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At present, the rules of APA citation are widespread in the field of social research, and its style is the most currently used to cite sources in this area. Therefore in case of any doubt regarding citations, we recommend consulting the *Publication Manual of the American Psychological Association* (6th edition), where it multiple examples of formats of research papers, text citations, footnotes, references, etc. can be found; here we have offered only general guidelines.

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EvalMOOC: A Pentadimensional Instrument of Improvement for the Quality Evaluation of MOOC

Miguel Baldomero Ramírez-Fernández a, Juan José Leiva Olivencia b and Noelia Margarita Moreno Martínez b

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Abstract: Some authors question the inadequate quality of the MOOC (Massive Open Online Courses) for which no registration fee is required. Considering this, the students could be affected as a consequence of the lack of a common base of knowledge and academic training for employability. In this regard, a line of research arises at Universidad Pablo de Olavide (Seville) that is developed at the Computational Intelligence Laboratory (LIC, by its acronym in Spanish) by a Research Group of EduInnovagogía (HUM-971) and that presents a comparative panorama of the evaluation indicators of two quality valuation instruments of the MOOC: EduTool and uMuMOOC. Once analyzed the strengths of both tools, this study proposes a design construct of the future instruments of improvement for quality evaluation, presented as a five vertex pyramid or pentadimensional representation. In the centre of gravity would be “the acknowledgement of training for employability”. In this way, as of this solid base, the evaluation tools would have to be configured in the following dimensions: learning design, communication-interaction, planning-management, levels of accessibility, and learning methodology.

Key-words: Online Teaching and Training, MOOC, Quality Evaluation, EduTool, uMuMOOC.

1. Introduction

The emergence of user generated content initiatives, in which the content is not delivered to the students but generated jointly by themselves,
the rise of open educational practices, (OEP), the MOOC, and the creation of new suppliers of self-learning solutions, such as the Open Educational Resources (OER) University, Peer2Peer University or University of the People, are transforming known settings into other domains of a much more uncertain nature. This trend is setting out a challenge for the conservative institutions, especially for universities (Sangrà and Wheeler, 2013).

In this same line, according to the proposals made by different authors (Castaño y Cabero, 2013; Vázquez, López and Barroso, 2015), the main characteristics of the MOOC can be described as follows: they are educational resources that have certain similarity with a class, they start and finish on certain date; they have an assessment mechanism, they are developed online, the access is free, they are open through the web and there is no admission criteria, and they allow the interactive participation on a broad scale of a massive group of students.

The philosophy of this educational modality may imply a democratization of the higher education (Finkle y Masters, 2014; Dillahunt, Wang and Teasley, 2015). Likewise, the demand for these courses places Spain among the five countries with the highest number of students in this educational modality, being leaded on an international basis only by countries such as the USA, Russia, the United Kingdom, Canada or Brazil (Aguaded, Vázquez-Cano and López-Meneses, 2016). Finally, as it is pointed out by different authors (López-Meneses, Vázquez-Cano and Román, 2015) there has been a worldwide rise of scientific items related to this topic since 2013.

However, this type of training is used by several educational organizations failing to guarantee the minimum quality standard required by the participants. In this regard, it becomes necessary that distance learning users can select the courses that better suit their needs and expectations, and that the educational organizations can improve their offer and, with this, the students satisfaction. Therefore, the comparative descriptive analysis between evaluation instruments of online courses will produce new scenes that will help the design of more efficient quality tools. These new elements will be able to reduce the possible differential existent between the expectations of the participants and their level of satisfaction and, therefore, the large offer of online learning courses will become more reliable and credible, reducing the risk of user withdrawal and offering online courses guaranteed by higher quality parameters (Baldomero, Salmerón and López, 2015).

In this study, the base of these new instruments will be designed grounded on the comparative analysis between the quality valuation tools EduTool® (Baldomero and Salmerón, 2015) and uMuMOOC (Guerrero, 2015) that could reduce the possible valuation deficiencies of the normative quality of the MOOC.
2. Antecedents and trends regarding quality evaluation instruments for MOOC

The amount of key research in matters of design of instruments that can be used to evaluate the quality of MOOC started in 2012, to comply with the item 6.2 of the Standard UNE-EN ISO 9001 about Quality Management Systems, when providing the necessary demand to its employees and guarantee their competence. In this regard, it has to be confirmed that the acquired online training complies with the purchase requirements pointed out according to the item 7.4 of the mentioned regulation.

Therefore, the Standard UNE 66181:2012 pretended to work as a guide to identify the characteristics of online learning actions, in a way that the users of online learning platforms could select the courses that best suit their needs and expectations, and that the educational organizations can improve their offer and, with this, the students satisfaction. So, based on this standard, the dimensions covered by the satisfaction factors of online learning are: Employability, Learning Methodology and Accessibility.

From this moment on, the line of research started in the study “Teaching Innovation 2.0 with Information Technologies and Communication in the European Higher Education Area”, framed by the Action 2 of Teaching Development and Innovation Projects of the Universidad Pablo de Olavide (Seville) and developed in the Computational Intelligence Laboratory (LIC) by the Systems and Information Technology Research Group (TEP-240) presents a scene of comparative study between the mentioned regulation standard UNE 66181:2012 and the instrument ADECUR (Baldomero, Salmerón and López, 2015). In this line, ADECUR is an instrument of evaluation able to analyze and identify the distinctive features of the online courses didactic quality, from the scales provided by the socio-constructivist and research paradigm, as a channel to promote an appropriate development of the teaching innovation processes (Cabero and López, 2009).

