CONSTRUCTION OF RUBRICS FOR THE EVALUATION OF TECHNOLOGY COURSES IN COLOMBIA

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Abstract

It is internationally recognized that technology education is fundamental for preparing citizens to actively participate in the current society. In Colombia, the Ministry of National Education (MNE) has established the guidelines for teaching Technology and Computer Science in schools through a document that suggests the competencies and competences that primary and secondary level students should reach. However, this document has neither performance indicators nor other mechanisms that allow measuring technological skills and, consequently, teachers only evaluate the student knowledge about a particular software tool instead of competences. As a proposed solution, two analytic rubrics that facilitate the monitoring of the educational process were built. The validation of these instruments was carried out by teachers from ten public schools in the country, who proposed to improve the scope of learning goals, attributes, evaluated skills and measuring scale. These suggestions were applied to the instrument in order to consolidate its structure, define specific skills and obtain a description that agrees with the competencies. At this moment, the rubrics are being used in the ten schools in order to continue their improvement.

Keywords: Evaluation, rubrics, competence, education in technology

1. Introduction

Education in technology plays an important role in economic and social development worldwide. Colombia, as other countries, has been working on the inclusion of technology education as an important area within the curriculum for primary and secondary education. In this regard, the MNE decided to include this area in the mandatory curriculum for primary and secondary education imparted in Educational Institutions (EI). This decision was made taking into account the importance of technology education to increase the opportunity of success in work activities, higher education and student's daily life.

In order to guide teachers in the inclusion of technology area in the student education process, MNE published the document "Guide Series #30. Be competent in technology: a need for development", which includes relevant aspects in technology education (MEN, 2008). This document begins with a conceptual framework that establishes basic definitions about the meaning of technology. Then, several relationships between technology and aspects of human evolution, such as: science, ethic and society development are presented. Finally, it describes a set of guidelines that organize educational and evaluative processes in the classroom through a hierarchical organization of components, competencies and performances for each grade of primary and secondary education.

At the top level of this hierarchy, technology education is divided into four components: Nature and evolution of technology, Appropriation and use of technology, Solving problems with technology and Technology and society. At the second level, each component is associated with a competence that needs to be developed within the student learning process in each educational level. At the third level, a set of performances is defined and related to each competence that allows measuring the competence level reached by the students.

However, in the structure described in the MNE document, the assessment of technological skills through performance indicators or other mechanisms is not clear. This assessment is usually performed using tests, short exercises, workshops, exhibitions and papers, but these mechanisms are not always focused on the development of skills and competences (Kimbell, 2012). Usually, these instruments allow the teacher to identify rote knowledge instead of the progress in technological skills development. With

this kind of assessment, the student has no clarity on how she is being evaluated and which is the objective of the educational process (Arsenault, 2005).

This aspect is very important because it has been observed that without guidance in this evaluation, teachers tend to make a subjective assessment focused only on the knowledge of a specific area of technology. As a solution to this need, this article proposes the design of rubrics oriented to the evaluation of student performance in technological competences, particularly for the following components: "Appropriation and use of technology" and "Solving problems with technology".

The organization of this paper is as follows: In Section 1, the main characteristics that define the rubrics, such as: its classes, features and the design stages are described. Section 2 details the process proposed to build the rubric of the two selected components, the set of performances to evaluate and their related skills. In addition, the selected assessment scale and the construction process of descriptors to identify the level of development of identified skills are included. Section 3 presents the validation process of the constructed rubrics and Section 4 includes the conclusions and future work.

2. Rubrics Design

The rubric or evaluation matrix is a pedagogical tool whose contribution to education has been recognized by teachers worldwide. This instrument allows establishing a measurement mechanism that reports the appropriation level of students on a given performance. Furthermore, it has a scale that allows teachers and students to identify the progress reached and the skills that need to be improved (Kocakülab , 2009).

There are two types of rubrics, which are used depending on the structure and approach of the proposed school activity (Blanco, 2008). The first is an analytic rubric that includes a set of skills regarding to a dimension of each competence; the second is a holistic rubric that combines different dimensions on a single descriptive scale. The analytic rubric is widely used in formative assessment processes, where a more rigorous monitoring is required, while the holistic is utilized when the evaluative process is of the summative type.

