Je-LKS

Journal of e-Learning and Knowledge Society

The Italian e-Learning Association Journal

SIe-L

Società Italiana di e-Learning

n.2
2017
MAY

Je-LKS
Journal of e-Learning
and Knowledge Society

www.sie-l.it
www.je-lks.org

The Journal is issued online three times per year.

Je-LKS is an Open Access Online publication. This means that everybody can free access online to abstracts and full lenght articles.

Libraries or researchers, can subscribe a Reprint Service Subscription. The Reprint Service Subscription is on a yearly basis and you can receive the three printed year issues for a 121€ annual fee (including taxes and shipping expenses).

In order to join SIe-L:

- segreteria@sie-l.it

- Tel. +39 052 2522521

For more information visit www.sie-l.it

Registration at the Rome Court in the pipeline.

eISSN: 1971 - 8829 (online)

ISSN: 1826 - 6223 (paper)

Resp. dir. Aurelio Simone

To the authors:

paper can be addressed to:
www.je-lks.org

Je-LKS

Journal of e-Learning and Knowledge Society

The Italian e-Learning Association Journal

Vol. 13, n. 2, 2017

Peer Reviewed Papers

Je-LKS
Journal of e-Learning and Knowledge Society
The Italian e-Learning Association Journal

THE ISSUE

VOL. 13, N.2, 2017

by Nicola Villa

The new issue of May 2017 includes a selection of multi-disciplinary works submitted by the authors and accepted after the review process.

Before the description of the contents of this issue, I would like to underline that from this month all past articles and, of course, future ones, have a specific Digital Object Identifier (DOI). The DOI of each paper is reported directly in the PDF version and on the journal's website.

I would also like to give a welcome to the new members of the staff and at the same time thank the former Assistant Editors for the great work and the indispensable collaboration to bring the magazine to this point. Good luck to all!

The number is opened by the Report by Filomena Faiella, that synthesizes the procedures and techniques used by Je-LKS to estimate the quality of the journal and to make improvements; this is the first report, that will be published every year.

Learning from decades of online distance education: MOOCs and the Community of Inquiry framework by **Dodzi Amemado** and **Stefania Manca** is a conceptual study based on the incorporation of the Community of Inquiry (CoI) framework into learning design practice to overcome current MOOCs pedagogical limitations.

The paper of **Eleonora Faggiano**, **Antonella Montone** and **Pier Giuseppe Rossi** (*The synergy between Manipulative and Digital Artefacts in a Mathematics Teaching Activity: a co-disciplinary perspective*) presents a teaching experiment aiming at constructing the meaning of axial symmetry through the mediation of a "duo of artefacts", made up by a digital artefact and a manipulative one.

Antonio Sánchez-Mena and **José Martí-Parreño** (*Teachers´ Acceptance*

of Educational Video Games: a Comprehensive Literature Review) provide a literature review on teachers' acceptance of Educational Video Games, an increasing approach to teach new generations of learners, such as millennials who make an intense use of video games, interactive technologies, and digital networks.

The review by **Massimiliano Barattucci** (*Approach to study as an indicator of the quality of teaching and of learning environment: the contribution of John Biggs*) investigates the contribution of John Biggs within learning research and educational system quality.

The paper written by **Ivan Mustakerov** and **Daniela Borissova** (*A Framework for Development of E-learning System for computer programming: Application in the C programming Language*) describes a framework for the development of an e-learning system for computer programming that includes not only the necessary course materials and the corresponding tests and exercises, but also offers an integrated environment to test written programming codes.

Rolf Kretschmann describes in his paper (*Employing Tablet Technology for Video Feedback in Physical Education Swimming Class*) a experiment in a swimming class to extimate the impact of technology-enhanced video feedback on swimming performance, particularly using a tablet computer.

Students' Experiences, Learning Outcomes and Satisfaction in e-Learning is the article by **Chin Fei Goh *et al.*** that tries to examinates whether students' experiences in e-learning are related to learning outcomes and satisfaction.

The article by **Mario Manzo** (*A model for Users Behavior Analysis and Forecasting in Moodle*) describes a possible model to investigate and predict the behavior of users, taken to explore the additional knowledge information and predict the learning outcomes.

Closes the issue the paper by **Federico León**, **Oswaldo Morales** and **Hugo Vértiz** (*Personality traits that differentiate Attendants of Higher- Education Online Courses*), that utilized the ten aspects of the Big Five personality system to detect differences in personality traits between attendants of higher education online courses and higher education face-to-face courses.

Please connect to the website **www.je-lks.org** to have have the free access to all the published paper, submit at any time new papers for the peer review and check the new call for papers that will be opened in the next weeks.

Nicola Villa
Managing Editor
Journal of e-Learning and Knowledge Society

Je-LKS
Journal of e-Learning and Knowledge Society
The Italian e-Learning Association Journal

SELF-ASSESSING QUALITY OF SCIENTIFIC JOURNALS

by Filomena Faiella

The case of the Journal of e-Learning and Knowledge Society (Je-LKS)

This report focuses on the procedures and techniques used by the **Journal of e-Learning and Knowledge Society (Je-LKS)** to estimate the quality of the journal and to make improvements. The report begins with an overview on scientific journals, types and their functions. Then, it considers requirements that contribute to journal quality, and indicators for quality control. The purpose of this document is offered an objective insight into performed processes and provided feedback on how improving and increasing the level of quality of the scientific journal.

Scientific Journals

In academic publishing, scientific journals are collections of papers, generally written by scholars and experts in the discipline for an audience whose readers are expected to have specialized knowledge or training, such as specialists and researchers. Scholarly journals are generally specialized for different disciplines, subjects and fields, to increasingly specific topics but may be also multidisciplinary, interdisciplinary, or related to a broad field.

They are also called "periodicals", due to the fact that are published at regular intervals (once a month, quarterly, six-monthly, yearly, etc).

Scientific journals constitute one of the main publication channels for scholarly research, one of the preeminent forms of scientific communication expected to further the progress of science and disseminate research findings. They contain academic articles categorized according to the kind of information they provides (e.g., theoretical articles, empirical research articles, literature reviews, case studies, methodological articles, book reviews, proceedings, communications).

According to Schaffner (1994), scientific journals absolve five functions: building a collective knowledge base, communicating information, validating

DOI: 10.20368/1971-8829/1371

the quality of research, distributing rewards, building scientific communities.

The first intent of scientific journals is that to further the advancement of human knowledge, usually making the benefits of science available to all. So, journals serve to create collective knowledge base that is the need of readers, current and future, and each article that appears in a journal becomes part of an archive available to all.

Schaffner assumes that the function of building a knowledge base is intrinsically linked to the second function, that of communicating information, especially now that publishing can be made «in a remarkable new way that is not only incomparably more thorough and systematic in its distribution, potentially global in scale and almost instantaneous in speed but so unprecedentedly interactive» (p. 36).

Validating the quality of research usually occurs through a process of refereeing, that is the process of subjecting a scholarly article to the scrutiny of reviewers who are peers, namely experts in the same field of the author, before that the article is published in journal. There are two ways that recruiting of reviewers is done: publisher/editor selects researchers inviting them in joining the editorial review board of journal or researcher introduces oneself for serving on a review board. Normally, reviewers don't get paid for their activity since that it is traditionally recognized as part of the professional obligations of researchers. Peer review may be open or blinded. It is open when «the author's and reviewers' identities are known to each other, and the reviewers' names and (optionally) their reports are published alongside the paper» (Ware, Mabe, 2015, p. 47). In the case of single-blind review, reviewer identity is hidden; in the case of double-blind review, author identities will be concealed at reviewers, too. Reviewers report back the results of referring process to journal publisher. Researchers believe that the system of peer review is a good method to maintain standards of quality (Ware, Monkman, 2008), although «research on bias in peer review - predicated on the ideal of impartiality - raises not just local hypotheses about specific sources of partiality, but much broader questions about whether the processes by which knowledge communities regulate themselves are epistemically and socially corrupt» (Lee *et al*., 2013, p. 13). Peer review referring is becoming dysfunctional and, therefore, new methods are needed to maintain quality.

The issue of reward is equally important. Although authors do not profit directly from it, publishing rewards authors indirectly through forms of recognition, prestige arising, and career advancement. Academics are required to write and publish for a wide variety of reasons including cultural, personal, and professional motivations. Wellington (2003) believes publishing is driven by internal and external factors. The external prompts are those are to do with outside pressures such as career enhancement, getting promotion, research

assessment exercise for universities, accountability, professional development, benefits to one's own institution. The internal ones can be regarding the intrinsic motivation to write, the whole gamut of personal outcomes of publishing, and the publishing as part of ethics of responsible research. The first type of internal prompts concerns the intrinsic motivation to write for purpose to clarify and refine one's thinking, while the personal outcomes of publishing are self-esteem, self-fulfilment, respect, credibility, fame, reputation, and satisfaction of making a difference. Finally, the motivations that are included in the idea of responsible development of scientific research has been described as those prompt of authors/scientists who believe research is not complete until published, who are certain of realize the full potential of research through share, communicate, and dissemination, who have faith in the value of dialogue and negotiation inside the research community for contributing to change and improvement.

The last function identified by Schaffner is the visibility of groups of researchers that, around to academic journals, build their identity of scientific community working in a particular field of science. Solomon (2008) gives some examples of how journals forming and maintaining scholarly communities: «editorials, opinion articles and letters to the editor often serve as a forum to debate the current issues in the discipline. Sometimes they are substantive and sometimes they extend to related areas, such as the social implications of findings, funding and/or training issues within the fields. Journals also commonly serve as a forum for news such as appointments to major positions or the passing of a well-known member of the community» (p. 14-15).

In the past, when journals were available only in print and the printing process was expensive, readers had to pay a subscription price or licensing fees for home delivery. Now, most of journals are available electronically via online archives. Access may be purchased with a subscription to journal's archive; or else it is possible to get issues and single article delivered to the reader's device or desktop. But access may also be free. When journals can offer free content means that the cost of peer review management, journal production, and online hosting and archiving is borne by academic institutions, scientific societies or research groups that have accepted responsibility for the activity in question.

Many journals have reduced the barriers to access to information, adopting policies of Open Access. «Open access (OA) literature is digital, online, free of charge, and free of most copyright and licensing restrictions» (Suber, 2012). This does not, of course, mean that all open journals offer free access to content. Willinsky (2006) distinguishes ten models of open access (home page open access, open access e-print archive, author fee open access, subsidized open access, dual-mode open access, partial open access, per capita open access, open access indexing, open access cooperative) that are according to

him demonstration not so much diffusion of many forms of opening access as adherence to "the access principle", which is concerned with impact, participation, and circulation of knowledge. In fact, he stresses the ethical imperatives connected with the open access publishing systems, which not only make knowledge freely available to all but also turn "this knowledge into a greater vehicle of public education".

Open access journals are electronically, quickly and easily searched through the use of online databases and search engines, which index information gathered. Indexing helps journals to achieve purpose of being accessible to a wide audience and being accessible in turn improves journals' reputation since indexed journals are considered to be of higher scientific quality. There are several indexation services available today. Each one works in a different way for scanning information (such as manuscripts, abstract of articles, and keywords) and uses different criteria to evaluate journals' suitability. Typically, a journal has to submit a formal application and provides evidences supporting its application. If journal meets all criteria, it gets indexed.

How self-assessing quality

Quality is a central element in academic research, and assessing quality of scientific journals has long been a major goal for researcher, institutions, and journals themselves. The several reasons for assessing quality of scientific journals are essentially the viewpoint of such stakeholders. Quality assessment is considered to be highly relevant for scientific journals not only to achieve higher quality but also to attract more or better authors, get recognition, and widen dissemination. For academic authors, it becomes a criterion to choose where to submit manuscripts since through publication in a high-quality journal the authors often obtain international recognition and scientific quality improvement. Universities have also need to know lists of reputed journals to evaluate its researchers or the aptness of a researcher, and to choose subscriptions for the library for the convenience of students, faculty, and researchers.

Assessing of quality of scientific journals is done using a set of statistical and mathematical indices called bibliometric indicators. Bibliometric indicators are important since they are widely used to compare the performance of the journals. Usually, some of the currently bibliometric indicators and a combination of these are used by the most important databases in order to select journals and to compare scientific impact of these.

In this case, yet, the goal is not to compare scientific impact of the journal but to identify strengths and weaknesses for choosing areas to improve and, consequently, increasing the level of quality of the journal. The purpose of

self-assessing quality is to make improvements. Therefore, this part of the document presents a pattern for self-assessing quality that seeks to capture general determinants of quality of a scientific journal starting from the assumption that assessing scholarly journals is a complex task that ideally examines complex multidimensional factors. First, the requirements will be identified; second, the requirements will be segmented in indicators describing such identified requirements and pointing to aspects that influence quality and should be managed.

In order to identify the requirements of the self-assessing pattern, a search was made for the principal assessing models of academic journals from which to derive the requirements used most frequently. They concern credibility, relevance and visibility of journal, editorial management of publication and scientific quality of content. Defining and classifying the indicators proved more difficult since the choice of indicators reflects the value judgements and priorities to promote.

Table 1 below represents the chosen indicators. Each description is followed by a short commentary suggesting some aspect, which are required to make the indicator more comprehensible, in terms of its meaning and its purpose.

Self-assessing the quality of the Je-LKS

The *Journal of E-Learning and Knowledge Society* (Je-LKS), launched in 2005, is an Italian open access journal for disseminating of research in the fields of e-learning, educational technology, Information and Communication Technologies (ICT), and Knowledge Management. It is published electronically (http://www.je-lks.org/) and the papers are provided in PDF format.

The types of articles published are "invited papers", that are a selection of articles regarding relevant themes or written from internationally renowned experts (normally, the editorial board invites authors), or "peer reviewed papers" and "peer reviewed communications", that are articles or short papers that have passed a peer double blind review.

In this part of the document the last year is analyzed in detail to determine what requirements the journal meets and indicators for quality control. The purpose of this section of the document is offered an objective insight into performed processes and provided feedback on how increasing the level of quality of the journal.

Journal credibility

The notion of credibility concerns the quality of being believable or worthy of trust and may be assessed by examining how much a journal is sensitive to

safeguards intellectual property rights, guarantee the validity of the contents, and improve its profile making public bibliometric indices.

Table 1
OVERVIEW OF REQUIREMENTS, INDICATORS, AND REQUIRED DEVELOPMENT

INDICATOR	DESCRIPTION	REQUIRED DEVELOPMENT
CREDIBILITY		
Bibliometric indicators	Some of the currently used bibliometric indicators are impact factor, crown indicator, h-index and so on.	Bibliometric indicators are widely used to compare the performance of the journals.
Digital Object Identifier (DOI)	The DOI system is an international standard, developed by the "International Organization for Standardization", that identifies and describes digital objects.	DOI is important for dissemination of content on electronic networks.
International Standard Serial Number (ISSN)	The ISSN is the international standardized code, which identifies all serials, journals, magazines, periodicals in printed or digital form.	A journal may have two ISSNs: an ISSN for the print version and an ISSN for the electronic version. This information have to be on the website.
International editorial board	The reputation of the editorial board is a good indication of the journals credibility.	Membership of the journal's editorial board has to be recognized experts in the field and available on the journal's site.
RELEVANCE		
Supported by reputable publisher or scholarly society	One indication to journal quality is the general reputation of the publisher, association, society or organisation publishing the journal.	Journals may have affiliation or sponsorship relationships with reputation publisher, association, scholarly society or scientific community.
Active role in the dissemination of research	Publishing activities serve the central mission of dissemination of knowledge in a specialized field.	Perception of the active role of a journal in the dissemination of research depends on the scientific community's own particular viewpoint and traits.
Relevant scope	Journal clearly indicates a mission to disseminate research content.	Relevance of the scope depends on the scientific community's own particular viewpoint and traits.
Excluded from the lists of predatory journals	Predatory Open Access Publishers are bogus open access journals that promise quick publication on payment of a fee.	Relevant journal must not be included in the lists of predatory journals.
VISIBILITY		
Presence in databases	Another indication to the quality of a journal is the number of journal databases, which index articles from the journal.	This information have to be on the website or available through UlrichsWeb.
Journal website	Journal should ensure that it is distributing its content appropriately, and that the website works.	Journal website is easy to locate or identify, and explains any publishing information in a clear manner.

INDICATOR	DESCRIPTION	REQUIRED DEVELOPMENT
Internationalization of knowledge	Scientific journals have been encouraged to internationalize, so that the production of knowledge can be disseminated beyond the National boundaries, in order to increase their visibility.	The publication in English can increase the visibility but the biggest challenge is to attract readers from various countries and foreign authors interesting in publishing. Content should be readable for an international audience. The aims and scope should be of interest to a wider international scientific community within a specific subject field. Journal may have an International board to represent it internationality.
Discrete advertising	Predatory Open Access Publishers advertise by sending spam messages to academic email addresses, something that reputable journals almost never do.	Advertising must be relevant, useful, and non-invasive. Journal is able to develop and implement effective promotional activities to increase the visibility, including the use of social media.
EDITORIAL MANAGEMENT		
Currently in-print	Opposite of out of print, currently in-print refers to an journal that is published.	Journal must regularly publish its numbers.
Managing publication phases	Journal organizes the editorial process from when authors submit their manuscript to publishing, as well as all other editorial activities.	A journal have to meet the challenges of rapidly changing technology, manage contacts and multiple activities, hire, manage, mentor and develop editorial staff, develop organizational, interpersonal, communication and presentation skills and create a collaborative and team-oriented mindset and attitude.
Instructions for authors	Instructions for authors are available.	A journal offers guidelines explaining to authors the manuscript submission process and acceptance criteria.
Instructions for reviewers	Journal provides adequate guidance for the reviewers.	A journal offers guidelines explaining to authors the manuscript submission process and acceptance criteria.
Ethics statement	Ethical issues in editing scholarly journals regard such issues as plagiarism, confidentiality, fabrication or falsification of data, conflicts of interest etc.	A journal offers guidelines explaining to authors the manuscript submission process and acceptance criteria.
SCIENTIFIC QUALITY OF CONTENT		
Peer reviewed	Peer review is the process to ensure that the articles meet the accepted standards of the discipline.	Adopting a peer review model and acknowledging reviewers article may ensure more responsible publishing.
International guest editors	Guest editors acquire content, and lead review process for a special issue. Usually, a guest editor is an expert in the specific research field of special issue and edits the editorial of special issue.	Guest editors have to be recognized experts in the field of the special issue. Aside from providing prestige, a guest editor engages other experts in the same discipline to submit manuscripts for special issue.
High-quality of editorials	In editorial an editor discuss themes of the issue, and describes the content.	Editorials of quality are good examples of argumentation, clear expression, and of a formal style of writing.

INDICATOR	DESCRIPTION	REQUIRED DEVELOPMENT
High-quality research of articles	Scientific journals contain articles describing high quality research that has been reviewed by experts in the field prior to publication.	A high quality research article must be focused on the research problem under investigation, fit with the acceptance criteria of the Journal being targeted, show that the authors understand the nature, the nuances and the complexities of the theme.
Formal style of writing of articles	Writing for a scientific purpose requires the formal style.	Academic writing must be grammatically correct and accessible to the readers, must have graphs and diagrams be well labelled and in good alignment with the text.
Articles are within the scope of the journal	Articles are within the scope of the journal and meet disciplinary standards.	Papers have to address important themes concerning journal scope.
High rejection rate	The higher the rejection rate seems to be correlated with the higher the journal quality.	Rejection/acceptance rates have to be available on the journal's site.

Je-LKS has two International Standard Serial Numbers (ISSN), an ISSN for the print version and an ISSN for the electronic version, and assigns a Digital Object Identifier (DOI) to all published articles in order to grant a persistent and unambiguous identification, and improve their accessibility and visibility.

Another good indication of the journals credibility is the reputation of the editorial board. Membership of the journal's editorial board is recognized experts in the fields of knowledge related to the profile of the journal, and is readily visible on the journal website. Aside from providing prestige, the functions of the editorial board include suggesting and writing a critical review of a book or a book chapter, proposing and editing special issues, evaluating the quality of the journal.

As far as the latter is concerned, the members of the editorial scientific committee have completed a questionnaire that asked for the level of expert agreement on a 5-point scale (1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, 5 = strongly agree) about six statements for each of the three requirements (scientific quality of the content, relevance and visibility of the journal). The questionnaire sent to the 27 members of the scientific editorial board, obtaining a total of 44% (12 responses) usable answers. Seventy-five percent (9 out of 12) of respondents are involved in the sector of Higher Education in the fields of Educational Sciences (5 out of 12), Engineering (3 out of 12), Computer and Information Sciences (2 out of 12), Psychology (1 out of 12), and other (1 out of 12).

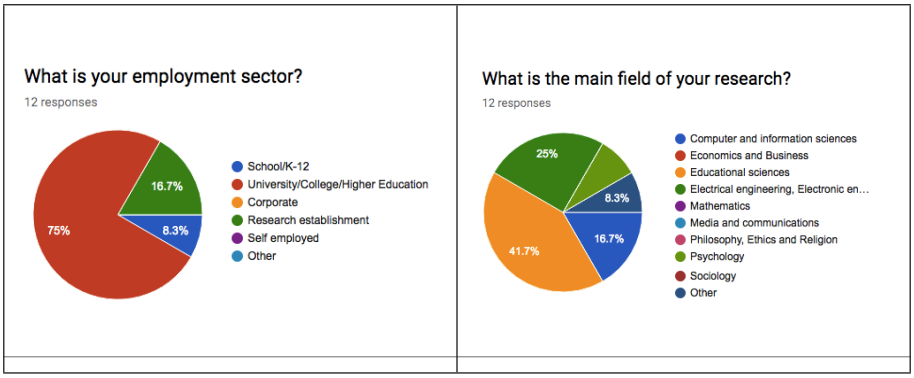

Fig. 1 - the employment sectors and the research fields of the board members.

The outcomes of the data analysis will be used and disseminated in the following sections of this document.

Journal relevance

Relevance concerns the impact of a journal to scientific community. This requirement tends to rely on a mix of subjective and objective indicators as part of a larger pertinence assessment process. The indicators are four. Two concern objective aspects such as the scholarly society that supports the journal and the exclusion of the journal from the lists of predatory journals. The other two (active role in the dissemination of research and relevant scope) depend on the scientific community's own particular viewpoint and traits and, accordingly, varies significantly by each discipline. Therefore, they will discuss on the basis of the experts' opinions, namely, of the members of the editorial scientific board.

Scientific societies aim to foster and disseminate knowledge about an academic subject area, and to enable the advancement of public education in such area. Societies work towards these aims in a variety of ways, including publishing journals. Publishing activities serve the central mission of the society by enabling the dissemination of information about the society's subject area within the scientific community that joins around such society. Therefore, the journal becomes relevant for that scientific community. Je-LKS is the official organ of scientific diffusion of SIe-L (Italian e-Learning Society), a non-profit association that promotes scientific research on e-learning and distance education, considering them strategic for education of citizen and training of practitioners.

The scope of the Je-LKS is the dissemination of research in the fields of e-learning, educational technology, Information and Communication

Technologies (ICT), and Knowledge Management. The relevance of such scope cannot be measured and evaluated objectively, but can be only detected through the opinions and viewpoint of the specific scientific community. Seventy-five percent of respondents expressing an opinion somewhat agree or strongly agree that the scope of the journal is relevant for own research.

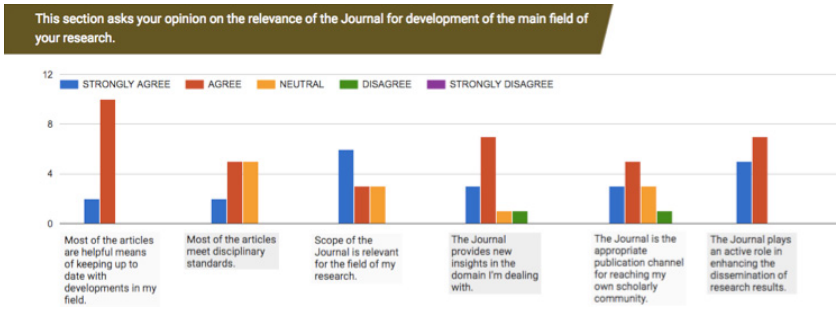

Fig. 2 - the opinions of the board members about the relevance of Je-LKS.

The limited number of answers does not allow reflecting critically on the relationship between the relevance of the scope and the research field of the respondents. However, it should be noted that there are no notable differences of opinions among the scholars, albeit few, in the fields of Computer and Information Sciences and Educational Sciences.

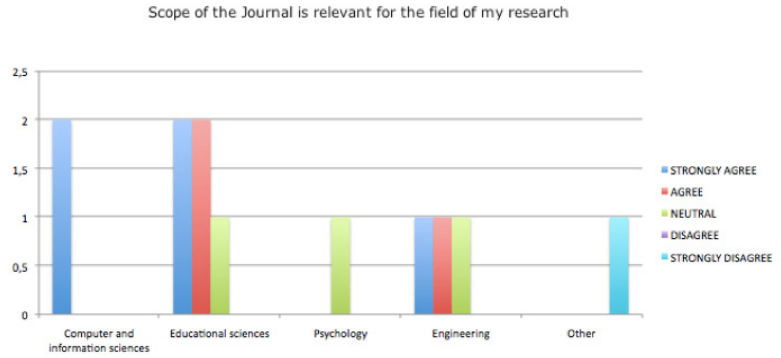

Fig. 3 - the opinions of the board members about the relevance of the scope.

Only two members of the board have suggestions advice on how the publisher can improve the relevance of the Journal. The first one proposes to make the journal better known outside Italy, striving to be included in the JCR listing. The second one suggests make a congress.

Journal visibility

A journal should promote and make the content visible in a timely way to potential readers and authors. The visibility of a journal can be increased in a variety of ways through traditional marketing, the use of libraries, the media, professional networks, and social media.

In this report the requirement of the visibility has been segmented into four indicators concerning presence in databases, journal website, internationalization of knowledge, and advertising.

Currently, SCOPUS, EBSCO, Google Scholar, Elsevier, Thomson Reuters Journal Citation Reports, and DOAJ, among other databases, indexed Je-LKS. Once a journal is indexed by a database, it is immediately made available to all users of that database. Indexing and abstracting services facilitate the visibility and, in turn, the credibility of the journal.

The website of Je-LKS is easy to locate and includes important information about all aspects of the process of refereeing, how submit a paper, the editor and publisher, structure and names of the editorial boards, author guidelines explaining the manuscript submission process, ethical code, reference to SIe-L.

Je-LKS can certainly be considered an International journal since published in English (the most common language for international communication in scientific publishing), its aims and scope are of interest to a wider international scientific community within the specific subject field of e-learning and knowledge management, and the members of the editorial board are internationally renowned experts.

Finally, advertising must be relevant, useful, and non-invasive and Je-LKS implements promotional activities to increase the visibility, including the use of Facebook.

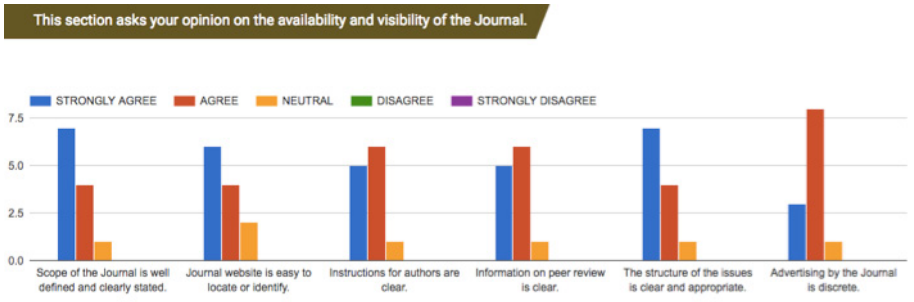

Fig. 4 - the opinions of the editorial board members about the visibility of Je-LKS.

Only two members of the editorial board have suggestions advice on how the publisher can improve the visibility of the Journal. The first one stressed

internationalization of the journal while the second one proposed to use the tools of web 2.0.

Editorial management

Editorial management of a journal involves responsibility for double-blind review process management of journal, namely, from when authors submit their manuscript to publishing, as well as assurance all editorial activities such as coordinating deadlines so that they may met in timely fashion, building PDF for authors, writing call for papers, promoting alternate authors, creating original news, and so on.

This requirement of quality implies that the journal is active, published, and regularly makes available its numbers. Furthermore, a journal may offer guidelines explaining to authors the manuscript submission process and acceptance criteria, a review form clearing up to reviewers acceptance criteria and how assess the quality and importance of submitted manuscripts, and ethical code for publications. Je-LKS meets all the indicators of this requirement.

Scientific quality of content

This is absolutely the most important requirement for a scientific journal and concerns a set of indicators connected with peer review, guest editors, editorials, research articles, formal style of writing, and high rejection rate. Je-LKS is a peer double blind reviewed journal and through this referring process ensures the quality of content. Adopting peer review model should ensure more responsible publishing. Je-LKS offers a review form that explaining acceptance criteria and help to judge the quality and importance of submitted manuscripts. The review process aims to raise the quality of papers, that will be so good examples of argumentation, clear expression, formal style of writing, grammatical correctness, accessibility for readers, centered on the research problem under investigation, fitted with the acceptance criteria, and with a solid understand the nature, the nuances and the complexities of the theme.

In 2016 Je-LKS did not have international guest editors and the members of the scientific board have considered the guest editors have been experts in their field of research. The members of the editorial scientific board are appreciated the quality of editorials. The quality of articles is judged positively by the Scientific Committee and is also confirmed by the high percentage of rejection rates. In fact, only 40 articles were published of the 125 received in 2016 (perceptual of acceptance of manuscripts: 32% and perceptual of rejection of manuscript: 68%).

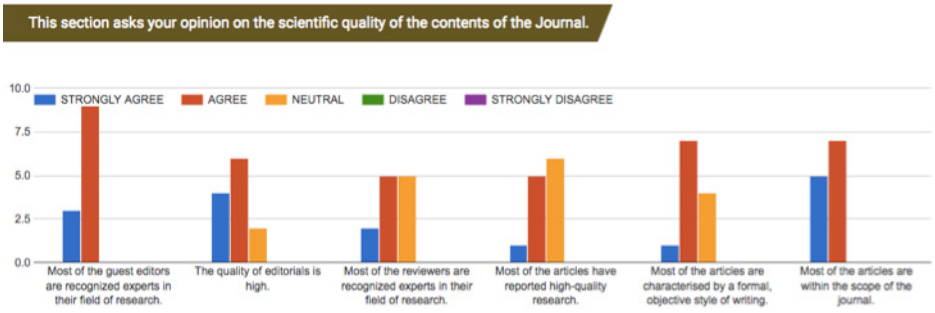

Fig. 5 - the opinions of the editorial board members about the contents of Je-LKS.

Only two members of the editorial board have suggestions advice on the quality of the content of the Journal. The first one suggested to negotiate criteria more shared among the reviewers. Instead, the second one proposed to add other members to scientific editorial board.

Conclusions

This report focused on the self-assessment process used by the Journal of e-Learning and Knowledge Society (Je-LKS) to estimate the quality of the journal and to make improvements. The aim was to offer an objective insight into performed processes and provided feedback on how improving and increasing the level of quality of the scientific journal.

Therefore, it is advisable:

- ***Improving the involvement of the members of the scientific editorial board.*** Members of the scientific editorial board represent the journal in the world. Other members could be added to the scientific editorial board. The scientific editorial board may be involved in telematic half yearly meetings, asking to write critical review, editing special issues, and acting as a group of self-assessment.

- ***Clarifying and write better the aims and scope of the journal website.*** The scope of the Je-LKS is the dissemination of research in the fields of e-learning, educational technology, Information and Communication Technologies (ICT), and Knowledge Management. It is necessary clarify better the aims and scope of the journal in order to interest to a wider international scientific community within of the specific subject fields.

- ***Adding the manuscript acceptance criteria to the author's guidelines available on the site.*** It is very important that who want to submit manuscript know the acceptance criteria of the journal, not only in order to submit a paper fitted with the acceptance criteria of the Journal, but primarily to communicate that Je-LKS accepts high quality research articles, focused on the research problem under investigation, with solid knowledge on the nature, the nuances and the complexities of the theme, grammatically correct, and graphs and diagrams well alignment with the text.

- ***Journal Citation Reports (JCR) listing.*** According to one of the members of the editorial board, «the journal is already very well indexed. Next step is becoming JCR».

Filomena Faiella
University of Salerno, Italy

REFERENCES

Alberts, B. (2013), *Impact Factor Distortions*. Science 340(6134), 787.

Lee, C.J., Sugimoto, C.R., Zhang, G., Cronin, B. (2013), *Bias in Peer Review*. Journal of the American Society for Information Science and Technology, 64(1), 2-17.

Morris, S. (2003), *Open publishing*. Learned Publishing, 16(3), 171-176.

Schaffner, A.C. (1994), *The future of scientific journals: lessons from the past*. Information Technology and Libraries, 13(4), 239-248.

Solomon, D. (2008), *Developing Open Access Journals: a pratical guide*. Oxford: Chandos Publishing.

Suber, P. (2012), *Open Access*. Cambridge: The MIT Press.

Ware, M., Mabe, M. (2015), *The STM Report: An overview of scientific and scholarly journal publishing*. Copyright, Fair Use, Scholarly Communication, etc.. Paper 9. http://digitalcommons.unl.edu/scholcom/9

Ware, M., Monkman, M. (2008), *Peer review in scholarly journals: Perspective of the scholarly community – an international study*. Bristol: Publishing Research Consortium.

Wellington., J. (2003), *Getting Published: A Guide for Lecturers and Researchers*. London: RoutledgeFalmer.

Willinsky, J. (2006), *The Access Principle The Case for Open Access to Research and Scholarship*. Cambridge: The MIT Press.

Je-LKS
Journal of e-Learning and Knowledge Society
The Italian e-Learning Association Journal
PEER REVIEWED PAPERS
Vol. 13, n.2, 2017
ISSN: 1826-6223 | eISSN: 1971-8829

LEARNING FROM DECADES OF ONLINE DISTANCE EDUCATION: MOOCS AND THE COMMUNITY OF INQUIRY FRAMEWORK

Dodzi Amemado[1]
Stefania Manca[2]

[1] Independent researcher, dodzi.amemado@umontreal.ca
[2] Institute of Educational Technology, National Research Council of Italy, stefania.manca@itd.cnr.it

Keywords: MOOCs, Community of Inquiry, distributed learning, learning design, learning science.

Despite their growing popularity, there are many contradictory arguments between supporters and detractors of MOOCs. Nevertheless, the advent of mass-scale online courses is increasingly credited to have the potential to reshape higher education significantly over time, and recent research analyses how and in which ways such a potential can be leveraged. Aim of this conceptual study is to incorporate the Community of Inquiry (CoI) framework into learning design practice to overcome current MOOCs pedagogical limitations. In order to be applied to a large number of participants, the three presences of the CoI framework (social, cognitive and metacognitive, and teaching) need to be adjusted and combined with the distributed learning approach. In this way, fostering distributed learning among participants would lead learners to take responsibility for their learning experience through the exploitation of roles and tasks traditionally assigned to distinct and separate roles. These adjustments could address

for citations:
Amemado D., Manca S. (2017), *Learning from decades of online distance education: MOOCs and the Community of Inquiry framework,* Journal of e-Learning and Knowledge Society, v.13, n.2, 21-32. ISSN: 1826-6223, e-ISSN:1971-8829
DOI: 10.20368/1971-8829/1339

issues of participation, motivation, and enhance successful learning experience.