Through this study, it is concluded that the offering proponents could be accredited with certified MOOC and avoid the offer of learning programs with weak teaching methodologies that are unsuitable according to the current pedagogical theories (Valverde, 2014) and preventing, to the extent possible, the tendency to standarization of knowledge and the serious problems to meet the individual differences due to the massification that leads to a unidirectional communicative design, teacher-centered and content-based. Therefore, the MOOC could be shown as a democratization of higher education but giving priority to the pedagogical interests instead of the economical ones.

Afterwards, the LIC mentioned above analyzed the normative quality of the MOOC through the instrument EduTool®, registered as a trademark in the Spanish Patent and Trademark Office (3.087.298, in force), that is developed under the sponsorship of the standard UNE 66181:2012 and is the result of the
work included in the PHD thesis entitled “Diffuse standards model for MOOC analysis and evaluation with the quality standard of virtual training”. This work concludes with the same result reached by other studies, where it is demonstrated that the MOOC have a solid pedagogical base in their formats (Glance, Forsey and Riley, 2013). On a general basis, it was possible to state that the quality valuation of the analyzed MOOC was not only above the average punctuation estimated, but that these presented punctuations slightly higher than the average (Roig, Mengual-Andrés and Suárez, 2014).

In this line, Sánchez-Vera and Prendes-Espinosa (2015) show alternative methods to evaluate MOOC in their work. Likewise, the authors point out the necessity of evaluation improvement, this means that they coincide in the need of more research on MOOC evaluation and the use of various methods to achieve it. In this way, the problem that is caused by the massification is found when considering the evaluation that takes part in the global teaching process; this is, when it is understood that to evaluate is to learn and that evolving and learning strategies must be used in this process. These authors follow the same thought as Sandeen (2013), when he states that the evaluation focuses the MOOC development from the beginning, but on the contrary, it is believed that a lot of MOOC focus their attention on the development of quality content or in the learning community, leaving the evaluation and certification behind.

On the other hand, some studies state that there is an inverse relation between the motivation through badges of honour or certification and the acquired knowledge (Daniel, Vázquez-Cano and Gilbert, 2015). In this regard, the certification opens the door for the income of courses fees and, on the other hand, it becomes necessary to know how the learning process is evaluated and how the certifications are valued by the employers.

Following this idea, Chen (2014) carries out a study in which the results are discouraging in respect to the quality evaluation of MOOC. In this line, elite universities are massively offering MOOC aiming to enlarge the access to higher education, commercialization and branding, and the development of new income sources. However, as it is stated by Daniel (2012), despite the fact that the elite universities that participate actively in MOOC got their reputation in research, they may not be the best at teaching, especially at online teaching. In other words, research is different from teaching and the fact that these elite universities that make important achievements in research are prestigious does not mean that they are qualified to offer quality MOOC. This author questions the acceptable quality that the MOOC must keep when no registration fee is necessary (except to obtain the corresponding certification) and that may be affected for the lack of a common base of knowledge and academic training among the students. Finally, he states that carrying out efficient evaluations of MOOC is still an important challenge and warns that there are a lot of different ways in which the participants can cheat during online evaluation, bringing as a result inefficient and null evaluations.
Therefore, it appears necessary a line of work at the LIC by the Research Group of EduInnovagogia (HUM-971), in which it is possible to make a study aiming to compare the instrument EduTool® and the tool uMuMOOC, that could eliminate possible defects in the quality evaluation of MOOC increasing their dimensional scope.

3. Used models

3.1. The instrument EduTool®

It is a model based on a non-experimental quantitative research design (McMillan and Shumacher, 2005) that adapts the standard UNE 66181:2012 to MOOC. In this adaptation, the information about quality levels was not taken according to a representation system of stars accumulation, as stated by the normative standard. This means that a MOOC could include indicators of different rubrics of higher quality levels not accumulated. Therefore, the MOOC quantitative quality could be evaluated with this instrument stating a difference from the qualitative quality of all the courses that contain the addition of the indicators of the same rubric levels. The aim of this instrument is not to correct the standard but to carry out a more detailed granularity valuation than the one merely qualitative.

In this regard, MOOC could include indicators of different quality levels rubrics without the restriction of being cumulative. Thus, with this instrument it is possible to make a qualitative and quantitative valuation of the dimensions covered by their factors, making an adjustment of the normative standard through a deliberation of the sub-factors of each of the dimensions of the standard UNE 66181:2012 through fuzzy logic (Baldomero and Salmerón, 2015).

The experts evaluated with linguistic variables each of the subfactors of the instrument dimensions and the Gaussian function associates for each element of X (expert’s opinion on the linguistic variables scale) a degree of belonging to the fuzzy set. In this context, the addition of the belonging functions of linguistic variables of the experts is shown in Figure 1.

![Figure 1. Function of addition of the belonging functions of the experts linguistic variables](Source: Baldomero and Salmerón (2015).)
The data presented by the experts is based on the fuzzy sets and is originated by the use of linguistic qualifications. In this way, the defuzzification used is focused in the method of the area centroid. As an example for the subfactor 2.2., a defuzzed value of a belonging function associated to the value of the variable X will be returned, as it is shown in the formula 1.

\[
\text{Subfactor 2.2} = \int_{0}^{1} \frac{-(x-0.5)^2}{2e} \frac{0.02256}{dx} + \int_{0}^{1} \frac{-(x-0.75)^2}{5e} \frac{0.02256}{dx} + \int_{0}^{1} \frac{-(x-1)^2}{3e} \frac{0.02256}{dx} = 0.6632
\]

Based on the content above, the tool EduTool® has the following tridimensional structure (Baldomero and Salmerón, 2015):

1. The dimension of acknowledgement of the learning process for employability has 6 items.
2. The dimension of learning methodology has 43 items distributed in subfactors: didactic-instructional design (11), teaching resources and learning activities (10), tutoring (9) and the technological-digital environment for learning (13).
3. The dimension of the accessibility levels has 21 items distributed in 3 subfactors: the hardware accessibility (7), the software accessibility (7) and the web accessibility (7).

