and Conclusion

The findings from the survey and in-depth interviews demonstrate that postgraduate teachers affiliated with Shivaji University have adopted various strategies to mitigate the impact of the digital divide on their teaching practices. These strategies encompass pedagogical, technological, and socio-cultural approaches, emphasising inclusivity, diversity, and student-centred learning. By employing diverse instructional strategies, utilising available digital resources, promoting digital literacy skills, building collaborative networks, creating inclusive classroom environments, and fostering positive teacher-student relationships, postgraduate teachers have demonstrated their commitment to overcoming the challenges posed by the digital divide. These strategies have enabled them to create effective teaching and learning experiences that accommodate their student's diverse needs and abilities, regardless of their digital access and abilities. The teachers have explored various tools and strategies to mitigate the impact of the digital divide. The teachers from various disciplines interacted and shared the tools /strategies they knew. The Open Educational Resources and Free Open Source Software were adopted and attempted to contextualise and apply for learning purposes. The study finds that postgraduate teachers face significant challenges in addressing the digital divide among their students. The study reveals that many students come from disadvantaged backgrounds and need access to technology and digital resources, leading to difficulties in completing assignments, participating in online discussions, and engaging with digital course materials. The study also finds that teachers need more resources and training to develop effective strategies to address the digital divide.

The postgraduate teachers concluded that, as postgraduate teachers, we need access to resources such as technology tools, software, and applications that can be utilised to support digital learning. We also need training on effectively integrating these tools into our teaching strategies. Support from our institutions in funding and technical assistance is also crucial for

addressing the digital divide and promoting digital equity among our students. Additionally, we must collaborate with other teachers and share best practices to develop further and enhance our strategies.

The other postgraduate teachers looking to develop effective strategies for mitigating the impact of the digital divide and promoting digital equity among their students are Conducting a needs assessment by identifying their students' technology needs and access levels. This information will help tailor strategies to meet their specific needs. Promote digital literacy by Providing opportunities for students to develop digital skills and literacy through training, tutorials, and workshops. Use various teaching strategies to Incorporate various teaching strategies such as online discussion forums, videos, and interactive multimedia to cater to diverse learning needs. Collaborate with other postgraduate teachers to share best practices, resources, and ideas for promoting digital equity and addressing the digital divide. Advocate for change in policies and initiatives that promote digital equity and access to technology for all students, particularly those from disadvantaged backgrounds.

Therefore, postgraduate teachers need to continue to explore and adopt innovative strategies that can mitigate the impact of the digital divide and promote inclusive and equitable education.

Acknowledgement

I sincerely thank the postgraduate teachers of Shivaji University, Kolhapur, for sharing their strategies to mitigate the digital divide. Their insights and experiences have been precious in addressing this pressing societal issue.

The postgraduate teachers' willingness to collaborate and share their knowledge has been instrumental in creating a more inclusive and equitable learning environment. The teachers' contributions have not gone unnoticed and will undoubtedly positively impact the lives of many.

Once again, thank you for the dedication and hard work in addressing the digital divide, and inspiring efforts will undoubtedly pave the way for a brighter future.

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Appendix 1 - Open ended Questionnaire

1. What strategies have you adopted to ensure that students from disadvantaged backgrounds have access to the necessary technology and digital resources to participate fully in your academic programs?
2. In what ways have you adapted your teaching methods to ensure that students with varying levels of digital literacy and proficiency can succeed in your academic programs?
3. How have you leveraged emerging technologies and digital tools to enhance the learning experience and promote digital equity among your students?
4. What challenges have you encountered in implementing strategies for mitigating the impact of the digital divide, and how have you addressed them?
5. How have you collaborated with other teachers, staff, and administrators to promote digital equity and ensure that all students have access to digital resources and opportunities?
6. How do you measure the effectiveness of your strategies for promoting digital equity and ensuring that all students have access to digital resources and opportunities?
7. In what ways do you foster digital literacy and digital citizenship among your students and encourage them to be responsible and ethical users of technology?
8. How do you incorporate issues related to the digital divide and digital equity into your academic programs and encourage students to engage with these issues?
9. What resources, training, and support do you need to further develop and enhance your strategies for mitigating the impact of the digital divide and promoting digital equity among your students?
10. Finally, what recommendations do you have for other post-graduate teachers who are looking to develop effective strategies for mitigating the impact of the digital divide and promoting digital equity among their students?