1 Introduction

Massive Open Online Courses (MOOCs) are becoming increasingly popular especially in North America and Europe. They encompass a wide spectrum of design approaches and scholars from diverse disciplines have contributed to an intense debate on MOOCs pedagogies and methodological models (Brown *et al.*, 2015; Macleod *et al.*, 2015). A number of syntheses of the literature that attempted to summarize research in this field have emphasized distinctions between strands of MOOCs (cMOOCs, xMOOCs, etc.), impacts on education and demographics of users (Ebben & Murphy, 2014; Raffaghelli, Cucchiara & Persico, 2015; Veletsianos & Shepherdson, 2016). However, as reported by Veletsianos and Shepherdson (2016), there are further areas that deserve attention for future research, such as learners' voices or instructor-related topics.

Despite current limitations, it is important to go beyond hype and underestimation if we want to identify the research challenges for the future (Fischer, 2014). Indeed, MOOCs appear to be an online crossroad where to learn from other areas of studies and from professionals and scholars of different backgrounds. For instance, Kop and colleagues (2011) point out the potential of MOOCs for "shared knowledge" and "distributed cognition" and stress that MOOCs would act as an environment in which new forms of distribution, storage, archiving, and retrieval offer the potential for the development of shared knowledge. MOOCs would also be better conceptualized as being one of the components in a rich landscape of learning (Fischer, 2014).

In this study we propose the conceptual model of the Community of Inquiry (CoI) (Garrison, Anderson & Archer, 1999) as a framework to cope with some of the critical issues that have emerged in the field so far. In the following, we outline the main pedagogical challenges faced by MOOCs and the need to accommodate online distance education best practices that have been made available in the last decades. We then introduce the CoI framework and the three presences (social, cognitive and metacognitive, and teaching), in combination with the concept of distributed learning and how it may affect the three dimensions of the framework. We conclude with some considerations and implications for future research.

2 Limitations of current MOOCs pedagogical models

A number of pedagogical foundations and methodological approaches of MOOCs have been raised in recent studies (Conole, 2015; Ebben & Murphy, 2014; Fischer, 2014; Raffaghelli, Cucchiara & Persico, 2015; Veletsianos &

Shepherdson, 2016). Ebben and Murphy (2014) reviewed a MOOC project that adopted connectivist pedagogy in initial phases and, then, focused on approaches mostly aimed at renewing higher education business models. Glance and colleagues (2013) found that the main tools used in a great number of MOOCs were formative quizzes, short video formats, peer and self-assessment and discussion forums. The authors also argue that MOOCs are mostly a restatement of online distance instruction that have been in use for some time, except for the numbers of participants.

In another study Toven-Lindsey and colleagues (2015) examined the pedagogical tools used in 24 MOOCs and reported that the range of pedagogical practices currently used tends toward an objectivist-individual approach. Although all four categories of the Teaching Approach Framework (objectivist-individualist, objectivist-group, constructivist-individual, and constructivist-group) were identified, all MOOCs relied on the objectivist-individualist approach. Margaryan and colleagues (2015) analyzed the instructional design quality of 76 randomly selected MOOCs, including 26 connectivist cMOOCs and 50 xMOOCs, in the light of ten instructional principles derived from contemporary learning and instructional theories about effective instruction. The study found that the majority of MOOCs of both types rely on design principles that privilege high quality content rather than overall instructional design and learning experience.

A further consideration concerns higher education attitude according to which "*universities do not adopt technologies primarily for pedagogical or teaching and learning task-related reasons. Counter-intuitively, it is only afterwards that pedagogical concerns come forward and universities try to take advantage of this opportunity of technology*" (Amemado, 2014, p. 28). The advent of MOOCs seems not to be an exception. Today they constitute a potentially valuable alternative to campus-based courses or large classroom teaching. At the same time, they can emphasize the power of harnessing a global, distributed learning community of peers (Conole, 2015). However, identification of effective learning design has become one of the key challenges facing education today and massive open courses specifically.

MOOCs need to address some intrinsic limitations, such as the impossibility to support tens of thousands of learners providing tailored individual support, and consider a number of alternatives (*Ibidem*). For instance, encouraging participants to create their own personal learning environment made of tools and peers to support their learning, or providing tutors that summarize key elements of learning at key points in the course, are instructional measures that can be effective in supporting cognitive processes. At the same time, since learning is also an emotional and affective experience that need to be sustained (Veletsianos, Collier & Schneider, 2015), participants value communication,

trust, collaboration, inclusiveness, innovation and commitment as key elements in developing quality in online education (Ossiannilsson, Altinay & Altinay, 2015).

In the following, we address the Community of Inquiry framework (Garrison, Anderson & Archer, 1999) as a pedagogical model and a learning design framework to place MOOCs in a context of pedagogically-founded learning design. In fact, we advocate that, despite the diverse pedagogical theories that are at the basis of connectivist (cMOOCs) and objectivist MOOCs (xMOOCs), learning design of large courses needs to be based upon common pedagogical foundations aimed at facilitating meaningful learning and engaging learners in a successful and satisfying experience. After a short presentation of the CoI framework, the three dimensions that constitute the model are presented and revised according to a logic of sustainability for large online courses that is largely based on the construct of distributed learning.

3 The case of the Community of Inquiry framework

The CoI framework was originally developed by Garrison and colleagues (1999) to describe collaborative learning activities that occur within threaded online discussion forums. The pedagogical model underlying the framework is based on the assumption that knowledge can be constructed through social negotiation and that discussion with others - peers or tutors - is a primary way to learn because it encourages critical thinking and understanding. The main idea of the Community of Inquiry is "*the urgency of a new academic culture based on collaboration between participants, in an online or a blended teaching and learning environment*" (Amemado, 2013, p. 404).

The model is based on three elements: social presence, cognitive presence and teaching presence. Each element was object of specific investigation, with the aim of identifying the several factors that contribute to a successful learning experience. Cognitive presence was defined as "*the extent to which learners are able to construct and confirm meaning through sustained reflection and discourse in a critical community of inquiry*" (Garrison, Anderson & Archer, 2001, p. 11). Social presence was defined as "*the ability of participants in a community of inquiry to project themselves socially and emotionally, as "real" people (i.e., their full personality), through the medium of communication being used*" (Garrison, Anderson & Archer, 1999, p. 94). Lastly, teaching presence was defined as "*the design, facilitation, and direction of cognitive and social processes for the purpose of realizing personally meaningful and educationally worthwhile learning outcomes*" (Anderson *et al.*, 2001, p. 5).

Since then, the framework has been object of great debate and numerous adaptions have been proposed by other scholars with the aim of integrating

further dimensions or revising existing ones (Kreijns *et al.*, 2014; Pozzi *et al.*, 2007; Shea *et al.*, 2014). The same founders have extensively revised some of the original constructs, mostly in relation to cognitive presence, which has been enriched by the metacognitive component (Garrison & Akyol, 2013).

Originally proposed as a conceptual framework for investigating learning processes that occur in asynchronous-based learning environments, the model has been applied to blended learning (Garrison & Vaughan, 2008) and to courses that do not contain online elements (Archer, 2010). Some authors have employed the framework to large online classes with specific reference to peer education (Nagel & Kotzé, 2010).

4 Distributed learning as keystone for sustainability in large open courses

Distributed learning is "*an instructional model that allows instructor, students, and content to be located in different, non-centralized locations so that instruction and learning occur independent of time and place*" (Salzberg & Polyson, 1995, p. 10). In online learning, distributed learning has been framed as an instructional paradigm that offers "*the potential to create shared 'learning-through-doing environments' available anyplace, any time, on demand*" (Dede, 1996, p. 4). This means that resources, expertise, educational strategies, digital technologies and learners' groups or communities can be identified in many places and many times.

The idea of distributed learning is strictly associated with the connectivist approach to learning as exploration, connection, creation and evaluation processes within networks of people, digital artefacts and content (Siemens, 2005). From this perspective, social networks play an essential role in learning environments for knowledge sharing and student support. In this light, peer teaching, tutoring and distributed simulations have been highlighted as measures to carry out distributed learning (Dede, 1996), along with models of distributed leadership (Janovic, McCloud-Bondoc & Ralston, 2014).

As far as MOOCs are concerned, Grover and colleagues (2013) claim that the distributed nature of intelligence and the associated learning experiences are what are heightened most in MOOCs. Learning activity is distributed across people, environments and situations, thus exemplifying both the social and the material dimensions of distributed intelligence. Roles and responsibilities, either learners' or instructors', are distributed because of the scale of the course and distributed assessment practices are preferable to automatic grading.

As presented above, in the perspective of the CoI framework, distributed learning may be assigned to specific categories and indicators of the three kinds of presence (social, cognitive and metacognitive, teaching). In the following, the three presences are presented with a specific focus on their application in

large massive courses.

5 Distributed social presence

One of the key components in MOOCs success is to facilitate social interactions between students and create learning networks that promote effective flow of information. Some might argue that distribution of social presence is the norm in online learning. However, the scale of MOOCs might limit opportunities for establishing sense of trust between learners, likely leading to much more utilitarian relationships.

Recent research has pointed out how a strong sense of community and affective expression prove to be an influential factor of motivation, engagement and persistence in large courses. Social presence facilitates trust building and engagement in group-based problem solving (Gasevic *et al.*, 2014). Sense of community may be fostered, for instance, openly sharing thoughts and helping others during the study group sessions, or providing comments and encouragement to fellow participants (Chen & Chen, 2015).

In the perspective of distributed learning, learners need to know they are mutually dependent on each other to accomplish learning tasks, especially in the absence of an instructor or teaching coordinator. Anderson and Dron (2011) pointed out that the activities of learners may be distributed through a plethora of network tools (wikis, web forums, social network sites, micro blogging sites, etc.) that could be enriched by "*the comments, contributions, and insights of students who have previously engaged in the course and that persist as augmentable archives to enrich network interactions for current students*" (p. 88).

Profile pages and group awareness tools are technical features that make members aware of the activities of the others and foster impression formation. This is the case, for instance, of social badges that allow the automatic awarding of user activities (Dron & Ostashewski, 2015). Tools of this kind help convey information about members' learning interests, their knowledge and expertise, and any other type of relevant information for group learning. However, the increasing use of multiple social media platforms in MOOCs poses further challenges in linking online identities and content dispersed and distributed across diverse platforms (Absar *et al.*, 2016). From this point of view, social media mining and social learning analytics could serve the purpose of detecting and analyzing social media communication in relation to learning processes (Manca, Caviglione & Raffaghelli, 2016).

6 Distributed cognitive and metacognitive presence

The idea of distributed cognition was developed in the 90s with the aim of studying cognition as off-loaded into the environment through social and technological means, where information is also made available to other agents (Salomon, 1996). A distributed cognition system involves the coordination between individuals, artifacts and the environment and is based on internal and external representations (Zhang & Norman, 1994).

Cognitive presence refers to higher-order thinking processes rather than to specific individual learning outcomes, although it includes learning processes and outcomes. The four phases of the cognitive presence (triggering event, exploration, integration, and resolution) imply a number of steps that can be carried out individually or in a group. Each phase may be supported through the activation of resources, materials, expertise, that can be identified in the networks of learners and in the online digital sites. As an example, synthesis and connection of ideas may be based upon the integration of information from various synthesis sources such as textbook, articles, personal experience, but also from further resources distributed in the networks of learners. In contrast with what the original CoI framework addresses as beneficial for the group of learners, cognitive processes may be enhanced thanks to the shift of focus from the group to the network as the locus of learning.

From the perspective of MOOCs, shared artifacts that support external representations to sustain the development of internal representations, or peers that summarize key elements of learning at key points in the learning task, can be effective in supporting cognitive processes (Conole, 2015). In a perspective of distributed competence, participants who tend to exhibit more expertise in a specific area can be assigned or self-assigned to carry out the task. This shift of focus has direct consequences for the teaching dimension as well, since the two presences are strictly intertwined, as pointed out in the next section.

Although it was not addressed in the original model, metacognition was subsequently incorporated in the framework as part of cognitive processes and metacognitive skills became an objective of the learning process. In MOOCs, careful deployment of metacognition strategies and self-regulation are crucial for student success and learners are expected to navigate networks of people and content resources in completing learning tasks (Shea *et al.*, 2014). Developing self-regulation skills may become determinant in performing efficiently in a large course and in completing the learning tasks. Designing learning experiences through the development of self-regulatory competences would result in students' better performance (Milligan & Littlejohn, 2014).

7 Distributed teaching presence

Teaching large masses of learners can be very challenging and providing tailored individual support is not possible, unless a number of alternatives are adopted (Conole, 2015). The need to cope with teaching issues in online distance education was addressed in the CoI framework according to which "*all participants assume teaching and learning roles and responsibilities to varying degrees*" (Akyol & Garrison, 2011, p. 189).

Distributed teaching among instructors and participants has become a prominent imperative in large online classes. One adopted measure is peer-to-peer learning and peer-led teaching (Walji *et al.*, 2016). Moreover, peer and self-assessment through which students assess their co-students' work has been suggested by many authors to overcome the constraints and limitations of large online courses (Kulkarni *et al.*, 2013; Nagel & Kotzé, 2010).

Another important issue related to distributed teaching presence in MOOCs is the review of students' assignments. Best practices suggest that students use an evaluation rubric to guide the review, whereas supervisors grade the final project for exam purposes (Nagel & Kotzé, 2010). Moreover, evaluating peers' work also exposes students to solutions, strategies and insights that they would otherwise not likely see. Providing students with ad-hoc technical features to carry out assessment could contribute to scale peer-assessment effectively (Kulkarni *et al.*, 2013).

Another recommended measure related to the issue of direct instruction is to take advantage of the different levels of skills and expertise related to the several topics of the course and exhibited by different cohorts of students. The idea of relying on diverse expertise and competence might be coupled with the distribution of artifacts and resources across the networks. From this perspective, since MOOCs are frequently attended by students with different educational backgrounds, age levels and cultural and geographical provenance, designing group learning activities that take into account these variances could be greatly beneficial. As already stressed in socio-constructivist learning environments, the affordances exhibited by group techniques such as Jigsaw, role play and reciprocal teaching (Pozzi, 2011) could also be adopted in massive online courses.

Conclusion

In this study we presented the main challenges of current pedagogical approaches and foundations in MOOCs design. We proposed that the Community of Inquiry framework, that has been validated through a great number of studies over the last fifteen years, could serve as a pedagogical

benchmark to cope with high numbers and weak instructional design that are currently at issue in all types of MOOCs.

The implications of applying the CoI framework to massive large courses are of multiple orders. The first is related to the dimension of instructional or learning design aimed at improving the quality of educational interventions and learning experiences. It is fundamental that MOOCs rely on a design model based on collaboration suitable for large groups. For now, and with respect to current pedagogical models, the main point would be to facilitate learning at scale by fostering a peer-to-peer learning approach. With its focus and emphasis on group collaborative thinking and learning, though conceived for online communities that deal with small numbers of students, the CoI framework may stand as an effective design model for massive open and online courses. Through the exploitation of the three dimensions of social, cognitive/metacognitive and teaching presence, learning activities could be designed to enhance cognitive and metacognitive skills aimed at acquiring self-regulated competences.

A second order is related to the experience of the optimal social atmosphere where participants should feel united and not isolated. From this perspective, technical and functional features suited to foster the development of networks of interpersonal relationships or social networks would support affective work relationships, shared social identity, group cohesiveness, mutual trust and a sense of belonging and community. Designing an optimal social space where participants can share their previous competences and professional identities would be an added value in large courses, where participants do not know each other and do not have the chance to meet in person.

A final order is related to research. Although a few studies have already adopted the CoI framework in massive and large courses, further experimental research is required to validate the framework. The addition of the construct of distributed learning is proposed here as a specification of the CoI model applied to MOOCs contexts. MOOCs present specific features, requirements and challenges that the long tradition of distance education courses has never faced: high numbers and geographically distributed participants are expected to tackle different learning styles and cultural attitudes towards learning.

REFERENCES

Absar, R., Gruzd, A., Haythornthwaite, C., & Paulin, D. (2016). Linking Online Identities and Content in Connectivist MOOCs across Multiple Social Media Platforms. In *Proceedings of WWW 2016 Companion*, April 11-15, 2016, Montréal, Québec, Canada, 483-488.

Akyol, Z., & Garrison, D. R. (2011). Assessing metacognition in an online community of inquiry. *The Internet and Higher Education*, 14(3), 183-190.

Amemado, D. (2013). Pedagogical Requirements in a University-Context Characterized by Online and Blended Courses. In Z. Akyol & D. R. Garrison (Eds.), *Educational Communities of Inquiry: Theoretical Framework, Research and Practice* (pp. 401-427). Hershey, PA: IGI Global.

Amemado, D. (2014). Integrating technologies in higher education: the issue of recommended educational features still making headline news. *Open Learning: The Journal of Open, Distance and e-Learning*, 29(1), 15-30.

Anderson, T., & Dron, J. (2011). Three Generations of Distance Education Pedagogy. *The International Review of Research in Open and Distance Learning*, 12(3), 80-97.

Anderson, T., Rourke, L., Garrison, D. R., & Archer, W. (2001). Assessing teaching presence in a computer conferencing context. *Journal of Asynchronous Learning Networks*, 5(2).

Archer, W. (2010). Beyond online discussions: Extending the community of inquiry framework to entire courses. *The Internet and Higher Education*, 13(1-2), 69.

Brown, M., Costello, E., Donlon, E., & Nic Giolla-Mhichil, M. (2015). A strategic response to MOOCs: How one European university is approaching the challenge. *The International Review of Research in Open and Distributed Learning*, 16(6), 98-115.

Chen, Y.-H., & Chen, P.-J. (2015). MOOC study group: Facilitation strategies, influential factors, and student perceived gains. *Computers & Education*, 86, 55-70.

Conole, G. (2015). Designing effective MOOCs. *Educational Media International*, 52(4), 239-252.

Dede, C. (1996). The evolution of distance education: Emerging technologies and distributed learning. *American Journal of Distance Education*, 10(2), 4-36.

Dron, J., & Ostashewski, N. (2015). Seeking connectivist freedom and instructivist safety in a MOOC. *Educación XX1*, 18(2), 51-76.

Ebben, M., & Murphy, J. S. (2014). Unpacking MOOC scholarly discourse: A review of nascent MOOC scholarship. *Learning, Media and Technology*, 39(3), 328–345.

Fischer, G. (2014). Beyond hype and underestimation: identifying research challenges for the future of MOOCs. *Distance Education*, 35(2), 149-158.

Garrison, D. R., & Akyol, Z. (2013). Toward the development of a metacognition construct for communities of inquiry. *The Internet and Higher Education*, 17, 84–89.

Garrison, D. R., Anderson, T., & Archer, W. (1999). Critical inquiry in a text-based environment: Computer conferencing in higher education. *The Internet and Higher Education*, 2(2/3), 87–105.

Garrison, D. R., Anderson, T., & Archer, W. (2001). Critical thinking, cognitive presence, and computer conferencing in distance education. *American Journal of Distance Education*, 15(1), 7−23.

Garrison, D. R., & Vaughan, N. (2008). *Blended learning in higher education: Framework, principles, and guidelines*. San Francisco, CA: Jossey-Bass.

Gasevic, A., Kovanovic, V., Joksimovic, S., & Siemens, G. (2014). Where is research on massive open online courses headed? A data analysis of the MOOC research initiative. *The International Review of Research in Open and Distance Learning*, 15(5), 134-176.

Glance, D. G., Forsey, M., & Riley, M. (2013). The pedagogical foundations of massive open online courses. *First Monday*, 18(5).

Grover, S., Franz, P., Schneider, E., & Pea, R. (2013). The MOOC as Distributed Intelligence: Dimensions of a Framework for the Design and Evaluation of MOOCs. In *Proceedings of the 10th International Conference on Computer Supported Collaborative Learning*, Madison, WI, June 16-19.

Janovic, D., McCloud-Bondoc, L., & Ralston, A. (2014). Leadership Strategies in Mobile English as a Second Language Training. *The International Review of Research in Open and Distance Learning*, 15(3), 331-345.

Kop, R., Fournier, H., & Mak, J. (2011). A Pedagogy of Abundance or a Pedagogy to Support Human Beings: Participant Support on Massive Open Online Courses. *The International Review of Research in Open and Distance Learning*, 12(7), 75–93.

Kreijns, K., Van Acker, F., Vermeulen, M., & van Buuren, H. (2014). Community of Inquiry: Social Presence revisited. *E-Learning and Digital Media*, 11(1), 5-18.

Kulkarni, C., Wei, K. P., Le, H., Chia, D., Papadopoulos, K., Cheng, J., Koller, D., & Klemmer, S. R. (2013). Peer and self-assessment in massive online classes. *ACM Transactions on Computer-Human Interaction,* 20(6), 1–31.

Macleod, H., Haywood, J., Woodgate, A., & Alkhatnai, M. (2015). Emerging patterns in MOOCs: Learners, course designs and directions. *TechTrends*, 59(1), 56-63.

Manca, S., Caviglione, L., & Raffaghelli, J. E. (2016). Big data for social media learning analytics: potentials and challenges. *Journal of e-Learning and Knowledge Society*, 12(2), 27-39.

Margaryan, A., Bianco M., & Littlejohn A. (2015). Instructional quality of Massive Open Online Courses (MOOCs). *Computers & Education*, 80, 77-83.

Milligan, C., & Littlejohn, A. (2014). Supporting professional learning in a massive open online course. *The International Review of Research in Open and Distance Learning*, 15(5), 197-212.

Nagel, L., & Kotzé, T. G. (2010). Supersizing e-learning: What a CoI survey reveals about teaching presence in a large online class. *The Internet and Higher Education*, 13(1–2), 45-51.

Ossiannilsson, E., Altinay, F., & Altinay, Z. (2015). Analysis of MOOCs practices from the perspective of learner experiences and quality culture. *Educational Media International*, 52(4), 272-283.

Pozzi, F. (2011). The impact of scripted roles on online collaborative learning processes. *International Journal of Computer-Supported Collaborative Learning*, 6(3), 471-484.

Pozzi, F., Manca, S., Persico, D., & Sarti, L. (2007). A general framework for tracking and analysing learning processes in computer-supported collaborative learning environments. *Innovations in Education and Teaching International*, 44(2), 169–

179.

Raffaghelli, J., Cucchiara, S., & Persico, D. (2015). Methodological approaches in MOOC research: retracing the myth of Proteus. *British Journal of Educational Technology*, 46(3), 488-509.

Salomon, G. (1997). *Distributed cognition: Psychological and educational considerations*. Cambridge, UK: Cambridge University Press.

Saltzberg, S., & Polyson, S. (1995). Distributed learning on the World Wide Web. *Syllabus*, 9(1), 10.

Shea, P., Hayes, S., Uzuner-Smith, S., Gozza-Cohen, M., Vickers, J., & Bidjerano, T. (2014). Reconceptualizing the Community of Inquiry framework: An exploratory analysis. *The Internet and Higher Education*, 23, 9-17.

Siemens, G. (2005). Connectivism: Learning as network creation. *ElearnSpace*. http://www.elearnspace.org/Articles/networks.htm

Toven-Lindsey, B., Rhoads, R. A., & Lozano, J. B. (2015). Virtually unlimited classrooms: Pedagogical practices in massive open online courses. *The Internet and Higher Education,* 24, 1-12.

Veletsianos, G., Collier, A., & Schneider, E. (2015). Digging deeper into learners' experiences in MOOCs: Participation in social networks outside of MOOCs, notetaking and contexts surrounding content consumption. *British Journal of Educational Technology*, 46(3), 570–587.

Veletsianos, G., & Shepherdson, P. (2016). A Systematic Analysis and Synthesis of the Empirical MOOC Literature Published in 2013–2015. *The International Review of Research in Open and Distance Learning*, 17(2), 198-221.

Walji, S., Deacon, A., Small, J., & Czerniewicz, L. (2016). Learning through engagement: MOOCs as an emergent form of provision. *Distance Education*, 37(2), 208-223.

Zhang, J., & Norman, D.A. (1994). Representations in Distributed Cognitive Tasks. *Cognitive Science*, 18(1), 87-122.

Je-LKS
Journal of e-Learning and Knowledge Society
The Italian e-Learning Association Journal
PEER REVIEWED PAPERS
Vol. 13, n.2, 2017
ISSN: 1826-6223 | eISSN: 1971-8829

THE SYNERGY BETWEEN MANIPULATIVE AND DIGITAL ARTEFACTS IN A MATHEMATICS TEACHING ACTIVITY: A CO-DISCIPLINARY PERSPECTIVE

Eleonora Faggiano[1]
Antonella Montone[1]
Pier Giuseppe Rossi[2]

[1]Università di Bari Aldo Moro
eleonora.faggiano@uniba.it; antonella.montone@uniba.it
[2]Università di Macerata - pgrossi.unimc@gmail.com

Keywords: Synergy between artefacts, Digital artefacts, Co-disciplinarity, Didactic Mediation, Theory of Semiotic Mediation.

This paper presents a teaching experiment aiming at constructing the meaning of axial symmetry through the mediation of a "duo of artefacts", made up by a digital artefact and a manipulative one. The meaning of the term "mediation" is described and used from a dual perspective, joining General Didactics and Mathematics Education. Herein, we describe an interactive book, created in a Dynamic Geometry Environment and a teaching sequence, based on the use of such a digital artefact, combined with a manipulative one. The main potential of the interactive book is based on the possibility to drag geometric objects and observe the effects of the dragging. The sequence has been experimented with a 4th grade class and the activities have been videotaped and analysed. Results have been analysed through the cited dual perspective and reveal how the mediation of the duo of artefacts can foster the construction of the mathematical meaning. In this paper we show how the digital artefact, acting in synergy

for citations:
Faggiano E., Montone A., Rossi P.G. (2017), *The synergy between Manipulative and Digital Artefacts in a Mathematics Teaching Activity: a co-disciplinary perspective,* Journal of e-Learning and Knowledge Society, v.13, n.2, 33-45. ISSN: 1826-6223, e-ISSN:1971-8829
DOI: 10.20368/1971-8829/1346

with the manipulative artefact, seems to exploit the potential of the sequence in terms of embodied involvement of the pupils in their cognitive process.

1 Introduction

Many researches in the latest years have investigated on the potentialities of the use of technologies in the teaching and learning processes. Definitive answers have not yet been given, however a research result seems to be confirmed, namely that successful outcomes depend on the consistency of the artefact, seen as an instrument (Rabardel, 1995), its potential and its affordances, as the models and the teaching strategies used. Crucial is also the educational environment that takes into account: the activities carried out with the artefacts by the students, individually or in groups; the interactions and the collective class discussions, in which experience is organized and structured.

The analysis of the research was done with a dual research perspective, conceived by the dialogue/interaction between General Didactics and Mathematics Education. The development of this dual perspective has required a special focus on the polysemic term "mediation", and related to it, on the term "artefact".

The research consists on the design, implementation and analysis of a teaching experiment, framed by the Theory of Semiotic Mediation (TSM) (Bartolini, Bussi & Mariotti, 2008) and the Didactic Mediation (Damiano, 2013; Rossi, 2016a), concerning the construction/conceptualization of axial symmetry at Primary School. It has been designed with the purpose of exploiting the potential of the synergic use of a "duo" (Maschietto & Soury-Lavergne, 2013) of artefacts/mediators, which is made up by: a digital artefact, developed in a Dynamic Geometry Environment (DGE); and a manipulative artefact, whose components are a sheet of paper and a pin.

The research discussed in this paper, was done comparing individual analysis made by each of the researchers on video collected during class interactions. In particular, a multimodal approach was used and the attention was focused on to both verbal aspects and gestures.

2 Theoretical framework

In order to make General Didactics and Mathematics Education interact, we have adopted co-disciplinarity (Blanchard-Laville, 2000). The reference framework used for Mathematics Education is the Theory of Semiotic Mediation (TSM) elaborated by Bartolini Bussi and Mariotti (2008) from a Vygotskian point of view, while the reference framework for General Didactics is the Didactic Mediation (DM) approach (Damiano, 2013) and the interactional

approach (Altet, 2012; Laurillard, 2014; Rossi, 2016b).

According to the TSM, there is an evolution from the artefact signs to the mathematical signs and during this evolution "pivot signs" play a key role. "Pivot signs" allow to bridge (see also Laurillard, 2014) common sense meanings and mathematical meanings, facilitating the transition from the context of the artefact to the mathematics context.

According to the DM theory, learning is a process that belongs to pupils, but it can occur only with teaching mediation. During the learning process, pupils organize and conceptualize their own experience and this is possible thanks to the interaction with didactic mediators that facilitate the transition from the specific experience to the generalization of it. In accordance with Damiano, every learning activity has a system of didactic mediators, that is the educational action makes use of functional multiples mediators that follow each other. In the TSM, the artefact and its affordance play a key role, while in the DM theory, the key role is played by the mediators.

So, the question is: what does change if in the mediators' system, or with the use of artefacts, there are also digital tools?

In the field of Mathematics Education, there have been many studies about the use of manipulative artefacts with regard to gestures, sensorimotor experiences and embodied cognition (Edwards *et al.*, 2009). Moreover, today scholars generally agree that digital artefacts can play a crucial role in the processes of teaching and learning (Monaghan *et al.*, 2016; Faggiano *et al.*, 2014). However, if an artefact, being manipulative or digital, is used only as an auxiliary tool to generate and show images, expand human memory or increase the turnaround in feedback, it would be unable to become an instrument and foster the progressive construction of mathematical knowledge, skills and attitudes. It is extremely important that teachers understand and become aware of the affordances, constraints, and mediating role of them as educational resources.

Thanks to the possibilities provided by the use of technology, for instance, it is possible to shift from using static representations to experimenting with dynamic and interactive modes of visualization and exploration (Hoyles & Lagrange, 2010). In particular, research has underlined the role of Dynamic Geometry Environment. A DGE is a computational microworld, embedding Euclidean Geometry, in which it is possible to construct geometric figures and interact with them, dragging the independent elements of the construction and observing relationships remain intact (confirmatory dragging) or whether any properties of the figure remain invariant (exploratory dragging). This typical characteristic, usually called the "dragging function", appears to be particularly important, as it can be instrumental in helping students to solve

construction problems, to explore geometrical situations and to formulate conjectures. Dragging allows to visualize the subsequent states of the same system and this can also be described as morphing (Rossi, 2016b). As Leung (2008) underlines, DGE is an experimental ground that enables the generation of various qualitatively different ways of seeing a geometrical phenomenon in action. Mathematical concepts can be naturally given visual dynamic forms, subject to our actions. Leung suggests that, the conceptualization process in DGE can be studied taking in consideration the theory of variation (Marton & Tsui, 2004). According to this theory «learning in terms of changes in or widening in our way of seeing the world can be understood in terms of discernment, simultaneity and variation» (Bowden & Marton, 1998, p.7).

Among the studies concerning digital artefacts, some researchers have created digital artefacts reproducing existing manipulative artefacts, aiming to understand the difference between the manipulative and digital versions based on the same concept. Other studies analyse the potentialities of using a duo of artefacts (Maschietto & Soury-Lavergne, 2013), intended as a couple of artefacts, a manipulative artefact and its digital equivalent, being used simultaneously during the same activity.

However, what does happen if the two artefacts, used in the same experience, although during different phases, differ in both structure and role?

In order to answer, we have to focus on the learning results, on the activated cognitive processes and on the role of the body in these processes (Sibilio, 2014; Rizzolatti & Sinigaglia, 2006). According to neuroscientific studies, the body actively participates in learning processes and this is connected to the centrality of the action in knowledge processes (Caruana & Borghi, 2016; Rivoltella, 2012; Rossi, 2011). Therefore, processes activated by different artefacts should be analysed while discourse and body language during manipulative and digital processes should be used. So the question is, if the role of action in knowledge processes is central, how should the action and role of the body be considered when digital artefacts are involved? Semiotic bundle (Arzarello, 2006) and Kress' (2015) multimodality concepts allow us both to understand the synergy between gestures and discourse in conceptualization and to explore the synergy of different types of communication, actions and simulations with manipulative and digital artefacts.

3 The duo of artefacts and the design of the teaching sequence

In order to analyse the impact of technology on the process, we first need to describe the teaching sequence. In this study, differently from what proposed by Maschietto and Soury-Lavergne, the digital artefact is not a counterpart of the manipulative one but it has different, whilst complementary, characteristic.

The manipulative artefact consists of a sheet of paper and a pin to be used to pierce the paper. This artefact allows an axial symmetry to be created in a direct fashion. The digital artefact is embedded in an Interactive Book (IB) created within the authoring environment of New Cabri (Cabrilog). The IB appears as a sequence of pages including the designed tasks, together with some specific tools. In particular, the tools are: those that allow the construction of some geometric objects (point, straight line, segment, middle point, perpendicular line, intersection point), the "Symmetry" and "Compass" artefacts and the "Trace" tool. A fundamental role is also played by the drag function, boosted by the tracing tool, that allows to observe the invariance of the properties characterizing the figures.

The expression didactic cycle refers to the organization of teaching in activities. These consist of using the artefact, individually producing signs and then in the end collectively producing and absorbing signs through Mathematical Discussion activities (Bartolini Bussi, 1998). In accordance with the TSM, the design of the teaching sequence follows the general scheme of (six) successive "didactic cycles". The use of one or the other artefact has been alternated throughout the sequence.

The sequence begins with a task to be accomplished with the use of the manipulative artefact. Given a black figure (convex quadrilateral) and a red line drawn on a sheet, the pupils are asked to draw in red a symmetrical figure to the black one, with respect to the red line, by folding the sheet along the line and using the pin to mark the necessary symmetrical points by piercing the paper. After completing this task, on the same paper they are asked to draw a blue symmetrical figure to the black one, employing a new blue line (Fig. 1). Finally, the pupils are asked to write an explanation of why and how they drew the red and blue figures and what looks the same and what looks different about them.

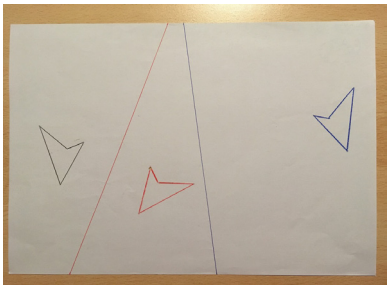

Figure 1: The manipulative artefact as it should appear at the end of the first cycle's tasks

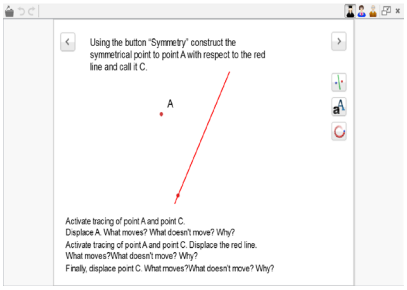

Figure 2: A screenshot of the first page of the digital artefact

The task of the second cycle focuses on the dual dependence of the symmetric point from the point of origin and from the axis, exploiting the potential of the dragging function and the tracing tool within the DGE[1]. The pupil is asked to build the symmetric point of a point A with respect to a given line, using the button/tool "Symmetry" and call it C. The second step is to activate the "Trace" on point A and point C, drag A, drag C, and drag the line and see, in each case, what moves and what doesn't, and explain why (Fig. 2).

The task of the third cycle requires to construct the symmetric point without the use of the pin with the aim to: observe that the line joining two symmetrical points is perpendicular to the axis and that the two points are equidistant from the axis; recognise that these two properties are reversible and that they characterise axial symmetry.

In the fourth cycle pupils are asked to construct the symmetric point of a point A, with respect to a given line, without the use of the button/tool "Symmetry". To do this, it is necessary to use in a right way the two properties already emerged during the third cycle, that is: to draw the perpendicular line to the axis, passing through the point A, and to use the "Compass" to look for the point on the perpendicular line which has the same distance from the axis that A has.

In the fifth and sixth cycle the order of use of the artefacts is inverted but the task is the same: a couple of two points, A and C, is given; it has to be interpreted as a couple of symmetrical points with respect to a hidden line; it is required to find and to draw the line; finally, pupils are asked to verify if the symmetric point of A with respect to the line drawn is C and to describe the procedure used, justifying it.