Each item is dichotomous (yes/no) and measures the clarity of the pretensions of each indicator of the subfactor of the corresponding dimension.

3.2. The instrument uMuMOOC

This tool values the pedagogical quality of MOOC in the context of the Universidad de Murcia and that is why it is called uMuMooc (Guerrero, 2015). Although in a second phase the designed instrument will be validated and become subject of a process of content validity through the experts opinion, in order to verify the characteristics of this tridimensional model, in this tool basically three dimensions have been established in which several subcategories or subfactors and indicators of each are integrated:
1. Planning/Management. This dimension includes the formal requirements and basic administration and management aspects that can be implied in the platform MOOC used, related to the learning process and in which two subfactors can be observed: Administration/Management and Accreditation/Certification. Some of the indicators established are: Information about the duration, schedule, certifications, accreditations carried out, if they paid, free, or both.

2. Learning design. This second dimension is related to aspects of educational design and integrated by 4 subfactors: teaching-instructional design, content, resources and activities, and evaluation. Some of the indicators mentioned in these components allow to value if the different elements indicated in the pedagogical design and elaboration of learning materials are oriented, for example, to the transfer of learning, competence development and evaluation, if they consider individual differences and different learning styles, if they consider cultural or contextual aspects, if they encourage the activity or participation, the learning connectivity or sequencing and the modular design.

3. Communication-Interaction. The third dimension includes aspects related to the implementation, course development and monitoring, and the communicative/tutorial tools of the platforms: forums, blogs, wikis, social nets, hangouts that allow the promotion and development of an active, cooperative and participative methodology. The subfactors that make part of it are Communication and Tutoring.

4. Study scene and research analysis

The study presented belongs to the line of work started with the research developed in the LIC by the Research Group of EduInnovagogía (HUM-971), in which a comparative scene is shown between both instruments of MOOC quality valuation that enlarges its dimensional scope and reduces as much as possible, deficient and null evaluations.

In Figure 2 it can be observed the representation in the space of two quality triangles of MOOC. On the one hand, there is the ideal MOOC orthic triangle of supreme quality that shows an equilateral triangle for tridimensional tools, with the maximum punctuations in all quality dimensions (it cuts the axis at point 1). This ideal triangle receives the name of orthic because it is the maximum surface of quality projection and will serve as a reference to measure the «lack of quality» of MOOC. In this regard, the real quality triangle has also been represented (stripped pattern) of any MOOC in both instruments that makes an intersection with the mentioned axis in points below 1.
5. Comparative between the evaluation instruments EduTool® and uMuMooc

In this study the common indicators of evaluation instruments will be treated as well as the differences of indicators between both tools. In this way, the aim is to carry out an internal analysis of EduTool® and uMuMooc to get to know the real situation of both instruments as well as the risks and opportunities that their utilization represents in the evaluation of virtual MOOC.

5.1. Common indicators analysis

It has been taken as a premise the analysis of the common indicators of the subfactors of quality evaluation of EduTool® and uMuMooc according to the dimensions of the first. Therefore, in Table 1 the only quality common indicators of the dimension «Acknowledgement of the learning process for employability» and «Learning Methodology» are shown, since there is no other dimension that has common indicators.

<table>
<thead>
<tr>
<th>Dimension 1: Acknowledgement of the learning process for employability</th>
<th>Indicators</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subfactor 1.1. Acknowledgement of the learning process for employability</td>
<td>The students receive an attendance diploma.</td>
</tr>
<tr>
<td></td>
<td>A certificate is granted to those students who pass an exam of evaluation of acquired knowledge.</td>
</tr>
</tbody>
</table>
The certificate of knowledge is recognized by the administration or by an external entity of prestige.

A monitoring process is carried out to the recognition of the learning program.

The degree or certificate acquired has international validity.

<table>
<thead>
<tr>
<th>Dimension 2: Learning methodology</th>
<th>Indicators</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Subfactor 2.1. Educational-instructional design</strong></td>
<td>General objectives are described.</td>
</tr>
<tr>
<td></td>
<td>Certain degree of freedom in the learning program (in modules, topics and activities).</td>
</tr>
<tr>
<td><strong>Subfactor 2.2. Teaching resources and learning activities</strong></td>
<td>The students can carry out self-evaluation activities.</td>
</tr>
<tr>
<td></td>
<td>An educational guide is provided with information about the course (content, methodology and evaluation systems).</td>
</tr>
<tr>
<td></td>
<td>Synchronous sessions are programmed for individual or group work invigorated by the teacher.</td>
</tr>
<tr>
<td><strong>Subfactor 2.3. Tutoring</strong></td>
<td>Individual feedback is provided on the work carried out.</td>
</tr>
<tr>
<td><strong>Subfactor 2.4. Technological-digital learning environment</strong></td>
<td>It allows or has mechanisms or components that facilitate the students’ orientation within the environment and learning process (navigation maps, simple search engines or by tags, options of going back or undo, usable interface, etc.).</td>
</tr>
<tr>
<td></td>
<td>It allows or has forums of debate and students service (formal and informal).</td>
</tr>
</tbody>
</table>

Table 1. Common quality indicators. Source: Baldomero Ramírez-Fernández (2016)

