# Validation criteria for a GQM plan in e-learning platforms evaluation

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The GQM methodology (Basili, 2002) is a top down approach that proceeds from the goals to the metrics of a paradigm of measurement and introduces the advantage to be completely independent from the dominion of application, allowing to get extremely specific results for the context in examination.

Once defined, the scheme of measurement with the methodology GQM, it must be submitted to a validation in order to check the syntactic and semantics correctness among the various levels of the method. The validation responds to the question: are we building (or has it been built) the correct GQM?

The paper shows as the validation of the GQM, used for the comparative evaluation of some bases of and-learning open source, has been conducted. To the moment the document is constituted of 13 clusters (macro goals), 48 goals, 79 quality focus, 495 questions and 91 metrics. The experimenta is still in progress both at laboratories of e-learning of the DIS of University of Naples Federico II and at DAUIN of polytechnic in Turin.

# 1. Introduction

The e-learning platforms evaluation can be performed from several points of view, and by several actors. This activity requires both the evaluation of implementing software package, the process we use in order to produce the formative act, the process used in order to evaluate the contents, and the process used in order to check the achieving of goals.

In this environment it is mandatory identifying several indicators to be measured in order to evaluate a formative process. Several methods are proposed (Basili, 2002; 1980; Fuggetta, 1998), which focuse on the formative method, but they don't consider the validation and the representation of the collected data. In this context we need a quantitative approach to quantify the whole formative process.

The GQM methodology is a top town approach that includes goals and metrics used to measure them. It is independent from the application dominion and it allows to get very specific results for the context under test.

It is based on the following questions:
– What do we want to measure? (Goals)
– Which factors do they engrave? (Questions)
– Which data do I have to pick up and which metrics do I have to appraise them with? (Metrics)
– What are the points of view through which can I look my measure activity? (Quality Focus)

So, we must define the formative goals process, get some questions or hypothesis from each goal, quantify the goal, collect the data, answer the questions with our data and/or validate our hypothesis.

It is important considering that the questions must cover all of the goals.

Therefore from the answers we must get measures (the Metrics). These metrics, when compared with threshold values (if available), give us the goals satisfaction.

In Fadini, Maresca et al. (2005) the concept of cluster is thus introduced. A cluster is a macro goal assemble a set of goals about the same argument.

For instance, in the cluster Communication Tools all the goals about communication tools (synchronous and asynchronous) are joined.

The cluster concept is useful to «slice» the platform and focus on a specific part of it, as we'll see later it is also useful to make comparison between the platforms and to analyze better the collected data.

The GQM methodology present a model that specifies the general goals for a measuring process. This model can be modified by the evaluator, and it must be validated before his application. This document is the GQM Plan, an official document of the GQM process (figure 1).
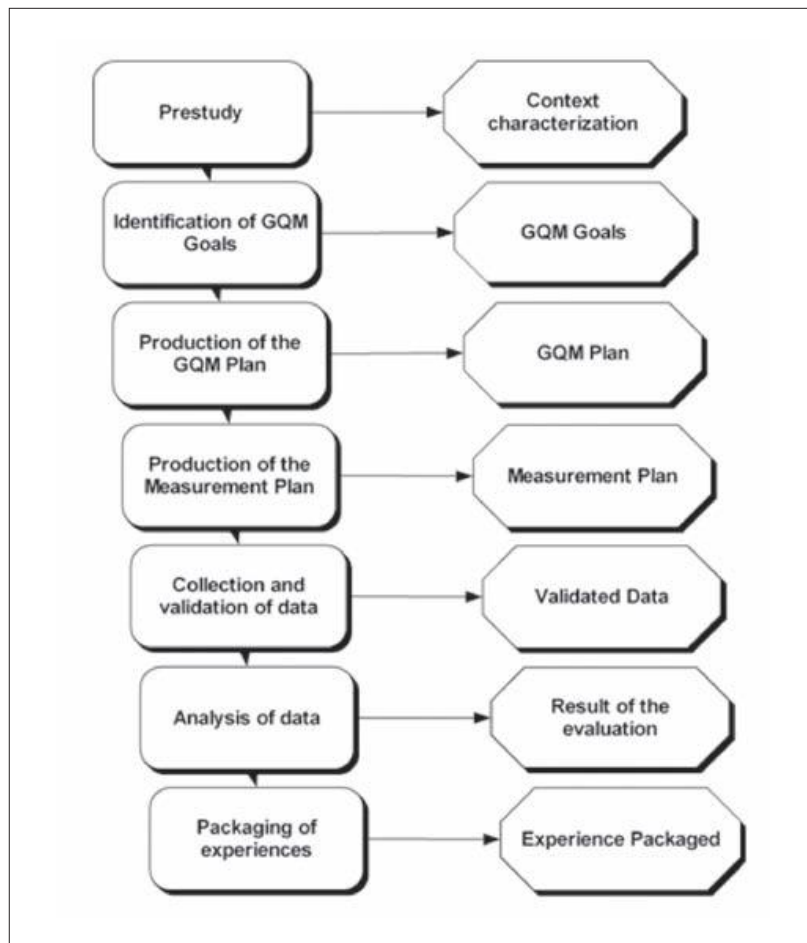
**Figure 1**    The GQM Process.