4 Research methodology

The research is based on a teaching experiment concerning the sequence described above (Montone *et al.*, 2017) developed in a fourth grade class, composed of 20 students. The teaching experiment was conducted during the normal school timesheet with biweekly meetings for three weeks. In the alternation of didactic cycles, students worked in randomly chosen pairs. The activities with the manipulative artefact were carried out in class, while activities with the digital artefact were conducted in the laboratory (in two shifts of ten children, working on five computers). At the end of each didactic cycle collective discussions were carried out. In the case of activities with digital artefact, an IWB has been used during the discussions. Activities have been videotaped and the video have been analysed by each of the researchers,

[1] The use of the tracing tool gives back the sequence of the various positions taken by both the points, while the point A is dragged by the student.

working independently. Notes on transcription and gestures have then been compared and discussed. In some cases, a shared vision emerged, sometimes a different meaning (but never opposite) was assigned to the same video fragment due to the different perspectives of researchers. For the video analysis the reference is the plural analysis (Altet, 2012, Vinatier & Altet, 2008). To analyse video fragments we also refer to Santagata and Guarino (2012) and to Scherin and van Es (2009). For the classification of gestures, we refer to the Semiotic Bundle (Arzarello, 2006).

5 The teaching experiment: results analysis and discussion

With the analysis of the results of teaching experiment we tried to figure out how the use of these two artefacts and their synergy are involved in the construction of the mathematical meanings and the interactions throughout the activities.

We will report a series of interactions in which the pupil refers to the digital artefact with both verbal communication and gestures in order to describe and explain a series of conceptual steps.

The first episode refers to the discussion held with the class at the end of the second cycle. During this discussion one of the children had constructed on the IWB the symmetric point of a given point with respect to a line. Pupils are asked to move the objects on the screen for the functional dependence between those objects to be perceived.

When the teacher focuses on why, when we move A, the symmetric point C moves too, S. states «if you move point A, point C has to move too because there must remain the symmetry», matching her verbal expressions with some gestures which will soon be caught and repeated by other pupils: by simulating the dragging of point A on the desk surface with her left hand, she moves it away from an imaginary line and simultaneously moves her right hand in the opposite direction; in particular, she opens her hands with the palms facing each other and puts them symmetrically ahead of her when she says, "there must remain the symmetry". Here, the pupil simulates with the gestures what she has visualized on the IWB and reproduces those movements on the desk, trying to explain what she observed and identify the existing relationship between the points and the line.

The immediately following discourse of another pupil (M.), shown in the Tab.1, underlines how the interpretation is changing and the digital artefact is becoming the mediator in the construction of the interpretation of what it is happening.

Table 1

M's discourse description

Her words	Her gestures
If you move point A only, point C has to move with point A because they must be symmetrical (a)	M. has her elbows on the desk and moves her hands ahead of her while speaking
like, if you move point A higher... (b)	She raises her left hand to indicate point A moving higher and looks towards her left hand
point C moves lower... so it is the same... (c)	She puts her hands in front of her face, to simulate, with the thumb and index of each hand, two identical segments, then she moves her right hand lower to show that, in this case, point C moves lower and looks towards her right hand
...because there must be... the same space... between the two points (d)	With a fast coordinated movement of her hands, she simulates two segments having the same length, using the thumb and index and bending the other fingers




a	b	c	d

This episode shows how the elements used by pupils to support their claims refer to the dragging process visualized in the digital artefact. The manipulative artefact gives a static vision because, for instance, after finding a symmetric point of a given point, making a hole in a sheet of paper by piercing it with a pin, the two points cannot move at all. Instead, in the previous transcription, the pupil refers to the dynamic process visualized with the digital artefact: "if you move it", "it moves" and matches words with hand gestures that simulate what she saw on the computer.

The role of the synergy needs also to be underlined: in order to indicate what a symmetric point is, pupils refer to the activity carried out with the paper and the pin and their initial conceptualization depends on the direct experience made by folding and piercing. In other words, the pupils refer to the manipulative artefact for the concept of symmetry and to the digital artefact when they want to describe the properties of the symmetric point. In this second case, it becomes essential to understand how point C moves when point A and the symmetry axis change and the dragging plays a key role in understanding this relationship. Thus, we talk about synergy: if the pupil action carried out with the manipulative artefact is essential to acquire the concept of symmetry,

the immersion in the digital simplifies the understanding of the relationships. In any case, one artefact refers to the other, since it is possible for the pupil to understand the relationships in the digital artefact only by referring to the previous experience with the sheet of paper and the pin. The same happens when going back to the manipulative artefact, the immersion in the digital supports the development of conceptualization.

The discussion continues and it seems interesting to report another episode (involving two other pupils: G. and V.) in which it is possible to underline the need to mentally go back to the digital artefact as for G. and the reference in synergy of both artefacts as for V.. The teacher restarts and asks again how they know that the distance is always the same, and G. says: «We figured it out because when [he] moved point A, point C moved too, but when they were very far away from the red line it was always the distance from the red line… from point C to the red line there was the same distance as… from point A to the red line».

G. matches his discourse gesticulating in the space ahead of him. In fact, he looks towards the IWB screen, points his finger towards a hypothetical point A in front of him, with his right hand, while he symmetrically raises his left hand at the same height. He leans back with his body and spreads his arms outwards simulating the two points moving and keeping the same distance from the axis. Here, it shows how the interaction with the digital artefact allowed G. to perceive the invariant element, the distance, thanks to the variation on the screen of the position of point A and consequently of point C, which depends on A. He visually perceives and anticipates the generalization of the invariance of the distance of these two points from the line. In other words, it is as if the pupil visually analysed the variation of an aspect of the whole configuration, keeping another aspect constant, hence anticipating the surfacing of invariant schemes.

Then V., in order to analyse the relationships and after carrying out the activity with the digital artefact, asks to and receives from the teacher a sheet of paper and a pin. She obtains a symmetric point with respect to a fold piercing the paper with the pin, reopens the paper, looks at it, and, simultaneously looking at the IWB adds: «It is more visible there and it is easier… because there you can move the point and so I easily realize that if I move the point… the already created figure… it is easier to realize that there is the same distance because just by moving, you can understand, especially when we distance a lot from the line, that also point C moves… and so there is always the same distance. But I was able to understand it on the paper, also».

V.'s discourse confirms the hypothesis that the digital artefact is acting in synergy with the manipulative one. However, it is also clear that the modality with which these two artefacts operate is different. The manipulative artefact

allows the direct action of the pupil. The pupil's body learns while acting and this emerges in other situations in which pupils simulate the folding and piercing, in order to describe what a symmetric point is. In other words, when they refer to the digital artefact pupils describe and simulate the actions that they perform with their own hands. When they refer to the digital artefact, the procedure to find the symmetric point seems to become less important and objects movements caused by dragging become essential instead. However, in this case, pupils do not refer to their action to describe what they made but they identify themselves with what they observed and simulate the movements of the points and lines as seen on the screen. Here they move their arms as lines and their hands as points drawing in the air those movements seen on the computer. The dragging function, together with the tracing, after allowed pupils to mentally move the objects and the previous visualization of what happened made explicit the implicit dynamism of thinking mathematical objects.

The next steps show the difference in the way pupils perceive that the distance between A and C from the line is always the same: with the manipulative artefact, folding the sheet of paper and observing the superimposition of the two holes; with the digital artefact, animating/moving point A and observing how consequently point C moves. The role of the animation seems to be more effective than the static analysis. The underlined difference is at the base of the synergic use of the two artefacts since they operate on cognitive processes and with different operative and non-superimposable modalities.

We must point out that besides the importance of the activities conducted with the two artefacts, the role of the elaboration of concepts and the debate after each activity is fundamental. Actually, according to the TSM, at the end of each activity pupils were asked to describe what they made, explain what happened and give interpretations. Neither direct action nor the one with the digital artefact alone allow pupils to conceptualize, but it is the subsequent collective Mathematical Discussion (Bartolini Bussi, 1998) at the end of each activity that allows them to construct the mathematical meaning starting from the carried out experience. During the discussion, pupils reorganize their knowledge thanks to the teacher guide and here the references to the performed actions are central. In fact, exchanges are both verbal and non-verbal.

Conclusions

This paper presents a teaching experiment investigating the synergy between manipulative and digital artefacts. The collective discussions have reified the construction of meanings. Artefacts have acted as pivot between experience and mathematical knowledge and as mediator between experience and conceptualization.

The experimentation has shown the different relationship of the body and representation when pupils work with the two artefacts. When they work with manipulative artefacts, the action is the focus, that is, in the specific case, folding, piercing, and manipulating the sheet of paper. When pupils work with the IB, they create the points and lines using the digital artefact and when they describe what they did using discourse and gestures, they seem to have mainly absorbed the effect of the action, not the action alone. They simulate movements with their hands and arms and use words that refer to the visualization of the objects on the screen. In fact, pupils say "it moves", "trace", "movement". In the second case it seems that pupils are immersed in the process and that they have identified themselves with what they saw and have absorbed not their own action but the objects movements.

The results obtained have to be confirmed by other experiments. It is necessary to verify how much the results depend on the specific digital artefact and on the specific sequence. The study could be developed in two directions: realizing different math teaching sequences to verify the synergy between digital and manipulative artefacts, and realizing sequences in other subjects to verify further synergies.

This experience has shown that we need to understand the different impact of the two artefacts in the incorporation and conceptualization of the experience itself and the importance of synergy. This refers to one of the hypothesis we started with: technologies today cannot be considered as a specific sector and a separated field of research in mathematics education as well as in general didactics.

REFERENCES

Altet, M. (2012). *L'apporto dell'analisi plurale dalle pratiche didattiche alla co-formazione degli insegnanti*. In P.C. Rivoltella, P.G. Rossi (eds.). L'agire didattico. Brescia: La Scuola.

Arzarello, F. (2006). Semiosis as a multimodal process, *Relime*, Numero Especial, 267-299.

Bartolini Bussi, M. G. (1998). *Verbal interaction in mathematics classroom: A Vygotskian analysis*. In H. Steinbring, M. G. Bartolini Bussi, & A. Sierpinska (Eds.), Language and communication in mathematics classroom (pp. 65–84). Reston, VA: NCTM

Bartolini Bussi, M. G. & Mariotti, M. A. (2008). Semiotic mediation in the mathematics classroom: Artifacts and signs after a Vygotskian perspective, in L. English (ed.), *Handbook of International Research in Mathematics Education*, (second edition), Routledge, 746-783.

Blanchard-Laville, C. (2000) *De la co-disciplinarité en sciences de l'éducation. Revue française de pédagogie*. 132, pp. 55-66.

Boweden, J. and Marton, F. (1998). *The University of Learning*. London: Kogan Page.

Caruana, F., & Borghi, A. (2016) *Il cervello in azione*. Bologna. Il Mulino.

Damiano E. (2013) *La mediazione didattica*. Franco Angeli. Milano.

Edwards, L., Radford, L., Arzarello, F. (Eds.). (2009). Gestures and multimodality in the construction of mathematical meaning. *Educational Studies in Mathematics*, 70(2).

Faggiano, E., Ferrara, F., Montone, A. (2014), Special issue: Papers from the 11th International Conference for Technology in Mathematics Teaching (ICTMT11), *Teaching Mathematics and its Applications,* Oxford University Press, Volume 33, Issue 1, pp. 1-2

Hoyles, C., & Lagrange, J.-B. (Eds.). (2010). *Mathematics education and technology Rethinking the terrain*. New York, NY/Berlin, Germany: Springer.

Kress, G. (2015) *Multimodalità. Un approccio socio-semiotico alla comunicazione contemporanea*. Progedit. Bari.

Laurillard, D. (2014) *Insegnamento come scienza della progettazione*. Franco Angeli. Milano.

Leung, A. (2008) Dragging in a Dynamic Geometry Environment Through the Lens of Variation, *International Journal of Computers for Mathematical Learning* (2008) 13:135–157.

Marton, F., Tsui, A.B.M. (2004) *Classroom discourse and the space of learning*. Mahwah, NJ: Lawrence Erlbaum Associates.

Maschietto, M., Soury-Lavergne, S. (2013) Designing a Duo of Material and Digital Artifacts: the Pascaline and Cabri Elem e-books in Primary School Mathematics. *ZDM Mathematics Education* 45(7), 959-971.

Monaghan, J., Trouche, L., & Borwein, J. (2016). *Tools and mathematics*. Dordrecht: Springer International Publishing

Montone, A., Faggiano, E., Mariotti, M. A. (2017) *The design of a teaching sequence on axial symmetry, involving a duo of artefacts and exploiting the synergy resulting from alternate use of these artefacts*. Proceedings of CERME 10, to appear

Rabardel, P. (1995). *Les hommes et les technologies; approche cognitive des instruments contemporains*. Paris: Armand Colin

Rivoltella, P.C., (2012) *Neurodidattica. Insegnare al cervello che apprende*, Raffaello Cortina Editore. Milano.

Rizzolatti, G. & Sinigaglia, C. (2006) *So quel che fai. Il cervello che agisce e I neuroni specchio*. Raffaello Cortina: Milano

Rossi, P.G. (2011). *Didattica enattiva*. Franco Angeli. Milano.

Rossi, P.G. (2016a). Gli artefatti digitali e la mediazione didattica. *Pedagogia Oggi*. 2, 41-64.

Rossi, P.G. (2016b). Allignment. *ESS*. 7, 2, 33-60.

Santagata, R. & Guarino, J. (2011). Using video to teach future teachers to learn from teaching. *ZDM The International Journal of Mathematics Education*, 43, 1, 133–145.

Sherin M.G. & van Es E.A. (2009). Effects of Video Club Participation on Teachers' Professional Vision. Journal of Teacher Education. 60. 20-37.

Sibilio, M. (2014). *La didattica semplessa*. Napoli. Liguori.

Vinatier, I. &Altet, M. (2008). *Analyser et comprendre le pratique enseignante*. PUR. Paris.

Je-LKS
Journal of e-Learning and Knowledge Society
The Italian e-Learning Association Journal
PEER REVIEWED PAPERS
Vol. 13, n.2, 2017
ISSN: 1826-6223 | eISSN: 1971-8829

TEACHERS´ ACCEPTANCE OF EDUCATIONAL VIDEO GAMES: A COMPREHENSIVE LITERATURE REVIEW

Antonio Sánchez-Mena[1,2]
José Martí-Parreño[1]

[1]Universidad Europea de Valencia
antonio.sanchezmena@universidadeuropea.es, jose.marti@universidadeuropea.es
[2]Universidad Europea de Canarias
antonio.sanchezmena@universidadeuropea.es

Keywords: Educational Video Games, Teachers, Acceptance, Comprehensive Literature Review, Higher Education.

Educational video games (EVGs) are receiving an increasing attention as an approach to teach new generations of learners, such as millennials, who make an intense use of video games, interactive technologies, and digital networks. Extant academic literature suggest several benefits of using EVGs including increasing students' motivation towards learning and enhancing engagement in the learning process. However, teachers are the real agents of change in the classroom and they choose whether to adopt or nor a given technological innovation in their courses. While a great effort has been devoted over the last years to better understanding EVGs effects on learning, research on teachers' acceptance of EVGs is scarcer. Moreover, to the best of our knowledge, no comprehensive literature review has been undertaken to summarize the main findings of this stream of research. To fill this research gap, the main goal of this study is to provide a comprehensive literature review on teachers' acceptance of EVGs. Main findings suggest a

for citations:
Sánchez-Mena A., Martí-Parreño J. (2017), *Teachers´ Acceptance of Educational Video Games: a Comprehensive Literature Review,* Journal of e-Learning and Knowledge Society, v.13, n.2, 47-63. ISSN: 1826-6223, e-ISSN:1971-8829
DOI: 10.20368/1971-8829/1319

wide range of barriers and drivers influencing teachers' acceptance of EVGs including i) technical and organizational support, ii) training on EVGs, iii) previous gaming experience, and iv) personal factors such as openness and innovativeness. Findings are summarized in nine propositions with implications for Teacher Training Programmes development.

1 Introduction

Extant academic literature suggest a great potential for educational video games (EVGs) in several areas including: i) increasing students' motivation to learn (Hanus & Fox, 2015), ii) supporting active learning and experiential learning (Oblinger, 2004), iii) facilitating scaffolded instruction (Hanus & Fox, 2015), and iv) improving students' competencies (Savard, 2015; Sung, Hwang & Yen, 2015). Due to the promising impact of EVGs in education there is an increasing interest amongst educational researchers to delve into all facets of this topic. In fact, academic literature related to game-based learning has increased fivefold over the last five years (Martí-Parreño, Méndez-Ibáñez & Alonso-Arroyo, 2016). Despite this increasing academic interest in EVGs, academic research adopting a teacher approach seems to be scarcer than other topics like learning outcomes of EVGs (e.g. Boyle *et al.*, 2016) or instructional effectiveness of EVGs (e.g. Sitzmann, 2011). However, teachers are the true agents of change in schools (Teo, 2008) and the use of EVGs depends largely on the acceptance by classroom teachers (Bourgonjon *et al.*, 2013; Niederhauser & Stoddart, 2001). Moreover, it has been pointed out that research on game-based learning has been largely ignoring the important role teachers play (Jong & Shang, 2015). It has been pointed out that neglecting the important role of teachers in game-based learning violates the literature on constructivist education and COGBL (*Constructivist Online Game-Based Learning*) in which teachers should play a vital role (Jong & Shang, 2015). Hence, teachers' acceptance of EVGs becomes a key issue to make EVGs usage a reality in the classroom.

By undertaking this comprehensive review on the topic we aim to provide researchers, practitioners, EVGs developers, and HR managers at education institutions with valuable insights related to factors affecting teachers' acceptance of EVGs. Our findings will benefit different areas related to the use of EVGs in education institutions including Teacher Training Programmes development.

This paper is structured as follows: first, we summarize literature reviews of EVGs. Second, we present the method used in this research and provide information about the sample and data analysis. Third, the results are presented and discussed. Finally, we present the conclusions, managerial implications, limitations of the study, and future research lines.

2 Literature reviews of EVGs

Several studies have attempted to review academic research aiming to conceptualise, to describe, and to develop theoretical frameworks related to EVGs. By reviewing extant literature on the topic, researchers try to summarize definitions, EVGs characteristics and learning goals, etc. This type of review also helps to clarify, to better define, and to develop a research agenda on the topic. One example of this type of research is Nolan and McBride (2014) in which the authors propose a conceptual framework to use digital game-based learning in early childhood curricula. Another example of this stream of research is Graafland, Schraagen and Schijven (2012) in which the authors systematically review 5 themes to develop a framework to assess digital serious games applied to health care. Systematic literature reviews analyse findings from multiple sources and multiples types of document (journal articles, conference papers, Doctoral dissertations, books, book chapters…) on the same topic. One example of a systematic literature review of educational video games is Boyle *et al*. (2016) who found large empirical evidence about the positive impacts and outcomes of digital video games in education. The authors provide empirical evidence of the use of EVGs in knowledge acquisition, skill acquisition in health and town planning, behaviour change in substance abuse and satisfaction with marital relationships, "as well as supporting collaborative interactions, soft skills and empathy" (Boyle *et al.*, 2016, p. 187). Meta-analytical reviews aggregate statistically data-based findings comparing multiples studies on the same topic. One example of meta-analytical reviews of educational video games is Sitzmann (2011) in which the author, using 65 independent samples, found that post-training self-efficacy, declarative knowledge, procedural knowledge, and retention was higher for trainees taught with simulation games relative to a comparison group. Another example of meta-analysis of educational video games is Wouters and Van Oostendorp (2013) in which the authors meta-analysed 29 studies to find that instructional support improves students' learning in game-based learning. Bibliometric analysis is a research technique using quantitative and statistical analyses to describe distribution patterns of research articles with a given topic and a given time period (Yang, Wang & Lai 2012). Martí-Parreño, Méndez-Ibáñez and Alonso-Arroyo (2016) used bibliometric analysis on a sample of 139 documents to identify distribution patterns of journals articles, most cited researchers and top institutions involved in this research topic. Finally, citation analysis is a bibliometric analysis technique which uses the published citation as the unit of analysis based on the assumption that "a heavily cited article or book must be considered important by a large number of scholars in a discipline" (Pasadeos, Phelps & Kim, 1998, p. 54). One example of citation analysis is Harman,

Koohang, and Paliszkiewicz (2014) although this research focused not only in EVGs but in academic literature related to gamification. Harman, Koohang, and Paliszkiewicz (2014) found that scholars believe gamification is worthy of serious study as proven by the increasing number of research on the topic suggesting that the concept is already vetted by the scientific community. No comprehensive literature review on teachers' acceptance of EVGs was found in this literature review. Hence, this study will fill this research gap.

3 Method

A comprehensive review approach was used in this research. By reviewing a large number of studies on the same topic, comprehensive reviews try to establish general rules and/or paradigms based on conclusive statements found in academic literature (Pasadeos, Phelps & Kim, 1998).

3.1 Search strategy

In order to find potential documents for analysis the following search strategy was run in two well-known academic databases (Web of Science and Scopus): ("GAME*-BASED LEARN*" OR "SERIOUS GAME*" OR GAMIF*) AND EDUCATION* OR "EDUCATION* GAME*" OR "EDUCATION* VIDEO GAME*"

3.2 Sample

The search strategy allowed to retrieve a total of 8025 documents. First of all, duplicates were removed. Following standard procedure the researchers carefully read titles and abstracts on the remaining 6313 documents to verify that all retrieved documents matched the topic under study. Sixty-five documents were removed because did not directly focus on the topic. 6248 documents remained for further analysis. A final sample of 14 documents met the inclusion criteria (were focused on teachers acceptance of EVGs) and were kept for analysis. However, the researchers had no access to the full text of 3 documents being the final sample for analysis 11 documents. Figure 1 depicts the flow diagram of the sample selection process. Table 1 provides bibliometric information of the sample.

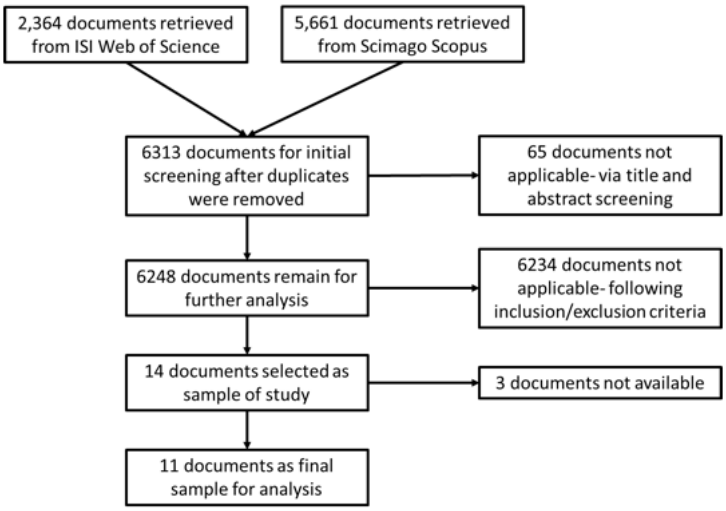

Fig. 1 - Sample selection process

Table 1
DOCUMENTS INFORMATION

Authors	Title	Document type	Publication Source
Emin-Martinez & Ney (2013)	Supporting Teachers in the Process of Adoption of Game Based Learning Pedagogy	Conference paper	VII European Conference on Games Based Learning
Hsu & Chai (2012)	Exploring preschool teachers' technological pedagogical content knowledge with educational games	Conference paper	20th International Conference on Computers in Education
De Grove, Bourgonjon, & Van Looy (2012)	Digital games in the classroom? A contextual approach to teachers' adoption intention of digital games in formal education	Journal article	Computers in Human Behavior
Bourgonjon *et al.*, (2013)	Acceptance of game-based learning by secondary school teachers	Journal article	Computers & Education
Hamari & Nousiainen (2015)	Why Do Teachers Use Game-Based Learning Technologies? The Role of Individual and Institutional ICT Readiness	Conference paper	48th Hawaii International Conference on System Sciences
Barendregt & von Feilitzen (2010)	Attacking Immune Attack™? An Evaluation by Teacher Students	Conference paper	4th European Conference on Games-Based Learning

Demirbilek & Tamer (2010)	Math teachers' perspectives on using educational computer games in math education	Conference paper	WCLTA 2010
Can & Cagiltay (2006)	Turkish Prospective Teachers' Perceptions Regarding the Use of Computer Games with Educational Features	Journal article	Educational Technology & Society
Ince & Demirbilek (2013)	Secondary and High School Teachers' Perceptions Regarding Computer Games with Educational Features in Turkey	Journal article	Anthropologist
Schifter & Ketelhut (2009)	Teacher acceptance of game-based learning in K-12: the Case of River City	Conference paper	Society for Information Technology & Teacher Education International Conference
Manessis (2011)	Early Childhood Post-Educated Teachers' Views and Intentions About Using Digital Games in the Classroom	Conference paper	4th European Conference on Games-Based Learning

4 Results

Table 2 provides basic information on sample characteristics available in the analysed documents. Both educational levels and sample size covered by the documents widely vary ranging from Preschool to High School and from 6 participants to 1668 participants. Turkey is the country in which more research has been conducted on this topic (three of the analysed studies took place in this country). Regarding participants, a large majority of the studies used in-service teachers to investigate teachers' acceptance of EVGs.

Table 2
SAMPLE CHARACTERISTICS

Source	Sample			Geolocation
	Educational level	Size	Participants	
Emin-Martinez & Ney (2013)	High school	6	in-service Teachers	France
Hsu & Chai (2012)	Preschool	352	in-service Teachers	Taiwan
De Grove, Bourgonjon, & Van Looy (2012)	Secondary school	517	in-service Teachers	Belgium
Bourgonjon *et al.*, (2013)	Secondary school	505	in-service Teachers	Belgium
Hamari & Nousiainen (2015)	Primary, lower Secondary and Upper Secondary school	1668	in-service Teachers	Finland
Barendregt & von Feilitzen (2010)	High school	13	Student teachers	Sweden

Source	Sample			Geolocation
	Educational level	Size	Participants	
Demirbilek and Tamer (2010)	lower Secondary and Upper Secondary school	13	in-service Teachers	Turkey
Can & Cagiltay (2006)	-----	116	Student teachers	Turkey
Ince & Demirbilek (2013)	Secondary school and High school	581	in-service Teachers	Turkey
Schifter & Ketelhut (2009)	Secondary school and High school	25	in-service Teachers	USA
Manessis (2011)	Preschool	50	in-service Teachers	Greece

Aggregate data of sample characteristics (Table 3) allows to identifying two research gaps: i) no study explored teachers' acceptance on a University level, and ii) student teachers are underrepresented in the sample with most of the studies using in-service teachers samples (mostly in secondary school).

Table 3
SAMPLE CHARACTERISTICS (AGGREGATE)

Participants	Educational level				
	Preschool	Primary school	Secondary school	High school	University
student teachers	–	–	13	–	–
in-service teachers	402	556	2718	31	–

4.1 Qualitative research

Four of the analysed documents used a qualitative approach using case study (Emin-Martinez & Ney, 2013; Barendregt & von Feilitzen, 2015; Schifter & Ketelhut, 2007); and constant comparative analysis (Demirbilek & Tamer, 2010). Emin-Martinez and Ney (2013) used Roger's Theory of Diffusion of Innovations as a framework to delve into the process of teachers' adoption of EVGs including the external factors that may favour a positive teachers' perception of EVGs (e.g. recommendations, assistance, tutorial, easy identification of domain knowledge and rules of the game…). Their results suggest that teachers move from becoming familiar with using EVGs (*knowledge*) to seeking EVGs consistent with the curriculum they teach (*persuasion*), testing the EVGs (*decision*), defining pedagogical scenarios that describes the integration of the game in a problem-solving approach (*implementation*) and finally, teachers analysed their students' answers to questionnaires on motivation and learning (*confirmation*).

Barendregt and von Feilitzen (2010) used a case study of a real EVG (*Immune Attack*), designed to teach cell biology, to delve into student teachers' acceptance and behavioural intention to use EVGs in their courses. The authors identified four main barriers preventing student teachers to adopt EVGs in the future: usability problems, embedding of the learning content, appeal, and learning motivation. Main factors related to usability problems include non-intuitiveness controls of the game and difficulties in reading and fully understanding the text for non-native English speakers. The participants also experienced a mismatch between playing the game and learning the content resulting in what the authors named as a *problem in embedding of the learning content*. This is, participants reported being able to advance in the game (up to the fourth level) as they were able to successfully manoeuvring the ship and control the technical operations but without learning the content. Another barrier for teachers was a lack of appeal both in terms of the graphic design and the characters (which they considered more suitable for younger children than for the teenagers the EVG is targeted to). Finally, some of the student teachers' participating in the study were no biology teachers and they had no real interest in the topic of cell biology. However, the game did not encourage them to become more interested in this topic, this is, participants did not find the motivational driver which is supposed to be present in EVGs due to the entertainment value.

Schifter and Ketelhut (2009) used a case study approach to delve into teachers' acceptance of an online video game-like multi-user virtual environment (MUVE) called *River City*. This MUVE was designed to teach scientific inquiry and 21st century skills to middle school students. After analysis of a three-year implementation of the project in different schools the authors suggest four principles to implement digital innovations like EVGs in the classroom: i) allow teachers time to practice with the EVG (to develop interest and knowledge, to evaluate usefulness for own classroom and students, to try new skills with students, and to adopt or reject the technology based on these opportunities), ii) effective ongoing, post-training technical support in the classroom, iii) ongoing communication and a local social support system, including significant support from the school's principal or other influential school staff, and iv) changes in classroom structures, roles and behaviours, knowledge and understanding, and values of technology in classrooms.

Demirbilek and Tamer (2010) used a grounded theory approach to analyse semi-structured interviews of in-service teachers through constant comparative analysis. The authors identified 6 main barriers to adopt EVGs including classroom management problems, technical infrastructure (e.g. computers not working or power cuts). Teachers also reported that not all subjects might fit with EVGs and that for teaching maths "board and chalk are indispensable".

Teachers also complained that the current software is not in line with the syllabus and that "because of the anxiety of not being able to complete all the curriculum topics, and because they have a lot of topics to teach, they don't use computer games". Teachers also lack of appropriate education on how to use EVGs. Among drivers, teachers feel that because students are always interested in computer games they can use EVGs to interest students in the classroom activities, this is, teachers believe they can use EVGs as a motivational driver for students. Regarding how to use EVGs in the classroom most of the teachers expressed that EVGs could be employed to re-engage students' attention to the lesson and as after school activities. Some of the teachers expressed that EVGs could be employed for evaluation purpose, as remediation stage, and for reinforcements and elimination of deficiencies. As overall opinions regarding the use of EVGs in maths teaching, most of teachers acknowledge that using EVGs in the lessons can motivate students and catch their attention along with making the lessons more entertaining. Teachers also acknowledge that EVGs decrease the negative attitude and behaviours towards math, help student to overcoming the fear of math, and can help to break the prejudice of math. As positive outcomes of using EVGS some of the teachers tell that educational computer games are: i) effective for making students gain some information and skills, ii) develop students creativity, iii) enrich the knowledge of vocabulary, iv) improve the skill of commenting, v) develop the skill of processing, vi) contribute to individual learning, vii) learning by discovering and learning by trial-and-error, viii) enlarge the scope of the topic, and ix) lessen the process of learning. Finally, participants expressed their belief that utilizing EVGs in the lessons increases the participation of the students, achieving a higher and active student-centric learning.

4.2 Quantitative research

Five of the documents used a quantitative approach using Exploratory Factor Analysis (EFA), Multiple Linear Regression (MLR), and path analysis (Hsu & Chai, 2012); Structural Equation Modelling (SEM) (De Grove, Bourgonjon & Van Looy, 2012; Bourgonjon *et al*., 2013); z-tests Manessis (2011); and Partial Least Squares (PLS) (Hamari & Nousiainen, 2015). Hsu and Chai (2012) developed a questionnaire to investigate preschool teachers' acceptance of EVGs. Results suggest that game knowledge (GK), game pedagogical content knowledge (GPCK), knowledge about how to use games with various pedagogical characteristics for teaching (but not necessarily related to content knowledge) (GPK), attitude towards digital game-based learning, and previous experience with games contribute to teachers' acceptance of EVGs while teachers' preferences for games do not necessarily affect EVGs acceptance.

De Grove, Bourgonjon, and Van Looy (2012) developed a model to test teachers' adoption of EVGs based on school-level variables (e.g. infrastructure, technical support…) and teacher-level variables (e.g. perceived ease of use, previous gaming experience…). Main findings suggest that school-level variables are not related to teachers' adoption while teachers' perceived learning opportunities when using EVGs and previous gaming experience influence adoption. More specifically, learning opportunities mediates curriculum-relatedness, this is, when teachers believe that EVGs can be fitted into the curriculum, they also regard EVGs as tools for learning, leading to a higher teachers' adoption. On the contrary, previous gaming experience was found to negatively correlate to learning opportunities and teachers having experience with games in the classroom consider digital games to have fewer learning opportunities than teachers with less experience.

Bourgonjon *et al.* (2013) tested a structural equation model of teachers' acceptance of EVGs finding that perceived usefulness is the main factor influencing teachers' acceptance of EVGs. The researchers also found that perceived usefulness of EVGs was influenced by personal innovativeness. Social influence also affects teachers' acceptance whereas complexity and previous gaming experience were found weak predictors of teachers' acceptance. However, main findings suggest that teachers were not really convinced that video games are very useful for enhancing their job performance. At the same time teachers believed that video games provide opportunities for learning. Results also suggested that on average teachers do not intended to use video games in their courses in the near future. The researchers also point out that due to the importance of the social influences in their model results suggests that teachers are sensitive to worked examples and showcases of good practices.

Manessis (2011) explores preschool teachers' intention to use EVGs in the classroom. Main findings suggest a high behavioural intention although teachers' intention was influence by years of teaching experience, previous experience in using digital games, and owning a computer at home. More experienced teachers, having a greater experience in using digital games, and owning a computer at home influence more positive views and intention to use EVGs.

Hamari and Nousiainen (2015) suggest that EVGs adoption is affected by teachers' perceived compatibly of Information and Communication Technologies (ICT) with teaching, teachers' perceived self-efficacy with ICT, teachers' perceived supportive ICT organizational culture, teachers' openness towards ICT, and teachers' perceived value of EVGs. Teachers' adoption was also influenced by teachers' openness towards ICT, teachers' attitude towards ICT, and teachers' perceived compatibly of ICT with teaching through teachers'

perceived value of EVGs. Gender affected both teachers' adoption and teachers' perceived value of EVGs whereas age only affected teachers' perceived value of EVGs but not teachers' adoption of EVGs. As a conclusion the authors state that teachers' willingness to adopt EVGs as a teaching methodology rely heavily not only on individual factors but also on social environment (e.g. supportive ICT organizational culture in the education institution).

4.3 Mixed-methods research

Two studies used a mixed-methods research approach. Can and Cagiltay (2006) used frequency analysis to analyse quantitative data while content analysis was used to analyse qualitative data. Ince and Demirbilek (2013) used T-test, ANOVA, and Chi-square to analyse quantitative data while content analysis was used to analyse qualitative data. Can and Cagiltay (2006) provide a descriptive approach to student teachers' behavioural intention to adopting EVGs in their courses in the future: 85% of the participants reported their behavioural intention to use EVGs in their courses in the future. In-depth interviews identified different barriers to adopting EVGs including student teachers' perceptions that EVGs are not suitable for all grade levels and subject matters. Other concerns related to EVGs adoption include: i) lack of possibilities and administrative issues; ii) time needed to use EVGs because they will restrict teaching other course content; iii) students-related factors (e.g. students may not like the selected game and could become bored and also may prefer traditional instruction, surfing on the Internet, or doing something else rather than playing the EVG); iv) problems to integrate the game into the course goals; v) difficulties to make students aware of the aim/goals of the activity involving the EVG (and also to make students aware how they will be assessed); vi) problems in redirecting students from games to normal instruction; vii) noise may increase during game play, and observing and managing the students will be harder; viii) using EVGs in the courses may have a negative effect on students' perceptions toward the importance of the course. An overall concern for teachers was that students may develop negative feelings towards the teacher as a consequence of their perceived inappropriateness of using EVGs in the course. Drivers for student teachers' behavioural intention to use EVGs in their courses include: i) students can learn more useful things using video games with educational features than through traditional methods and this learning will be more permanent; ii) students are engaged in activities during the game play (e.g. they apply their knowledge, they investigate and discover, and they learn by doing); iii) students' critical thinking processes will be enhanced as a result of their dealing with the logical processes of the EVG; iv) EVGs will help students to develop their creativity, imagination,

and visualization skills; v) the course content will be more understandable when using EVGs, and previous knowledge will be reinforced by means of the EVGs; vi) EVGs will also help with the development of eye-hand coordination, interest in computers, and computer-related skills and knowledge; vii) students' motivation, attention, and enthusiasm about learning the course content will increase when playing computer games with educational features, viii) students will have positive feelings about the teacher, and the teacher will be pleased, since the instructional process will be easier, ix) students will be silent during the course, and the classroom management will be easier.