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Adapting design of Learning Spaces for Education 4.0: a case of architectural institutions in India

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Abstract

A new generation of higher education institutions need spaces designed to support interaction, collaboration, flexibility, social engagement, and the use of technology to make the youth competent for Industry 4.0. The learning spaces of Education 4.0 in Architecture colleges are unexplored; whether they also need the same type of spaces as other higher education institutes for 21st century pedagogy, is yet to be determined. The aim of this research is to find out the change required in formal and informal learning spaces in architecture colleges with the new trend of learning and skills required in Architecture Education. The research methodology adopted here is the case study research approach, together with the tools of survey and interview. A comparative analysis of the learning spaces in four architectural institutions in north India is done on the basis of flexibility, integration of technology and interactive social spaces. A further survey of 150 students and 75 teachers, were conducted to understand the preference of types of learning spaces of the users. The conclusion specifies that there is an equal need for both formal and informal learning spaces to enhance the learning of the students, and changes are required in the formal and informal learning spaces to incorporate these three factors of flexibility, integration of technology, and interactive social spaces for empowering youth with skills for fourth Industrial Revolution. This research will assist architects in creating a better learning environment for the Education 4.0 and future architects.

KEYWORDS: Learning Spaces, Architecture Colleges, Innovative Learning Environments, Education 4.0.

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1. Introduction

Educational spaces have recently regained importance in the ever-changing trend of learning. The stakeholders of these spaces want to revitalise the campus's formal and informal learning spaces to provide quality education. Quality education requires the development of competency-based skill in youth to meet the needs of the industry 4.0, the Fourth Industrial Revolution (Islam, 2022). Learner-centred approach is required for empowering youth with competency-based skills. So, the learning-teaching process has a shift from teacher-centred to learner-centred, but still the educational space has not been modified from "instruction space' to a "learning space". Now the future of learning is not restricted to the classrooms alone, but the informal spaces have also gained the importance in this next generation Education 4.0 era.

Pedagogy, space, and technology are interrelated, as defined by Radcliffe (2009) in the PST (Pedagogy, Space, and Technology) framework. Technology can support learning spaces and enhance learning. Moreover, it is important to incorporate technology as the students should be competent in using technology for fulfilling the needs of Industry 4.0. Technology also stimulate curiosity and inspire students' desire to learn. Provision of technology will help the students get information at their fingertips. Now the need of 21st century learner centred learning is to bring together formal and informal activities in an environment that supports learning at any place and any time. Instead of replacing the traditional classroom, the goal is to rethink

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it and incorporate it with other learning settings to create a setting that is more focused on the needs of the learners.

Learning spaces can be categorized as informal, formal or virtual learning spaces. Informal learning spaces provide places for collaboration and study to occur before or after class. These spaces include libraries, public or gathering spaces, quiet and breakout areas, interactive spaces, physical education areas, nature walks/ pathways, green areas, and corridors/transition spaces created within corridors. Formal learning spaces are learning spaces used for regularly scheduled classes. These spaces are identified as traditional classrooms, lecture halls, technology-infused classrooms, design studios, workshops, computer labs, laboratories, and active learning classrooms. Web-based environments or platforms for learning are used in virtual learning spaces, which are typically found in educational institutions.

In Architecture education, creativity and long hours of dedicated work is very important so institutes need learning spaces that can foster creativity, provide flexibility, collaboration and integration, and support the students to enjoy and do work without stress. Architecture education deals with the learning of the built environment but the students are not provided with the learning environment required to fit well in their learning. New forms of collaborative and interacted learning spaces must not only be integrated into formal learning, but must also be in design adapted for different spaces present in the campus. Although our understanding of learning and the conditions under which it is facilitated have substantially improved; the majority of Architecture colleges have classrooms as well as the design studio, which is the core of Architecture Education, remained in a rather traditional form. Further, another challenge is the integration of technology in the teaching-learning process to provide technology-enhanced environment. Moreover, the Architecture is moving towards Digital Architecture. Now it's a challenge to bring together space, technology and learning to develop learning environment for the students that suits well to new trend of learning.

2. Defining learning spaces

2.1 Learning spaces

Learning spaces are places where learning occurs either in physical or virtual mode (Macphee, 2009). The term is used mostly in classrooms, but it actually refers to an indoor or outdoor location, which can be either actual or virtual. Though classrooms and laboratories are known to most people, auditoriums, performance rooms, computer labs, and studios are also important formal learning spaces (Lomas, 2005). In educational institutions, learning rooms are used in a wide range of ways and have a wide range of configurations and locations. These settings support a range of pedagogies, such as silent, cooperative, or active learning, virtual or real-world learning, vocational, experiential, and hands-on learning, among others (Wikipedia). A learning space should be able to motivate learners, promote learning, support collaborative and individual learning, provide a personalised and inclusive environment, and be flexible to adapt to the changing needs of the students (JISC, 2006). Malcolm Brown states in the research paper titled 'Educating the Net Gen' that the Net Generation students use a variety of digital devices and turn every space into an informal learning space outside the classroom.