In the next section we will explain how a GQM plan is arranged. In section 3 we will consider his validation and in the section 4 the experimental results of the first phase of the project will be reported.

## 2. GQM Organization

The document is developed in 3 sections:

1. purpose of the measuring plan;
2. point of view adopted in the evaluation;
3. context (environment in which the goal is considered).

Following the main model guidelines you can create several templates. The template choosen for this work is the following:

– *Purpose of the measuring plan:* to (define, analyze, validate…), the (product, process…), to (understand, evaluate, improve).

– *Point of view adopted for the evaluation:* to analyze (cost, process, product, user satisfaction).
– *Context (environment in which the goal is considered):* characterized by problem factors, people factors (manager, users, experience), process factors (methodologies, standards) tools, methods, etc.

A GQM plan example has been given in Fadini, Maresca et al. (2005a; 2005b; 2005c). From this example it is possible to see it as a complex and dynamic document, and it is possible to introduce many types of errors; for this reason the validation process is very important.

## 3. GQM Plan Validation

When the measuring schema is defined it must be validated to check the semantic and syntactic correctness through the levels (Fadini, Maresca et al., 2002).

The validation process is composed of two phases: semantic and syntactic phase. The first one monitors if it follows the original plan, the second one controls the respects of the measure plan. The two phases are important to discover bugs that can invalidate all the GQM process.

### GQM Plan Validation: syntactic analysis

In our work we used the following check list:

1. Are the questions classified with goals?
2. Do have the questions their own metric?
3. Are the goals and metrics description clear?
4. Is the derivation method for each metric shown?
5. Is the measure unit for each metric shown?
6. Is a threshold value for each metric shown?

### GQM Plan Validation: semantic analysis

In our work we used the following check list:

1. Are all the questions relevant for the selected goal?
2. Is the connection goal-question evident?
3. Are the metrics valid for the questions?

The validated GQM model define which metrics must be collected in order to evaluate the product and the process, and them will be compared with the threshold values.

The threshold values, are, usually got from the rules or from the customer requests.

If these values are not defined you can take them from the technical literature.

## 4. Experimental results

Experiences are so far very satisfactory, mainly thanks to the easiness of the in-the-field data gathering campaigns, regardless of the intrinsic complexity of the target problem. The actual GQM plan for an e-learning platform includes (Fadini et al., 2005) so far 48 goals, 79 quality focuses, 495 questions and 91 metrics.

At the University «Federico II» in Naples and at the Politecnico di Torino, in Turin (Italy) we performed a comparative analysis of a set of open-source e-learning platforms. The Platforms are: Moodle, A-Tutor and Dokeos, which are the best three in the GQM rough's ranking.

In the following table there are the scores got by the platform in each cluster of goal. All the data are normalized to 10.