Ince and Demirbilek (2013) investigate Secondary and High school teachers' perceptions about adopting EVGs in their courses. Results suggest Secondary school teachers use EVGs in their courses more than High school teachers (30.12% versus 11.19%) acknowledging the following benefits of EVGs usage: motivation, long-term retention, fun, visual aesthetics, effortless, and individual learning. Student motivation provided by EVGs ranked the highest in teachers' positive perceptions. Teachers' requirements (potential barriers) to using EVGs in their courses include: i) the need of internet access, ii) equipment (computer and projector), and iii) technical information and the ability to judge the appropriateness of the game to match curricular needs. Another potential barrier is that teachers viewed themselves as technically unprepared for computer usage skills needed to manage EVGs and expressed the necessity of increasing the amount of EVGs aligned with the curriculum. A gender effect was found with male teachers having a more positive attitude towards EVGs than female teachers. Results also found that actual users of EVGs in their courses were more positive about the learning potential of EVGs than non-users.

4.4 Drivers and barriers for teachers' acceptance

The main drivers for teachers' acceptance of EVGs include: i) teachers' perceived learning opportunities of EVGs, ii) teachers' personal factors (such as openness and innovativeness), iii) student-related factors (EVGs capacity to motivate students to learn), iv) teachers' previous gaming experience, v) teachers' attitudes towards digital game-based learning, and vi) social influence (e.g. colleagues adoption and examples of best practices). The main barriers identified in this literature review to adopting EVGs include: i) concerns in making possible to integrate EVGs in the curriculum, ii) lack of support (technical and organizational), iii) problems related to classroom management, and iv) lack of training (teachers' ability to use EVGs in their courses). Results suggest the complexity of teachers' beliefs with some factors acting both as barriers and drivers. On the one hand, Can and Cagiltay (2006) found that

teachers believe that using EVGs might increase noise in the classroom during game play, and observing and managing the students will be harder. On the other hand, the authors also found that teachers also believe that using EVGs will make classroom management easier because students will be silent during game play. Student-related factors also arise dual perceptions on teachers. Some teachers are concerned about the possibility of students developing negative feelings towards the teacher as a consequence of their perceived inappropriateness of using EVGs in the course. For example, students may not be aware of the aim/goals of the EVG activity when they play the game and might begin to wonder how they will be assessed. Moreover, students may not like the selected game and become bored. Nevertheless, teachers also believe that EVGs might help them to develop students' positive feelings about the teacher if students do show a positive attitude towards EVGs. Table 4 summarizes the main findings related to factors influencing teachers' acceptance of EVGs.

Table 4
FACTORS INFLUENCING TEACHERS' ACCEPTANCE OF EVGS

Factor	Negatively influences	Positively influences
Classroom management	Demirbilek and Tamer, 2010; Can & Cagiltay, 2006	Can & Cagiltay, 2006
Curriculum integration	Demirbilek and Tamer, 2010; Can & Cagiltay, 2006; Emin-Martinez & Ney, 2013; De Grove, Bourgonjon, & Van Looy, 2012; Barendregt & von Feilitzen, 2010; Ince & Demirbilek, 2013	
Gaming experience		Hsu & Chai, 2012; De Grove, Bourgonjon, & Van Looy, 2012; Manessis, 2011
Environment (technical infrastructure and support)		Demirbilek and Tamer, 2010; Hamari & Nousiainen, 2015; Ince & Demirbilek, 2013; Schifter & Ketelhut, 2009
Social influence		Bourgonjon et al., 2013; Schifter & Ketelhut, 2009
Training on EVGs		Demirbilek and Tamer, 2010; Emin-Martinez & Ney, 2013; Ince & Demirbilek, 2013; Schifter & Ketelhut, 2009
Student-related factors	Can & Cagiltay, 2006	Demirbilek and Tamer, 2010; Can & Cagiltay, 2006; Emin-Martinez & Ney, 2013

Factor	Negatively influences	Positively influences
Perceived learning opportunities		Can & Cagiltay, 2006; Bourgonjon et al., 2013; De Grove, Bourgonjon, & Van Looy, 2012
Personal factor (openness, innovativeness...)		Bourgonjon et al., 2013; Hamari & Nousiainen, 2015; Manessis, 2011

Conclusions, limitations, and future research

This comprehensive literature review suggest the complexity of factors influencing teachers' acceptance of EVGs. Several factors were identified as barriers and drivers of teachers' behavioural intentions regarding the adoption of EVGs in their courses. Moreover, some factors show a dual nature potentially acting as both barriers and drivers. Factors acting as barriers and drivers cover a wide range of areas including environmental factors at educational institutions, student-related factors, and teachers' personal factors. Findings in this literature review can be summarized in the following nine propositions:

- **Proposition 1.** Teachers' perceptions of EVGs impact on classroom management influence teachers' acceptance of EVGs.
- **Proposition 2.** Teachers' perceptions of EVGs integration within curriculum influence teachers' acceptance of EVGs.
- **Proposition 3.** Teachers' previous gaming experience positively influences teachers' acceptance of EVGs.
- **Proposition 4.** Environmental factors (such as technical infrastructure and support from the management at the educational institution) influence teachers' acceptance of EVGs.
- **Proposition 5.** Social influence (e.g. colleagues adoption of EVGs) positively influences teachers' acceptance of EVGs.
- **Proposition 6.** Teachers' previous training in using EVGs influences acceptance of EVGs.
- **Proposition 7.** Student-related factors (such as students beliefs' about EVGs) influence teachers' acceptance of EVGs.
- **Proposition 8.** Teachers' perceived learning opportunities of EVGs positively influences teachers' acceptance of EVGs.
- **Proposition 9.** Teachers' personal factors (such as openness, innovativeness, attitudes towards ICT and video games, and teaching experience) influence teachers' acceptance of EVGs.

By identifying factors influencing teachers' acceptance of EVGs in this comprehensive literature review, managers in charge of Teacher Training

Programmes (TTP) at educational institutions can better design TTP aiming to prevent factors acting as barriers to adopting EVGs. Drivers can be used to better motivate and to encourage teachers to adopting EVGs. For example, TTP might include examples and cases of colleagues using EVGs at the same educational institution to benefit the social influence effect found in literature on teachers' acceptance of EVGs. TTP should also address how to help teachers in integrating EVGs in the curriculum. TPP can also favour teachers' perceived learning opportunities of EVGs to foster teachers' acceptance.

One main limitation of this study is its qualitative approach and the small sample used. Future research might adopt a quantitative approach (e.g. a meta-analytic review) and a bigger sample in order to test the proposed propositions. Another limitation is that the analysed sample presents one important bias with High school teachers underrepresented in the sample.

More research is needed to better understand High school teachers' acceptance of EVGs. University teachers are not represented in the analysed sample suggesting both a research gap and a promising opportunity to expand this stream of research. A better knowledge of student teachers' acceptance of EVGs can also provide useful insights to the topic. Future research should increase the body of reviewed literature incorporating more studies using student teachers samples.

Acknowledgements

This work was supported by Laureate International Universities through the David A. Wilson Award for Excellence in Teaching and Learning under Grant LIU-WIL 2015.

REFERENCES

Barendregt, W., & von Feilitzen, M. (2010), *Attacking Immune Attack™? An Evaluation by Teacher Students*. In Proceedings of the 4th European Conference on Games-Based Learning: Academic Conferences Limited.

Bourgonjon, J., De Grove, F., De Smet, C., Van Looy, J., Soetaert, R., & Valcke, M. (2013), *Acceptance of game-based learning by secondary school teachers*. *Computers & Education*, *67*, 21–35.

Boyle, E. A., Hainey, T., Connolly, T. M., Gray, G., Earp, J., Ott, M., & Pereira, J. (2016), *An update to the systematic literature review of empirical evidence of the impacts and outcomes of computer games and serious games*. Computers & Education, 94, 178–192.

Can, G., & Cagiltay, K. (2006), *Turkish prospective teachers' perceptions regarding the use of computer games with educational features*. Educational Technology &

Society, *9*(1), 308–321.

De Grove, F., Bourgonjon, J., & Van Looy, J. (2012), *Digital games in the classroom? A contextual approach to teachers' adoption intention of digital games in formal education*. Computers in Human Behavior, 28(6), 2023–2033.

Demirbilek, M., & Tamer, S. L. (2010), *Math teachers' perspectives on using educational computer games in math education*. Procedia-Social and Behavioral Sciences, 9, 709–716.

Emin-Martinez, V., & Ney, M. (2013), *Supporting teachers in the process of adoption of game based learning pedagogy*. In Proceedings of the 7th European Conference on Games Based Learning: Academic Conferences International Limited.

Graafland, M., Schraagen, J. M., & Schijven, M. P. (2012), *Systematic review of serious games for medical education and surgical skills training*. British Journal of Surgery, 99(10), 1322–1330.

Hamari, J., & Nousiainen, T. (2015), *Why do teachers use game-based learning technologies? The role of individual and institutional ICT readiness*. In Proceedings of the 48th Hawaii International Conference on System Sciences (HICSS) (pp. 682-691). IEEE.

Hanus, M. D., & Fox, J. (2015), *Assessing the effects of gamification in the classroom: A longitudinal study on intrinsic motivation, social comparison, satisfaction, effort, and academic performance*. Computers & Education, 80, 152–161. doi: 10.1016/j.compedu.2014.08.019

Harman, K., Koohang, A. & Paliszkiewicz, J. (2014), *Scholarly interest in gamification: a citation network analysis*. Industrial Management & Data Systems, 114(9), 1438–1452.

Ince, E. Y., & Demirbilek, M. (2013), *Secondary and high school teachers' perceptions regarding computer games with educational features in Turkey*. Anthropologist, 16(1–2), 89–96.

Jong, M. S.-Y. & Shang, J. (2015)*, Impeding Phenomena Emerging from Students' Constructivist Online Game-Based Learning Process: Implications for the Importance of Teacher Facilitation*. Educational Technology & Society, 18 (2), 262–283.

Manessis, D. (2011, October), *Early childhood post-educated teachers' views and intentions about using digital games in the classroom*. In Proceedings of the 5th European Conference on Games Based Learning. Academic Conferences International Limited.

Martí-Parreño, J., Méndez-Ibáñez E. & Alonso-Arroyo, A. (2016), *The Use of Gamification in Education: A Bibliometric and Text Mining Analysis*, Journal of Computer Assisted Learning, 32, 663–676. http://dx.doi.org/10.1111/jcal.12161

Niederhauser, D. S., & Stoddart, T. (2001), *Teachers' instructional perspectives and use of educational software*. Teaching and Teacher Education, 17(1), 15–31.

Nolan, J., & McBride, M. (2014), *Beyond gamification: reconceptualizing game-based learning in early childhood environments*. Information, Communication & Society, 17(5), 594–608.

Oblinger, D. G. (2004), *The Next Generation of Educational Engagement*. Journal of Interactive Media in Education, 8(1), 1–18.

Pasadeos, Y., Phelps, J., & Kim, B. H. (1998), *Disciplinary impact of advertising scholars: Temporal comparisons of influential authors, works and research networks*. Journal of Advertising, 27(4), 53–70.

Savard, A. (2015), *Making Decisions about Gambling: The Influence of Risk on Children's Arguments*. The Mathematics Enthusiast, 12(1), 226–246.

Schifter, C., & Ketelhut, D. (2009), *Teacher acceptance of game-based learning in K-12: the case of River City*. In Proceedings of the Society for Information Technology & Teacher Education International Conference (pp. 3836-3842).

Sitzmann, T. (2011), *A meta-analytic examination of the instructional effectiveness of computer-based simulation games*. Personnel Psychology, 64(2), 489–528.

Sung, H. Y., Hwang, G. J., & Yen, Y. F. (2015), *Development of a contextual decision-making game for improving students' learning performance in a health education course*. Computers & Education, 82, 179–190.

Teo, T. (2008), *Pre-service teachers´ attitudes towards computer use: a Singapore survey*. Australasian Journal of Educational Technology, 24(4). 413–424. http://dx.doi: 10.14742/ajet.1201

Wouters, P., & van Oostendorp, H. (2013), *A meta-analytic review of the role of instructional support in game-based learning*. Computers & Education, 60(1), 412–425. http://dx.doi.org/10.1016/j.compedu.2012.07.018.

Yang, Y., Wang, C., & Lai, M. (2012), *Using bibliometric analysis to explore research trend of electronic word-of-mouth from 1999 to 2011*. International Journal of Innovation, Management and Technology, 3(4), 337–342.

Je-LKS
Journal of e-Learning and Knowledge Society
The Italian e-Learning Association Journal
PEER REVIEWED PAPERS
Vol. 13, n.2, 2017
ISSN: 1826-6223 | eISSN: 1971-8829

THE GROUP E-PORTFOLIO TO IMPROVE TEACHING-LEARNING PROCESS AT UNIVERSITY

Esteban Vázquez-Cano[1]
Eloy López Meneses[2]
Alicia Jaén Martínez[2]

[1] National University of Distance Education (UNED), Department of Didactics and School Organization, Spain - evazquez@edu.uned.es
[2] University of Pablo de Olavide, Department of Education and Social Psychology, Spain - elopmen@upo.es; ajaemar@upo.es

Keywords: e-portfolio, Collaborative learning, online environments, multimedia educational material.

This study analyzes the experiences with group electronic portfolios at the University Pablo de Olavide as a strategy of educational innovation to improve teaching-learning process at University. These experiences consist of the use of group e-portfolios inside and outside the classrooms, which were applied by the students to verify the achievements, difficulties, and most relevant evidence in the planning and implementation of a multimedia educational material (MEM) aimed at prevention and social awareness, with emphasis on social groups at risk and social vulnerability. The results, obtained by using a qualitative methodology, support that group e-portfolios improve the capacity of students to work collaboratively, enable an awareness of their own mistakes, facilitate their self-assessment, and provide evidence of their academic progress. Students consider the considerable time and effort needed to implement group e-portfolios as among the limitations of their use.

for citations:
Vázquez-Cano E., López Meneses E., Jaén Martínez A. (2017), *The Group e-portfolio to improve Teaching-Learning Process at University,* Journal of e-Learning and Knowledge Society, v.13, n.2, 65-76. ISSN: 1826-6223, e-ISSN:1971-8829
DOI: 10.20368/1971-8829/1221

1 Introduction

Teaching through information and communication technologies (ICT) requires a series of changes that generate a break from the traditional model but at the same time presents a challenge to the quality of university education (Aguaded, López-Meneses & Alonso, 2010). Also, students must acquire new skills for an adequate acquisition of knowledge, think critically, analyzing, synthesizing, making inferences, and the ability to solve new and complex social situations, communication skills, teamwork and reciprocity, characteristics of an in-depth learning approach (Barnett, Parry & Coate, 2001; Martín-Monje, Vázquez-Cano & Fernández, 2015). For these purposes, the potential of group e-portfolios (GEPs) for both students and professors have generated significant interest and investment by universities over the past seven years (Coffey & Ashford-Rowe, 2014) and as useful resources for a formative evaluation of students (Klenowski, Askew & Carnell, 2006; Chatham-Carpenter, Seawell & Raschig, 2010; Fernández-Márquez, Vázquez-Cano & López Meneses, 2016).

2 The Group e-portfolio

GEPs are a comprehensive collection of students' works that show their efforts, progress, results, and achievements in one or more areas over time (Paulson, Paulson & Meyer, 1991; Xu, 2003; Love, McKean & Gathercoal, 2004). In addition, GEPs have a major role in generating reflections on learning activities and giving value to the selection of evidence (Ellsworth, 2002; Klenowski, Askew & Carnell, 2006). In their review of perspectives on e-portfolios in Australian tertiary institutions, Hallam *et al.* (2010) indicated that e-portfolios are broadly acknowledged to have the potential to assist students to become reflective learners, leading staff to be more conscious of their strengths and weaknesses. Therefore, an e-portfolio can show the growth in the achievement of learning outcomes to measure what students have learned during a particular period of time (Tubaishat, 2015; Vázquez-Cano, Martín Monje & Fernández, 2014; López Meneses, Vázquez-Cano & Fernández Márquez, 2014; Vázquez-Cano & López Meneses, 2016).

In the present study, we used GEPs as a digital system that enables users to document competencies, events, and plans that are relevant to them in a school, college, or training context (Barbera, 2008; Vázquez-Cano, López-Meneses & Fernández, 2013). The GEPs are accessible, easy to view, and downloadable, allowing a cross-review and the construction and reconstruction of a hypermedia and evolutionary narrative of students' works (López-Meneses & Vázquez-Cano, 2013; Vázquez-Cano, Martín-Monje & Castrillo, 2016). According to Barrett (2006), the use of technology can motivate students to

use portfolios, especially if the process is engaging for the learners and gives them an opportunity to express their own voice and leave their mark in their portfolios.

GEPs have unique advantages over paper-based portfolios. First, learners can easily integrate multimedia materials into GEPs, allowing them to use various tools to show and develop understanding. This may be especially advantageous for at-risk children whose competencies may be better reflected through such authentic tasks. At the same time, by engaging these learners, their deficiencies in core competencies may be overcome. Second, e-portfolios are better in terms of cataloguing and organizing learning materials and illustrating the process of a learner's development. Finally, e-portfolios have different and numerous communication advantages. They are easy to share with peers, teachers, parents, and others, and they allow those involved to provide feedback through a single electronic container. Furthermore, the reflective nature of the portfolio has been shown to be its most important feature (Chen & Light, 2010; Joyes, Gray & Hartnell-Young, 2010; Vázquez-Cano, López Meneses & Sánchez-Serrano, 2015).

Similarly, different authors (Cambridge, 2010), have identified several advantages of e-portfolios in training, such as that e-portfolios facilitate the editing and incorporation of various multimedia materials. These are "interconnected documents" that allow links between portfolio elements, as well as with other external objects through hyperlinks, and the construction and reconstruction of a hypermedia narrative. The e-portfolios are "portable" and can provide a "rich picture" of the learning and skills of students. They can also involve students in the learning process and provide connections between academic and nonformal learning, as well as contribute to reflection and facilitate the assessment and evaluation of the students' learning. Finally, Vázquez-Cano et al. 2013 suggested that the potential of e-portfolios is a real revolution, a clear demonstration of the possibilities of e-learning throughout life, summarized in the motto: "E-portfolio for life."

In the present research, GEPs were used and applied to formal education. Each student used a single edublog, in which they included their own contributions and the group activity (http://diariotrabajosocial.blogspot.com/). The blog-publishing service Blogger (https://www.blogger.com) was used to implement the edublogs. Blogger is ranked 18th in the Listing 2.0 tools for learning outlined by the Center for Learning and Performance Technologies (C4LPT).

2.1 Context and objectives

This diachronic study originates from two teaching innovation projects

developed under a more general project on educational innovation and development at the University Pablo de Olavide (UPO, Seville, Spain), funded by the Department of Teaching and European Convergence of the University. The educational experience consists of a diachronic study on university experiences with GEPs done by students who have studied the subject "Information and Communications Technology in Social Education" within a first course of Social Education and a double degree in Social Education and Social Work. Both courses are taught at the Faculty of Social Sciences of the University Pablo de Olavide and were developed over six academic years from 2009-2010 to 2014-2015. The data include a total of 607 students (Table 1)

Table 1
SAMPLE

Studies/Academic Years	09-10	10-11	11-12	12-13	13-14	14-15	Total
Social Education Degree	79	39	42		77	68	305
Social Education and Social Work	7	35	57	58		74	302
Total	158	74	99	58	77	142	607

This study aims mainly to analyze the possible achievements, difficulties, and relevant evidence during the implementation of an educational multimedia group project (4 to 8 students per group) consisting of the design and development of a multimedia educational material (MEM) related to a social and educational problem selected by the students; the project implementation covers a period of six academic years (2009-2015).

From the academic year 2012-2013, the most significant GEPs were uploaded on YouTube and compiled on the web page http://videosestudiantes.jimdo.com/videos-de-estudiantes-doble-grado-2012-13/. The second activity consisted of collecting relevant evidence on the reflections, evolution, progress, and particular difficulties related to the implementation of the GEPs through comments (posts) uploaded on the subject edublog: http://diariotrabajosocial.blogspot.com. Subsequently, the professor of the subject developed a tracking system through e-mail and personal mentoring sessions for tutoring students on their e-portfolios. In the last posts/comments, students were asked to develop a self-assessment activity through a rubric on the functionality of e-portfolios. A rubric for the assessment of e-portfolios was created with four main categories: Main topic and contents (3 Points); Technical issues (2 Points); Portafolio development (3 Points) and Exposure of audiovisual material (2 points).

The assessment of the university activity accounted for 30% to 40% of the final subject grade, and this depended on the initial votes made by the students at the beginning of each academic year.

2.2 Method

This diachronic study was developed from a descriptive and qualitative method for studying a particular phenomenon over an extended period of time, therefore allowing the verification of changes that may occur and improving the learning process. The data used in this study include e-portfolios made by students during the academic year 2009-2010 to 2014-2015. All GEPs are published in the subject blog http://diariotrabajosocial.blogspot.com.es/.

The data were coded and analyzed with the use of the qualitative analysis software NVivo 10, which facilitates the development of instrumental coding phases and texts. This program also promotes transparency of the analytical process by allowing the researcher to search a particular text in a fast and more precise way (Flick, 2004). The research phases were: coding, categorization, interpretation, and inference (Miles & Huberman, 1994). After analyzing the data from the six academic years under study (2009 to 2015), a comparison of the data was carried out to confirm the stability of the results. The same node system was used in the different years; however, in the last academic year (2014-2015) a new sub-node under the category "group work planning" within the topic "teaching strategies" emerged, as did a new sub-node under the category "mentoring and monitoring" within the topic "introduction to job."

Regarding the reduction process and the structure of the theoretical information phase, a process of encoding, categorization, interpretation, and inference (Miles & Huberman, 1994) was followed. In the data reduction phase, feedback on the various e-portfolios published in the subject blog (http://diariotrabajosocial.blogspot.com) was used. Subsequently, encoding was done by using the text format compatible with the NVivo program.

The first qualitative phase was analyzed with the participation of two coders who were instructed to independently unitize the MCMs' text messages. After a first round of unitizing, inter-coder reliability-measures were calculated. We calculated Guetzkow's U, which measures the reliability of the number of units identified by two independent coders, as follows (Holsti, 1969): $U = (O1 - O2) / (O1 + O2)$.

O1 represents the number of units identified by coder 1, and O2 the number of units identified by coder 2. After the first unitizing run, Guetzkow's U equaled.0061, showing almost 95% conformance in the number of units identified by the coders. To check textual consistency of the identified units (Weingart *et al.*, 1990), inter-coder unitizing reliability was additionally calculated (compared electronically units of coder 1 and coder 2 using the Excel-program). In our case, textual consistency was as high as 82.12% in the first round, which is considered an excellent result (Simons, 1993). Using these main categories and the respective subcategories (total: 17 categories), the two

coders independently assigned a single code to each unit. After this first main coding round, we calculated Cohen's kappa to check inter-coder reliability. The basic version of Cohen's kappa suggested by Brennan and Prediger (1981) that we used is calculated as follows: $\kappa = (\Sigma Pii - \Sigma Pi \times Pi) / (1 - \Sigma Pi \times Pi)$.We found a relatively middle-high coding correspondence of $\kappa = .83.11$ Kappa values above.80 are generally considered a very good result (Brett *et al.*, 1998).

2.3 Results

As a first general assessment, we present the numerical results obtained for each of the categories from the academic years under study (2009-2015) (Table 2). We can observe that the posts' percentage comments was maintained throughout the study.

Table 2
NUMBER OF REFERENCES AND CATEGORIES

	Topics	Code	Number of References					
			09/10	10/11	11/12	12/13	13/14	14/15
Group Work	Personal Information	LEP	4	14	3	17	13	6
	Difficulties	DTG	24	24	35	7	2	15
	Planning and Distribution of tasks	PRT	52	24	21	25	13	76
	Topic election procedures	PET	20	7	19	7	3	10
	Workspaces	ETG	21	33	40	14	21	45
	Topics	TTG	18	20	18	9	14	17
	Sources	FTG	10	15	22	4	3	12
Portfolio Use	Advantages	VUP	8	8	12	9	10	23
	Disadvantages	IUP	7	7	10	7	10	19
Tutoring and teaching follow-up	Tutoring and teaching follow-up	TSG	36	19	6	10	8	11
Self-Assessment	Self-Assessment	ATG	8	12	21	14	14	25
Technical Aspects	Software	PI	7	12	2	3	1	9
	Technical Difficulties	DTT	19	22	11	15	16	32
	Media	TMA	8	12	2	3	1	4

Another category that showed continuity was "planning and division of work," with an appearance of 52, 24, 21, 25, 13, 76 textual references. References to the "workspace" used during group work also appeared frequently throughout all the courses studied. Finally, categories related to the "pros" and "cons" and the technical difficulties of using the portfolio were also created

(Figure 1).

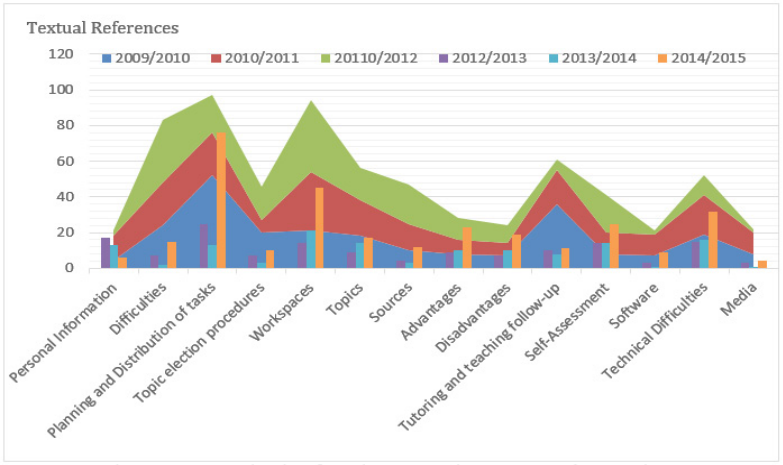

Fig. 1 - Topics comparative analysis.

In general, we can assess the importance of each of the categories in this research in terms of total percentage of appearance throughout the six college years studied, as shown in Figure 2.

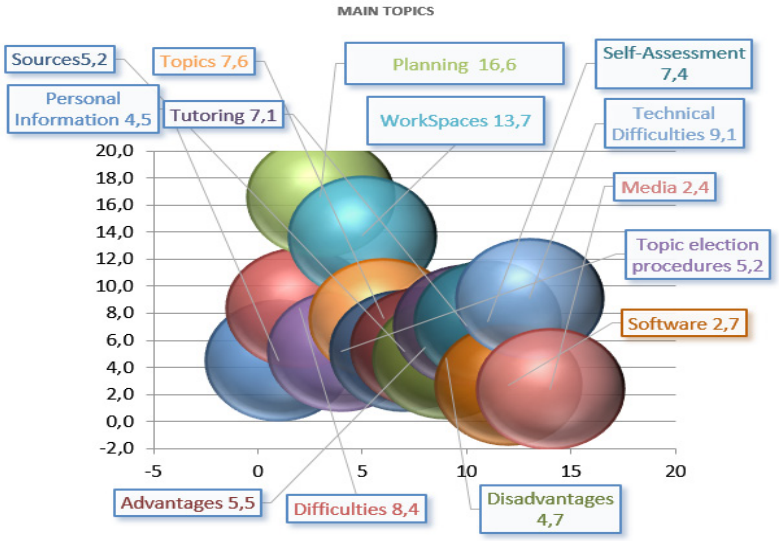

Fig. 2 - Main topics. 2009-2015.

Based on the figure, the highest percentage of textual references (17% of the total references) focused on describing the planning process followed throughout the MEM project. This topic is followed by comments on the spaces used for the development of group sessions (14%) and the different technical difficulties encountered (9%). Students also cited difficulties in working collaboratively (8%). Finally, 7% of the references focused on describing the mentoring processes carried out by the teacher and the description of the process of self-assessment in the group. We then evaluated the comments in each of the categories and subcategories.

It should be noted that the teachers' intention was to create a connective and constructive assessment culture from a discursive perspective in line with O'Keeffe and Donnelly (2013), who showed that students could regard the assessment as a positive experience toward learning rather than as a punishment. To conclude this analysis, another node referred to the "pros and cons" in using this methodology. This category is compulsory because it forms part of the last task to be included in the group portfolio (Table 3).

Table 3
NODE CODIFICATION: "ADVANTAGES AND DISADVANTAGES"

	Node: Advantages	Node: Disadvantages
Document 2009/2010_1	e-Portfolio allows us a better planning of the work and it facilitates our improvement process, allowing us to be aware of mistakes and correct them in time.	Sometimes the development of portfolios is slow and you need to dedicate a lot of time.
Document 2010/2011_3	It promotes participation and responsibility of students to assess their own learning. It is a good method of organization and promotes self-learning. It helps to certify student's competence, basing the assessment in authentic work.	The generalization of the results is limited although they are inappropriate for measuring the level of knowledge of facts. We think it is appropriate to be used in combination with other traditional assessments.
Document 2014/2015_8	To write in the portfolio has been very useful to establish a clear sequence of work. Finally, it is very positive to see others comments in order to get a general overview of the activity.	You need sometimes to be very concise to record all the activities done during portfolio implementation.

According to the comments made by the participants, it can be inferred that the advantages of the methodology are that it improves the group work planning, allows students to know previously reported mistakes, and facilitates self-assessment and control of learning. The main limitation of the technique, according to different authors (Barrett, 2000; Imhof & Picard, 2009) is the increased time and effort required to implement the digital portfolios.

Conclusions

One noteworthy conclusion of this study is that a transversal objective of the university experience, that is, "To encourage the involvement of students in their learning process," was fully achieved, as evidenced by the work done by the students in their edublog (http://diariotrabajosocial.blogspot.com.es/). Another educational goal, "To know and use social software applications," was also attained through most of the edublogs. In this sense, e-portfolios can be considered as an essential curriculum element toward professional development and as an aid toward the inclusion of emerging technologies in future social interventions (Lopez-Meneses, 2012). Also, the use of e-portfolios helps enhance the learning process related to the design, development, and evaluation of an educational multimedia object. In line with Hallam *et al.* (2010), e-portfolios have a great potential to help students become reflective learners. Although in this research some freshmen do not have a systemic and deep reflective exercise of their learning process.

It is important for students to be involved in the structural design of these processes to promote a more thoughtful and enriching evaluation. In this sense, Farmer, Yue, and Brooks (2008) indicated that hetero-assessment processes among students promote a more optimal and appropriate professional development in the European context. Regarding the university professors, in line with Jarauta and Bozu (2013), e-portfolios can be a valuable tool toward developing a reflective professional practice. In this sense, one of the most important aspects is that the teacher's role in this activity can help to develop the learning process, the working methods of their classes, the tutoring processes, and the degree of acquisition of skills of students, as well as to minimize the possible difficulties of students when working in teams, among others.

In accordance with Iglesias (2013), the teachers can observe their students' evolution with respect to the beginning of the learning period. Furthermore, students can state their perceptions and comments in relation to their motivation, the difficulties they encountered, and their doubts, strengths, weaknesses; in other words, they can reflect on their learning process and analyze it critically.

In short, as noted by Miller and Morgaine (2009), e-portfolios offer a rich resource for both students and teachers to express the achievements and results of their academic progress, establish meaningful relationships between different parts of the curriculum, and show evidence of the learning process, leading to the improvement and development of their identities as learners or as facilitators of learning. After six academic courses, it can be inferred that this reflexive methodological strategy provides a great educational potential for the improvement of university education, besides being a motivational tool for reflection on the educational process, allowing an intentional collection

of systemic evidence of learning (Aguaded, Lopez-Jaen & Meneses, 2013). Also, this strategy provides a more authentic form of learning assessment and a student-centric approach to learning (Orland-Barak, 2005). In this sense, e-portfolios can and should play an important role in the process of methodological innovation, assessment, and educational research (López-Fernández & Rodríguez-Illera, 2009; Aguaded, López-Meneses & Alonso, 2010).

Finally, we must address serious challenges to the implementation of this methodology, such as its incompatibility with many public university classrooms, which are often overcrowded and without the adequate technological and building conditions to develop this type of teaching strategy (Guasch, Guàrdia & Barbera, 2009). According to Hallam *et al.* (2010), for an optimal integration of e-portfolios in the academic context, a strong institutional commitment to provide strategic direction, greater involvement of the university community, and adequate funding are required.

REFERENCES

Aguaded, J. I., López-Meneses, E., Alonso, L. (2010), *Innovating with Blogs in University Courses: a Qualitative Study*, The New Educational Review, 22 (3-4), 103-115.

Aguaded, J. I., López-Meneses, E., Jaén, A. (2013), *Portafolios electrónicos universitarios para una nueva metodología de enseñanza superior*. Desarrollo de un material educativo multimedia (MEM), Revista de Universidad y Sociedad del Conocimiento (RUSC), 10 (1), 7-28.

Barnett, R., Parry, G., Coate, K. (2001), *Conceptualising curriculum change*, Teaching in Higher Education, 6 (4), 435- 449.

Barrett, H. (2000), *Electronic teaching portfolios: Mulitmedia skills + portfolio development t=powerful professional development*, Association for the Advancement of Computing in Education (AACE).

Barrett, H. (2006), *Using electronic Portafolios for Formative/Classroom-Based Assessment*, Connected Newsletter, 13 (2), 4-6.

Brennan, R.L., Prediger, D.J. (1981), *Coefficient Kappa: Some Uses, Misuses, and Alternatives*, Educational and Psychological Measurement, 41, 687-99.

Brett, J.M., Shapiro, D.L., Lytle, A.L. (1998), *Breaking the Bonds of Reciprocity in Negotiations*, Academy of Management Journal, 41, 410-24.

Cambridge, D. (2010), *Eportfolios for lifelong learning and assessment,* San Francisco, CA: Jossey–Bass.

Chatham-Carpenter, A., Seawel, L., Raschig, J. (2009), *Avoiding the pitfalls: Current practices and recommendations for ePortfolios in higher education*, Journal of Educational Technology Systems, 38 (4), 437-456.

Chen, H., Light, T. (2010), *Electronic portfolios and student success: Effectiveness,*

efficiency and learning, Washington, D.C., Association of American Colleges and Universities.

Coffey, U., Ashford-Rowe, K. (2014), *The changing landscape of ePortfolios: A case study in one Australian university*, Australasian Journal of Educational Technology, 30 (3), 284-294.

Ellsworth, J. Z. (2002), *Using student portfolios to increase reflective practice among elementary teachers*, Journal of Teacher Education, 53 (4), 342-355.

Farmer, B., Yue, A., Brooks, C. (2008), *Using blogging for higher order learning in large cohort university teaching: A case study*, Australasian Journal of Educational Technology, 24 (2), 123-136.