5.2. Analysis of non-common indicators

The internal analysis of non-common indicators will imply, for the instrument that lacks them, some weaknesses. In this way, these aspects limit the capacity of the effective reach of such dimension that corresponds to the tool in the evaluation of any MOOC. However, they will represent some strengths for the instruments that do have these non-common indicators, and this will suppose an advantage in the capacity of the evaluation dimensional scope, as it is shown in Table 2.
<table>
<thead>
<tr>
<th>EduTool&lt;sup&gt;®&lt;/sup&gt;</th>
<th>Dimension 2: Learning methodology</th>
<th>Indicators</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Subfactor 2.1. Educational-instructional design</strong></td>
<td>General learning objectives are set out.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Specific learning objectives are set out.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>An identifiable learning method is set out and the activities presented are designed according to it.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>A knowledge evaluation is carried out at the end of the course. This makes it possible to identify the students who have reached the course aims.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>The activities and problems are developed in a realistic context.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>There is an initial knowledge evaluation that makes it possible to give the students information about their concrete learning needs and, after the final evaluation, the knowledge acquired during the course.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>The learning objectives are organized by competences.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>The learning methodology is based on the solution of problems and/or the realization of real projects with direct implication in the society.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>A post-course monitoring is carried out on the level of implementation of what was learnt.</td>
<td></td>
</tr>
<tr>
<td><strong>Subfactor 2.2. Teaching resources and learning activities</strong></td>
<td>The teaching resources are only reference material for self-learning.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>The teaching resources allow the interaction among students.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Instructions are provided for teaching resources use for the learning activities.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>The students must carry out individual or group practical activities that are part of the course plan.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>There is variety in the teaching resources (texts, audios, videos, exercises, simulations) and different interaction models (different activities or exercises typologies, such as multiple choice questions, open questions, putting items in order…; maps or interacting images; hypertext navigation; interactive animations…).</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Complex individual or group activities are proposed (real environment simulations;</td>
<td></td>
</tr>
</tbody>
</table>
| Subfactor 2.3. Tutoring                                                                 | practical cases of individual correction, cooperative work dynamics…).
|                                                                                       | Knowledge management is facilitated (students’ contributions, appreciation of those contributions).

| Subfactor 2.3. Tutoring                                                                 | Course tutors respond to the students questions at any time.
|                                                                                       | The answers to the students consultation about course content are given in a pre-established time.
|                                                                                       | Existe una programación de contactos que se personalizan en función del avance de los alumnos.
|                                                                                       | The tutors monitor both the learning process and the students improvement.
|                                                                                       | The students’ evolution is considered based on the progress and the learning indicators that have been set (assessment tests, individual activities, participation in group activities…).
|                                                                                       | Personalized and individual monitoring is carried out on the learning process of each student.
|                                                                                       | Synchronous sessions of interactions are organized 1 on 1 student-tutor.

| Subfactor 2.4. Learning technological-digital environment                             | There is information available about hardware and software requirements for the students’ equipment.
|                                                                                       | There is at least one asynchronous communication tool that allows students’ interaction.
|                                                                                       | There is a learning technological-digital environment that integrates content and communication.
|                                                                                       | It incorporates a section of questions (Frequently Asked Questions) and/or Help.
|                                                                                       | It makes it possible to manage groups of students and tasks with registers of access and reports.
|                                                                                       | It allows or has the possibility of restarting the learning process where the previous session was left (persistence).
|                                                                                       | It allows or has repositories for the exchange of digital files among its members.
|                                                                                       | It allows or has visual indicators or learning progress.
|                                                                                       | It allows the management and reuse of good
practices in teachers and students. It allows the use of different presentation formats based on the learning characteristics and styles. It allows or has cooperative or active participation technology (Really Simple Syndication or RSS, wiki, blog, social network…).

<table>
<thead>
<tr>
<th>Dimension 3: Accessibility levels</th>
<th>Subfactor 3.1. Hardware accessibility</th>
<th>All.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Subfactor 3.2. Accesibilidad software</td>
<td>All.</td>
</tr>
<tr>
<td></td>
<td>Subfactor 3.3. Web accessibility</td>
<td>All.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>uMuMooc</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Dimension 1: Planning/Management</strong></td>
</tr>
<tr>
<td><strong>Subfactor 1.1. Administration/Management</strong></td>
</tr>
<tr>
<td>It has information about the duration, schedule, level of content, diffusion, particular conditions of the course.</td>
</tr>
<tr>
<td>It has asynchronous communication tools.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Dimension 2: Learning design</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Subfactor 2.1. Educational-instructional design</strong></td>
</tr>
<tr>
<td>The content responds to the aims set.</td>
</tr>
<tr>
<td>The evaluation corresponds to the methodology established.</td>
</tr>
<tr>
<td>It has a well selected bibliography, etc.</td>
</tr>
<tr>
<td>The workload for the students is defined and adequate.</td>
</tr>
<tr>
<td>There are different types and level of content according to the students: previous knowledge, characteristics, conditions, abilities, language…</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Subfactor 2.2. Content</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>All.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Subfactor 2.3. Resources and activities</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>The activities are interesting and innovative, and include additional material, diagrams, summaries and synopsis.</td>
</tr>
<tr>
<td>There are different modalities and types of activities: of reinforcement or support or extension resources (mandatory or optional materials that reinforce the lessons or content); individual or collective.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Subfactor 2.4. Evaluation</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>It includes partial assessment tests, of each module and global, or the students progress is verified in other ways.</td>
</tr>
<tr>
<td>Different assessment activities are included: peer evaluation, questionnaires, rubrics, problems…</td>
</tr>
<tr>
<td>New evaluation modalities are included, learning focused evaluation, authentic</td>
</tr>
</tbody>
</table>
Dimension 3: Communication-Interaction

<table>
<thead>
<tr>
<th>Subfactor 3.1. Communication</th>
<th>Indicators</th>
</tr>
</thead>
<tbody>
<tr>
<td>They have a facilitator or “content curators”.</td>
<td></td>
</tr>
</tbody>
</table>

| Subfactor 3.2. Tutoring | All |

Table 2. Non-common quality indicators. Source: Baldomero Ramírez-Fernández (2016)

Figure 3 represents graphically EduTool® and uMuMooc strengths. In order to illustrate it better, the instruments dimensions are presented as intertwined nodes of different sizes. In turn, every dimension is connected to the sub-factors that integrate it. In this way, the strengths of each tool can be represented as a map of dimensions and non-common subfactors. In turn, the number within the node that corresponds to each subfactor represents the non-common indicators of the tool that integrates it and it is proportional to its size. Therefore, the number within the node that corresponds to each dimension represents the non-common indicators of all the subfactors that integrate it and it is also proportional to its dimension.