2.2 Importance of learning spaces in learning

Deeper and richer learning can be encouraged when the spaces are designed with learning in mind. Educators must create structures that support this learning. Space strongly influences learning, and the type of space designed determines the type of learning that is going to occur in that space (Chism, 2006). The physical learning environment supports formal teaching and informal learning as well as individual and social learning when designed with proper considerations. They were all interactive and totally supportive of one another (Kuuskorpi & Cabellos, 2011). Researchers (Obeidat & Share, 2012) highlighted the need to design the learning space or environment according to the needs of the students and teachers, such as a design studio where students and teachers spend the maximum time in architecture education and require an environment that is suitable to their needs. Intentionally created spaces are harmonious with learning theory and the needs of current students, moreover it reflect several elements such as: flexibility, comfort, sensory stimulation, technology support, collaboration, and socialism (Chism, 2006). The transformation of learning spaces into creative spaces is a great challenge and depends on our understanding of how students learn (Dittoe, 2006). Space can have a significant impact on teaching and learning. Exactly how space, technology, and learning are brought together will continue to evolve (Oblinger, 2006).

2.3 Impact of student's habits & culture on learning spaces

Another researcher stated that learning environments on campus can have a significant impact on students' lifestyles and cultures (Obeidat & Share, 2012). Architecture education is a 24-hour learning process. If a suitable environment is not provided to them, then they will lack interest and dedication towards their work. According to researchers Lomas and Oblinger, well-designed learning environments made possible by technology inspire students to spend more time on campus, become more engaged, and improve retention. Discussions about learning spaces are aided by knowledge of students' characteristics and routines. As they read, take notes, write, chat, or simply enjoy

campus life, students relax alone or in small groups. They are also seen to be involved in using mobile phones, iPods, personal digital assistants (PDAs), and laptops (Lomas & Oblinger, 2006). Learning spaces promote learners to work on group projects, interact in collaborative or cooperative learning, showcase their work publicly and guide others (Lomas, 2005). 21st century learners organise their own schedules, as well as track and assess their own learning (Shaw, 2017). So learning spaces should be designed to shape and support learners' needs, habits, and culture.

2.4 Various learning settings in educational institutions

Kenn Fisher (2004), in his research 'linking pedagogy and space', has explained various spatial settings that are required for different pedagogic activities. He brings out five main pedagogical activities as delivering, applying, creating, communicating, and decision making; which require various learning settings such as individual, group, activity-rich, informal learning, and staff settings (Department of Education and Training, 2004). Each learning setting is supported by different spatial settings. Similarly, the researchers (Baburaj & Mukherjee, 2011) also identified various learning settings as group learning settings, simulated environments, peer-to-peer learning settings, individual learning settings, social learning settings, and multi-purpose learning settings, for which different learning spaces need to be designed. The study of various researches gives an idea of the various learning settings that need to be taken care of while designing spaces for any educational institute. Learning spaces must incorporate spaces for all the learning settings.

2.5 Learning spaces in architectural institutions

Historical context: Until the mid-nineteenth century, architectural education was based on an apprentice system where young architects served under the mastery of an accomplished architect, as in the Ecole des Beaux-Arts located in Paris. The Beaux Arts period in Paris had four primary elements: the Ecole, private ateliers, the Salon, and café life. The Ecole was the traditional study of classical painting and architecture, associated with the Grand Prix de Rome, a competition in which the winner would get a full scholarship to study in Rome. In the small independent ateliers, students learned directly under a "master," with all the success of the students reflected directly back on the master. The annual Paris Salon was the show in which the best works, as chosen by a jury, were displayed to the public. Lastly, café life was the informal extension of the ateliers and the Ecole, where people came together to discuss design (Woznaik, 2016). The ateliers brought a new approach to architectural design education, which can be described as "learning by doing" in a design studio. Since then, the design studio has been the core of education in the field of architecture. Design knowledge, thinking and understanding are created in the design studio through projects, charettes, discussions, workshops and other activities (Pak &Verbeke, 2012).

In the 1920s, with the influence of the modernist movement, architectural education was reformed to fit the needs of the emerging socio-economical context. At the heart of the modernist movement, the German Bauhaus School led this transformation and integration of new concepts related to mass production and new technologies. This reform has had a significant and global impact on the schools of architecture, especially during and after the Second World War. Although the Bauhaus ideas have transformed architectural education, the studio-based learning model has remained mostly unchanged (Pak &Verbeke, 2012). One of the great insights of the Bauhaus movement is to recognise that creative education is about more than passing on and refining technical knowledge or skills. The Bauhaus School's learning culture encouraged experimentation at a fundamental level by encouraging students to produce their own creative designs based on their own subjective perceptions. Even parties and stage performances were part of the curriculum, with students encouraged to experiment in costume and stagecraft. The parties promoted contact between the college and the public. There was also the fact that they lived and ate together, with recreational activities and sports, for which the Bauhaus building in Dessau provided many opportunities (Life at Bauhaus).