Fernández-Márquez, E., Vázquez-Cano, E., López Meneses, E. (2016), *Los mapas conceptuales multimedia en la educación universitaria: recursos para el aprendizaje significativo*, Campus Virtuales, 5 (1), 10-18.

Flick, U. (2004), *Introducción a la investigación cualitativa*. Madrid, Morata.

Guash, T., Guàrdia, L., Barberà, E. (2009), *Prácticas del portafolio electrónico en el ámbito universitario del Estado Español*, RED. Revista de Educación a Distancia, 8, 1-11.

Hallam, G., Harper, W., McAllister, L., Hauville, K., Creagh, T. (2010), *Australian ePortfolio Project. ePortfolio use by university students in Australia: Informing excellence in policy and practice*, Retrieved from http://www.eportfoliopractice.qut.edu.au/survey/index.jsp

Holsti, O.R. (1969), *Content Analysis for the Social Sciences and Humanities*, Reading, MA: Addison-Wesley.

Iglesias, M. (2013), *Practical Implications of a Constructivist Approach to EFL Teaching in a Higher Education Context*, Journal of University Teaching & Learning Practice, 10 (2), 1-16.

Imhof, M., Picard, C. (2009), *Views on using portfolio in teacher education*, Teaching and Teacher Education, 25 (1), 149-154.

Jarauta, B., Bozu, Z. (2013), *Portafolio docente y formación pedagógica inicial del profesorado universitario. Un estudio cualitativo en la Universidad de Barcelona*, Educación XX1, 16 (2), 343-362.

Joyes, G., Gray, G., Hartnell-Young, E. (2010), *Effective practice with e-portfolios: How can the UK experience inform implementation?* Australasian Journal of Educational Technology, 26 (1), 15-27.

Klenowski, V., Askew, S., Carnell, E. (2006), *Portfolios for learning, assessment, and professional development in higher education,* Assessment & Evaluation in Higher Education, 31 (3), 267-286.

López Meneses, E., Vázquez-Cano, E., Fernández Márquez, E. (2014), *Análisis de la percepción de los alumnos sobre las áreas de intervención del futuro educador y trabajador social a través de una didáctica digital con mapas conceptuales multimedia*, RED. Revista de Educación a Distancia, 41, 1-17.

López-Fernández, O., Rodríguez-Illera, J. (2009), *Investigating university students adaptation to a digital learner course portfolio*, Computers & Education, 52 (3), 608-616.

López-Meneses, E., Vázquez-Cano, E. (2013), *WEB 2.0 Tools for social Educator training in Higher Education*, International Journal of Research In Social Sciences, 3 (2), 1-13.

Love, D., McKean, G., Gathercoal, P. (2004), *Portfolios to webfolios and beyond: Levels of maturation*, EDUCAUSE Quarterly, 27 (2), 24-37.

Martín-Monje, E., Vázquez-Cano, E., Fernández, M. (2015), *Peer assessment of language learning resources in virtual learning environments with e-rubrics*. International Journal of Technology Enhanced Learning, 6 (4), 321-342.

Miles, M., Huberman, M. (1994), *Qualitative data analysis: an expanded sourcebook,* Newbury Park, CA, Sage.

Miller, R., Morgaine, W. (2009), *The benefits of e-portfolios for students and faculty in their own words*, AAC&U, 8-12.

O'Keeffe, M., Donnelly, R. (2013), *Exploration of ePortfolios for Adding Value and Deepening Student Learning in Contemporary Higher Education*, International Journal of ePortfolio, 3 (1), 1-11.

Orland-Barak, L. (2005), *Portfolios as evidence of reflective practice: What remains 'untold'*, Educational Research, 47 (1), 25-44.

Paulson, F. L., Paulson, P. R., Meyer, C. (1991), *What makes a portfolio a portfolio?* Educational Leadership, 48 (5), 60-63.

Simons, T. (1993), *Speech Patterns and the Concept of Utility in Cognitive Maps: The Case of Integrative Bargaining*, Academy of Management Journal, 36, 139-56.

Tubaishat, A. (2015), *Can e-portfolio improve students' readiness to find an IT Career?* Issues in Informing Science and Information Technology, 12, 198-202.

Vázquez-Cano, E., López Meneses, E. (2016), *Experiencia didáctica con mapas conceptuales interactivos con estudiantes universitarios sobre las áreas de intervención socio-laboral del educador social*, Aula de encuentro, 18 (1), 5-23.

Vázquez-Cano, E., López Meneses, E., Fernández Márquez, E. (2013), *Concept Mapping for developing competencies in European Higher Education Area*, International Journal of Humanities and Social Science, 3 (15), 1-12.

Vázquez-Cano, E., López Meneses, E., Sánchez-Serrano, J.L. (2015), *Analysis of social worker and educator's areas of intervention through multimedia concept maps and online discussion forums in Higher Education*, Electronic Journal of e-Learning, 13 (5), 333-346.

Vázquez-Cano, E., Martín Monje, E., Fernández, M. (2014), *El rol de las e-rúbricas en la evaluación de materiales digitales para la enseñanza de lenguas en entornos virtuales de aprendizaje*, Revista de Docencia Universitaria, 12, 135-157.

Vázquez-Cano, E., Martín-Monje, E., Castrillo, M.ªD. (2016), *Analysis of PLE´s implementation under OER design as a productive teaching-learning strategy in Higher Education. A case study at Universidad Nacional de Educación a Distancia*. Digital Education Review, 29, 62-85.

Weingart, L.R., Olekalns, M., Smith P. (2004), *Quantitative Coding of Negotiation Behavior*, International Negotiation, 9, 441-55.

Xu, J. (2003), *Promoting School-Centered Professional Development through Teaching Portfolios: A Case Study*, Journal of Teacher Education, 54 (4), 347-361.

Je-LKS
Journal of e-Learning and Knowledge Society
The Italian e-Learning Association Journal
PEER REVIEWED PAPERS
Vol. 13, n.2, 2017
ISSN: 1826-6223 | eISSN: 1971-8829

APPROACH TO STUDY AS AN INDICATOR OF THE QUALITY OF TEACHING AND OF LEARNING ENVIRONMENT: THE CONTRIBUTION OF JOHN BIGGS

Massimiliano Barattucci

Faculty of Psychology, Ecampus University, Novedrate (CO), Italy.
maxbarattucci@gmail.com

Keywords: Approach to study, Teaching quality, Learning environment, Education.

This review investigates the contribution of John Biggs in playing an important role within learning research and educational system quality. Schools and Universities have gradually structured their policies on the bases of their students' perceptions, satisfaction, and needs. The interest in the measurement of student's study strategies and perceptions is the result of the needs for educational institutions to demonstrate their effectiveness in teaching. Biggs's model conceptualizes the learning process as an interactive system of three sets of variable: the learning environment and student characteristics, students' approach to learning, and learning outcomes. By exploring findings from educational studies, the review seeks to examine the evolution of Biggs's learning model and his contribution to understand individual, interpersonal and contextual factors that determine effectiveness of learning.

for citations:
Barattucci M. (2017), *Approach to Study as an Indicator of the Quality of Teaching and of Learning Environment: the contribution of John Biggs*, Journal of e-Learning and Knowledge Society, v.13, n.2, 77-88. ISSN: 1826-6223, e-ISSN:1971-8829
DOI: 10.20368/1971-8829/1311

1 Introduction

Considered one of the most notable figures in the field of learning and educational processes, John Biggs, by gradually developing his model, has influenced over the last thirty years the learning and teaching assessment systems still used today. His early studies date back to the early '70s, when Anglo-Saxon and northern European scientific literatures started showing a growing scientific interest in the description and measurement of students' study strategies. This interest was driven by the need to improve the teaching policies and the quality of educational systems, a need due to both the increased competition between schools and universities, and the importance of institutional training as key factor to demonstrate teaching efficiency and effectiveness and obtain funding (Entwistle & McCune, 2004; Barattucci & Zuffo, 2012). His studies sparked an extensive debate on the construct known as approach to study or approach to learning (Webb, 1997; Entwistle, 1997; Ekeblad, 1997; Beattie, Collins & McInnes, 1997; Kember, Wong & Leung, 1999), on measurements of approach to learning and on the development of the theory of Student Approaches to Learning (Biggs, 1993a), which is considered the central framework for the systemic conceptualization of teaching and learning (Biggs, Kember & Leung, 2001).

2 The origins of Biggs's interest in learning processes

Biggs's early research in learning theory dates back to the late '60s. His first theoretical model of learning process was clearly influenced by cognitive psychology and integrated with the emerging research area related to the information processing theory. According to his model, the information processing system was affected by emotional factors (arousal). In the wake of a growing interest in personality and motivational factors influencing learning outcomes, Biggs developed a questionnaire (Study Process Questionnaire, SPQ) in order to measure the emotional variables, such as anxiety and motivation, implicated in the study process (1970a; 1970b). The first version of the questionnaire was handed out to a group of students, together with a personality test battery and a comprehension task. Biggs hypothesized that factors such as cognitive style, personality and student's values would influence the coding process and information retrieval. In his immediately subsequent studies, Biggs began to broaden his interest to contextual variables such as the student's sociocultural background (Biggs, 1972), the assessment system used by teachers (Biggs, 1973), the type of subject studied (Biggs, 1976), noting that some environmental variables had an important role in the choice of specific study strategies and in study performance. Nevertheless, with the development

of a qualitative research aimed at analyzing the study behavior in natural environments (Marton & Säljö, 1976a), the learning models derived from the Information Processing Theory (IP) showed their limits in taking into account the influence that the characteristics of the study environment could have on learning strategies. While the IP models and studies focused on how much the student has learned (in terms of amount of information retained in memory after exposure to the input), many researchers began to focus their studies on how students learn and on the processes by which a student meets the specific task requirements. While Biggs was extending his interest into learning contextual variables, Marton and Säljö (1976a) led a qualitative research, which required controlled environmental conditions and dealt with the methods and study strategies that students implemented to face learning tasks given by teachers. Students were asked to read a scientific article and to prepare to answer some questions. The instructions were purposely ambiguous in order to encourage students' self-organization and learning strategies. After the analysis of the results of the interviews and of the comprehension task, Marton and Säljö hypothesized two main types of study strategy or approach to the task: the deep approach and the surface approach. Students with a surface approach to study were motivated by the main goal, namely memorizing information to succeed in the memory test, and were focused especially on the literal aspects of the text, omitting the real meaning and favoring in this way retention with neither personal contributions nor critical analysis. On the contrary, students with a deep approach showed a study strategy that clearly focused on the understanding of the meaning and that was motivated by the aim to obtain not only a content storage, but also a personal abstract of the text. The differences in these study strategies derive from the different information processing levels and different understandings of the nature of the task (reading to memorize versus reading to understand); in fact, deep approach was associated with the intention to comprehend, whereas surface approach with the mere will to store information. The coexistence of differences in intention and study process led the authors to identify them as approaches to learning, namely methods to interpret the task requirements as they are presented in a specific context. In a further study (1976b), Marton and Säljö showed that the choice of a deep or surface approach could depend on the student's "expectations" about the task requirements. When they were asked questions that required a mere repetition of content, students tended to implement a surface approach to the material. On the contrary, when they had to face questions that involved an accurate textual analysis, some of them opted for deeper strategies. Therefore, students chose approaches to study according to their expectations about how to carry out the task. At the same time, other authors responded to these studies by elaborating definitions of various approaches to study that are totally comparable with

those provided by Marton and Säljö. Pask (1976) conceived a holistic approach, aimed at general understanding, and a serial approach, aimed at the organization of the material. Similarly, Svensson (1977) elaborated a holistic and an atomistic approach, where the former was aimed at understanding and the latter at making the learning materials more effective in preparation for the memory test. Even studies related to the IP had described two types of learning styles, one called fact retention or information retention strategy, and another known as elaborative learning or processing learning (Schmeck, Ribich & Ramanaiah, 1977). The choice of the study strategy was influenced by some factors, such as motivation, nature of the input and amount of time available to process information, whereas the influence of environmental variables was not considered at all. Because of his interest in environmental factors and context, seen as independent variables that influence learning styles, Biggs goes beyond his experience in the field of IP and embrace more ecological studies that can be generally related to the natural study environment.

3 The evolution of Biggs's theoretical models

Biggs's first explanatory model of study performance (1978) reproduces, with some changes, Dunkin and Biddle's model (1974), which originally pertained to teaching processes and hypothesized three factors influencing the study process: predictive variables (presage), process variables (process), performance variables (product). According to this first model, the interaction between personological and environmental variables entails the activation of specific study strategies that can determine study performance. Specifically, among the predictive factors of performance, there could be individual characteristics such as cognitive style, intelligence, personality and sociocultural background, as well as environmental features encountered by the student, such as course design, assessment systems, teaching methods and study subjects. The interaction between the student's characteristics and the learning environment originates a complex set of values that affects the learner's study experience and identifies goals, reasons and motivations behind his study behavior. Motivations (motives) play a key role in generating consistent study strategies that will influence study performance. Thanks to the factor analysis of the results collected during the first SPQs (Study Process Questionnaire) (Biggs, 1970a; 1970b), Biggs identified three macro profiles or approaches to study (utilising, internalising, achieving). These included three distinct types of motivation related to the different study strategies. With regard to values, the first profile (utilising) is characterized by pragmatism and study is seen as a task to accomplish and overcome in order to pursue the study career. In addition, with regard to motivations behind study, this profile shows

some concern and relies on functional strategies to achieve the bare minimum needed and reproduce the material. With regard to values, the second profile (internalising) is distinguished by interest in personal growth, powerful intrinsic motivation behind learning, deep study strategies, personal text processing and critical ability to compare and correlate the various notions studied. The third profile (achieving) is definitely result-oriented and is typified by a lack of interest in personal growth and the use of opportunistic strategies aimed at achieving the highest performance. The strategies utilising e internalising, which are related to the first two profiles, substantially correspond with the surface and deep approaches identified by Marton and Säljö. Whereas, in the theories derived from the IP, study strategy is conceived as a top-down process where the cognitive component affects the motivational one, in Biggs's theory approach to study becomes a bottom-up process, in which affective component and context influence the cognitive response to the task. In the evolution of the model proposed in 1987, Biggs defines more accurately the variables involved in learning (Figure 1).

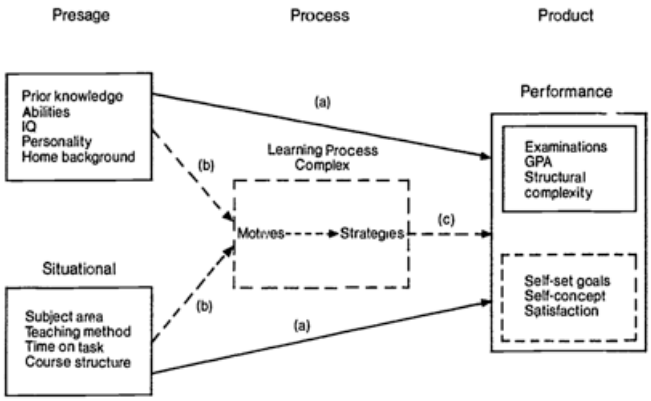

Fig. 1 - Biggs's 3P model of learning (1987)

In the process variables there are motivational and strategic components of study, whereas regarding learning (product) variables, Biggs talks about both objective variables of study performance, such Average test score, and subjective variables such as course satisfaction. The 1987 model still reveals a linear concept of the relationship between the factors involved in the determination of study performance, where predictive elements act affecting the process features that, in turn, influence the learning outcomes. This concept has been gradually modified since 1993, when it turned into a systemic representation of the processes involved in learning that underlies the adoption of a new model

describing the whole study environment. Biggs (1993a) proposes comparing the college training with a macrosystem composed by four main microsystems. The first is the student microsystem; the second is the classroom system, which includes teachers, educational facilities and teaching context; the third is the institutional microsystem, composed of departments and faculties. Each subsystem can implement, encourage or impede student learning. The fourth subsystem, called college community, can influence institutional and classroom systems. In this new systemic approach, Biggs (1993b) includes the revision of his linear model and hypothesizes that a particular approach to learning is influenced by the interaction between personological and many contextual variables within a specific educational ecosystem (Figure 2) (Biggs, 1999). The model assumes that learning outcomes are determined by several factors interacting with one another.

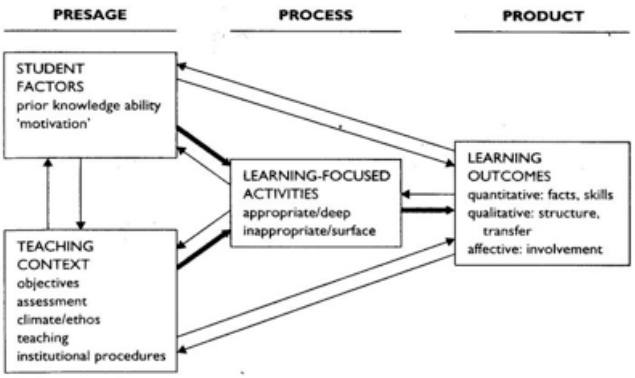

Fig. 2 - Biggs's 3P model of student learning (1993)

Just like the previous ones, the 3P model consists of three groups of variables involved in the learning process: predictive variables (student's characteristics and educational context), process variables (approach to learning) and product variables (outcomes). With regard to the predictive variables, we can see that the student's individual characteristics include information processing skills, personality, age, prior knowledge in similar or preparatory subjects, prediction of success, motivation (Biggs & Telfer, 1987). The characteristics of the educational context include environmental variables such as course and exam design, teaching and assessment methods, type of exams, teachers' beliefs about teaching and students (Biggs & Moore, 1993). Compared to the previous models, the division into groups of variables (predictive, process, product) involved in the learning process, is neither strict nor unidirectional. In fact,

not only changes in predictive variables can determine changes in approach to study and, as a result, in outcomes, but outcomes, in turn, can affect the subsequent learning experiences and can act backwards by influencing process and predictive variables.

4 Learning and Teaching

Biggs describes this new model as a model of teaching and learning (Biggs, 1999). This description introduces something new and represents a reversal in the theorization of the processes related to learning in college contexts. In fact, since the students' study performances depend on the characteristics of the learning context, the model will be able to provide a theoretical framework that will be useful to understand the teacher and teaching systems and their effects in terms of learning outcomes. The situational factors are called "teaching context factors", namely factors related to teaching context. This expression refers to what should be taught and how it should be taught and assessed, to teacher's experience and to classroom and institutional climate (Biggs, 1999). The three components of the teaching system that can influence the most the quality of learning are study content, teaching method and assessment system of student learning. With regard to these elements, Biggs introduces the concept of alignement, namely compatibility between the components of the system. The components of the teaching system not only have to be effective and of good quality, but also must be compatible with one another. In order to work properly, the various components of the college educational system (curricula, teaching methods and assessment procedures) should be aligned, namely consistent and aimed at achieving common goals that focus on the student. The presence of imbalances in the system could generate "breaks", namely the student perception of an unproductive education, the adoption of a surface approach, the presence of dashed expectations or teaching practices that are at odds with the syllabus. The concept of learning environment as a set of variables influencing the approach to study derives directly from Biggs's definition of teaching effectiveness. Effective teaching does not depend on the learner's identity, considering that the quality of learning is not completely related to the student's prior skills. It is not even fully affected by what the teacher does, since the adoption of a teaching method that proved effective in another context is not enough to predict positive outcomes. The indicator of teaching effectiveness is represented by what the student concretely does, namely by the outcomes he perceives and achieves. The model includes an additional element of innovation, namely the division of learning outcomes into quantitative outcomes (how much the student has learned), qualitative outcomes (how the student has learned) and affective outcomes (students'

attitudes towards their study experience and level of engagement in college life), which is expressed in terms of satisfaction and perception of the development of cross skills. These outcomes are relatively stable. They can influence the subsequent learning experiences and can act backwards in the model by influencing process and predictive variables. Students interpret the teaching context according to their concepts, experiences and motivations and organize their study through meta-learning, monitoring, planning and assessment skills (Biggs & Moore, 1993). The student will choose a (deep or surface) strategy that will be determined specifically by the way he perceives the requirements of the learning environment. Therefore, teaching methods can determine changes in how students perceive the learning environment and this element, in turn, could influence the adoption of specific approaches to study.

Conclusion

Despite the presence of many paths to the conceptualisation of learning, 'approaches to learning research' leads to a broad range of studies and institutional interest. The quantity of research in the area of learning style and learning strategies leads to the diversity of the disciplines and domains in which the research is conducted, with fragmented and disparate topic (Cassidy, 2004). Because learning style has been the focus of such a vast number of research and studies in the area, there exist a variety of definitions, theoretical positions, models, interpretations and measures of the construct (For a review: Cassidy, 2004). Within these learning theories, Biggs' model and the deep/surface dichotomy were defined as stimulating and suggestive, but receiving, at the same time, many criticisms. Some authors underlined significant issues relating to the model's supporting evidence and conceptualisation (Howie & Bagnall, 2013). The language is considered ambigous (familiar and non-technical), while the model is found to be underdeveloped and circular, with a lack of definition of the structure (Haggis, 2003; Marshall & Case, 2005; Heikkilä & Lonka, 2006). From a practical relevance point of view, the 3P learning process model supports a systematic control of teaching quality and its assessment, of environmental variables, and learning outcomes. It's through the methodologies developed by this model that a large number of universities are monitored and evaluated, in order to ensure increasing learning standards, obtain fundings, and contend for students in an internationally competitive market. In Biggs's models, approach to study is one of the components of the educational system, including both teaching and learning. It also represents effectively an important overall indicator of the quality of the system; in fact, it can reveal if the educational system works or not (Biggs, 1993a). The concept of approach to study, conceived in the wake of Marton and Säljö's research

(1997) and in line with the results of other authors (Pask, 1976; Svensson, 1977; Entwistle, Hanley & Hounsell, 1979), became the basic construct for the development of Biggs's theory of Student Approaches to Learning (SAL) (1993a). Nowadays, thanks to its centrality and specificity, this theory is a framework for the systemic and constructivist conceptualization of teaching and learning (Biggs, Kember & Leung, 2001), that could fit several learning environments (Barattucci & Zuffo, 2012; Barattucci *et al.*, 2017). The strength of the construct approach to study lies in the fact that it is focused on a set of factors influencing the quality of learning, such as learning and teaching environment, types of teaching and assessment, and the related students' perceptions (Prosser & Trigwell, 1999; Ramsden, 2003). The adoption of specific learning strategies is affected not only by personological variables, but also by contextual variables such as the learning environment. Approach to study is considered both a critical factor influencing educational performance (Minbashian, Huon & Bird, 2004) and an important predictor of students' perception of a supportive learning environment. The latter, in turn, is a variable that can modify learning outcomes (Trigwell, 2006; 2012; Trigwell, Ashwin & Millian, 2013). Consequently, several educational institutions showed a growing interest in paying attention to how study environment affects students' perceptions and the value they attribute to it. This attention responds to the desire to improve the educational systems, due to the impact they have in creating representations of positive and supportive environments (Ramsden, 2003). The adjustment of educational systems centered on Student Focused Learning (Prosser, 2004) has become a strengthened and recognized aspect of the activity of successful educational systems (Biggs & Kirby, 1984). The relationship between students' perception of learning environment, their learning approaches and (quantitative and qualitative) outcomes are central in the field of education. It is through the understanding of perceptions students have of themselves and the learning context that it becomes possible to interpret the variations in study results and act on learning environment, in order to obtain the best approach to study.

REFERENCES

Barattucci, M., & Zuffo, R. G. (2012), Measuring learning environment perceptions: validation of the Italian version of the approaches to studying inventory and the student course experience questionnaire. *TPM*, 19, 1, 15-33. doi: 10.4473/TPM19.1.2

Barattucci, M., Pagliaro, S., Cafagna, D., & Bosetto, D. (2017) An examination of the applicability of Biggs' 3P learning process model to Italian university. *Journal of*

e-Learning and Knowledge Society, 13, 1.
Beattie, V., Collins, B., & McInnes, B. (1997) Deep and surface learning: a simple or semplicistic dichotomy? *Accounting Education*, 6, 1, 1-12.
Biggs, J. B. (1970a). Faculty patterns in study behaviour. *Australian Journal of Psychology*, 22, 161-174.
Biggs, J. B. (1970b). Personality correlates of certain dimensions of study behaviour. *Australian Journal of Psychology*, 22, 287-297.
Biggs, J. B. (1972). Study behaviour and matriculation performance in two school populations. *Australian Journal of Education*, 16 (2), 187-204.
Biggs, J. B. (1973). Study behaviour and performance in objective and essay formats. *Australian Journal of Education*, 17 (2), 157-167.
Biggs, J. B. (1976). Dimension of study behaviour: Another look at ATI. *British Journal of Educational Psychology*, 46, 68-80.
Biggs, J. B. (1978). Individual and group differences in study processes. *British Journal of Educational Psychology*, 48, 266-279.
Biggs, J. B. (1993a). From theory to practice: A cognitive systems approach. *Higher Education Research and Development*, 12 (1), 73-85.
Biggs, J. B. (1993b). What do inventories of students' learning processes really measure? A theoretical review and clarification. *British Journal of Educational Psychology*, 63, 3-19.
Biggs, J. B. (1999). *Teaching for quality learning at university*. Buckingham, UK: Open University Press.
Biggs, J. B. & Kirby, J. R. (1984). Differentiation of learning processes within ability groups. *Educational Psychology*, 4 (1), 21-39.
Biggs, J. B. & Moore, P. J. (1993). *The process of learning* (3rd ed.). New York: Prentice Hall.
Biggs, J., & Tang, C. (2007), *Teaching for quality learning at university*, Buckingham, UK: Society for Research into Higher Education and Open University Press.
Biggs, J. B. & Telfer, R. (1987). *The process of learning* (2nd ed.). Sydney: Prentice Hall.
Biggs, J.B., Kember, D. & Leung, Y.P. (2001) The revised two-factor study process questionnaire: R-SPQ-2F. *British Journal of Educational Psychology*, 71, 133-149.
Cassidy, S. (2004) Learning Styles: An overview of theories, models, and measures. *Educational Psychology*, 24, 4, 419-444.
Dunkin, M.J. & Biddle, B.J. (1974). *The study of teaching*. New York: Holt, Rinehart & Winston.
Entwistle, N.J. (1997). Reconstituting approaches to learning: A response to Webb. *Higher Education*, 33, 213-218.
Entwistle, N.J. & McCune, V. (2004). The conceptual bases of study strategy inventories in higher education. *Educational Psychology Review*, 16 (4), 325-346.
Entwistle, N.J., Hanley, M. & Hounsell, D. (1979). Identifying distinctive approaches to studying. *Higher Education*, 8, 365-380.
Haggis, T. (2003) Constructing Images of Ourselves? A Critical Investigation into

'Approaches to Learning' Research in Higher Education. *British Educational Research Journal*, 29, 1, 89-104.

Heikkilä, A. & Lonka, K (2006) Studying in higher education: students' approaches to learning, self-regulation, and cognitive strategies. *Studies in Higher Education*, 31, 1, 99–117.

Howie, P., & Bagnall, R. (2013) A critique of the deep and surface approaches to learning model. *Teaching in Higher Education*, 18, 4, 389-400. http://dx.doi.org/10.1080/13562517.2012.7336890.

Kember, D., Wong, A. & Leung, D.Y.P. (1999). Reconsidering the dimensions of approaches to learning. *British Journal of Educational Psychology*, 69, 323-343.

Marshall, D. & Case, J. (2005) 'Approaches to learning' research in higher education: a response to Haggis. *British Educational Research Joumal*, 31, 2, 257-267.

Marton, F. & Säljö, R. (1976a). On qualitative differences in learning: I – Outcomes & process. *British Journal of Educational Psychology*, 46, 4-11.

Marton, F. & Säljö, R. (1976b). On qualitative differences in learning: II – Outcome as a function of the learners conception of the task. *British Journal of Educational Psychology*, 46, 115-127.

Marton, F. & Säljö, R. (1997). Approaches to learning. In F. Marton, D. Hounsell e N. Entwistle (eds.), *The experience of learning*. Edinburgh: Scottish Academic Press.

Minbashian, A., Huon, G.F. & Bird, K.D. (2004). Approaches to studying and academic performance in short-essay. *Higher Education*, 47 (2), 161-176.

Pask, G. (1976). Styles and strategies of learning. *British Journal of Educational Psychology*, 46, 128-148.

Prosser, M. (2004). A student learning perspective on teaching and learning, with implications for problem-based learning. *European Journal of Dental Education*, 8, 51-58.

Prosser, M. & Trigwell, K. (1999). *Understanding learning and teaching*. London: Society for Research into Higher Education and Open University Press.

Prosser, M., Trigwell, K. & Taylor, P. (1994). A Phenomenographic study of academics' conceptions of science learning and teaching. *Learning and Instruction*, 4 (3), 217-231.

Ramsden, P. (2003) *Learning to teach in higher education* (2nd ed.). London: Routledge.

Schmeck, R.R., Ribich, F. & Ramanaiah, N. (1977). Development of a self-report inventory for assessing individual differences in learning processes. *Applied Psychological Measurement*, 1 (3), 413-431.

Svensson, L. (1977). On qualitative differences in learning: III – Study skill and learning. *British Journal of Educational Psychology*, 47, 233-243.

Trigwell, K. (2006) An analysis of the relations between learning and teaching approaches. In P. Sutherland e Jim Crowther (a cura di) *Lifelong learning: Concepts and contexts*. London: Routledge.

Trigwell, K. (2012), Scholarship of Teaching and Learning. In L. Hunt and D. Chalmers (Eds.), *University Teaching in Focus: A learning-centred approach*, (pp. 253-267),

Camberwell, Victoria: Acer Press.

Trigwell, K., & Ashwin, P. (2003), *Undergraduate students experience of learning at the University of Oxford*, Oxford, UK: Oxford Learning Institute.

Trigwell, K., Ashwin, P., & Millan, E. S. (2013) Evoked prior learning experience and approach to learning as predictors of academic achievement. *British Journal of Educational Psychology*, 83, 363–378.

Webb, G. (1997). Deconstructing deep and surface: Towards a critique of phenomenography. *Higher Education*, 33 (2), 195-212.

Je-LKS
Journal of e-Learning and Knowledge Society
The Italian e-Learning Association Journal
PEER REVIEWED PAPERS
Vol. 13, n.2, 2017
ISSN: 1826-6223 | eISSN: 1971-8829

A FRAMEWORK FOR DEVELOPMENT OF E-LEARNING SYSTEM FOR COMPUTER PROGRAMMING: APPLICATION IN THE C PROGRAMMING LANGUAGE

Ivan Mustakerov[1]
Daniela Borissova[1,2]

[1] Department of Information Processes and Decision Support Systems, Institute of Information and Communication Technologies – BAS, Sofia, Bulgaria
[2] University of Library Studies and Information Technologies, Sofia, Bulgaria
mustakerov@iit.bas.bg, dborissova@iit.bas.bg

Keywords: Course development; C programming language; e-learning; e-assessment; software architecture.

This paper describes a framework for development of e-learning system for computer programming. The proposed framework includes not only the necessary course materials and the corresponding tests and exercises, but also offers an integrated environment to test written programming codes. The described approach corresponds to recent trend in distance education by providing massive open online course for unlimited participation and accessible through the Internet. The modern capabilities of ICT and database are integrated to support the learning process in a user friendly environment. The functionality of the e-learning framework is composed of five basic modules for learning content, testing, exercises, questions and answers, and help module. The described framework is implemented in developed e-learning system for C programming language. The e-learning system was tested in real educational environment and was very well accepted both of

for citations:
Mustakerov I., Borissova D. (2017), *A Framework for Development of e-learning System for computer programming: Application in the C programming Language,* Journal of e-Learning and Knowledge Society, v.13, n.2, 89-101. ISSN: 1826-6223, e-ISSN:1971-8829
DOI: 10.20368/1971-8829/1299

students and teachers. The preliminary results show applicability of the system leading to improvement in the acquired knowledge and C programming skills. This was confirmed by decreasing the number of students failed on the C programming exam.

1 Introduction

E-learning systems have noticeable impact on both of researchers and practitioners. The term of e-learning system is used describes various information systems that facilitate learning and teaching. Due the progress of information and communication technologies e-learning became a focus of the modern education society. Using of the multimedia tools in the learning content adds new dimensions to the traditional educational methodology (Borissova & Mustakerov, 2009). In recent years e-learning and distance learning are increasingly growing and cover different educational topics. Educational systems are those that encourage e-learning and its application contribute to substantially improvement of the quality of education. Open educational resources and online learning try to help in providing of scalable solutions to address the education gap in society, independently of a geographic location. One of the main requirements for successful application of e-learning systems is their usability. This indicator requires providing the learning systems with interactivity and feedback directed to specific goals while overcoming any factor of nuisance that interrupts the training stream.

Recent trend in distance education is to provide Massive Open Online Courses (MOOC) that allows unlimited participation and open access through the Internet, thus making higher education more accessible (Atiaja & Guerrero, 2016). The MOOC as an innovation, influence on the public academic attention and also have impact in the evolution of e-learning and especially on the higher education worldwide.

In computer science, the skills are essential element in education on software engineering. The courses for computer programming are characterized by large amount of exercises that students are expected to practice intensively in order to develop good programming experience (Lam *et al.*, 2008). Many efforts are needed to acquire experience and to master techniques of writing computer programs. This requires providing the students with specific for computer programming tools – editor, compiler or integrated development environment (IDE) (Cedazo, 2015). Computer programming skills can be viewed as core competencies of the students from computer science and many efforts have to be done in developing of supporting learning systems with ability for assessment (Alruwais *et al.*, 2016). That is why, it is important to provide at least a combination of a virtual learning environment and ability for self-testing. In this respect, many researchers have attempted to design and

develop individualized learning environments based on specific learning styles. Combining the advantages of online digital media with traditional classroom methods, the blended learning systems could be achieved via face-to-face instruction with computer mediated instruction (Mesh L. (2016).

Various problems have been developed using C language, making it the right choice for many engineers and scientists not only because the powerful commands and data structure, but also because it can easily be used for system-level operations (Etter, 2012). The design, development and application of learning tools and systems are essential to improve the learning outcome. Many authors attempt to improve the learning of C programming using the capability of modern technologies as.NET platform to perform the communication between the system and the compiler of C language using redirect technology (Wang *et al.*, 2008). For checking the knowledge about the statements in a C programming and algorithms comprehension some FLASH animations or Java applets could be used to visual representation (Han *et al.*, 2008).

In contrast to the other authors, the proposed framework for development of e-learning system for computer programming is based on freeware is easy accessible tools as HTML, JavaScript and free student's edition and cross platform Ch environment[1]. The proposed framework for e-learning gives the opportunities not only to follow the learning content, but also to get feedback and provides self-testing during the education process. The learning system can be used to facilitate the conduction of official examination. The existence of the module for writing and testing of program codes allows the students to verify the ability to writing the codes. The rest of the paper is structured as follows: architecture of the proposed e-learning framework and its basic modules, description of the basic functions of developed e-learning system, discussion and conclusion.

2 A framework for e-learning system development

This section describes the proposed framework for the e-learning system composed of the basic learning modules and represented via proper architecture. The aim of e-learning system for C programming language is to assist the learners in the educational process. That means to provide not only the courseware to the domain of C programming, but also to give some tools to assess knowledge in the learning process. Taking into account the advantages of Web-technologies, the proposed learning system is based on client-server technology and relies on web browser accessibility. The proposed e-learning system for computer programming can be represented as interactive computer-based information system that combines the computer capabilities, Internet,

[1] http://www.softintegration.com/

and database to support the learning process in a user-friendly learning environment. The e-learning system is composed of three-layer architecture – user interface (presentation layer), functional logic (functional layer) and data access logic (data layer) as shown in Fig. 1.