For each type of rubric a particular measurement scale is defined: the holistic uses one descriptor and one measurement scale. On the other hand, the analytic rubric comprises several skills that are expected to be developed, a measurement scale that commonly have between three and five levels, and multiple descriptors for each level (Kocakülab 2009). These aspects allow both quantitative and qualitative analysis of the learning process.

### 2.1. Design stages of an analytic rubric

Considering the aforementioned characteristics and the need of a detailed description for the selected components and their skills, the analytic rubric was selected. In this regard, the literature reports a series of steps to construct this type of rubric (Carrizosa, 2007),(Metler, 2001), (Blanco, 2008), (López, 2007):

1. Review in detail the objectives or learning performances and identify the appropriate evaluation criteria, i.e. specific skills to observe in students.

2. Set the levels for each skill and determine a weight for each criterion. It is common to find levels as low, basic, intermediate and advanced (García, Terrón López & Blanco Archilla 2009) and (Andrade, 2000)

3. Generate a complete first draft of the rubric involving skills, descriptors and levels.

4. Perform the instrument validation based on three fundamental stages.

3. Rubrics construction for the selected components

Construction process of analytic rubrics implies four main stages described by (Carrasco, 2007), which are: skills selection based on the learning objectives or competencies, selection of the number of evaluation levels, construction of the descriptors that represent each level and, finally, the validation process. Figure 1 shows the sequence of activities and the required inputs for the rubric construction and validation processes.

Figure 1. Sequence of activities for rubric construction process
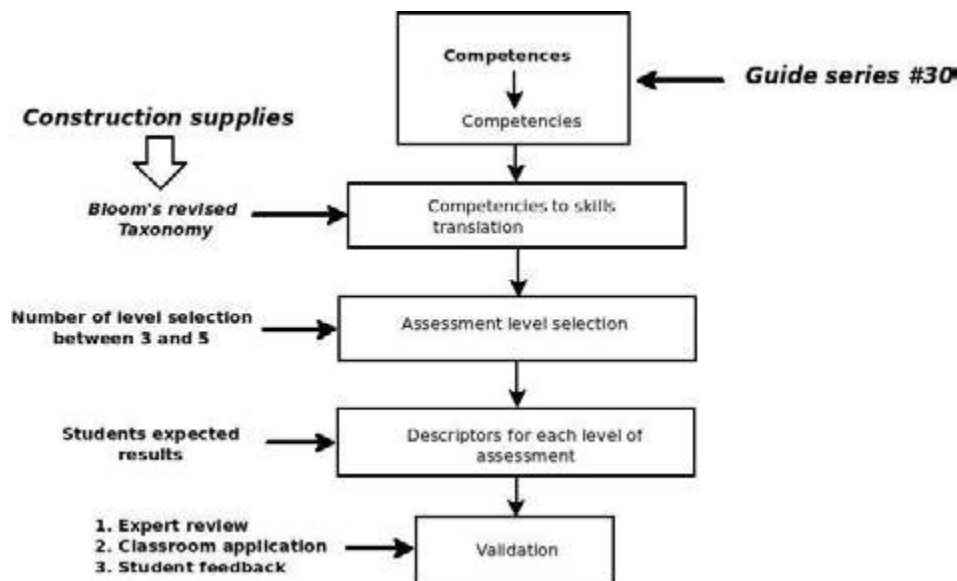
For the first stage "translation from competencies to skills", it was necessary to identify and classify each competency quality on a cognitive level, according to Bloom's taxonomy (Krathwohl, 2002). To achieve this task, the main verb of each competency (defined on the Guide series #30 document) was used. Additionally, the cognitive domain was categorized using the Krathwohl scale and both the learning objective and the student expected results were determined (Martínez, Amante, Cadenato & Gallego, 2012). The remaining items of the competency give additional information to determine the students desired results, which allows establishing the indicators or quality guides (Gatica-Lara, 2012) to assess the student learning.

For example, we translated the following competency: "I propose, analyze and compare different solutions to the same problem, explaining its origin, benefits and challenges". The main verbs for this competency are: propose, analyze and compare. Each one of these verbs is located in a specific level of the taxonomy (e.g. propose is in the level of creation, which is located at the highest point of the taxonomy). To develop this performance in terms of skills we can use any of the following verbs: to propose, create, prepare and issue, because they belong to the same cognitive level. In this case, we selected 'propose' as the verb to be evidenced by the student, obtaining the next skill: "proposes different solutions to a problem from its advantages and difficulties".