Contemporary learning spaces: Contemporary architecture schools maintain many of the core ideas of the Beaux Arts method: the creation of competition and intensity between students; the strict hierarchy of students and teachers; and the jury or professor's power to decide upon the "correct" and best student work' (Woznaik, 2016). 'Despite huge changes in lifestyle and technology, no significant differences can be found in traditional and contemporary classrooms. The standard layout in schools, which consists of pupils sitting at perfectly aligned desks for the majority of the day and a teacher standing in front of the classroom to deliver the lecture, may be more streamlined desks and/or feature an interactive whiteboard mentions (Wierman, 2016). In the present situation, the design studio still plays a central role in architectural education. Studio work is individually mentored by the course instructor and reviews are given. Active participation in group discussions and constructive class critiques is encouraged by the instructor. ' The findings of this study indicated that a student's way of working in the architectural design studio was tied back to several factors, including the influence of their course instructor (Salama, 1995), the student's learning style, the student's interests, and the type of environment of the studio (Lueth, 2008).

The researchers (Pak &Verbeke, 2012) stated that e-learning supports the whole learning process in the design studio, but the balance between e-learning and

face-to-face learning is important for the success of the e-learning practices.

On the campus, the architecture students move between multiple locations during the concept development stage, where their architectural vision develops. These spaces include libraries, on-campus and off-campus social areas, and open spaces. When it comes to design development, the studio is preferred, where formal discussion and team work are done. The research further concluded that students prefer a space where different activities can be carried out alternately. An open space adjacent to the library is frequently used by students in comparison to the interior of the library. So, design studios designed adjacent to outdoor spaces function as generic spaces (Abdullah et al., 2011).

Today, schools have lost their informal café aspect as well as the spirit of discussing designs in an informal setting. 'If we dismantle the rigid hierarchy and need for competition and recreate the informal café style of architectural discussion and innovation in contemporary architecture schools, then they would become better environments for learning and designing' (Woznaik, 2016).

2.6 Approaches to learning spaces for 21st century

21st century learning spaces support multidisciplinary, team-taught, interactive learning, not restricted by conventional class period-based constraints, within a setting that supports social interaction and fosters student and instructor engagement (Pearlman, n.d). Classroom design for the 21st century aims to create an environment that fosters students' personal growth in communication, collaboration, creativity, and leadership skills (Wierman, 2016). The report "Designing spaces for effective learning: guide for the 21st century learning design" defines the 21st century learning space as being able to motivate learners and promote learning as an activity; support collaborative as well as formal practice; provide a personalized and inclusive environment; and be flexible in the face of changing needs. Flexible, future-proofed, bold, supportive, and creative learning spaces should be designed (JISC, 2006).

The researcher (Oblinger, 2005) supports a more focused and learner-centered approach to the 21st century learning spaces. According to (Broodryk, 2015), flexibility, openness, and access to resources are the most important features to be considered for modern learning environments. Furthermore, the researchers (Baburaj & Mukherjee, 2011) also bring out the learning environment design features such as flexibility & comfort, technology, and spaces for social and collaborative learning. The design of learning spaces for a student-centered approach should follow the principles of multiple use, flexibility, use of vertical dimension, integrate campus functions, maximize teacher and student control, maximize alignment of different curricula activities, student access to, and use and ownership of, the learning environment (Jamieson et al., 2000). Brown and Long (2006) suggest three main principles to facilitate learning space design. First, it should be focused on the learning experience and pedagogical theories, and then on how students learn individually and in groups. Second, there should be an increase in the ownership of technological devices that enrich learning. Thirdly, the design process should be influenced by human-centered concerns and integrate resources that support learning rather than be just accessible. Through various researches related to 21st century learning, it has been derived that the main features that are required for active, social, and collaborative learning in the 21st century are flexibility, integration of technology, and interactive and collaborative social spaces.

Flexibility: Flexibility can have multiple meanings (Head, 2016). Flexible learning spaces are ready for today and future-proofed for any changes to teaching and learning in the years to come. Flexible learning spaces consist of multiple spaces for many types of individual and group-based teaching and learning practices. These spaces also enhance and enable innovative learning environments, where student-centred learning and collaborative teaching practices are at the core of a school's educational vision. Flexibility is provided in all the spaces, whether they are indoor spaces, outdoor spaces, access & circulation, or storage (Evaluation and Education Policy Analysis, 2015). A related concept is "versatility," which one architect defined as a space that motivates users and "inspires different uses," for example, the computer lab that also serves as a maker space (Head, 2016). Flexibility allows multi-functionality within a class session, as it makes it possible to quickly re-organize the available space for a particular activity (s). One recent approach to increasing flexibility has been to divide a total area to allow for specific functions, for example: formal class, group work, computing, etc. (Jamieson, 2000).