In this regard, it can be deducted that the tool EduTool® has 34 non-common indicators of the dimension 2 and 21 of the dimension 3. As for the tool uMuMooc, it has 2 non-common indicators of the dimension 1, 14 of the dimension 2 and 3 of the dimension 3.

Once analyzed the strengths of the instruments mentioned above, this study proposes some guidelines of configuration bases of a new instrument that does not imply the deficiencies of the two described previously but does include their strengths. In order to achieve that, the new tool will have to include five dimensions: learning methodology, accessibility levels, planning/management, learning design and communication-interaction. To the three dimensions that make part of the tool uMuMooc will be added the non-common indicators of the two dimensions of the instrument EduTool®. In this way, the possible fourth and fifth dimensions are added by the educational progression axis «learning methodology» and «accessibility levels» of this last instrument, that contains very few common indicators with uMuMooc, and this implies two new key efficiency factors in the configuration of new tools that include the common dimension «acknowledgement of the learning process for employability». In Figure 4 this design construct of future quality evaluation instruments of the MOOC is shown as a five-vertex pyramid or pentadimensional representation. In the gravity centre is placed the “acknowledgement of the learning process for employability” and some indicators of the “learning methodology”. From this solid base, the evaluation tools will have to be configured considering the five dimensions expressed in the representation.

Figure 4. Pentadimensional representation of the future instruments of quality valuation of MOOC. Source: Baldomero Ramírez-Fernández (2016)
Based on the previous considerations, in Table 3 it is shown the possible configuration of EvalMOOC, a new quality evaluation tool of the MOOC. This instrument will have to consider a base of common quality indicators (Table 1), the pentadimensional configuration of the pyramid (Figure 4) and the sub-factors or axis of non-common indicators progression (Table 2).

### Table 3. Bases for the design of EvalMOOC as a new tool for MOOC quality evaluation. Source: Baldomero Ramírez-Fernández (2016)

<table>
<thead>
<tr>
<th>Common Quality Indicators</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Dimension 1:</strong> Acknowledgement of the learning process for employability (tool EduTool®)</td>
</tr>
<tr>
<td>All the indicators</td>
</tr>
<tr>
<td><strong>Dimension 2:</strong> Learning Methodology (tool EduTool®)</td>
</tr>
<tr>
<td>Partial indicators in the subfactors:</td>
</tr>
<tr>
<td><strong>Subfactor 2.1</strong></td>
</tr>
<tr>
<td><strong>Dimension 3:</strong> Accessibility levels (tool EduTool®)</td>
</tr>
<tr>
<td>Partial indicators in the subfactors:</td>
</tr>
<tr>
<td><strong>Subfactor 2.1</strong></td>
</tr>
</tbody>
</table>

| **Dimension 2:** Learning methodology (tool uMuMOOC) |
| Partial indicators in the subfactors: |
| **Subfactor 2.1** | **Subfactor 2.2** | **Subfactor 2.3** | **Subfactor 2.4** |
| **Dimension 3:** Planning/Management (tool uMuMOOC) |
| Partial indicators in the subfactors: |
| **Subfactor 2.1** | **Subfactor 2.2** | **Subfactor 2.3** | **Subfactor 2.4** |

| **Dimension 2:** Design/Learning (tool uMuMOOC) |
| Partial indicators in the subfactors: |
| **Subfactor 2.1** | **Subfactor 2.2** | **Subfactor 2.3** | **Subfactor 2.4** |
| **Dimension 3:** Communication/Interaction (tool uMuMOOC) |
| Partial indicators in the subfactors: |
| **Subfactor 2.1** | **Subfactor 2.2** | **Subfactor 2.3** | **Subfactor 2.4** |

7. Discussion and conclusions

This study adjusts the differences between EduTool® standards and the indicators of the instrument uMuMOOC to the learning program evaluation of MOOC in a more efficient way and aiming to represent a new visual and analytical scene for the design of new tools that reduce the weaknesses of the current ones that were analyzed. In this regard, the research has been concluded with vital importance of the dimension of “acknowledgement of the learning process for employability” and some aspects of the “learning methodology” that quality valuation instruments of MOOC must have. In this
same line, and based on such dimension, it appears obvious the necessity of a pentadimensional tool, called EvalMOOC, based on the following axis:

1. Acknowledgement of the learning process for employability.
2. Learning Methodology.
3. Planning/Management.
4. Learning Design.
5. Communication-Interaction.

In this way, it appears necessary to carry out future research about the design of new modular and multidisciplinary instruments that use a multimethod, mixed, eclectic, holistic, systemic and conciliatory approach, overcoming the methodological monism and quantitative/qualitative polarity to come together in the dialectical symbiosis of both perspectives in an strategy of knowledge complementarity and convergence and integral analysis of the phenomenon object of study. Therefore, prospective observatories about the future of MOOC, such as it could be the International Observatory OCIMOOC®, the only existent in the world with these characteristics, with valid trademark (OEPM): 3530108 and URL: http://ocimooc.eu/ (under construction), could combine the dimensions of this new scene under study. Following the same line, each of the five dimensions to be considered would become endorsed and more reliable and the quality level of the courses offered could be certified in an efficient way in advance, both on a qualitative and quantitative basis and mainly considering the acknowledgement of the learning process for employability and the learning methodology aspects considered.