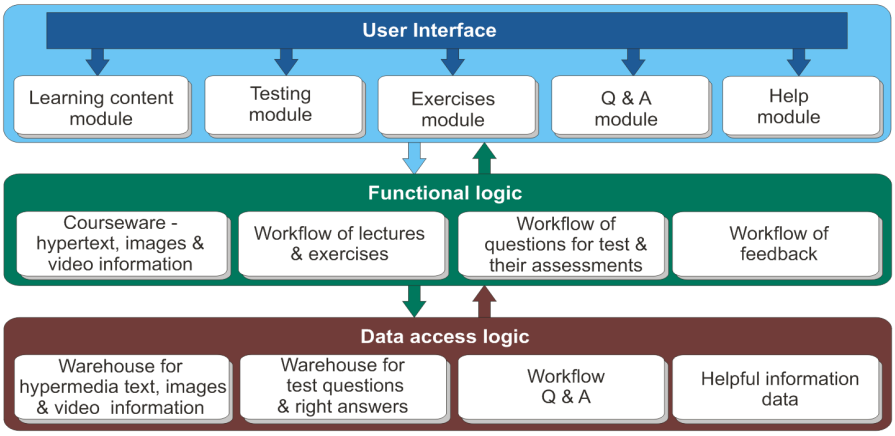

Fig.1 - Architecture of distance e-learning system for C programming

The *learning content* module is composed of different multimedia information as text and hypertext, images and video consistent to the particular lectures. This module also provides an alphabetical index of terms, allowing quick access to their detailed description in the lectures by appropriate hyperlinks. The teaching material should be generated dynamically to help the students to navigate different learning topic through hyperlinks.

The *exercises* module contains instructions for programming tasks corresponding to the learning content of units. In this module the students can write and test different program codes as the programming skills cannot be obtained without programming practice. This allows the students to set breakpoints, to run a program step by step, to watch and change values of variables in stacks during its execution, etc.

The comprehension states of the learners can be measured by tests during learning via *testing* module. To estimate the students' knowledge, the learning system integrates self-testing combined with an automated evaluation. The assessment part of the testing module should be capable to evaluate the quality of learners correctly. The module for questions and answers is composed of a separate text file from which the selected item is loaded when activated the testing module. The right answers of testing questions can be stored to be available in process of forming the current and total scores of tests. The relation

between learning content and self-assessment module is of great importance because it facilitates the e-learning process and influences on increasing of learning motivation. Computer programming has essential practical context and the assessment of programming learning performance is challenging. Different online assessment system could be used to count total scores used to define the final estimation (Harley & Harley, 2011; Mustakerov & Borissova, 2011; Wang *et al.*, 2012). In self-test assessment mode, test module should be able to mark errors and provide a feedback to students for deficiencies in their knowledge. This self-test assessment mode allow the users to see what they do well and what they need to improve. Multiple choice questions are easier to use with technology than short or essay question, but learners can answer the questions more quickly and respectively the number of questions and the coverage of the curriculum can be increased (Farrell & Rushby, 2016).

The *Questions and Answers* (Q&A) module provides frequently asked questions and answers of these questions. This module is composed of a separate database (questions repository) from which different themes can be selected and loaded. The Q&A module could be viewed as additional information based on the students' questions and teachers' answers in respect of the learning content.

The *Help* module contains information about the organization of the course and its usage rules. The structuring of the learning system in modules allows easily maintenance the courseware management and future updates.

The user interface allows interacting with the specialized modules for *learning content, exercises, testing, questions and answers*, and *help*. The second layer is responsible to provide functional logic between requested unit from the lectures, tests, exercises, questions & answers and corresponding learning content. The data layer provides the needed access logic in accordance to the selected module. The e-learning system should be based on asynchronous learning method to facilitate the uses of online learning resources information sharing outside the constraints of time and place among a network of users. This facilitates the learning process in traditional education, distance education, and also the continuing education.

3 Description of main system functions

This section provides information about the required modules for realizing the functionality of the e-learning system. The developed e-learning system is self-contained and presents all learning content online. The basic horizontal navigation menu of the system allows links to the main modules: 1) module for learning content, 2) module for testing, 3) module for exercises, 4) module for Q&A and 5) module for additional helpful information (Fig. 2). The content of lectures differs from the original approach of presentation proposed by

developers of the C language – Kernighan and Ritchie (Kernighan & Ritchie, 1988). This approach is widely accepted for teaching and learning of programming in C, although it is not the easiest for beginners in programming. From didactic point of view more appropriate for beginners is presentation of learning content with gradually increasing difficulty – starting from allowable symbols, keywords, etc. (Fig. 2). The learning content is divided into two main parts – for novice programmers and for students which have some programming experience (Bogdanov & Mustakerov, 2004). The first part presents the main language symbols and elements illustrated by examples. Each new element is introduced by formal description, explanation, examples and exceptions. The syntactical description for language elements in the beginning can be used as reference by any C programmer. Passing the first part, the students will have the basic knowledge to write and test some simple C codes.

The second part covers all insights of ANSI C and also could be used for reference and from more experienced C programmers. Each educational unit includes learning material as lecture text and code of examples (based on learned to that point language elements), and is accompanied by appropriate explanations. Integrated part of the learning process is the assessment.

Fig. 2 - Screenshot of the part of first lecture content

Assessment encourages the learning and provides feedback on learning for both students and teachers. Assessment is perhaps the best way to identify the learners needs, so the testing module essential. It is composed of questions with multiple options to choose from. This type of assessment is quicker in delivery, gives more specific and directed feedback to learners and can provide greater curricular coverage.

The module for testing is composed of two main parts. The first one is intended to store the questions and answers while the second one aims to calculate the testing scores and to form the final result. Due the used JavaScript language, minimal resource is needed. JavaScript functions interact with languages such as CSS and HTML via document object model. Through Ajax technology, the Web page is updated without reloading the whole page via requesting and receiving data from a server in the background. Loading of module for testing is based on *open(method, URL, async)* to point the method and web address of the file on a server accessible through *XMLHttpRequest* object. The "*async*" parameter specifies whether the request should be handled asynchronously or not. *XMLHttpRequest* as an API can be used by JavaScript to transfer and manipulate data to and from a web server using HTTP, establishing an independent connection channel between a webpage's client-side and server-side. When the file is loaded, the test can be started (Fig. 3).

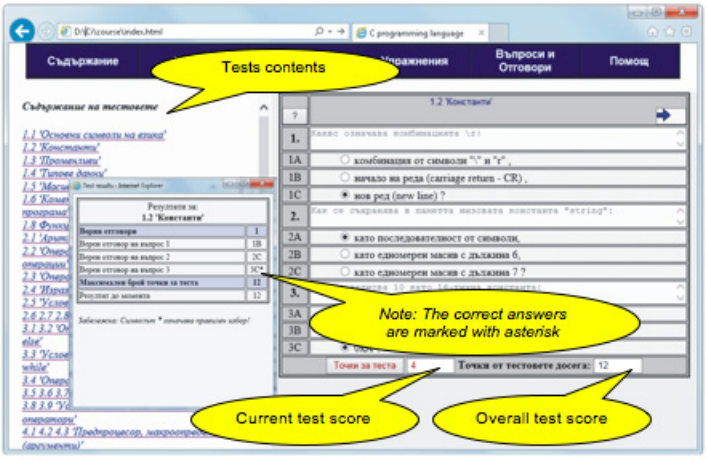

Fig. 3 - Screenshot of window for C programming testing

The answers of questions are realized by radio buttons. The second part of the module test checks whether the answers are correct and calculates the current test score and also provides an overall assessment of the answers to

the questions so far (Fig. 3). The chosen topic on the left pane defines the questions to be loaded in the right pane. The questions are visualized through table template where form template is used for processing of data. For processing of questions' answers data, the JavaScript is chosen as a flexible and expressive scripting language, which makes it possible to implement the interactive asynchronous Web applications by Ajax technology. In the contexts of the current e-learning system for C programming, the JavaScript function, which processes the current and total score of the test, is listed below:

```
    function getScore()
    {
        if(check==0 && parent.conttest.tpass[parent.conttest.tochka]==0)
        {
          Score = 0; da[0]=" "; da[1]=" "; da[2]=" ";
          var A1=eval("an"+parent.conttest.tochka+"[0]");
          var A2=eval("an"+parent.conttest.tochka+"[1]");
          var A3=eval("an"+parent.conttest.tochka+"[2]");
          var Answers = new Array();
          Answers[0]  = [A1, test.question1];
          Answers[1]  = [A2, test.question2];
          Answers[2]  = [A3, test.question3];
          for (i=0; i < ansNum; i++)
        {
             var currQuestion = Answers[i][1];
             if(!currQuestion[0].checked && !currQuestion[1].checked &&  !currQuestion[2].
checked)
             { alert("Изберете отговор за всеки въпрос!");  return; }
             for (j=0; j<currQuestion.length; j++)
             {if (currQuestion[j].checked && currQuestion[j].value == Answers[i][0])
               { da[i]="*"; Score++; break;}
             }
        }
        Score = Math.round(Score/ansNum*100);
        if (Score <33) Score= 0;
        else if (Score <67  && Score>=33) Score= 4;
        else if (Score <100 && Score>=67) Score= 8;
        else if (Score==100)              Score= 12;
        if(parent.conttest.TotalScore>0)
          TotalScore=parent.conttest.TotalScore;
        document.test.score.value=" " + Score;
        document.test.totalscore.value=" " + TotalScore; check=1;
        parent.conttest.tpass[parent.conttest.tochka]=1;
        stat(test);
      }
    else window.alert("Тестът вече е изпълняван!");
    }
```

The self-testing process can be more useful if after the student has marked his answers, the correct answers are shown. They are presented in a pop-up window and are marked with asterisk (*) as shown in Fig. 3. This pop-up window is generated via JavaScript function on the fly when the button current test score is activated. This function does not allow going back to questions that are already passed but the test can be repeated from the beginning as many times as it is needed. Because the students are able to see their answers that resulted in errors, they have the opportunity to go back to the learning content

to understand what knowledge they have missed. The self-assessment allows the students to estimate their acquired knowledge on any computer and at any place (provided there is Internet connection).

The testing module is realized following the proposed conceptual approach for development of educational Web-based e-testing system (Mustakerov & Borissova, 2011). This module can be adjusted to perform different levels of test difficulty and can be used also for official student examination if the test run is limited to single run for given time period and total questions score are sent to the tutor. The programming skills cannot be obtained without programming practice. Testing codes is an absolute prerequisite for success in programming and any developed e-learning programming course requires availability of tool for writing and testing of program codes. This tool can be implemented as a module in the e-learning system (Rehberger *et al.*, 2013; Cedazo *et al.*, 2015).

The main problem is that C programs have to be linked to appropriate libraries and compiled to get the executable code. Only after execution of this code, the programmer will be able to assess the correctness of the program. An alternative approach for exercising of C programming is to use some specially designed tools for professional programming with proven effectiveness. The developed of e-learning system for the C programming language is based on Ch environment for C programming. This environment extends C for scripting and shell programming and provides many options needed for quick start in learning of C programming. The free student's edition also provides an easy to use cross platform Integrated Development Environment (ChIDE) (Fig.4).

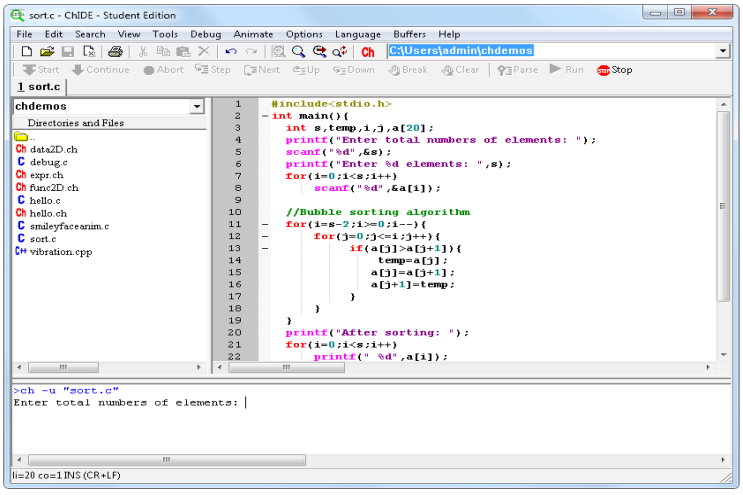

Fig. 4 - GUI of ChIDE for exercises on C programming

The use of ChIDE gives the opportunities the students to create a solution C code or edit the developed one according to the received feedbacks. The users can set breakpoints, run a program step by step, watch and change values of variables in different stacks during the program execution, etc. This is due to the comprehensive facilities of ChIDE for editing, debugging or running of C programs. Advantage of ChIDE is the ability to set the user interface among over 30 local languages. This environment can be downloaded for free from any student or teacher and can be used for training of C programming skills.

4 Results and discussion

The proposed online learning system for C programming language is based on modular architecture and can be modified and extended with additional modules. The selection of content of learning and testing depends on users' preferences. Each of the learning units can be accessed separately, as they are independent of each other. Since the different system modules are accessible via simple and intuitive navigation menu, the usage of the described e-learning system requires only basic knowledge for using of Web browser. The incorporated modules in the learning system give the opportunities not only to follow the learning content, but also provide opportunities for self-testing to verify the gained knowledge. The used module for writing and testing of program codes allows setting of breakpoints, running a program step by step, watching and changing values of variables in stacks during execution.

The described e-learning system for C programming language was tested in a course of higher education during one semester. Two ways of system using are included in testing: 1) in classroom teaching where learning content of the system is presented by the teacher and 2) distance education using the support provided by the described e-learning system. At the end of the semester, all students pass test for C programming language syntax and coding. The results of examination after completing the courses are compared with those of students not using system and following the traditional way of teaching using learning content presentation based on Kernigan & Ritchie (Kernighan & Ritchie, 1988). The testing results for all groups of students are shown in Table 1.

Table 1
TESTING RESULTS

	Male	Female	Some experience in programming	Novices in programming
Students using e-leaning system				
Classroom teaching (CT)	44	28	16	56
CT – Excellent results	16	11	11	16
CT – Number of fails	1	1	0	2
Distance education (DE)	26	25	10	41
DE – Excellent results	11	10	8	13
DE – Number of fails	0	1	0	1
Students not using e-leaning system				
Traditional teaching in classroom (TE)	42	34	21	55
TE – Excellent results	12	10	13	9
TE – Number of fails	3	2	1	4

The results show, that the students in distance education have a little better results compared with the students that are present in-class during the educational process and using e-learning system. For example, the excellent results from students in distance education exceed the excellent results from the in-class teaching with about 4% (41.2% vs. 37.5%) while the fail results are less with about 1% (1.96% vs. 2.8%). This could be explained with the better motivation of the self-learning students. The testing also show that students in distance education have better results than in class learning students (80% vs. 68.75%). This might be explained with existence of a better motivation of the self-learning students. Another visible fact is that the gender of the students does not impact essentially on the final exam results, i.e. the ambition to learn has nothing to do with sex of students. The comparison between in classroom teaching by e-learning system using and traditional way of teaching (without e-learning system) show higher excellent scores (about 11 %) and about 4 % more fails.

Overall, the testing results show the learning system applicability for both of students in distance education and for in classroom teaching. The improved final results demonstrate the capability of the system to assist the students to write correct programming codes which is the ultimate goal of C programming course.

To get feedback for system usage benefits, an anonymous evaluation of system from the students was held at the end of the semester. The evaluated components are learning content, exercises and tests. The student's satisfaction varies in different modules as follows: for learning content 89 %, for exercises 89.3 %, and for tests 98.2 %. The overall satisfaction from the usage of the e-learning system for C programming language reaches more than 90 %. This gives confidence that the developed system really helps the learning process and

especially writing the correct codes. This is due not only to the well-structured learning material, but also as a result of appropriately organized modules to verify the acquired knowledge. Using of asynchronous communication and online learning contribute to the minimal requirements of hardware resources and ability to use at the student's pace. The conducted testing with described e-learning system demonstrate an improvements of student's skill and knowledge level over a specific topic, facilitate the exchange of ideas and feedback between students and teacher and creates a meaningful learning experience for the students.

Conclusion

This article describes a framework for development of e-learning system for computer programming. The proposed system architecture is composed of three-layer: 1) user interface, 2) functional logic, and 3) data. Due the modularity, some modification, expanding, and maintenance can be easily realized. The proposed e-learning system is platform-independent as it is compatible with web browsers and relies only on the availability of Internet. The proposed architecture is used to develop e-learning system for C programming language. A distinguish feature of the described e-learning system is the possibility to be used independently for study of the course on C programming language or to be incorporated in some existing learning management system. The Internet allow students to acquire knowledge and skills in C programming at a convenient for them time and place by using the functionality of the described distance learning system.

The preliminary testing of the system in real teaching process shows that is very well accepted both by the students and by teachers. Structuring of learning content in a way known from other procedural programming languages unlike the widely accepted approach from Kernighan & Ritchie, contributes for easier perception of the C programming language specifics. The learning content and system functionality will be tested continuously in real educational environment and analysis of the results will be used in order to improve it.

REFERENCES

Alruwais, N., Wills, G. & Wald, M. (2016), *Identifying factors that affect the acceptance and use of e-assessment by academics in SAUDI universities*. International E-Journal of Advances in Education, 2(4), 132-140.

Atiaja L., Guerrero R. (2016), *MOOCs: Origin, characterization, principal problems and challenges in Higher Education*. Journal of e-Learning and Knowledge Society,

12(1), 65-76.

Bogdanov, D. & Mustakerov, I. (2004), *Programming in C*. Tehnika, Sofia (in Bulgarian).

Borissova, D. & Mustakerov, I. (2009), *A framework of multimedia e-learning design for engineering training*. In Advances in Web Based Learning, LNCS, 5686, 88-97.

Borissova, D. & Mustakerov, I. (2011), *Methodology for design of Web-based laparoscopy e-training system*. European Journal of Open, Distance and E-Learning. Article 48, http://www.eurodl.org/materials/contrib/2011/Borissova_Mustakerov.pdf

Cedazo, R., Garcia Cena, C. E. & Al-Hadithi, B. M. (2015), *A friendly online C compiler to improve programming skills based on student self-assessment*. Computer Applications in Engineering Education, 23(6), 887-896.

Etter, D. M. (2012), *Engineering Problem Solving with C*. Pearson Education.

Farrell, T. & Rushby N. (2016), *Assessment and learning technologies: An overview*. British Journal of Educational Technology, 47(1), 106-120.

Han, S., Choi, K., Kim, D., Jeon, Ch., Hong, M., Woo, S. & Jeon, H. (2008), *Development of contents improving the effectiveness of self learning for the C program language*. In Advances in Web Based Learning, LNCS, 5145, 208-220.

Harley, E. & Harley, Z. (2011), *E-learning and e-assessment for a computer programming course*. In Proc. of International Conference on Education and New Learning Technologies, Barcelona, Spain, 2074-2080.

Kernighan, B. W. & Ritchie, D. M. (1988), *The C programming language*. Second edition. Prentice Hall Software Series.

Lam, M.S.W., Chan, E.Y.K., Lee, V.C.S. & Yu, Y.T. (2008), *Designing an automatic debugging assistant for improving the learning of computer programming*. Lecture Notes in Computer Science, 5169, 359-370.

Mesh L. (2016), *A curriculum-based approach to blended learning*. Journal of e-Learning and Knowledge Society, 12(3), 87-97.

Mustakerov, I. & Borissova, D. (2011), *A conceptual approach for development of educational Web-based e-testing system*. Expert Systems with Applications, 38(11), 14060-14064.

Rehberger, S., Frank, T. & Vogel-Heuser, B. (2013), *Benefit of e-learning teaching C-programming and software engineering in a very large mechanical engineering beginners class*. In Proc. IEEE Global Engineering Education Conference, Berlin, Germany, 1055-1061.

Wang, J., Chen, L. & Zhou, W. (2008), *Design and implementation of an Internet-based platform for C language learning*. In Advances in Web Based Learning, LNCS, 5145, 187-195.

Wang, Y., Li, H., Feng, Y., Jiang, Y. & Liu, Y. (2012), *Assessment of programming language learning based on peer code review model: Implementation and experience report*. Computers & Education, 59, 412-422.

Je-LKS
Journal of e-Learning and Knowledge Society
The Italian e-Learning Association Journal
PEER REVIEWED PAPERS
Vol. 13, n.2, 2017
ISSN: 1826-6223 | eISSN: 1971-8829

EMPLOYING TABLET TECHNOLOGY FOR VIDEO FEEDBACK IN PHYSICAL EDUCATION SWIMMING CLASS

Rolf Kretschmann

Gesamtschule Emschertal, Duisburg, Germany
rolf.kretschmann@get-duisburg.de

Keywords: Physical education, Technology integration, Video feedback, Swimming, Tablets.

Although technology has found its way into modern physical education (PE), technology-"unfriendly" environments beyond the gym, such as swimming pools, still haven't been focused on in terms of technology-enhanced teaching and research efforts. Approaching this blind spot, the main objective of this study was to determine the impact of technology-enhanced video feedback on swimming performance, particularly using a tablet computer. Two 5th grade PE swimming classes were randomly assigned experimental group (n = 16) and control group (n = 15). Experimental group students were exposed to a standardized video analysis and feedback program using a tablet computer by a trained PE teacher for 7 weeks. The control group PE swimming class didn't integrate any media and technology at all and used traditional teaching methods such as verbal feedback only. Students' swimming performance for front crawl was measured at baseline and after the 7-weeks class period using a pre-post test design. Experimental group

for citations:
Kretschmann R. (2017), *Employing Tablet Technology for Video Feedback in Physical Education Swimming Class,* Journal of e-Learning and Knowledge Society, v.13, n.2, 103-115.
ISSN: 1826-6223, e-ISSN:1971-8829
DOI: 10.20368/1971-8829/1322

students significantly ($p < 0.05$) improved in front crawl racing-results from pre- to post-test. Semi-structured interviews with selected experimental group students revealed that the students judged the video feedback scenario using a tablet computer being helpful for their learning process of improving their front crawl technique and eventually their race results. Conclusively, video feedback via tablet technology in PE swimming classes served as a sufficient and effective teaching method for improving front crawl swimming performance in 5th grade students. The teaching scenario proved to be superior compared to traditional teaching methods and feasible in the swimming pool environment.

1 Introduction

Modern physical education (PE) has opened itself for technology integration (e.g., Kretschmann, 2015; Mohnsen, 2012). Various technologies have found its way into regular PE classes, especially mobile devices such as (digital) cameras (Lim, Henschel Pellett & Pellett, 2009), smart phones (Cummiskey, 2011), laptops (Kretschmann, 2010), and tablet computers (Nye, 2010).

However, there are technology-"unfriendly" teaching environments beyond the gym that still haven't been focused on prominently in terms of technology-enhanced teaching and research efforts. These spaces contain swimming pools, track and field stadiums, and other outdoor areas and settings (e.g., tennis courts, soccer fields, rock climbing areas, mountain bike race tracks, parks, etc.) (Kretschmann, 2010).

Integrating technology into those technology-unfriendly PE settings may be regarded as an important task and chance to fully accomplish covering PE in its diverse facets. Particularly, motor skills acquisition and motor development can be fostered through technology, featuring the psychomotor learning domain (Mitchell, McKethan & Mohnsen, 2004).

Swimming is mandatory in the German PE, covered by national and state level PE curriculums (Prohl & Krick, 2006). In this case, improving PE students' swimming performance and technique appears to be the obvious mandatory task. Simply speaking, without the ability to swim, students are not able to conquer the element water at all. Swimming class PE students' learning outcomes therefore primarily focus on swimming performance in deep water swimming pools.

As feedback is an utmost valuable asset in improving students' motivation and motor performance (Harris, 2009; Koka & Hein, 2003), technology-enhanced video feedback may provide an ideal application of teaching efforts. Providing PE students with instant feedback on their swimming technique on-hand right after their individual swimming performances may boost their learning outcomes exponentially, compared to traditional forms of feedback (Boyce *et al.*, 1996; Lees, 2002).

The idea is that students can see themselves, taking a mental step back from the first-person intrinsic perspective to a third-person point of view, comparing

the subjective with the objective human movement outcome via video on screen (Hamlin, 2005). Additional teacher feedback guides students' attention to the essential movement parts, potentially making the learning experience even more in-depth and valuable.

2 Literature Review

Literature research on digital video feedback in PE revealed diverse terminology. Terms as "augmented feedback", "enhanced-video", "annotated video", "technology-based feedback", and "video-mediated instruction" popped up. "Multimedia" and "computer-assisted instruction (CAI)" were also featured prominently among practice and research papers.

From the conceptual point of view, video feedback has the potential to engage students in self-assessment and peer assessment, including teacher-mediated feedback conditions. According to Hamlin (2005, p. 8), using video technology for feedback purposes can help students to "'step outside themselves' to become actively involved in a process of making adjustments. Skill adjustments occur immediately during skill practice and again after viewing the videotape. Students use the video to better visualize and reflect on errors, strengths, and weaknesses".

Hamlin (2005, p. 8) also emphasizes on the slow motion ability that adds a "unique dimension to learning", as essential elements of a movement can be picked out and focused on using particular cue points. Furthermore, recorded student performance data can be stored and accessed later, preserving data loss compared to direct observation (Darden & Shimon, 2000).

Surprisingly, as video feedback may be regarded as one of the premier scenarios of technology use in PE (Kretschmann, 2010) and despite a decent number of practice papers (e.g., Darden & Shimon, 2000; Harris, 2009), little empirical evidence on video feedback in PE could be identified. These studies will be presented in alphabetic order in the following paragraphs.

Brooker and Daley-James (2013) examined British year-two class students. They used information and communication technology (ICT) for video feedback to improve children's technique in gymnastics. The findings showed that ICT improved the plan, perform, and evaluate stages, and the children's technique.

Boyce *et al.* (1996) compared the effectiveness of peer, teacher, and video feedback with teacher cuing during elementary students' skill development units in PE (overhead pass, and forearm strike in tennis). They found that teacher-directed feedback was more effective in younger students, whereas video feedback with teacher cuing was more effective for older students.

Casey and Jones (2011) investigated using digital video feedback technology for enhancing student engagement in year seven PE students. Students showed

a deeper understanding of throwing and catching and an enhanced engagement level in PE.

Harvey and Gittins (2014) applied a game-centered approach (GCA) to British middle school PE students, integrating video-based feedback into a teaching games for understanding (TGfU) soccer unit. Using an experimental design with two different video-feedback scenarios and one control group, results showed statistically significant improvements in both video-feedback groups according to game performance.

O'Loughlin, Ní Chróinín and O'Grady (2013) employed digital video feedback in elementary PE students aged 9-10 years for improving basketball skills. Digital video was used to provide feedback and to support self-assessment via rubrics. Student performance was positively impacted by self-assessment using digital video. Student motivation and engagement also increased through using digital video.

Palao, Hastie, Cruz and Ortega (2013) tested secondary school PE students in regard to skill improvement and knowledge gain for the track and field discipline hurdles, applying three different feedback conditions: a) verbal feedback by the teacher, b) video and teacher feedback, and c) video and student feedback. The video and teacher feedback condition showed statistically significant improvements in skill execution, technique, and knowledge, and therefore proved to be the most effective one.

Tanaka, Murakami, Kakoi, Wada and Takahashi (2014) used tablets for instant video feedback in Japanese PE students. Evaluation questionnaires showed that the vast majority of the students found video necessary and useful during the learning process.

Conclusively, empirical evidence on digital video feedback in PE is limited, especially regarding tablet technology, since - to our knowledge - there is only one study report available on this technology asset (Tanaka *et al.*, 2014). Nevertheless, all featured studies reported positive results. However, to cover the full picture, negative results of implemented digital video feedback for motor skill learning have also been reported (Emmen *et al.*, 1995), although that study did not feature PE and did not employ up-to-date modern technology compared to today's standards.

3 Methodology

3.1 Objectives

The main objective of this study was to determine the impact of a technology-enhanced teaching scenario in PE featuring video feedback on swimming performance, particularly using a tablet computer. Secondly, feasibility of

integrating tablet technology via the technology-enhanced teaching scenario in the swimming pool-based PE environment should be judged on.

3.2 Hypotheses

Following the main objective, two main hypotheses of this study can be stated:

- H1: It was predicted that a tablet-computer-enhanced video-feedback teaching-scenario (experimental group) in PE significantly improves student's swimming performance (25 meter front-crawl race-performance).
- H2: It was predicted that a tablet-computer enhanced video-feedback teaching-scenario (experimental group) in PE improves student's swimming performance (25 meter front-crawl race-performance) to a higher level compared to a "traditional" teaching scenario (control group).

In addition, two second-tier hypotheses emerged out of the study's objectives:

- H3: It was predicted that there is no gender difference regarding students' race-performance results in neither group (experimental group and control group).
- H4: It was predicted that integrating a tablet via the technology-enhanced feedback teaching-scenario in the swimming pool-based PE environment is feasible.

Hypothesis H3 is based on the assumption that at the participants' age, and swimming experience level and proficiency, gender differences in swimming performance shouldn't be significant. This assumption is backed up by several research findings (Rüst, Rosemann & Knechtle, 2014; Vaso *et al.*, 2013).

3.3 Study Design

In a pre-/post-test design, two 5th grade PE swimming classes of a German secondary school were randomly assigned experimental group (n=16) and control group (n=15). Experimental group students were exposed to a standardized video analysis and feedback program using a tablet computer. A trained PE teacher administered the program, which lasted for seven weeks. The tablet-computer-enhanced video-feedback teaching-scenario contained video feedback after diverse swimming exercises in the swimming pool during PE class as well as classroom sessions providing theoretical background and

content. For instance, experimental group students were given feedback using slow motion right after their individual front crawl performance.

The PE swimming class that was designated control group didn't integrate any media and technology at all. Only "traditional" teaching methods such as verbal feedback and teacher explanations were applied.

3.4 Methods

For both experimental group students and control group students, front crawl performance under competitive race conditions (elapsed time for 25 meters) was measured at baseline (before the teaching scenario was administered) and after the teaching scenario ended (after the seven weeks class period).

The front crawl was not featured in the PE swimming classes prior to this study, whereas both PE swimming classes have covered the breaststroke.

Swimming style selection was based on the rationale that in favor of a valid research design, participants should be on the same experience and performance level at the beginning of the teaching scenario. As the breaststroke style is common as first swimming style to be learned by beginners (Barth & Dietze, 2004), front crawl was selected for this study, because it shares the same face-down position as the breaststroke to have a common basis to learn the front crawl.

The race-performance setting was chosen to generate a quantifiable measure, and was based on the direct relation of swimming technique and swimming speed, as a better swimming technique usually leads to swimming faster (Maglischo, 2003).

The race length of 25 meters is simply based on the length of the swimming pools' swim lanes, as they were only 25 m long in this case. This distance also suspends endurance, exhaustion, and turn technique as potential confounders.

Independent samples t-tests were used to analyze group differences in students' front crawl performance, as the sample showed normal distribution according to Kolmogorov-Smirnov testing.

In addition, selected students of the experimental group were surveyed regarding their perceptions towards the experienced application of tablet-based feedback in PE swimming class, using semi-structured interviews. The interviews consisted of the following questions:

- How do you rate the video feedback via tablet in this swimming class?
- Do you want video feedback via tablet to be used more frequently in PE?
- Did you experience any (technology-enhanced) video feedback in PE or sports prior to this swimming class?

Basically, the semi-structured interviews relate to hypothesis H4 ("It

was predicted that integrating a tablet via the technology-enhanced teaching feedback teaching-scenario in the swimming pool-based PE environment is feasible"), as they allude to feasibility of tabled-enhanced video-feedback in swimming classes from the students' perspective.

Due to the interviews being relatively short in length, the interviews were transcribed and analyzed according to relevant statements in order to get information about how the students judged the tablet-enhanced teaching scenario feasible or not.

4 Results

4.1 Race Performance

Experimental group students improved in front crawl racing-results from pre-testing (M=33.39 seconds) to post-testing (M=31.19 seconds) statistically significantly ($p<0.05$). Control group students improved only slightly from pre-testing (M=39.56 seconds) to post-testing (M=38.53 seconds). There were no statistically significant differences between experimental group students' base levels and control group students' base levels at baseline ($p>0.05$). Table 1 shows the 25m front crawl race performance pre-post group comparisons.

Table 1
25M FRONT CRAWL RACE PERFORMANCE PRE-POST GROUP COMPARISON

Group	25 m front crawl race		
	Pre (SD) (seconds)	Post (SD) (seconds)	Pre-post difference (seconds)
Experimental group	33.39 (9.43)	31.19 (6.85)	-2.2*
Control group	39.56 (8.35)	38.53 (8.68)	-1.03
Note. * = significant at the $p < 0.05$ level. Values are means. m = meters.			

Table 2 displays the experimental group descriptive study results. Table 3 displays the control group descriptive study results. Both tables list each student's performance pre- and post-program, as well as pre-post difference. Student names were anonymized.

Table 2
EXPERIMENTAL GROUP DESCRIPTIVE STUDY RESULTS

Name	Gender	Pre (seconds)	Post (seconds)	Pre-post difference (seconds)
Luna	f	55.72	36.76	-18.96
Sarah	f	36.02	31.71	-4.31

Name	Gender	Pre (seconds)	Post (seconds)	Pre-post difference (seconds)
Eve	f	26.74	25.16	-1.56
Francine	f	30.42	29.04	-1.38
Madita	f	46.39	45.37	-1.02
Annabell	f	33.83	34.22	+0.39
Laura	f	28.59	29.11	+0.52
Steven	m	45.55	40.92	-4.63
Merlin	m	27.09	24.43	-2.66
Tim H.	m	38.24	36.32	-1.92
Moritz	m	31.59	30.06	-1.53
Tim B.	m	29.88	28.53	-1.35
Leon A.	m	18.39	18.25	-0.14
Simon	m	22.63	23.28	+0.65
Robin	m	33.66	34.63	+0.97
Finn	m	29.45	31.19	+1.74
Note. n=16. f=female. m=male.				

Table 3
CONTROL GROUP DESCRIPTIVE STUDY RESULTS

Name	Gender	Pre (seconds)	Post (seconds)	Pre-post difference (seconds)
Kim	f	51.36	43.68	-7.68
Zuzanna	f	54.42	53.87	-0.55
Lea	f	44.61	44.95	+0.34
Jana	f	32.49	33.73	+1.24
Helena	f	44.71	50.5	+5.79
Quentin	m	38.86	31.95	-6.91
Marcel	m	38.59	31.76	-6.83
Jonas	m	34.85	29.82	-5.03
Christian	m	31.65	26.91	-4.74
Felix	m	52.83	49.87	-2.96
Can	m	27.59	26.51	-1.08
Jonas	m	38.52	37.6	-0.92
David	m	36.85	36.65	-0.2
Leon P.	m	35.69	41.33	+5.64
Johannes	m	30.34	36.81	+6.47
Note. n=15. f=female. m=male.				

Descriptively, boys swim faster than girls in general. Experimental group

boys improved in front crawl racing-results from pre-testing (M=30.72 seconds; SD=8.05) to post-testing (M=29.73 seconds; SD=7.05). Experimental group girls also improved in front crawl racing-results from pre-testing (M=36.82 seconds; SD=10.56) to post-testing (M=33.05 seconds; SD=6.62). Moreover, experimental group girls improved to a much greater extent (M=-3.77 seconds) compared to experimental group boys (M=-0.99 seconds). However, there were no statistically significant differences between experimental group boys and girls at baseline and post-testing ($p>0.05$).

Control group boys improved in front crawl racing-results from pre-testing (M=36.58 seconds; SD=6.87) to post-testing (M=35.12 seconds; SD=7.22). Control group girls also improved in front crawl racing-results from pre-testing (M=45.52 seconds; SD=8.43) to post-testing (M=45.35 seconds; SD=7.7). Control group boys improved to a slightly greater extent (M=-1.46 seconds) compared to control group girls (M=-0.43 seconds). There were no statistically significant differences between control group boys and girls at baseline. However, there were statistically significant differences between control group boys and girls at post-testing ($p<0.05$).