Students can come together to discuss, interact, and create in the open, flexible spaces, which supports a 21st-century learning method (Wierman, 2016). In a design studio classroom, flexibility in furniture arrangement is critical; students may need to rearrange their tables in various ways to accommodate self-study and cooperative projects; as well as additional levels of interaction (Obeidat & Share, 2012). The layout of the room and the furniture used can have a big impact on how well students learn (JISC, 2006). Flexible spaces in learning centers, on the other hand, engage learners in a continuous flow of learning and allow for tutor-to-learner support sessions and group assignments to be initiated (Painter et al., 2012).

Integration of technology: Modern classroom design places a strong emphasis on technology integration. Teachers and students, however, are taking advantage of 21st-century classroom design that applies technology in novel and distinctive ways. Technology is a tool used in these classrooms to generate the interest of students and

to motivate them to learn constructively (Bhandari et al., 2020). Technology, including computers, tablets, and mobile devices, puts knowledge at students' fingertips and inspires them to conduct study and come up with discoveries (Wierman, 2016). The findings of other research suggest that technology can help in promoting more interactive and engaging teaching learning experiences (Anireddy et al., 2022; Casanova & Mitchell, 2017). It has altered learning spaces by stimulating more interaction through the use of personal response systems or by videoconferencing with international experts (Oblinger, 2006).

In many simulation environments, video cameras are also a teaching aid, used to record performances in tasks, so that techniques and skills can be improved (JISC, 2006). A wall-mounted camera records key demonstrations, which can be used for distribution to learners from remote areas, or for revision purposes and help in progress. Mobile devices such as laptops and PDAs also encourage learners to access resources available at the institution's network and the internet, and write up their observations as they progress (JISC, 2006). The way that learning environments are used and set up is changing as a result of mobile and personal technologies. It makes learning possible practically everywhere, including research, collaboration, producing, writing, production, and presenting. It encourages teachers and students to personalise learning environments, creating a sense of ownership and relevance (Zandvliet, 2017).

Interactive social spaces: Interactive social spaces are mixed-use spaces where conversation, collaboration, and informal learning are encouraged, facilitated, and expected. A social space is also intended to support academic and leisure activities and events, and cafes/coffee bars, maker spaces, and art galleries' (Head, 2016).

Well-designed social spaces are likely to increase students' motivation and may even have an impact on their ability to learn. Often large underutilized spaces already exist in most of the Colleges and the Universities. If common rooms, even corridor space, were reconsidered as social meeting and group learning environments, institutions could both save on large-space provision and make a statement about their vision for learning as a pervasive and inclusive activity based on social interaction (JISC,2006).

Social spaces need not make distinctions between different types of users. The principle of pervasive, communal learning, which sees both staff and learners as co-users of a space, is potentially achievable through the re-purposing of spaces which are currently allocated separately to staff or students, such as common rooms (Painter et al., 2012).

Emerging designs place emphasis on one high-quality social space as a central focal point in the building, which caters for the needs of all users of the building – visitors, staff, learners and potential learners of all abilities. The area is both a public facility providing meals and refreshments, and a place where learners and staff can meet for short discussions. It is wireless enabled, but it is not set apart from learning—student services may also be located adjacent to this space to take advantage of its widespread use (Hill, 2013).

The development of purpose built informal social learning spaces as a strategy to enhance the student experience is becoming more prevalent, although empirical research in this area is lacking. As a result of encouraging active learning, social contact, and a sense of belonging among tertiary students, the study's findings show that social learning environments can boost student engagement. According to the study, students' impressions of social learning spaces are influenced by design, among other things (Matthews et al., 2011). These informal learning and social spaces are respectful of student cultures (Newton, 2011).

3. Methodology

Case studies of Chandigarh College of Architecture (CCA), Chandigarh; Centre for Environment planning and technology (CEPT), Ahmedabad; Gateway college of Architecture and Design (GCAD), Sonipat, Haryana and Regional institute of management and technology (RIMT), Sirhind, Punjab are taken for study. CCA and CEPT came into existence in the 20th century whereas GCAD and RIMT are 21st century Architectural colleges. A visual analysis was conducted to study the learning spaces in these colleges. This analysis of the spaces is done on the basis of three aspects: flexibility, integration of technology, and social interaction.

A survey is done on teachers and students of these colleges to find out their perception in terms of learning spaces. A sample size of 150 students is used here, with an average of 30 students from each college, and a sample size of 75 is taken for teachers. The survey is conducted with the help of a self designed questionnaire in order to find out the preference of teachers and students towards learning spaces in Colleges. A different set of questions are asked from Teachers and students. Teachers are asked to respond regarding the questions like type of learning spaces preferred in an Architecture College, type of classrooms preferred, type of arrangement and facilities preferred in studio. Further teachers were enquired about type of learning spaces required in Architecture College, type of classrooms for effective learning, studio arrangements, and cafeterias to support teaching learning process and teacher workspace required, etc.