Through all that, the offering platforms could be recognized with certified MOOC courses and avoid the offer of learning programs with weaknesses in their learning methodologies that could be considered not appropriate according to the current pedagogical theories (Valverde, 2014) and preventing, to the extent possible, the tendency to the standarization of knowledge and the serious problems to meet the individual differences due to the massification that leads to a unidirectional communicative design, teacher-centered and content-based. Therefore, the MOOC could be shown as a democratization of higher education but giving priority to the pedagogical interests instead of the economical ones based on unreliable evaluation methods.

In any case, the quality valuation of the MOOC is a future line of research and it also appears necessary a higher number of studies about some quality indicators in online courses, as well as linear (Stödberg, 2012) or comparative studies (Balfour, 2013). And, more specifically, it would be important to continue researching in order to provide an answer to questions about methods that improve the reliability, validity, authenticity and safety of the students evaluation, or about techniques that offer an efficient automatized
evaluation and systems of immediate feedback; and how they could be integrated in open learning environments (Onçu and Çakır, 2011), to give more usability guarantee to the quality pentadimensional tools that may be developed from this work and to the future trial of MOOC relevant platforms.

References


Abstract: The following work presents the result of a mixed research study, exploratory and descriptive; carried out at postgraduate studies, with a sample of 20 students enrolled in the first semester of the Master of Education. Its aim was to analyze the use of Moodle as an appropriate Virtual Learning Environment, conducive to strengthen the Virtual Learning Spaces for developing formative research. To carry out this qualitative research, the technological resources of the three first courses that correspond to the first semester of the abovementioned master were analyzed, in addition to the application of a semi-structured interview, from which key variables emerged: the students’ concept of research, its linkage to their professional field, and the use and frequency of technological tools in Moodle, as resources to create Virtual Learning Spaces that benefit the processes of formative research in the students. Among the main findings, it was found that students find a close relation between the Virtual Learning Environments and the development of research, which encourages interest for learning and collaborating with peers; however, the role of teachers in enhancing these spaces to strengthen the process of research in their students was also emphasized.

Key-words: Virtual Learning Environments, Virtual Learning Spaces, Formative Research, Postgraduate Studies, Higher Education.

1. Introduction

Higher Education attempts four basic functions: teaching, management, extension studies and research; the latter takes fundamental relevance in the

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XXI century society, since from the perspective of Arechavala (2011), the University is no more a repository of knowledge to place itself with a focus on creation, both individually and collaboratively. From this representation, research training of university students begins to prove itself as one of the priority tasks that enables them with the necessary tools to transit from an information society to a knowledge society.

However, training for research is a challenge for universities; in this regard Hernández, Fernandez and Baptista (2015) argue that it is necessary to strengthening both, the institutional conditions and the trained staff, as well as implementing a where the student trains by doing research from a direct learning, that enhances their investigative skills, and in this way, acquire more tools to meet the needs and demands of their working context, De Ibarrola (1989) confirms this proposal ensuring that

The greatest and most profound training of researchers in a specific degree, is developed through daily performance in the profession, and from the limits and possibilities of personal development, as well as from the field of research itself, where it is achieved.

In recent years, international proposals on this topic have increased significantly, and are exposed by different institutions highlighting the importance that research acquires as a resource for understanding educational issues, and based on the results generated, build strategies that lead to increase the improvement of educational quality, and thus, the performance of students, in the case of UNESCO (2015) states that:

“Scientific research has changed its priorities and moved towards problem solving, and so, respond to the urgent challenges of the development. The change in the research priorities can be clearly seen in the amount of research funds granted to the applied sciences” (p.42)

Tünnermann (2008) argues that research should be integrated in university tasks, however, the problem arises when trying to define the emphasis or focus of research, when questioning where to emphasize and what type of activities are to be developed in the research with students, since most of the courses in the universities are orientated towards teaching research, and not in the training of it, from the perspective of Sanchez (2014).

From this perspective, universities are challenged to train professionals who go beyond theory; where the notion of scientific field is understood, and that according to Bourdieu (2003), represents the social world that exerts control, independently from the pressures of the macro social where it is included. Working from a scientific field, would allow students to strengthen the development of investigative skills, through training that abandons the dividing theory-practice traditional and scholastic paradigms, to work from paradigms that link theory and practice, giving sense and meaning to their daily work in the professional field; but at the same time, enhancing its analysis through a view oriented to the research; learning to research by researching; working with people who have more experience in research, as
well as with peer groups, where learning communities are generated from a horizontal perspective, where members have something to learn and something to share with others.

Another aspect that has made the methodological research process more complex is the use of Information and Communication Technology, where work is developed from new spaces that allow acquisition of information, as well as interaction with people, both synchronously and asynchronously; in this sense, the field of research would not only be addressed from natural and urban environments, but also from digital environments (Chan, 2004).

Based on the above proposals, the goal of this research was to analyze the use of Moodle as a Virtual Learning Environment conducive to strengthening Virtual Learning Spaces for developing formative research.

2. Theoretical framework

2.1 Virtual Learning Environments and Spaces (VLE) and (VLS)

The concepts of environment and learning environment have been present in the field of education for a long time, and when carrying out the literature review of these terms, they are sometimes used interchangeably; however, it is important to set up the conceptual difference between them for the approach this research.