4.2 Interviews

Semi-structured interviews with selected experimental group students revealed that the students judged the video feedback scenario using a tablet computer being helpful and motivating for their learning process of improving their front crawl technique and eventually their race results.

Luna placed emphasized on mental imagery, when stating that the video of her own performance helped her to see exactly what she did wrong. Especially her individual improvements could be made visible in a very helping way and motivated her. Francine reported a motivational boost as well, that was reportedly not connected to final grading considerations.

Robin explicitly focused on the benefits of the tablet-enhanced video feedback compared to traditional verbal feedback. He considered the video feedback way more efficient, easier going, and motivating than traditional feedback methods.

Simon reported the video feedback was fostering his learning because he could understand the PE teacher's cues better compared to traditional verbal feedback and could adapt faster. He praised the slow motion tool, which he deemed extraordinary useful for motor learning processes in general.

Merlin, Tim H., and Robin wished for a wider implementation of digital video feedback and analysis in PE. According to Merlin, the same feedback scenario should be applied to soccer units, whereas Tim mentioned the potential of video feedback for tactical components of sports games.

No interviewed student had prior experience with digital video analysis in the realm of motor learning in PE. However, Luna reported she used her smart phone to record a teammate's table tennis technique (fore and backhand topspin) outside school.

4.3 Hypotheses

The main hypotheses H1 ("It was predicted that a tablet-computer-enhanced video-feedback teaching-scenario (experimental group) in PE significantly improves student's swimming performance (25 meter front-crawl race-performance)") and H2 ("It was predicted that a tablet-computer enhanced video-feedback teaching-scenario (experimental group) in PE improves student's swimming performance (25 meter front-crawl race-performance) to a higher level compared to a "traditional" teaching scenario (control group)") can be confirmed by the given evidence.

Hypothesis H3 ("It was predicted that there is no gender difference regarding students' race-performance results in neither group (experimental group and control group)") can be partially confirmed/rejected, as there was only a significant difference between experimental group boys and girls at baseline and post-testing. According to the interview analysis, hypothesis H4 ("It was predicted that integrating a tablet via the technology-enhanced teaching feedback teaching-scenario in the swimming pool-based PE environment is feasible") can be confirmed.

5 Discussion

The experimental group's performance improvement (M=-2.2 seconds) is to be considered an enormous improvement, as a one-second improvement already means a clear and huge performance increase in swimming.

Differences in boys and girls' performances may be explained by biologically different physical conditions. However, as the digital video feedback scenario didn't have different effects on boys and girls, is may be concluded that this method is equally effective and beneficiary regardless of gender.

On the other hand, as control group results have shown, traditional verbal feedback methods may show different levels of efficiency regarding gender. Therefore, boys may be more prone to traditional feedback than girls. Nevertheless, these results should be treated with caution, as the number of females and males within the study group was not equally balanced. Furthermore, stages of cognitive development may have influenced motor development as well.

The fact that there were no statistically significant differences between

experimental group and control group in regard to base level at baseline upgrades this study's results' significance. However, talent level was not accounted for and not assessed.

One may ask why certain students declined in performance, which could be observed in both experimental and control group (compare Table 2 and Table 3). One possible explanation could be found in the emphasis on the correct execution of the front crawl technique during the particular classes. Both 25m race results and technique execution accounted for the students' front crawl final grade.

Taking a closer look at the students' single results, Luna did improve enormously (-18.96 seconds). According to the PE teachers' assessment her front crawl technique improved enormously too. This goes well hand in hand with her statement that the digital video feedback raised her motivation to work on her technique.

Although Annabell's and Simon's values have declined, their technique has improved. This phenomenon also accounts for Robin. According tot he PE teacher's assessment, the reason for the decline may be found in the lack of stamina and endurance.

The positive feedback regarding the teaching scenario by Francine could also be confirmed by her race results improvement (-1.38 seconds). Notably, Leon A.'s improvement (-0.14 seconds) shows that even advanced students with very good baseline values can still improve.

The fact that no student has ever experienced digital video feedback prior to this unit accounts for the fact that technology and PE is still an under-researched and underdeveloped topic (Kretschmann, 2010; 2012). However, Luna's report of video feedback applications outside the school PE setting may be regarded as a sign that digital video feedback holds a substantial contribution to motor learning in general (Liebermann *et al.*, 2002).

Conclusion

Video feedback via tablet technology in PE swimming class served as a sufficient and effective teaching method for improving front crawl swimming performance in 5th grade students. The technology-enhanced video-feedback teaching scenario proved to be superior compared to traditional teaching methods and feasible in the swimming pool environment, as students deemed it a sensible and beneficiary add to PE.

Future research and teaching should continue to integrate tablet-technology and video feedback, especially in technology-unfriendly environments such as swimming pools, as they seem to eminently qualify for a successful technology integrating in PE.

Acknowledgements

Special thanks go to the PE teacher Christian Sauer for applying the tablet-enhanced video-feedback teaching-scenario and collecting the data, all students who volunteered to participate in the study, and all parents who gave permission to their child to participate.

REFERENCES

Barth, K. & Dietze, J. (2004), *Learning Swimming*. Aachen: Meyer & Meyer.

Boyce, B.A., Markos, N.J., Jenkins, D.W. & Loftus, J.R. (1996). *How should feedback be delivered?* Journal of Physical Education, Recreation & Dance, 67(1), 18-22.

Brooker, S. & Daley-James, D. (2013), *Using ICT to improve children's planning, performing and evaluating skills in gymnastics, in a year 2 class, to enhance their technique*. Education 3-13: International Journal of Primary, Elementary and Early Years Education, 41(1), 32-38.

Casey, A. & Jones, B. (2011), *Using Digital Technology to Enhance Student Engagement in Physical Education*. Asia-Pacific Journal of Health, Sport and Physical Education, 2(2), 51-66.

Cummiskey, M. (2011), *There's an App for that: Smartphone Use in Health and Physical Education*. Journal of Physical Education, Recreation & Dance 82(8), 24-29.

Darden, G. & Shimon, J. (2000), *Re-visit an 'old' technology: Videotape feedback for motor skill learning and performance*. Strategies: A Journal for Physical and Sport Educators, 13(4), 17-21.

Emmen, H.H., Wesseling, L.G., Bootsma, R.J., Whiting, H.T. & Van Wieringen, P.C. (1995). *The effect of video-modelling and video-feedback on the learning of the tennis service by novices*. Journal of Sports Sciences, 3(2), 127-138.

Hamlin, B. (2005), *Motor Competency and Video Analysis*. Teaching Elementary Physical Education, 16(5), 8-13.

Harris, F. (2009), *Visual technology in physical education. Using Dartfish video analysis to enhance learning: An overview of the Dartfish project in New Brunswick*. Physical & Health Education Journal, 74(4), 24-25.

Harvey, S. & Gittins, C. (2014), *Effects of Integrating Video-Based Feedback into a Teaching Games for Understanding Soccer Unit*. Ágora para la ef y el deporte [Agora - for PE and sport], 16(3), 271-290.

Koka, A. & Hein, V. (2003), *Perceptions of teacher's feedback and learning environment as predictors of intrinsic motivation in physical education*. Psychology of Sport and Exercise, 4(4), 333-346.

Kretschmann, R. (2010), *Physical Education 2.0*. In M. Ebner & M. Schiefner (Eds.), Looking Toward the Future of Technology-Enhanced Education: Ubiquitous Learning and the Digital Native (pp. 432-454). Hershey, PA: IGI Publishing.

Kretschmann, R. (2012), *What do Physical Education Teachers Think about Integrating Technology in Physical Education?* European Journal of Social Sciences, 27(3), 444-448.

Kretschmann, R. (2015), *Physical Education Teachers' Subjective Theories about Integrating Information and Communication Technology (ICT) into Physical Education*. The Turkish Online Journal of Educational Technology, 14(1), 68-96.

Lees, A. (2002), *Technique analysis in sports. A critical review*. Journal of Sports Sciences, 20(10), 813-828.

Liebermann, D.G., Katz, L., Hughes, M.D., Bartlett, R.M., McClements, J. & Franks, I.M. (2002). *Advances in the application of information technology to sport performance*. Journal of Sports Sciences, 20(10), 755-769.

Lim, J., Henschel Pellett, H. & Pellett, T. (2009), *Integrating Digital Video Technology in the Classroom*. Journal of Physical Education, Recreation & Dance, 80(6), 40-45, 55.

Maglischo, E.W. (2003), *Swimming Fastest* (Rev. ed.). Champaign, IL: Human Kinetics.

Mitchell, M., McKethan, R. & Mohnsen, B.S. (2004). *Integrating technology and physical education*. Cerritos: Bonnie's Fitware Inc.

Mohnsen, B.S. (2012), *Using technology in physical education* (8th ed.). Big Bear Lake, CA: Bonnie's Fitware Inc.

Nye, S.B. (2010), *Tablet PCs: A Physical Educator's New Clipboard*. Strategies: A Journal for Physical and Sport Educators, 23(4), 21-23.

O'Loughlin, J., Ní Chróinín, D. & O'Grady, D. (2013), *Digital video: The impact on children's learning experiences in primary physical education*. European Physical Education Review, 19(2), 165-182.

Palao, J.M., Hastie, P.A., Cruz, P.G. & Ortega, E. (2013), *The impact of video technology on student performance in physical education*. Technology, Pedagogy and Education, 24(1), 51-63.

Prohl, R. & Krick, F. (2006), *Lehrplan und Lehrplanentwicklung - Programmatische Grundlagen des Schulsports* [Curriculum Development in German Physical Education]. In Deutscher Sportbund [German Sports Confederation] (Ed.), DSB-Sprint-Studie. Eine Untersuchung zur Situation des Schulsports in Deutschland [German National Physical Education Education Survey] (pp. 11-44). Aachen: Meyer & Meyer.

Rüst, C.A., Rosemann, T. & Knechtle, B. (2014), *Sex difference in age and peformance in elite Swiss freestyle swimmers competing from 50 m to 1,500 m*. SpringerPlus, 3, 228.

Tanaka, Y., Murakami, S., Kakoi, C., Wada, T. & Takahashi, H. (2014), *Practice of Physical Education Classes Utilizing Video*. In L. Gómez Chova, A. López Martínez & I. Candel Torres (Eds.), INTED2014 Proceedings (pp. 725-729). IATED Academy.

Vaso, M., Knechtle, B., Rüst, A., Rosemann, T. & Lepers, R. (2013), *Age of peak swim speed and sex difference in performance in medley and freestyle swimming – A comparison between 200 m and 400 m in Swiss elite swimmers*. Journal of Human Sport & Exercise, 8(4), 954-965.

Je-LKS
Journal of e-Learning and Knowledge Society
The Italian e-Learning Association Journal
PEER REVIEWED PAPERS
Vol. 13, n.2, 2017
ISSN: 1826-6223 | eISSN: 1971-8829

STUDENTS' EXPERIENCES, LEARNING OUTCOMES AND SATISFACTION IN E-LEARNING

Chin Fei Goh[1], Choi Meng Leong[2], Kalsum Kasmin[1], Puong Koh Hii[1], Owee Kowang Tan[1]

[1] Faculty of Management, Universiti Teknologi Malaysia, Johor, Malaysia

[2] UCSI University Kuching Campus, Kuching, Sarawak, Malaysia.

gcfei@utm.my

Keywords: Course design, Interaction with the instructor, Interaction with peer students, Learning outcomes, Learning satisfaction.

This study was aimed to examine whether students' experiences in e-learning are related to learning outcomes and satisfaction. Three learning experiences, which are course design, interaction with the instructor and interaction with peer students were identified as the predictors of learning outcomes and satisfaction. Self-administered questionnaire was adopted. The paper questionnaires were distributed to students at a university in Malaysia. In total, 670 valid responses were obtained. Exploratory factor analysis was performed to confirm the underlying factor structure for the observed variables. Regression analyses indicated that course design, interaction with the instructor and interaction with peer students are positively related to the learning outcomes and satisfaction. Among all learning experiences, interaction with peer students make the strongest contributions to learning outcomes and satisfaction. This study demonstrates the importance for University administrators and instructors to design e-learning course to

for citations:
Goh C., Leong C., Kasmin K., Hii P., Tan O. (2017), *Students' Experiences, Learning Outcomes and Satisfaction in e-Learning,* Journal of e-Learning and Knowledge Society, v.13, n.2, 117-128.
ISSN: 1826-6223, e-ISSN:1971-8829
DOI: 10.20368/1971-8829/1298

optimal students' experiences to enhance their learning outcomes and satisfaction.

1 Introduction

The traditional face-to-face teaching relies on the instructors to control and regulate the course contents and teaching effectiveness (Horton, 2001). In these two decades, the evolvement of information systems has provided an alternative way on teaching delivery through e-learning. E-learning is a method that adopts technology to complement traditional teaching practices. E-learning can take place without some restrictions such as geographical location and time (Richardson & Swan, 2003).

Instructors can use e-learning to enhance teaching effectiveness (Al-Adwan *et al.*, 2013). For example, learning materials can be updated regularly, and students can access the latest materials instantly. E-learning also offers a collaborative learning environment to enhance richer learning experiences and learning process. E-learning represents a vehicle for educational industry to transform traditional face-to-face teaching to flexible individual-based learning.

It is important to note that most of the higher-education institutions in Malaysia have incorporated e-learning as part of teaching vehicle in two ways (Hussin *et al.*, 2009). First, some Malaysian higher-education institutions have introduced full e-learning courses. Second, many higher-education institutions have adopted blended learning by combining the traditional teaching with the e-learning (Hung & Chou, 2015).

To date, there are limited studies available to examine the effectiveness of e-learning implementation in the Malaysian higher-education context (Embi *et al.*, 2011; Oye *et al.*, 2012; Al-rahmi *et al.*, 2015). Previous studies have investigated learning satisfaction of using e-learning (Ramayah & Lee, 2012), e-learning continuance intention (Ismail *et al.*, 2012), the effectiveness of e-learning (Al-rahmi *et al.*, 2015). However, there is lack of study on perceived learning outcomes and satisfaction among students using e-learning in the Malaysian higher-education context. There is also lack of studies to investigate the impact of learning experiences on both learning outcomes and satisfaction in the e-learning context. Thus, this study aims to examine whether learning experiences contribute to learning outcomes and satisfaction. This study also intends to identify the relative impact of predictors on learning outcomes and satisfaction. Therefore, the following research questions are formulated:

1. Do learning experiences relate to learning outcomes?
2. Do learning experiences relate to learning satisfaction?
3. Which learning experiences are significant predictors of learning outcomes?
4. Which learning experiences are significant predictors of learning

satisfaction?

2 Literature Review

The framework of students' experiences in e-learning is rooted in the work by Moore *et al.* (1996). Such students' experience can be classified as three type of interactions, which are interaction with course content, interaction with the instructor, interaction with peer students (Moore, 1989; Moore *et al.*, 1996). These interactions are believed to close the transactional distance in the e-learning context. Experience with course design is viewed as interaction with course content and learning material (Paechter & Maier, 2010). The researchers believe that these three types of experiences can provide insights with regard to the learning outcomes and satisfaction in e-learning.

2.1 Experiences concerning course design

Interaction with course content typically refer to the total of time spent with the course content and learning material, such as textbooks, PowerPoint, Web pages and discussion forums (Su *et al.*, 2005). Kuo *et al.* (2014) assert that a good course design will ensure course content be presented in a well-organized manner while it is easy to be accessed by students. Experiences concerning course design is a one-way communication. It can be understood to be the student's internal conversation to comprehend course content (Moore, 1989). That is, students interact with information and knowledge from the course content (Kuo *et al.*, 2014). Students will intricate, systematize, and demonstrate the new knowledge from the cognitive perspective by synthesizing the previous knowledge (Moore & Kearsley, 1996). Thus, course design and learning material is a major factor to enable meaningful learning among students.

2.2 Interaction with the instructor

An instructor acts as a course designer and organizer, facilitator, social supporter, technology facilitator and assessment designer. Interaction between students and instructor occurs not only when the instructor delivers information and knowledge but also involves other interactions such as gives encouragement to students, provides a timely response to students and facilitates an open communication (Sher, 2009). In this regard, teaching presence can trigger motivation among students (Garrison *et al.*, 1999). That is, an instructor can provide assistance and performs a variety of tasks in the teaching process, which includes content structure and feedback of students' accomplishment to sustain learning motivation among students. The timely response and the presence of instructor are the strong contributors to students' experience toward

e-learning (Bolliger, 2004; Lee *et al.*, 2011). Such interaction will boost the social relationship between students and an instructor and eventually lead to socio-emotional exchange (Paechter & Maier, 2010). It will also influence students' intrinsic and extrinsic motivation in the learning process (Paechter *et al.*, 2010).

2.3 Interaction with peer students

Peer interaction refers to peer support which students actively support each other during learning process. Peer interaction can foster an active learning process through collaborative knowledge sharing, for example, group discussions and group based projects, where communication can take place through many channels such as emails, chat groups or newsgroup (Sher, 2009). Paechter *et al.* (2010) argue that interaction with peer students enable students to exchange information concerning course contents and to form socio-emotional support. Students are expected to enhance learning effectiveness in such a positive environment. For example, students who involve in group work can enhance their learning in a cohesive learning environment (Paechter & Maier, 2010). The study by Hussin *et al.* (2009) also shows that an effective learning environment is based on whether a meaningful interaction happens among students. Thus, interaction with peer students is likely to represent a contributor to learning outcomes and satisfaction (Broadbent & Poon, 2015).

2.4 Learning outcomes and satisfaction

Learning outcomes measure whether students attain competences in their learning (Weinert, 2001). The competence aspects comprise of factual and conceptual knowledge, methodical knowledge, social and personal competences as well as media competence (Paechter & Maier, 2010; Paechter *et al.*, 2010). It typically represents the cognitive side of the course outcomes, and thus it is important to be evaluated in e-learning context. On the contrary, learning satisfaction represents the attitudinal construct and it measures the affective aspect. A satisfied student typically has positive learning experiences in e-learning.

2.5 Conceptual Framework and Hypotheses

This study identified three important predictors in learning outcomes and satisfaction in the e-learning context. These predictors are experience with course design, interaction with the instructor and interaction with peer students. Three hypotheses are formulated to address the research objectives:

H1A: Course design is positively related to learning outcomes.

H1B: Course design is positively related to learning satisfaction.
H2A: Interaction with the instructor is positively related to learning outcomes.
H2B: Interaction with the instructor is positively related to learning satisfaction.
H3A: Interaction with peer students is positively related to learning outcomes.
H3B: Interaction with peer students is positively related to learning satisfaction.

3 Method

3.1 Measures

In this study, self-administered questionnaire was used to collect the data from students who enrolled into e-learning courses. The researchers developed the survey instruments based on the prior literature. In total, there are 5 survey instruments in the questionnaire, which are course design, interaction with the instructor, interaction with peer students, learning outcomes and learning satisfaction. The survey instruments were adapted from prior studies that relate to e-learning (Kuo *et al.*, 2014; Paechter & Maier, 2010; Paechter *et al.*, 2010).

The survey instrument for course design (4 items) measures the curiculum components and learning material in the learning environment. Course design instrument measures whether online course materials help students to understand the class content, stimulate students' learning interest and relate students' personal expeirence to new knowledge as well as ease of access to the materials. Interaction with the instructor (6 items) measures the two-way communication between instructor and students. This includes the frequency of interactions between students and instructors via various electronic means and whether students receive enough feedback from instructors. Interaction with peer students instrument (8 items) measures two-way reciprocated communication among students. Such interaction covers feedback, sharing and comment on the course content through class projects, group activities via different electronice means. Learning outcomes instrument (6 items) measures whether students acquire subject-specific conceptual and methodical knowledge, social, personal and media competences. Finally, learning satisfaction (5 items) measures to what extent students are satisfied with the class and course contribution to their educational and professional development.

The questionnaire consists of two main sections: (i) demographic information and (ii) course design, interaction with the instructor, interaction with peer students, learning outcomes and learning satisfaction. Five-point likert scale

was used to measure respondents' perception on the survey questions.

3.2 Sample

In total, 700 questionnaires were distributed to undergraduate students in a Malaysian university. The researchers managed to collect 690 questionnaires, which indicates a 98.6% response rate. During screening, 10 incomplete questionnaires were discarded, and another 10 questionnaires were excluded due to the presence of extreme outliers. The researchers used Statistical Package for the Social Science (SPSS) 18.0 to perform Pearson correlation, exploratory factor analysis and multiple regression in this study.

4 Findings

4.1 Descritpive and Correlation Analyss

Table 1 presents the demographic statistics the valid responses (670 respondents) in this study. The results show that females represent the majority (73.15%) in the sample. Most participants are between 19-21 years old. Furthermore, most students spend more than 6 hours online based on online frequency results.

Table 1
DEMOGRAPHIC ANALYSIS

Variable		Number	Percentage
Gender	Male	180	26.9%
	Female	490	73.1%
Age	Less than 18	7	1.0%
	19-21	561	83.7%
	22-24	98	14.6%
	More than 25	4	0.6%
Online Frequency (per Week)	5 or less than 5 hours	183	27.3%
	6-10 hours	152	22.7%
	11-15 hours	125	18.7%
	16-20 hours	72	10.7%
	Above 20 hours	138	20.6%

Pearson Correlation Coefficient was performed to examine strength and direction of linear relationships among variables, i.e., course design, interaction with the instructor, interaction with peer students, learning outcomes and learning satisfaction (see Table 2). Correlation analysis shows that all variables

are positively correlated ($p < 0.01$). Interaction with the instructor and interaction with peer students have strong correlation with learning outcomes and learning satisfaction because the correlation coefficients are greater than 0.5.

Table 2
CORRELATION ANALYSIS

Variable	1.	2.	3.	4.	5.
1. Course design	1	0.50**	0.48**	0.44**	0.37**
2. Interaction with the instructor		1	0.63**	0.53**	0.56**
3. Interaction with peer students			1	0.62**	0.59**
4. Learning outcomes				1	0.61**
5. Learning satisfaction					1

4.2 Exploratory factor analysis

Exploratory factor analysis (EFA) was performed to the survey instruments, i.e., 29 questions from 5 variables in the questionnaire. EFA is a statistical technique to identify the underlying factor structure for the observed variables. It is observed that KMO value is 0.943 and the Barlett's test ($p < 0.01$), which suggesting the data in this study is suitable for further analysis. The communality analysis shows that the community of all items are greater than 0.5, suggesting these items can be classified into respective groups.

In the EFA, eigenvalue cutoff of 1.0 was specified and the results show that 27 questions produce only 5 factors, which is consistent with our proposed 5 variables. The total variance explained by the 5 factors solution is 65.46%, which exceeds the minimum threshold of 50% variance explained. Each of the 5 factors can be broken down as interaction with peer students (16.03%), learning outcomes (13.62%), interaction with the instructor (13.23%), learning satisfaction (11.96%) and course design (10.63%). Furthermore, it is observed that first four items are all loading high on the *fifth factor*, the next 6 items are all loading high on the *third factor*, followed by the next 8 items are loading high on the *first factor*, the next 6 items are loading high at *second factor* and finally the last 5 items are loading high at *fourth factor* (see Table 3). Furthermore, the assessment of factor loadings for all factors range from 0.57 to 0.83, exceed the threshold of 0.4.

Table 3
ROTATED COMPONENT MATRIX

	1	2	3	4	5
LC1					**0.82**
LC2					**0.83**
LC3					**0.79**
LC4					**0.74**
SI1			**0.60**		
SI2			**0.69**		
SI3			**0.74**		
SI4			**0.72**		
SI5			**0.77**		
SI6			**0.68**		
SS1	**0.63**				
SS2	**0.69**				
SS3	**0.76**				
SS4	**0.71**				
SS5	**0.66**				
SS6	**0.57**				
SS7	**0.70**				
SS8	**0.68**				
LO1		**0.71**			
LO2		**0.75**			
LO3		**0.78**			
LO4		**0.69**			
LO5		**0.72**			
LO6		**0.65**			
S1				**0.77**	
S2				**0.75**	
S3				**0.75**	
S4				**0.75**	
S5				**0.64**	

In addition to EFA, internal reliability test was performed. The results show that Cronbach's Alpha for all variables exceeds the minimum threshold of 0.7, indicating sufficient internal reliability.

4.3 Multiple Regression Analysis

Multiple regression analysis was performed to examine whether course

design, interaction with the instructor, interaction with peer students affect learning outcomes and learning satisfaction.

Two multiple regression models were applied to examine the impact of course design, interaction with the instructor, interaction with peer students on learning outcomes and learning satisfaction (see Tables 4 and 5). The F statistic values for both regression analyses are significant ($p < 0.001$), confirm the validity of the regression models. Furthermore, the variance inflation factor (VIF) for all independent variables are less than 3, suggesting the absence of multicollinearity in both regression models. The normal P-P plot shows that all points lie in a reasonable straight diagonal line and thus the normality assumption is fulfilled for both regression models.

Table 4
REGRESSION ANALYSIS (DEPENDENT VARIABLE = LEARNING OUTCOMES)

Variable	Unstandardized Coefficients	Standardized Coefficients	*t*	Sig.
(Constant)	6.45		9.00	0.00
Course design	0.17	0.13	3.73	0.00
Interaction with the instructor	0.18	0.19	4.91	0.00
Interaction with peer students	0.32	0.44	11.55	0.00
R-Squared = 0.43; F statistic = 172.16				

Table 5
REGRESSION ANALYSIS (DEPENDENT VARIABLE = LEARNING SATISFACTION)

Variable	Unstandardized Coefficients	Standardized Coefficients	*t*	Sig.
(Constant)	5.02		7.42	0.00
Course design	0.04	0.04	0.99	0.32
Interaction with the instructor	0.26	0.30	7.68	0.00
Interaction with peer students	0.26	0.39	9.86	0.00
R-Squared = 0.41; F statistic = 157.59				

5 Discussions

Multiple regression analyses show that interaction with the instructor and interaction with peer students are positively related to learning outcomes and learning satisfaction, respectively. As a result, the hypotheses of H_{1A}, H_{2A}, H_{3A}, H_{2B} and H_{3B} are supported. First, the positive effect of course design suggests that course content and learning material are well-designed and presented in the e-learning system. This result is consistent with a previous study which stating course design is related to learning outcomes (Kuo *et al.*, 2014). Second,

interaction with the instructor is positively related to learning outcomes and satisfaction. That is, students seem able to interact with instructors and get feedback from the instructor through internet mediated tools for an e-learning course (Eom *et al.*, 2006; Lee *et al.*, 2011; Paechter & Maier, 2010; Paechter *et al.*, 2010). Third, interaction with peer students is positively related to learning outcomes and satisfaction. This indicates that e-learning environment allows students to exchange information and sharing knowledge, which leads to better learning outcomes and satisfaction. This finding is consistent with prior studies (Broadbent & Poon, 2015; Paechter & Maier, 2010; Paechter *et al.*, 2010). Overall, the study suggests that students' learning experiences, i.e., course design, interaction with the instructor, interaction with peer students, are important considerations in planning e-learning courses.

Standardised coefficients in multiple regression were examined to identify relative contribution in explaining the learning outcomes and satisfaction. The largest beta coefficient denotes that the independent variable has the strongest contribution to the dependent variable. The results show that interaction with peer students is the most important predictor of learning outcomes and satisfaction. This denotes that peer interaction is important in an e-learning course because peer interaction not only facilitates learning process among students, but also provides socioemotional supports in a computer-mediated learning environment.

Conclusion

The purpose of this study is to examine whether course design, interaction with the instructor, interaction with peer students affect learning outcomes and satisfaction in e-learning courses. This study confirms that such students' experiences are salient predictors on learning outcomes and satisfaction in e-learning. This study provides empirical evidence to the e-learning literature by investigating learning outcomes and satisfaction (Paechter & Maier, 2010; Paechter *et al.*, 2010). University administrators should recognize that interactions are the crucial constructs in determining the quality of e-learning courses. Interactive teaching styles should be adopted by an instructor in e-learning courses. Course design and learning material are equally important. Furthermore, instructor should design a teaching plan that can encourage peer interaction among students in e-learning courses.

Acknowledgements

The authors acknowledge the support from UTM Vote 4J252 and Ministry of Education Malaysia.

REFERENCES

Al-Adwan, A., Al-Adwan, A., & Smedley, J. (2013), *Exploring students acceptance of e-learning using Technology Acceptance Model in Jordanian universities*, International Journal of Education and Development using Information and Communication Technology, 9(2), 4.

Al-rahmi, W. M., Othman, M. S., & Yusuf, L. M. (2015), *The effectiveness of using e-learning in Malaysian higher education: A case study Universiti Teknologi Malaysia*, Mediterranean Journal of Social Sciences, 6(5), 625.

Bolliger, D. U. (2004), *Key factors for determining student satisfaction in online courses*, International Journal on E-learning, 3(1), 61-67.

Broadbent, J., & Poon, W. L. (2015), *Self-regulated learning strategies & academic achievement in online higher education learning environments: A systematic review*, The Internet and Higher Education, 27, 1-13. doi: http://dx.doi.org/10.1016/j.iheduc.2015.04.007

Eom, S. B., Wen, H. J., & Ashill, N. (2006), *The determinants of students' perceived learning outcomes and satisfaction in university online education: An empirical investigation*, Decision Sciences Journal of Innovative Education, 4(2), 215-235. doi: 10.1111/j.1540-4609.2006.00114.x

Embi, M.A., Abdul Wahab, Z., Sulaiman, A.H., Atan, H., Ismail, M., & Mohd Nordin, N. (2011), *E-learning in Malaysian higher education institutions: Status, trends & challenges*, Kuala Lumpur, Malaysia: Department of Higher Education, Ministry of Higher Education Malaysia.

Garrison, D. R., Anderson, T., & Archer, W. (1999), *Critical inquiry in a text-based environment: Computer conferencing in higher education*, The Internet and Higher Education, 2(2–3), 87-105. doi: http://dx.doi.org/10.1016/S1096-7516(00)00016-6

Horton, W. K. (2001), *Leading e-learning*, Alexandria, VA: American Society for Training and Development.

Hussin, H., Bunyarit, F., & Hussein, R. (2009), *Instructional design and e-learning: Examining learners' perspective in Malaysian institutions of higher learning*, Campus-Wide Information Systems, 26(1), 4-19. doi: 10.1108/10650740910921537

Ismail, N., Razak, M., Zakariah, Z., Alias, N., & Aziz, M. (2012), *E-learning continuance intention among higher learning institution students*, Procedia-Social and Behavioral Sciences, 67, 409–415.

Kuo, Y.-C., Walker, A. E., Schroder, K. E. E., & Belland, B. R. (2014), *Interaction, Internet self-efficacy, and self-regulated learning as predictors of student satisfaction in online education courses*, The Internet and Higher Education, 20, 35-50. doi: http://dx.doi.org/10.1016/j.iheduc.2013.10.001

Lee, S. J., Srinivasan, S., Trail, T., Lewis, D., & Lopez, S. (2011), *Examining the relationship among student perception of support, course satisfaction, and learning outcomes in online learning*, The Internet and Higher Education, 14(3), 158-163. doi: http://dx.doi.org/10.1016/j.iheduc.2011.04.001

Moore, M. (1989), *Three types of interaction*, The American Journal of Distance Education, 3(2), 1-6.

Moore, M. G., Kearsley, G., & Scriven, B. (1996), *Distance education: A systems view*, Distance Education, 17(2), 412-412.

Oye, N., Iahad, N., Madar, M., & Rahim, N. (2012), *The impact of e-learning on students' performance in tertiary institutions*, International Journal of Computer Networks and Wireless Communications, 2(2), 121-130.

Paechter, M., & Maier, B. (2010), *Online or face-to-face? Students' experiences and preferences in e-learning*, The Internet and Higher Education, 13(4), 292-297. doi: http://dx.doi.org/10.1016/j.iheduc.2010.09.004

Paechter, M., Maier, B., & Macher, D. (2010), *Students' expectations of, and experiences in e-learning: Their relation to learning achievements and course satisfaction*, Computers & Education, 54(1), 222-229. doi: http://dx.doi.org/10.1016/j.compedu.2009.08.005

Ramayah, T., & Lee, J. W. C. (2012), *System characteristics, satisfaction and e-learning usage: A structural equation model (SEM)*, TOJET: The Turkish Online Journal of Educational Technology, *11*(2), 196-206.

Richardson, J., & Swan, K. (2003), *Examining social presence in online courses in relation to students' perceived learning and satisfaction*, Journal of Asynchronous Learning Networks, 7(1), 1-21.

Sher, A. (2009), *Assessing the relationship of student-instructor and student-student interaction to student learning and satisfaction in web-based online learning environment*, Journal of Interactive Online Learning, 8(2), 102-120.

Su, B., Bonk, C. J., Magjuka, R. J., Liu, X., & Lee, S.-h. (2005), *The importance of interaction in web-based education: A program-level case study of online MBA courses*, Journal of Interactive Online Learning, 4(1), 1-19.

Weinert, F. E. (2001), *Concept of competence: A conceptual clarification*, US: Hogrefe & Huber Publishers.

Je-LKS
Journal of e-Learning and Knowledge Society
The Italian e-Learning Association Journal
PEER REVIEWED PAPERS
Vol. 13, n.2, 2017
ISSN: 1826-6223 | eISSN: 1971-8829

A MODEL FOR USERS BEHAVIOR ANALYSIS AND FORECASTING IN MOODLE

Mario Manzo

IT Service Center, Naples (Italy)
mario.manzo@uniparthenope.it

Keywords: Moodle, User forecasting, Time series, Web performance, Distance Education.

The learning process, among its different phases, involves monitoring of users behaviour in order to extract knowledge. Details about users have significant weight to understand the interests and intentions and produce forward-looking statements, as well as keep track of the learning management system (LMS). In this work, a model to investigate and predict the behavior of users, taken to explore the additional knowledge information and predict the learning outcomes, is described. In the first instance, the information are extracted through a suitable tool, and, subsequently, are submitted to an analysis phase. Time series analysis techniques are adopted to detect partial similarities between the navigation data and, subsequently, to extract a classification. Finally, performance are measured through statistical measures to evaluate the goodness of proposed approach and test its significance. The results, obtained on Moodle platform, show that the proposed model leads to accurate outcome prediction about users behavior

for citations:
Manzo M. (2017), *A model for Users Behavior Analysis and Forecasting in Moodle,* Journal of e-Learning and Knowledge Society, v.13, n.2, 129-139. ISSN: 1826-6223, e-ISSN:1971-8829
DOI: 10.20368/1971-8829/1287

and can be adopted to improve the learning paths, both in its implementation and design.

1 Introduction

Despite having many potentials the web analytics technologies are poorly published. Unlike the classic scenarios, a new application field of the web analytics algorithms concerns to improve the effectiveness of distance learning. Although web analytics are rapidly being implemented in various educational settings, the current implementation indicates significant potential for the generation of knowledge, learning and education.

The strategic planning of e-learning involves planning, decision making and multiple options of implementation on different levels: faculty, curriculum and individual. Distance education can be adopted as support tool for established education systems. Otherwise, it can be implemented as an independent form of teaching, as a separate teaching program or be partially introduced. The fusion of distance and standard teaching leads to extremely interesting information.

Mining data coming from education activities involves a research field relating, but not limited to, data mining, machine learning and applied statistics to information generated by e-learning environment (Hughes & Dobbins, 2015). In this field, the aim is to improve the technique for the exploration of data in order to design new algorithms to predict the learners' performance and to improve existing contents. Learning future performance prediction can be reached through the building of a model applied to a learning environment, such as Moodle, which includes information about individual learners, behaviors, activities, knowledge and student performance. Learning environments host knowledge which can be easily recovered by extraction methods. User learning and engagement data decision-making provides a constant improvement about courses and digital environment. Afterwards, a selection of digital activities and a better organization of the materials, adopted to support student learning, can be obtained.