Another survey for students' respondents were surveyed about their perception towards learning spaces in college, facilities preferred in studio, computer aided labs and library spaces for effective learning, informal spaces required to enhance their learning including cafeterias etc.

4. Analysis of data

Visual Analysis of the Architecture Colleges came to the conclusion that Architecture colleges constructed in the late 20th century have a vision for informal learning, as they have more of informal learning spaces than formal learning spaces. Informal spaces like corridors, walkways, and courtyards are distributed all throughout the campus. On the other hand, architecture colleges constructed in the beginning of 21st century have a. linear planning developed with rows of classrooms around the corridors. They gave more emphasis on formal learning environments than on informal ones. Informal spaces like the library and canteen are restricted to the corners, while corridors are just used as a passage. GCAD have a vision for contemporary learning and have informal learning spaces almost equal to their formal learning spaces. Interactive informal spaces are placed in between formal spaces, which have been spread all throughout the building.

The architecture colleges were visually analyzed to understand the uses of formal and informal spaces by the students and teachers to find out the need for various features of flexibility, integration of technology, and social interaction in architecture colleges. Various spaces that have been studied include lecture halls/classrooms, studios, workshops, computer-aided design labs, libraries, cafeterias, corridors/ walkways, break-out spaces, transitional spaces, gathering spaces, think spots, multipurpose spaces, storage spaces, teacher spaces, and outdoor well-defined spaces.

Flexibility is adapted to only a certain extent in RIMT and GCAD. CEPT have incorporated flexibility in the arrangement of furniture, flexibility in the use of learning spaces, and flexibility in working hours. Use of technology is restricted to the use of projection screens and projectors in the colleges considered under study. Only a few colleges with the vision to contemporize learning have used it to a greater extent. Interactive social spaces are very important in architecture education as they develop strong interaction between the students and encourage team work. Most colleges of 21st century are unaware of the importance of these spaces and have not used them wisely for the interaction of students. However, 20th century colleges have successfully created interactive social spaces and integrated them into the learning process. They have also used the courtyard and pathways as effective interactive social spaces.

Figure 1 – CEPT Site plan.

Figure 2 - CCA Floor plan (Yellow, green, orange and cream colour represents various informal areas).

Figure 3 - RIMT Ground Floor plan.

Figure 4 - GCAD Ground Floor plan.

Perception of Students

The analysis of the survey is based on the results of 105 student responses. More than 80% of students believe that both formal and informal learning spaces must be incorporated into colleges. Among the formal spaces, 70% of students prefer flexible and interactive classrooms. Within their studio, they would like to have flexible furniture which they can arrange according to themselves. It should have sufficient space for the movement of teachers and students between the tables and must permit interactive sessions. Around 65% of them believe that separate provision for use of laptops is required and lecture provision is not required within the studio. Around 50% of them think that plug points, projectors, and projection screens must be provided in the formal learning spaces together with Wi-Fi connectivity in the informal learning spaces like learning commons, transitional spaces, and small interactive spaces within the building. More than 65% of students also wish to have break-out interactive spaces to relax within their long design classes. In colleges, most students don't prefer to

Responses of the student survey

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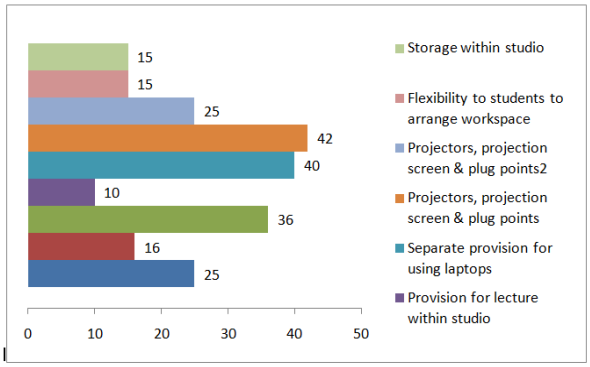

Figure 5 - Preferred Arrangement of studio spaces.

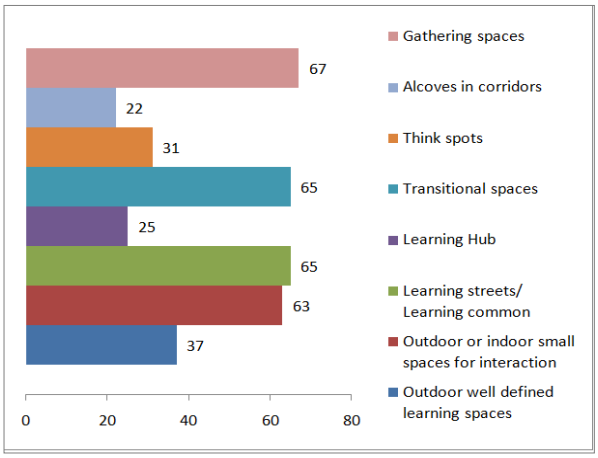

Figure 6 - Preferred Type of Informal spaces.