Table 1

SCORES GOT BY THE PLATFORM (DATA ARE NORMALIZED TO 10)

| | *Moodle* | *Dokeos* | *A-Tutor* |
|---|---|---|---|
| Installation and Standards Compliance | 9.12 | 8.25 | 7.75 |
| SCORM Compliance | 4.07 | 9.17 | 7.98 |
| General Characteristics | 8.5 | 7.25 | 6.375 |
| Content Management | 7.11 | 7.2 | 7.33 |
| Curses and Users Management | 6.33 | 6.14 | 5.83 |
| Communication Tools | 7.17 | 8.88 | 7.1 |
| Learning Tools | 8.33 | 4.66 | 4.83 |
| Co-working tools | 8.87 | 5.1 | 0 |
| Tracking e Reports | 8.02 | 8.5 | 4.5 |
| Help and Documentation | 9.5 | 8 | 5.5 |
| ISO 9216 | 9.18 | 8.17 | 8.17 |

Using, the kiviat diagrams you can easily see the weak points and the strong point of each platform and choose the best one.

For instance you can see what is the best platform in terms of SCORM Compliance (Morrison, 2006; SCORM, 2006), or you can just compile the GQM Cluster regarding Learning Tools and choose the best learning tools platform according to the qualities characteristics (IEEE98; IEEE97; IEEE99).
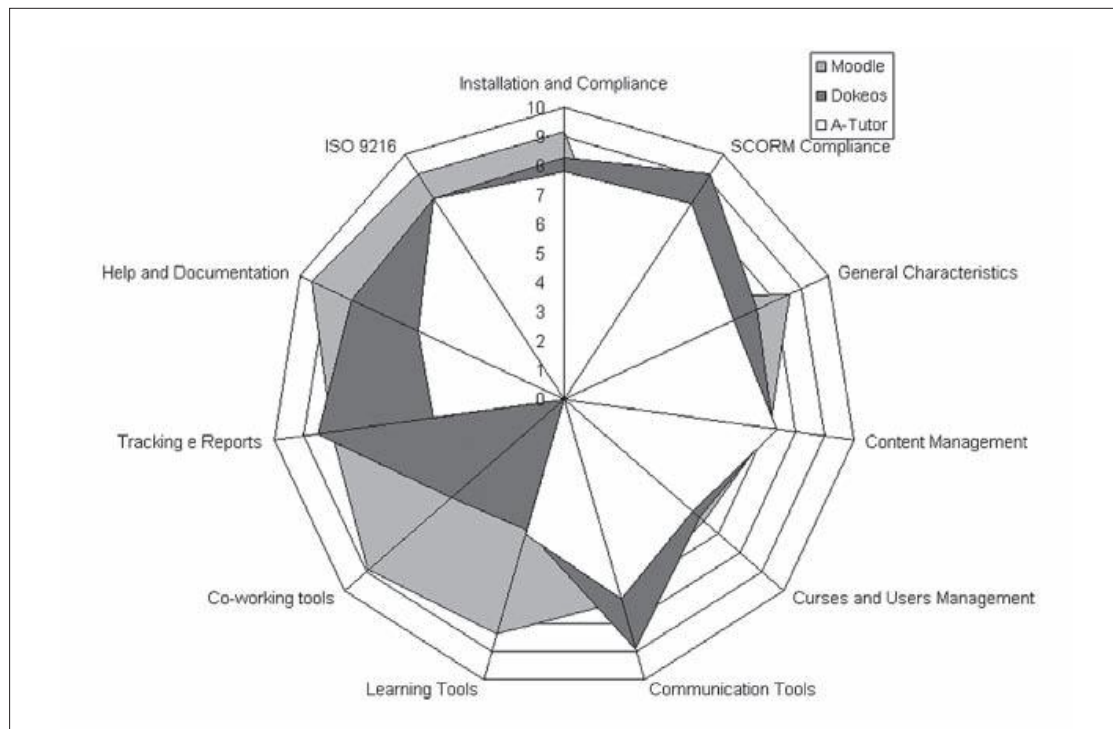
**Figure 2**    A kiviat diagram of the data in tab 1.

## 5. Conclusions

The measuring activity of a complex system, such as an e-learning platform can be controlled during his path. The GQM helps to generate a structured approach, but the system can degenerate quickly if you don't follow some validation criteria.

This criteria are useful to monitor the GQM growing. During the validation phase would be useful to have some automatic or semi-automatic checkers in order to speed up the activity. In this way the GQM construction can proceed side by side with the validation, however the validation should be performed by a different team.

In our experience the use of this process allowed us to find out many contradictions between the goals, and to be more accurate in the choosing of the quality focus, and of the metrics.

As future development we will require a tool to perform the evaluating phase.

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