In this paper the problem of user behavior forecasting is addressed through a model which learns on past information. The knowledge about users is extracted, for further processing, by Google Analytics and Moodle logs. The aim is to highlight the student interaction with distance education environment and to check effectiveness of teaching activities in analyzing the learning outcome. This knowledge can be adopted in designing courses, improve the structure of course, weight assessment tasks and improve users learning experience. Finally, the quality of the prediction results are evaluated by performance measures to demonstrate the effectiveness of model in distance education contexts. The paper is organized as follows: the following sections are dedicated to related work, general architecture, preprocessing, data filtering and session definition,

knowledge extraction and users behavior forecasting. Experimental results and conclusions are, respectively, reported in the two final sections.

2 Related works

Artificial Intelligence technologies are capable of conferring computers the ability to reproduce some faculties of the human mind. Machines are capable of think and make decisions like humans, thanks to the intelligent exploitation of a significant amount of information and data. The applications are innumerable and transversal to all sectors including distance education. One of these concerns prediction and analysis of user behavior and is very specific and hard due to the rough nature of data. Consequently, in most cases a preprocessing phase is required. Specifically, research about the analysis of users behavior in Moodle offers several case studies, solutions and insights.

In (Cristóbal *et al.*, 2008) the application of data mining techniques, such as statistics, visualization, classification, clustering and association rule mining, on Moodle data is described. The goal is to introduce, both theoretically and practically, users interested in this new research area and in particular to online instructors and e-learning administrators.

In (Rodrigues *et al.*, 2013) the attention is focused on the importance of stress during the learning process. Stress detection in an distance education environment is an important and crucial factor to success. The estimation of the students' levels of stress in a non-invasive way is performed taking measures to deal with inclusi l'apprendimento a distanzait.

In (Horvat *et al.,* 2015) the differences in student perception of the significance of Moodle quality features and differences in student satisfaction in regard to such features are addressed. The analysis of the average waiting time for a response, feedback quality, material thoroughness, material clarity, website user-friendliness, cooperation diversity and material quantity demonstrate that the components of quality features were more important to female students.

In (Fortenbacher *et al.,* 2013) an application prototype for learning analytics, called LeMo, which collects data about learners' activities from different learning platforms is described. LeMo is a system architecture which performs user path analysis by algorithms of sequential pattern mining and visualization of learners' activities.

In (Mansur *et al.*, 2013) the behavior of students, by putting ontology on domain social learning network (Moodle), is analyzed. The activities are placed as clustering parameter according to the ontology model. The ontology is created to capture the activities of the student inside Moodle. Five attributes are adopted as group cluster for classifying the students' behavior. The constructed cluster is calculated based on the e-learning hits during the learning process.

3 General Architecture

The proposed architecture hosts an intelligent prediction model for users performance analysis and forecasting through different steps. Blocking approach is introduced to monitor all phases and possibly to attend in case of problems. Figure 1 illustrates an overview of the system. First, Google Analytics and logs are adopted to extract users navigation data from Moodle. The obtained data are submitted to a preprocessing stage, as described in the above section, with purpose to prepare the information for the next step. Second, users time series are diversified based on prediction to perform (related format is compatible with machine learning software adopted). Finally, prediction phase provides the forecasting users outcome. The system includes flexibility and adaptability features related to data and focuses on user interests and needs. Particulary:

- learning of user behavior;
- creation or refinement of customized study paths;
- possible attendance reporting with relative increase in hardware and software resources;

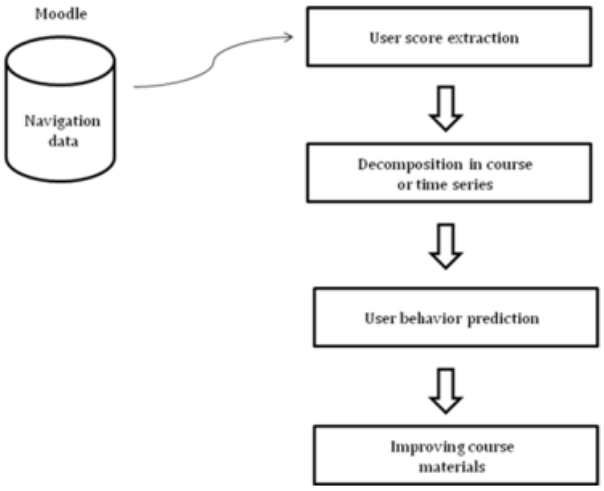

Fig. 1 - Diagram of proposed approach.

4 Preprocessing

In this scenario, the main problem concerns the knowledge to extract from the past in order to design educational paths and prevent less educative content. Refining content is the main goal of educators to best meet the interests and intentions of users. The first step towards this process concerns the analysis

of users navigation data in Moodle. The LMS hosts user profiles, contents, examination scores of different kinds. For this purpose, preliminary steps must be performed to prepare the contents and to obtain the data required. Rough data are extracted using a double strategy. The first concerns the extraction of Moodle logs for individual courses and platform. The second concerns data coming from Google Analytics tool as described in the next section. The choice is related to higher attendance courses from which a greater amount of data has arisen. Clearly, an integration of two data sources is perfomed to make information homogeneous and of greater quality with purpose to reach the final goal.

5 Data filtering and session definition

Data filtering refers to a wide range of strategies for refining data without including repetitive, irrelevant or even sensitive information. In first instance, groups representing dominant information must be isolated. Otherwise, the detection of similarities between students, activities or courses in a specific sets could be an alternative solution. Our strategy can be seen as a more top-down process, starting from a large amount of data. Sequentially, the information are refined by identifying activities with greater affluence by eliminating little indicative details. The raw data is also filtered based on the concept of session. Session means a group of interactions within a given range of time. A single session may contain multiple screens or page views, events, social interactions and transactions. A session can be considered as a container for actions taken by a user on the site. A single user can open multiple sessions, which may occur on the same day or within several days, weeks, or months. A session is defined based on two rules: timeout (after 30 minutes of inactivity), campaign change (if a user visits the site through a campaign, comes out of the site, and then returns to another campaign). In this work the timeout is adopted.

6 Knowledge extraction

Learning analytics includes a set of tools useful to improve learning and education. In this field, two are the main factors. First, the introduction of web counter popular today as Google Analytics. Second, the development and application of artificial intelligence techniques in distance education. Consequently, the concepts of sever logs and behavior analysis are essential. The first concerns the extraction and analysis of services monitoring, in terms of internal pages, resources, etc. While, the second provides for a set of observations useful to extract different information to follow the progress. Therefore, prediction and study of the behavior result to be more complex.

Both are used in this work. Google Analytics for navigation data extraction is adopted. It is a tool to collect and extract data about the access to websites and applications. It detects users browsing data, considering variables such as access, time, operating system, browser or location and other metrics/dimensions. Also, this information are integrated with platform log data. Given the large amount of available data produced by online activities, our attention is focused on specific subsets of information provided by Moodle. Based on this knowledge the progress is monitored and analyzed to provide improvements.

7 Users behavior forecasting

Forecasting involves techniques to make predictions for the future, through by information from past or present data. In the case of web analysis, prediction models are trained based on users chronology, through a single regression model, arising from a set of web pages. Time series analysis is adopted for prediction and analysis of the performance and users behavior. It concerns the application of statistical techniques to model and explain a series of time dependent data points. Time series data are composed of a natural time order, differently from machine learning applications in which each data point is a self-concept and, therefore, it is necessary to learn the layout within a data set. The main goal is to compare the prediction and real behavior of the users to improve the quality of contents. MATLAB has been chosen to analyze and manage the users navigation data. It is a high-level language for technical computing and is an interactive environment for algorithm development, data visualization and analysis. The data are organized as rows where attributes correspond to the columns. Through these available algorithms a set of prediction of the new behavior data can be performed.

8 Experimental Results

Experimental phase is performed on department platforms of Economic and Law of an academic institution, working through virtual architecture. LMSs host course structured in different hours of lessons, with multimedia material compliant to the SCORM (Maratea *et al.*, 2012b; 2012a; 2013). Furthermore, the platforms host more than 5000 users and, therefore, the workload, everyday, is high due to several accesses.

The building of the model, useful to learn users behavior, is a crucial step and is the starting point of forecasting. AutoRegressive Integrated Moving Average (ARIMA) (Box *et al.*, 1994) model is adopted in order to predict the behavior of users during the activities. ARIMA model acts to investigate time series having particular features and is part of the family of the non-

stationary linear processes. It starts from the assumption that the alteration in a series derived from the so-called noise. It predicts a value in a response time series as a linear combination of its own past values, past errors (named shocks or innovations), and current. Finally, it provides great flexibility and a comprehensive set of tools for univariate time series model identification, parameter estimation and forecasting. MATLAB **arima** routine is adopted. It creates model objects for stationary or unit root nonstationary linear time series model. For the experiments, the configuration includes a multiplicative seasonal model with no constant term and Gaussian innovation distribution with constant variance. In addition, model parameters are estimated through the routine **estimate**. It uses maximum likelihood based on the observed univariate time series data.

Our attention, in the following tests, is focused on number of sessions spent by users on the Moodle home page. Data are filtered in order to restrict attention to this information as Google Analytics produces data of different kind. Data are converted from CSV (Comma Separated Value) format, provided by Google Analytics, to MAT format accepted by MATLAB. Figure 2 shows results on 6 month of observation with a forecast of 20 days. The horizontal axis represents the days considered for the observation and forecast, while the vertical axis represents the sessions. As can be note, forecasting results are very close to original data. Certainly, this is a big advantage because a massive attendance can be predicted by strengthening hardware and software related to machine hosting the LMS.

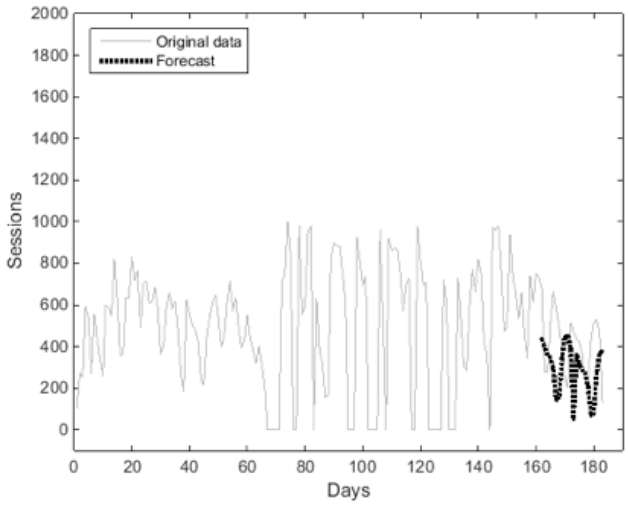

Fig. 2 - Forecasting results.

In the second test the performance are measured through by Mean Absolute Percentage Error (MAPE) between forecast F_t and original data A_t.

$$MAPE = \frac{100}{n}\sum_{t=1}^{n}\frac{|A_t - F_t|}{|A_t|}$$

MAPE is calculated on an descending number of days of observation and a increasing number of days of forecasting (5/50, 10/45, etc). Figure 3 shows results on a 6 month of activities. The horizontal axis represents the days considered for forecasting, while the vertical axis represents MAPE values. The trend can be divided into two parts (the break point is about 50 days of forecasting). First part in which the MAPE values are low. This behavior is the result of the creation of ARIMA model on consistent data number of observation. Then the model has the best chance to learn the trend and therefore better predict. The observation is crucial for the generation of forecast values and affects, in different way, the ARIMA model. It constitutes a central point to understand and obtain information about the prior trend. Based on gained knowledge, the algorithms produce prediction values near or far respect to trend learned. Otherwise, ARIMA model for second part is not built on a large number of data. Consequently, the error appears to be higher.

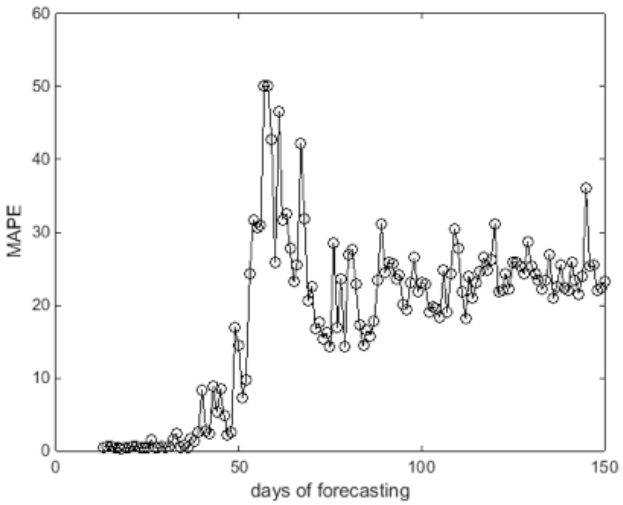

Fig. 3 - MAPE on ARIMA model.

A variant of ARIMA model, AutoRegressive Integrated Moving Average with eXogenous inputs (ARIMAX), is adopted for second testing phase. Also in this case the arima routine is adopted but with a different configuration. Figure 4 shows results on a 6 month of activities. The horizontal axis represents the days considered for forecasting, while the vertical axis represents MAPE values. Also in this case, the trend can be divided into two parts. Left to value 50 a lower error trend is achieved while an higher trend to the right. This result is due to ARIMAX model that fits the data in different way. This behavior, right to value 50, is connected to the low number of days, adopted for model building, unsuitable for accurate prediction. Clearly, the number of days is related to the educational activities held in a limited temporal slice and the building model significantly affects the performance. The alternative would be to try with a longer period that certainly cannot correspond to a real learning path.

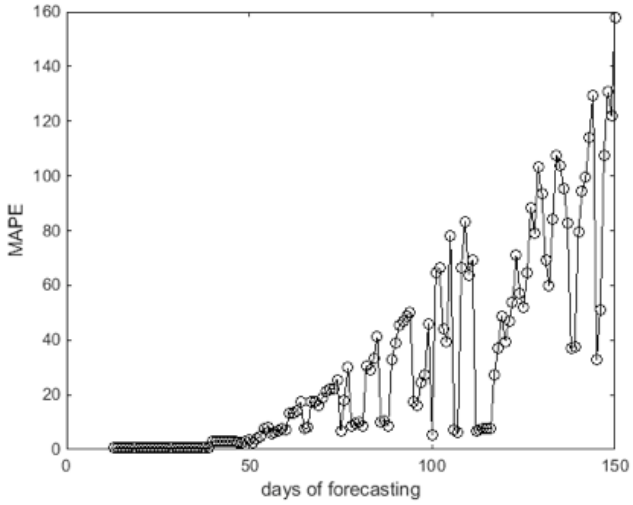

Fig. 4 - MAPE on ARIMAX model.

Last experiment is measured through by Mean Absolute Deviation (MAD). The values e_t and vector E represent the error generated by the difference between forecast, producted by using ARIMA and ARIMAX models, and original data (same of previous).

$$MAD = \frac{1}{n}\sum_{t=1}^{n} |e_t - m(E)|$$

In figure 5 the horizontal axis represents the days considered for forecasting, while the vertical axis represents MAD values. The results obtained using the ARIMA model produces a greater error than the ARIMAX model especially in the range 50-70. This behavior is already detected from the previous test.

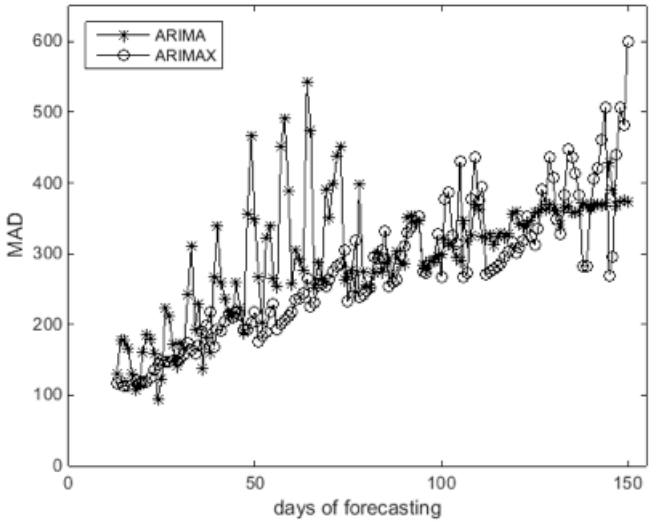

Fig. 5 - MAD on ARIMA and ARIMAX models.

Conclusions

The organization of a blended learning strategy is not always of easy management. Starting from strong technological foundation, the goal is to determine the best content to be delivered/designed or a set of attractive activities. Accordingly, the control and monitoring of online users activities, in order to improve the design and implementation, begin essential. The extraction and analysis of LMS data became crucial in order to provide, to teachers and administrator, guidelines to monitoring users progress and action planning. In this work, an intelligent predictive model for users behavior forecasting and analysis in Moodle is presented. Forecasting analysis is a very attractive research field of recent times. Navigation data forecasting and

analysis is essential for performance accuracy of many systems to support intelligent decisions. The proposed model predicts the users behavior based on their navigation history. The goal is to verify the current trends in order to improve the content and better meet the users needs. Experimental results demonstrate the effectiveness of proposed system. Future work is in trying to analyze distributed distance education environments, individual resources, sets of learning objects and materials which require a residence time.

REFERENCES

Box, G. E. P., G. M. Jenkins, and G. C. Reinsel (1994), *Time Series Analysis: Forecasting and Control*. 3rd ed. Englewood Cliffs, NJ: Prentice Hall.

Hughes, G., & Dobbins, C. (2015), *The utilization of data analysis techniques in predicting student performance in massive open online courses (MOOCs)*. Research and Practice in Technology Enhanced Learning, 10(1), pp. 1-18.

Maratea A., Petrosino A. & Manzo M. (2012a), *Automatic generation of SCORM compliant metadata for portable document format files*. In Proceedings of the 13th International Conference on Computer Systems and Technologies. ACM, pp. 360–367.

Maratea A., Petrosino A. & Manzo M. (2012b), *Integrating navigational and structural information in SCORM content aggregation modeling*. In Advanced Learning Technologies (ICALT), 2012 IEEE 12th International Conference on. IEEE, pp. 379–380.

Maratea A., Petrosino A. & Manzo M. (2013), *Generation of description metadata for video files*. In Proceedings of the 14th International Conference on Computer Systems and Technologies. ACM, pp. 262–269.

Cristóbal, R., Ventura, S. and García, E. (2008), *Data mining in course management systems: Moodle case study and tutorial*. Computers & Education, 51(1), pp. 368-384.

Rodrigues, M., *et al.* (2013), *Keystrokes and clicks: measuring stress on e-learning students*. Management Intelligent Systems, pp. 119-126.

Horvat, A., Dobrota, M., Krsmanovic, M., & Cudanov, M. (2015), *Student perception of Moodle learning management system: a satisfaction and significance analysis.* Interactive Learning Environments, 23(4), pp. 515-527.

Fortenbacher, A., *et al.* (2013), *LeMo: A learning analytics application focussing on user path analysis and interactive visualization*. In IDAACS, pp. 748-753.

Mansur, A. B. F., & Yusof, N. (2013), *Social learning network analysis model to identify learning patterns using ontology clustering techniques and meaningful learning*. Computers & Education, 63, pp. 73-86.

Je-LKS
Journal of e-Learning and Knowledge Society
The Italian e-Learning Association Journal
PEER REVIEWED PAPERS
Vol. 13, n.2, 2017
ISSN: 1826-6223 | eISSN: 1971-8829

PERSONALITY TRAITS THAT DIFFERENTIATE ATTENDANTS OF HIGHER-EDUCATION ONLINE COURSES

Federico R. León[1]
Oswaldo Morales[2]
Hugo Vértiz[2]

[1] Universidad San Ignacio de Loyola, Lima, Peru
federicorleone@gmail.com
[2] Universidad ESAN, Lima, Peru
omorales@esan.edu.pe; hvertiz@esan.edu.pe

Keywords: Personality of participants, Big Five aspects, Online courses, Higher education.

This study utilized the ten aspects of the Big Five personality system to detect differences in personality traits between attendants of higher education online courses and attendants of higher education face-to-face courses. Distance education theoreticians have formulated hypotheses on the personality traits that make the Autonomy, Connectedness, Diversity, and Openness attributes of the connectivist learning model attractive. 753 participants in executive extension courses of a Peruvian university in Lima (mean age = 34.62 years) filled-in an online questionnaire which included the Big Five Aspect Scales. Whereas none of the Big Five factors discriminated between attendants and non-attendants of online courses, the former emerged as significantly higher in Industriousness (an aspect of Conscientiousness) and lower in Orderliness (the second aspect of Conscientiousness) and Enthusiasm (an aspect of Extraversion) than the latter. Theoretical and practical implications of the findings are addressed

for citations:
León F., Morales O., Vértiz H. (2017), *Personality traits that differentiate Attendants of Higher-Education Online Courses,* Journal of e-Learning and Knowledge Society, v.13, n.2, 141-148.
ISSN: 1826-6223, e-ISSN:1971-8829
DOI: 10.20368/1971-8829/1331

and the conduct of confirmatory studies outside Peru and involving MOOCs is recommended.

1 Introduction

Favored by exponential progress in computing and telecommunication technologies, the new century has witnessed a spectacular increase in the number and complexity of third-generation distance education courses; these rely on interactive multimedia, the Internet, access to Web-based resources, computer mediated communication, and campus portals. The learning theory developed for this digital age is connectivism (Siemens, 2007), according to which all learning starts with a connection on neural, conceptual, or social levels and learning requires constructing and traversing connections. Or, as Downes (2007, paragraph 1) contended, "knowledge is distributed across a network of connections, and therefore learning consists of the ability to construct and traverse those networks". Tschofen and Mackness (2012) derived personality trait correspondences to the key components of connectivism - Autonomy, Connectedness, Diversity, and Openness. The present study tests the hypothesis that students in higher education prefer online courses to face-to-face instruction to the extent that they are higher in Conscientiousness, Neuroticism, and Openness to experience and lower in Extraversion.

Conscientiousness is a tendency to be organized and dependable, show self-discipline, act dutifully, aim for achievement, and prefer planned rather than spontaneous behavior. Neuroticism is the proclivity to experience unpleasant emotions easily, such as anger, anxiety, depression, and vulnerability, and to withdraw from social relations. Openness to experience refers to cognitive exploration, intellectual curiosity, and a preference for novelty and variety associated with appreciation of art and emotion. Extraversion implies energy, positive emotions, assertiveness, sociability, and the tendency to seek stimulation in the presence of others. The Big Five factor for which hypotheses are not formulated is Agreeableness, a tendency to be compassionate and cooperative rather than suspicious and antagonistic toward others. To obtain more precise differentiations, we use DeYoung, Quilty, and Peterson's (2007) division of the Big Five personality factors into two aspects per domain. Within Neuroticism, they distinguished *Volatility* from *Withdrawal*. The former is associated with emotional lability, irritability or anger, and difficulty controlling emotional impulses whereas the latter is characterized by facets such as Depression, Anxiety, and Vulnerability, which imply problems of inhibition and negative affect directed inward. Agreeableness contains *Compassion* (Warmth, Sympathy, Tenderness), an aspect strongly related to emotional affiliation, and *Politeness* (Cooperation, Compliance, Straightforwardness), a more reasoned consideration of and respect for others' needs and desires.

Conscientiousness entails *Industriousness* and *Orderliness*. The former refers to purpose, efficiency, and self-discipline and the latter entails dutifulness, order, and perfectionism. *Assertiveness* and *Enthusiasm* are the two aspects of Extraversion. *Assertiveness* implies agency and dominance whereas *Enthusiasm* describes a gregarious and friendly person with positive emotionality. Finally, *Intellect* (an exploration of ideas, evidence, mainly through reasoning) and *Openness* (experiencing art, feelings, nature) are differentiated as two forms of the motivation to explore. DeYoung, Quilty and Peterson (2007) showed that a subdivision of the Big Five personality factors into 10 aspects not only is empirically justified but has a biological substrate. Subsequent studies have demonstrated the usefulness of this categorization for explaining political, interpersonal, and economic behavior, as well as cognitive, artistic, and scientific abilities.

2 Derivation of hypotheses

Tschofen and Mackness' (2012) personality trait correspondences were formulated in the context of MOOCs. Autonomy may represent choice opportunities that foster expression of the self in the context of MOOCs, but the choice of higher-education online courses (HEOC) is less wide than the choice of MOOCs. Thus, in many instances, the nature of the choice involving HEOCs may be governed by the student's self-concept regarding the self-directedness needed for administering an online course. Given the degree of control the learner has over preparation and execution of learning, Conscientiousness can be expected to predict preference for and success in HEOCs. Indeed, this personality factor has been found associated with preference for attending online versus face-to-face courses (Keller & Karau, 2013) and procrastination negatively influences performance more in online courses than in lecture-type ones (Elvers, Polzella & Graetz, 2003). Also, Conscientiousness has correlated positively with the number of online modules approved in a course but not with performance indicators for a lecture component (Nakayama, Yamamoto & Santiago, 2007); achievement, a concept similar to the Industriousness aspect of Conscientiousness, has contributed to performance in online but not face-to-face settings (Varela, Cater III & Michel, 2012).

Connectedness refers to the feeling of "being sufficiently connected" and, thus, is related to the degree of student-teacher and student-student interactivity. In this realm, distance education theoreticians have emphasized the concept of transactional distance. Tschofen and Mackness (2012) suggested that Agreeableness would determine perceptions of Connectedness while the presence of Neuroticism could destroy such perceptions. There is no empirical evidence on these relationships. But these theoreticians also proposed that

Connectedness should stimulate extraverts and be a burden to introverts. Since face-to-face interaction cannot be reproduced in whole in the online environment, it seems unlikely for even the best transactional closeness to satisfy the extravert's need for engaging in interpersonal interactions as the classroom situation does. In fact, there is evidence that extraverts prefer classroom settings and introverts online learning (e.g., Anitsal *et al.*, 2008; Harrington & Loffredo, 2009). The extent of student active participation within classroom settings vis-à-vis online courses goes along the extravert-introvert dichotomy (Caspi *et al.*, 2006) and gregariousness negatively affects performance in online but not face-to-face courses (Varela, Cater III & Michell, 2012).

Diversity refers to the heterogeneity of participants and their goals. "The intent and design of … a (digital community) system should not be to in some way make everybody the same, but rather to foster creativity and diversity among its members, so that each person … instantiates, and represents, a unique perspective, based on personal experience and insight" (Downes, 2010, p. 3). Tschofen and Mackness (2012) regarded Conscientiousness as a relevant trait in this respect, albeit it is not clear on what basis. On the other hand, if fostering diversity implies making place for socially undervalued groups, Neuroticism comes to mind. Compared to face-to-face learning, HEOCs offer invisibility to the inhibited participant and are expected to generate disinhibition opportunities that foster participation (Suler, 2004). Therefore, the relevant aspect in this realm is Withdrawal. But Volatility has also been involved; students taking online courses have been reported to be more emotionally stable (Amital *et al.*, 2008) than students taking traditional courses. Neuroticism as a whole has also been involved: students who actively participated only in online-learning were more neurotic than those who actively participated in classroom instruction, in both, or in none (Caspi *et al.*, 2006).

Finally, Openness entails free transit for participants and wide sharing of materials (Downes, 2010). Tschofen and Mackness (2012) incorporated Openness to Experience into the connectivist perspective. This Big Five factor has been reported to be more prevalent among online than on-ground students (Anitsal *et al.*, 2008).

The specific questions leading to the research were: Do the Big Five differentiate attendants of online courses and non-attendants? Or they do not but aspects of the Big Five do?

3 Methodology

3.1 Context and participants

ESAN, a university based in Lima, Peru launched in 2013 an Online Management Extension Program for Executives as an alternative to its traditional face-to-face Executive Extension Program. Students of both programs were targeted for the present study and invited to participate via electronic mail. The offer of their personality profile when the data were collected was used as incentive.

3.2 Measurements

DeYoung, Quilty, and Peterson's (2007) 100-item Big Five Aspect Scales were forward-back translated to Spanish and utilized to measure the 10 aspects among participants. Data on gender (female = 1, male = 2), age, and whether online (= 1) and on-ground (= 2) executive extension courses had ever been attended were requested.

3.3 Analytic Strategy

We used bootstrapping to avoid problems with variables which might not satisfy the assumptions of the statistical models.

4 Results

Of the 753 students who responded, only 728 had data on all variables and, of these, 80 had participated in HEOCs. 52% were males and 48% females. Average age was 34.15 (SD =.50). The results indicate that the research subjects self-attributed low Volatility and Withdrawal and high Politeness and Intellect. Both Neuroticism scores were negatively correlated with the other variables while the other traits were positively intercorrelated. Being male was associated with lower Neuroticism, Agreeableness, and Enthusiasm scores, and similar was the case of being younger. The greater the time spent working in the private sector, the lesser the Neuroticism and the greater the Conscientiousness. Similar, though less marked trends are observed with respect to the public sector. Table 1 shows results of regressing the HEOC participation – no participation dichotomy on Big Five scores and control variables. None of the personality scores predicted participation in HEOCs, while the greater the time in the private sector, the lesser the participation.

Table 1
NON-STANDARDIZED COEFFICIENTS (B), WALD CHI-SQUARES, AND ODDS-RATIOS FROM THE LOGISTIC REGRESSION OF DISTANCE EDUCATION (NON-PARTICIPANTS = 1, PARTICIPANTS = 2) ON BIG FIVE SCORES AND CONTROL VARIABLES

Predictors	B	Chi-square	Odds-ratio
Neuroticism	.000	.000	1.000
Agreeableness	-.003	.041	.997
Conscientiousness	-.018	1.294	.982
Extraversion	-.006	.134	.994
Openness to experience	.006	.132	1.006
Gender	-.028	.906	1.037
Age	.036	.012	.973
Years working in private sector	-.096	4.718*	.908
Years working in public sector	-.061	1.253	.941

*p <.05 (after bootstrapping).

Table 2
NON-STANDARDIZED COEFFICIENTS (B), WALD CHI-SQUARES, AND ODDS-RATIOS FROM THE LOGISTIC REGRESSION OF DISTANCE EDUCATION (NON-PARTICIPANTS = 1, PARTICIPANTS = 2) ON TEN ASPECTS OF THE BIG FIVE AND CONTROL VARIABLES

Predictors	B	Chi-square	Odds-ratio
Volatility	.007	.079	1.007
Withdrawal	-.003	.008	.997
Compassion	.035	1.725	1.035
Politeness	-.036	1.312	.967
Industriousness	-.06	3.975*	1.083
Orderliness	.080	8.730**	.932
Enthusiasm	-.071	4.167*	.946
Assertiveness	.022	.443	1.022
Intellect	-.038	1.218	.963
Openness	.015	.302	1.015
Gender	.061	.055	1.063
Age	.053	1.841	1.055
Years working in private sector	-.117	6.406*	.890
Years working in public sector	-.086	.2.301	.918

*p <.05, **p <.01 (after bootstrapping).

Results entailing the ten aspects of the Big Five appear in Table 2. Participants in HEOCs were significantly more industrious, less orderly, and less enthusiastic than non-participants.

Discussion and Conclusions

The study findings demonstrate the usefulness of the ten-aspects-of-the-Big-Five system in the detection of personality differences in the distance education domain. Had only the Big Five system been available to the researchers, they would erroneously have concluded that personality traits do not differentiate attendants from non-attendants of HEOCs. The hypothesis entailing Conscientiousness was supported by evidence concerning one of its aspects and contradicted by evidence concerning the other aspect. Participants in HEOCs emerged as more industrious but lower in Orderliness than non- participants, which suggests that personality research targeting Conscientiousness may generate distorted findings. And HEOC participants were less enthusiastic than non-participants; the Enthusiasm aspect of Extraversion includes items such as Show my feelings when I am happy, Make friends easily, Laugh a lot, Warm up quickly to others, and Keep others at a distance (inverse scoring). On the other hand, the study results 1. showed that the other aspect of Extraversion, Assertiveness, does not differentiate participants and non-participants in HEOCs and 2. failed to support the study hypotheses entailing Neuroticism and Openness to Experience. Independent from age, years working in the private sector was negatively correlated with attendance of HEOCs; that is, the greater the professional experience of the student, the more likely his/her participation in face-to-face than online courses. More experienced professionals may recognize that face-to-face courses have the side advantage of offering opportunities to make contacts and advance one's career.

The findings introduce greater precision in the literature by presenting an industrious, but less orderly and less gregarious participant in HEOCs, in contrast with the less industrious, but more orderly and more gregarious majority who attends face-to-face courses. What future research can do is establishing if these personality characteristics associated with HEOCs are also present in MOOCs and outside Peru. The population registering in MOOCs may differ in relevant aspects from the population registering in HEOCs and other societies may be more individualistic or more collectivistic than the Peruvian society. In the theoretical realm, the study findings are consistent with the general concept that HEOCs have specific attributes which attract persons with certain specific aspects of the Big Five. Future studies may relate such specific attributes to specific aspects of the Big Five either experimentally or in cross-sectional research to obtain sharper descriptions. Practical implications can also be derived from the study findings. Online courses could be advertised as especially adapted to the student who is industrious but likes to do things his/her own way and with independence from others.

REFERENCES

Anitsal, M. M., Anitsal, I., Barger, B., Fidan, I., Allen, M. R. (2008). Student evaluation of course attributes on online courses versus on-ground courses: Impact of student personality traits. *Proceedings of the Academy of Marketing Studies*, 13, 1-8.

Caspi, A., Chajut, E., Saporta, K., et al. (2006). The influence of personality on social participation in learning environments. *Learning and Individual Differences*, 16, 129-144.

DeYoung, C. G., Quilty, L. C., & Peterson, J. B. (2007). Between facets and domains: aspects of the Big Five. *Journal of Personality and Social Psychology, 93,* 880-896.

Downes, S. (2007, February 3). What connectivism is [Web log post]. Retrived from http://halfanhour.blogspot.com/2007/02/what-connectiveness-is.html.

Downes, S. (2010, October 10). What is democracy in education? Retrieved from http://halfanhour.blogspot.com/2010/10/what-is-democracy-in-education.html.

Elvers, G. C., Polzella, D. J., & Graetz, K. (2003). Procastination in online courses: Performance and attitudinal differences. *Teaching of Psychology*, 30, 159-162.

Harrington, R., & Loffredo, D. A. (2009). MBTI personality type and other factors that relate to preference for online versus face-to-face instruction. *Internet and Higher Education*, http://dx.doi.org/10.1016/j.iheduc.2009.11.006.

Howell, S. L., Williams, P. B., & Lindsay, N. K. (2003). Thirty-two trends affecting distance education: An informed foundation for strategic planning. *Online Journal of Distance Learning Administration,* 6(3).

Keller, H., & Karau, S. J. (2013). The importance of personality in students‘ perceptions of the online learning experience. *Computers in Human Behavior*, 29, 2494-2500.

Nakayama, M., Yamamoto, H., & Santiago, R. (2007). The impact of learner characteristics on learning performance in hybrid courses among Japanese students. *Electronic Journal e-Learning*, 5, 195-206.

Rustichini, A., DeYoung, C. G., Anderson, J., & Burks, S. V. (2012). Toward the integration of personality theory and decision theory in the explanation of economic and health behavior. *IZA Discussion Paper No. 6750*. Bonn: Institute for the Study of Labor.

Siemens, G. (2007). Connectivism: Creating a learning ecology in distributed environments. In T. Hug (Ed.), *Didactics of microlearning: Concepts, discourses and examples*. Munster, Germany: Waxmann Verlag.

Suler, J. (2004). The online disinhibition effect. *Cyberpsychology & Behavior*, 7, 321-326.

Tshofen, C., & Mackness, J. (2012). Connectivism and dimensions of individual experience. *The International Review of Research in Open and Distributed Learning*, 12(1).

Varela, O. E., Cater III, J. J., & Michel, N. (2012). Online learning in management education: An empirical study of the role of personality tests. *Journal of Computers in Higher Education*, http://dx.doi.org/10.1007/s12528-012-9059-x.