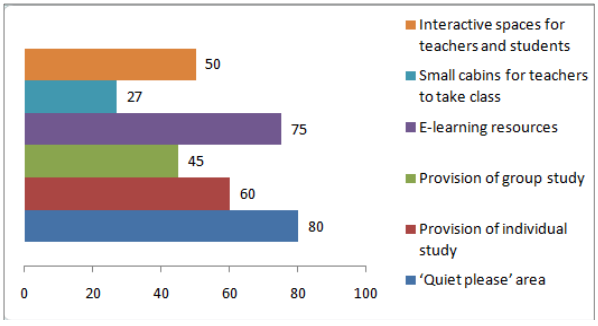

Figure 7 - Preferred Library spaces.

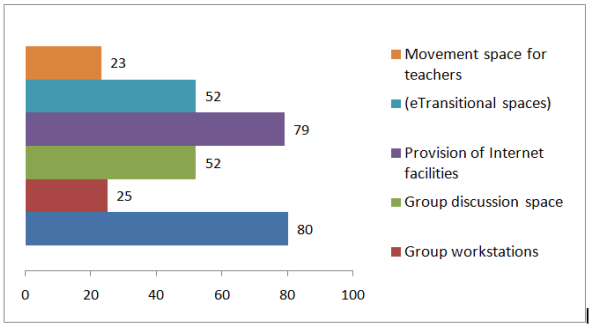

Figure 8 - Preferred Computer lab spaces.

separate individual spaces. Group learning spaces are preferred by only 45% of the students. The provision of small cabins for teaching within the library is not appreciated by most of the students. They think that it would be better to provide interactive spaces for teachers and students within the library. The cafeteria must be away from teaching-learning spaces with a mix of refreshment and Wi-Fi access according to 75% of students. Around 65% wish to have group learning spaces within the cafeteria to promote interaction between students and teachers. They don't prefer individual learning spaces in cafeterias. Around 80% of students want internet facilities in a CAD lab with individual workstations. Group discussion space, together with sufficient space for movement of teachers and students, is required to be provided by 50% of the students.

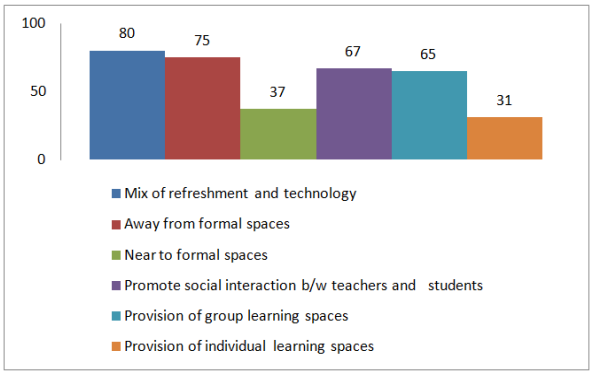

Figure 9 - Preferred Cafeteria spaces.

Flexibility is adapted to only a certain extent in most colleges. Only a few colleges have incorporated flexibility in the arrangement of furniture, flexibility in the use of learning spaces, and flexibility in working hours. Use of technology is restricted to the use of projection screens and projectors in most colleges. Only a few colleges with the vision to contemporize learning have used it to a greater extent. Interactive social spaces are very important in architecture education as they develop strong interaction between the students and encourage team work. Most colleges are unaware of the importance of these spaces and have not used them wisely for the interaction of students. However, some colleges have successfully created interactive social spaces and integrated them into the learning process. They have also used the courtyard and pathways as effective interactive social spaces.

Responses of teachers' survey

The analysis of the survey on teachers is based on the responses of 49 teachers of these architecture colleges. Around 80% of the teachers believe that there must be a mix of formal and informal spaces in a college. Around 60% prefer to have interactive classrooms, while around 50% also wish to have flexible classrooms. None of them preferred to have a traditional classroom. Around 80 % believe that studios must be equipped with projectors, projection screens, and plug points for students, together with separate provision for laptop tables. According to around 50% of the teachers, the space must have flexible furniture together with space for presentation and display. Break out spaces and provision of lectures within the studio is preferred by only 40% of the teachers. Around 50% of the teachers preferred gathering spaces, learning streets/ learning commons, and transitional spaces as informal learning spaces within the architecture college. More than 50% also preferred outdoor and indoor small spaces close to the teaching learning zone and around 25% preferred

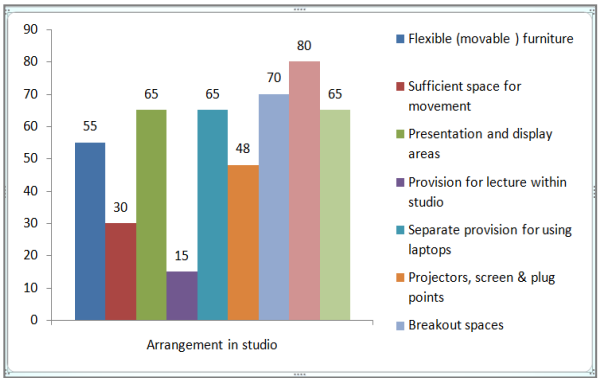

Figure 10 - Preferred Arrangement in Studio spaces.