In the second stage of the instrument development, the assessment scale is defined. After a bibliographic revision, it is concluded that an adequate number of evaluation levels is between three and five, being four the most commonly used (Andrade, 2000). Another criterion for selecting the number of levels is the difficulty to reach the skill and its possibility to be measured (Krathwohl, 2002), (Gatica-Lara, 2012), (Andrade, 2005). According to these criteria, student advances are going to be measured through four evaluation levels (*beginning*, *developing*, *accomplished* and *exemplary*). Furthermore, since describing labels give more information about the educative process results for teachers and students, they were included in the rubric.

For each specific level of the selected skills, it was defined a descriptor that allows assessing and presenting to the student the obtained achievement. For this task, we utilized the Bloom's taxonomy, which includes the cognitive levels, the performance verbs related and the specific attributes of each skill (Krathwohl, 2002). Hence, the construction of descriptors allows representing the main characteristics of each skill and gives to students the opportunity to identify their strengths and weaknesses in the skills proposed for each competency. This aspect is crucial for students because it provides the necessary feedback to correct their mistakes for future activities (Gatica-Lara, 2012).

The last stage of the rubric construction is the instrument validation through teacher and student opinions (Reeves, Stanford, 2009). Taking into account that this process must be adjusted according to the perception of each involved agent, three key steps are developed. The first step consists in the review by designers and experts in educational assessment, in order to set learning goals, skills, measurement scales and descriptors for each one of the skills and their possible levels. The second step allows the instrument validation through its implementation in the classroom and considering teachers' opinion. In this step, the usefulness of the rubric in the learning process, the validity of the rating scale and the

relevance of the proposed descriptors are evaluated. The third step consists in the preliminary review by students, in which they mention if the built descriptors provide feedback to their learning process, explain the goals obtained and give them the opportunity for improvement in the future. Currently the process is in the second step, i.e. it is under review by teachers in the classroom.

Figure 2 shows the structure of the instrument developed to validate the rubrics. Each teacher filled out this instrument individually. Before the evaluation, the instrument and its components were explained to teachers and they evaluate it considering the following aspects: scope of learning goals, evaluated skills, measurement scale, descriptors and its possibility of use in the classroom. One of the skills that received feedback is: "explains the restrictions of a design using text or graphics". In this case, teachers mentioned the necessity of descriptors with a clear characterization of when a student explains properly and when she does not. Similarly, it is important to describe when a student identifies or not the constraints of a design. Additional contributions were described in the space of *comments* and at the end of the session the opinions and concerns about the instrument were socialized. This information was processed and used in order to generate each level descriptor and improve different aspects of the rubric.

Figure 2. Tool structure for teachers' validation

Component	Competence					
Competency	Skills to assess	Assessment level				Comments
		Beginning	Developing	Accomplished	Exemplary	
Consult and document information ...	Skill 1					
	Skill 2 ...					
	... Skill n					

Each level Descriptors

4. Conclusions and future work

It has been identified that in Colombian educational institutions the criteria to evaluate technological competences are not clear neither for students nor teachers. The rubric construction and validation was performed in order to evaluate technological skills for the components 'Appropriation and use of technology' and 'Solving problems with technology'. During the validation we noticed that teachers do not have knowledge about rubrics as an assessment mechanism in the classroom. Also, as a down side the design and construction of rubrics implied an increased workload for teachers, but they recognized that this instrument reduces the subjectivity in the evaluative process. Furthermore, rubrics provide clear assessment criteria to the students and give them a consistent feedback of their skills during the development of activities.

As future work, it is expected that teachers use the rubrics in the classrooms of ten public schools in Colombia in order to evaluate their relevance and utility. In this process, teachers and students will perform a second validation stage in which recommendations and suggestions will be generated. Subsequently, the suggestions and recommendations arising from the above process will be implemented and a new version of these instruments will be developed. Finally, it is planned to develop a software tool to facilitate rubric use by teachers and simplify the processing and interpretation of the resulting information.

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