From the perspective of Duarte (2013), the environment refers to the interaction that is set up between the human being with the natural environment that surrounds them, awarding it an active conception, since it involves the human being and the pedagogical actions in which they learn, leading to think on their own actions. In this sense, the difference is clear, the environment is not only the physical environment, but the elements and subjects that surround it; it refers to the mediation and interactions performed, and that create a learning space. In this sense, the environment would have a static nature, while the space a dynamic one.

According to the perspective of Churches (1996), the learning environment consists of four dimensions: a) the physical dimension, which identifies the space and how it is organized, in a way that different scenarios can be created to perform several activities with students; b) the functional dimension, which defines the purpose and use of the spaces and the conditions in which the activities are performed; c) the temporal dimension, which highlights how and when the spaces are used and the different times in which activities are performed with students; and finally d) the relational dimension, which identifies who uses the space and the conditions in which it is.

The following figure is a graphic representation of the learning environments and learning spaces and their dimensions:
The learning environment is the intersection of the physical, functional, relational and temporal dimensions; it is integrated by the subjects, as well as the processes that develop from their interaction; it is surrounded by the learning environment, the first is characterized by being dynamic and complex, and it is influenced by the features and elements of the second.

Approaching this topic from a virtual perspective, the notion of learning space considers environments that are no longer limited to the natural and urban contexts, but to the digital environment; in these three environments, acts and interactions are carried by the subjects, which settles the development of the learning space (Chan, 2004). Virtual Learning Environments (VLE) have supported the interactions in the educational process, and is it directly related to three elements: content, student’s performance and teacher’s performance (Coll, Mauri and Onturria in Bustos and Coll, 2010).

Moodle is a Virtual Learning Environment (VLE); it is a Learning Management Systems (LMS) application, an acronym that stands for Modular Object Oriented Dynamic Learning Environment (Baths, 2007), and it is when teachers and students work in Moodle that the Virtual Learning Space (VLS) is generated.

2.2 Formative research and research training in postgraduate studies

The relevance of developing research, both in undergraduate and graduate studies has increased significantly in recent years; it is relevant that students are able to identify and understand the problems they face, and solve those from a scientific perspective. Specifically, postgraduate studies can be classified into two types, research-oriented and professionalizing; in the second type of studies, work is done from a pedagogical research, which is known as formative research, and it is defined by Miyahira (2009) as:
“A tool in the teaching-learning process, that is, its purpose is to spread existing information and encourage the student to merge it as knowledge (learning). Formative research can also be referred as teaching through research, or teaching using the research method”. (p.1)

According to Restrepo (2003), there are three meanings related to the term formative research; the first is synonymous of an exploratory research, as a search for needs and problems that occur in a specific context; the second refers to training in and for research from different types of activities, using the methodology of Problem-Based Learning; and finally, the third points out that research allows the transformation of practice, that is, it recuperates the importance of identifying the problematic situation, assess it, and carry out activities and strategies to transform it.

This type of research is characterized from Gamboa’s proposition (2013) as a pedagogic strategy based on the constructivist perspective, he stresses the active participation of both the student and the teacher in the development of the research process in specific situations that occur in the classroom, which allow the confrontation between empirical facts with theoretical views, i.e., it becomes a thoughtful circle that moves from theory to understand it by analyzing practice, and from practice to describe it from the theoretical perspective, the events occur in the classroom, and from this context, the reason and the way to solve them occur.

Sarabiego, Ruiz and Sanchez (2013)  mention three principles on which formative research focuses: 1) the question, the doubt, where the student takes an active role of self-learning and administrator, 2) the non-directivity of the teacher, as he serves a guide, counselor, a mediator; and finally 3) the inductive teaching, which takes the student as the center of teaching-learning process, which involves the interaction that takes place between the environment, the educational community and the curriculum, and in this way, proposals and collaboratively conclusions between different actors and from different perspectives, both theoretical and empirical are constructed.

According to Rama (2007, p. 33) "postgraduate studies represent the modern way where the wide and growing variety of disciplines expresses, and the process, which associated with the evolution of social division and technical work, are created; recreating, disappearing or merging the different existing disciplines ", from this view, it can be perceived as a dynamic process that clearly shows the relationship between the academia and the workplace, since it is does not remain static, but it evolves according to the needs that appear in different work contexts.

2.3. Formative research Environments and Virtual Learning Environments

The development of formative research is present in both, classroom and virtual settings; and in this second space, its use has increased considerably over the last decade, not only for the distance programs, but also
for traditional and mixed modalities, supported by educational platforms like Moodle, Blackboard and Sakai, to name a few.

However, the challenge is not on the search of information but on moving from information processes to knowledge processes, as Castells (2001):

“States that the way to understand education in today's society is oriented towards the acquisition of the necessary intellectual capacity of learning to learn throughout life, getting information digitally stored, recombining it and using it to produce knowledge for the desired goal every time”. (p.307)

Research processes from the use of Information and Communication Technology have changed considerably; some years ago, the main difficulties were presented by the lack of material on a subject, now, information on different topics is huge, and one can get access to it easily, however, this process has become more complex in assessing what type of information is reliable, updated and relevant. The XXI century researcher can get access to different services using ICT, Guazmayan (2004) explains the following: remote connection to other equipment, transfer of information, use of email, participation in discussion forums and use of different tools such as wikis and blogs, to name a few.

In addressing the topic of formative research in learning environments and spaces, similar traits and characteristics as those considered in classroom environments are identified; however, the conditions where they develop are different, and are characterized according to Londoño (2011), a Problem Based learning (PBL) model to think on their own learning process; a devoted teacher who plays the role of mediator, guide, facilitator, and has digital skills to move in Virtual Learning Environments and Spaces; collaborative work and participation in networks where communication between the participants is performed both synchronously and asynchronously, using specialized databases to deepen on the subject under study from the analysis of current instruments and quality.