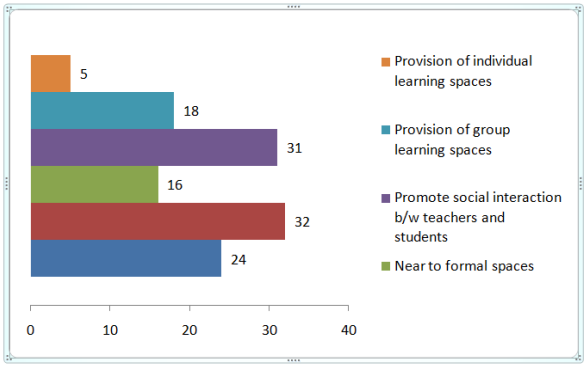

Figure 11 - Preferred Cafeteria spaces.

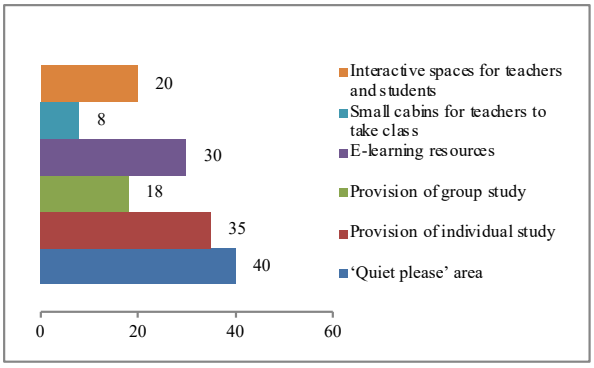

Figure 12 - Preferred Library spaces.

having think spots, while other spaces like alcoves in corridors and learning hubs were not preferred by almost 75% of them. Around 80% of teachers believe the library should be a 'quiet place' with individual learning spaces for the students. The provision of group study and interactive space for teachers and students is preferred by only 40% of the teachers. Around 60% of the teachers believe that e-learning resources must be provided in the library.

60% of teachers agree that cafeterias should be separate from formal spaces and allow students and teachers to interact. 50% of them think that a cafeteria must have a mix of refreshment with technology together with group learning spaces. Around 60% of the teachers prefer teaching in clusters, 25% prefer separate classrooms, while the rest don't have any choice. 90% of the teachers wish to have individual faculty cabins instead of a common area for all the teachers. All of them prefer an interactive space for teachers.

5. Conclusion

According to the findings of the study, these three features of 21st century learning spaces, flexibility, integration of technology, and interactive social spaces, are neglected in most of the colleges of 21st century architectural institutions while they exist to varying degrees in 20th century architectural institutions in India. Changes are required in learning spaces to accommodate these factors of flexibility, technology, and interactive spaces in various formal and informal learning spaces.

Flexibility can be a hindrance to the discipline of the institutions. So, flexibility must be provided, keeping in mind the stage of study of the students. Flexible learning methods in classrooms according to the needs and requirements of the topic can be provided with flexible furniture which can be rearranged for individual and group learning. Flexibility of space in classrooms can also be provided through the provision of break-out spaces. Outdoor teaching spaces as well as indoor learning commons should be created to allow teachers to extend their classes even to these spaces and connectivity must be provided between outdoor and indoor spaces. Multipurpose space should be provided as it promotes flexibility of using the space. Workshops must be extended to outdoor spaces also. A computer lab must have both individual and group learning spaces. The library should be divided into various sections like reading, study, and group discussion, to provide flexibility to use the space for various purposes according to the needs of the students.

The 21st century generation is much more comfortable with technology than the 20th century generations. Wi-Fi connectivity should be provided in all colleges to meet the needs of 21st century learning. E-learning resources must be provided in the libraries. Provision of technology-enhanced environments is a must in both formal and informal spaces for teaching as well as learning purposes. Interactive social spaces must be provided at places that can be easily monitored or that are within the visibility of the administrative authorities or the teachers. Interactive social spaces must not include any hidden areas. Interactive spaces must be provided in indoors as well as outdoors. Interaction among the students within the classes is as important as outside the classes.

Further recommendations are given to study the learning spaces with a greater sample size. The study is restricted to some architectural institutions in north India and further study is required on learning spaces in architectural institutions all throughout India to generalize the findings.

Statements and Declarations

We confirm that this work is original and has not been published elsewhere, nor is it currently under consideration for publication elsewhere.

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