3. Methodology

This research was developed from a mixed methodology, which focuses on understanding the object of study from quantitative data, as well as from the perspective and point of view of the participants in relation to their context (Hernández, Fernandez and Baptista, 2010), with an exploratory / descriptive scope, since its purpose was to analyze the use of Moodle as a Virtual Learning Environment conducive to strengthen the Learning Spaces for developing formative research.

The research was conducted in the context of a public institution in the state of San Luis Potosi in Mexico, which offer Bachelor, Master and Doctorate programs in Education, research was done with the first semester of
the Master of Education, whose population is 20 students, 18 women corresponding to 90%, and 2 men, equal to 10%. The average age of students is 23 years. On the graduation rate of the bachelor program, 95% corresponds to the degree in Elementary Education and 5% corresponds to the Bachelor in Basic Education, 95% of the population is working as classroom teachers in the elementary level and 5% of the population is dedicated exclusively to master studies, which is complex because of the professionalizing orientation of the program, in which the academic units that are developed demand a link between theory and practice from teachers in their classrooms, and from that, a thinking process for raising awareness of the context, and the transformation of the practice is generated.

The professionalization orientation of the Master in which the study is conducted, "are intended to provide students with a broad and solid training in a field of knowledge, with high capacity for professional practice" (CONACYT, 2015, p.11); and it is developed from formative research, which presents two main purposes: pedagogical and training, which is intended for the student to learn research by researching and thinking on their own practice; and based on this, they acquire more tools for identifying and solving the problems that occur in the classroom with their students. Such type of research has two main characteristics "it is directed and guided by a professor as part of their teaching and research activity and the research agents are not researchers, but research subjects in training" (Arakaki, 2009, p.1).

As this is a with mixed methodology study, it was divided into two stages, in the first an analysis of the courses that students took in the first semester was conducted, and the recovery of the amount and frequency of use of technological tools was recovered from a quantitative view.

For the qualitative analysis the technique used was the interview, which is defined by Alonso (2007) as:

“A conversation between two people, an interviewer and an informant, directed and recorded by the interviewer with the purpose of promoting the production of a conversational, continuous and with an argumentative line, not fragmented, segmented, pre-coded and closed by a previous questionnaire from the respondent about a defined topic in the framework of the research” (p.228).

The interview guide was structured with 10 questions that delved into the development of Virtual Learning Spaces in the Moodle platform as spaces to strengthen research, which was raised from four main variables, the first in which students defined research from their previous referents; in the second they thought about the relationship set up between research and their work as teachers of basic elementary education; the third to assess the link between research and master they are studying; and finally, the last variable was focused on the development of research in Virtual Learning Spaces, from the use of Moodle.
As for the analysis and interpretation of information, this was carried out in the following times: in the first time the analysis was quantitative and it identifies the use of the platform in the three courses that correspond to the first semester; the second time was for the design, piloting and implementation of the interview for randomly selected students, and a third time, the transcription of information as well as its categorization; finally, the analysis, interpretation and conclusions.

4. Results

As mentioned in the previous section, the study was divided into two stages, the first quantitative and the second qualitative oriented; from the analysis and interpretation of the information obtained, some findings in relation the use of Environments and Learning Environments as spaces to enrich the formative research were identified.

Quantitative results are represented in the following graph:

![Graph showing quantitative results](image)

**Table 1. Use of Moodle. Source: Veytia Bucheli (2016)**

When analyzing the results, these show that one out of the three teachers in charge of the academic units corresponding to the first semester of the master does not use it, even though it is demanded by the institution, and two of them use it indeed to strengthen the teaching-learning process that is developed in the classroom session; additionally, they also perceive it as a preparation space for the next session, referred by the institution as inter-session. 66% structure the sections by topic; there is also evidence that both students and teachers submit PDF files and Power Point presentations to work in their classroom sessions.

On the tools to improve communication between students and collaboratively knowledge construction, only 33% have used Wikis to deepen into a topic, and manage forums to discuss on the topics, linking theory and
practice by sharing experiences and situations in their contexts, which set up alternatives of solution, argued from a theoretical viewpoint, from the identification of the empirical problem of its context.

No evidence was found in the analysis on the courses of the academic units in the first semester about the management of other activities or resources that presents the Moodle platform such as: databases, chat, asking, questionnaires, predefined surveys, external tool, Hotpot, JClic, Lesson, SCORM, Workshop; and in terms of the resources, there is no evidence of the use of labels, books, pages, content package. Based on the results obtained, a very low percentage is related to the activities and resources offered by the Virtual Learning Environment, in this case, the Moodle platform, as a base for generating Virtual Learning Spaces with the students. Findings from the qualitative part were structured in the following categories of analysis:

**Research Conceptualization and research skill.** In this category, one of the key words that students use to define research was inquiry, and their argument was oriented in three directions, the first related to developing a topic of interest which is relevant for their professional development as for the different areas in their lives. The second is related to the need to know different theories that support and solve the problems that occur in context with their students, sustaining this with theoretical basis. One of the respondent states that "research covers several aspects, focused to the students, it is the way to inquiry or search for information necessary to solve any problem that occurs in the group," and finally, the third direction, to enrich their knowledge, to complement what they already know and to test the hypotheses they have on a certain topic.

In addressing the issue of research skill, they defined it as the development of skills that enable people to know what, how and where to find information to understand a topic and / or the resolution of problems that come up, as well as the use of different tools to do so. In this section they mentioned the importance that the context represents in achieving the skill. None of the students mentioned knowledge and values as elements of the skill, they only focused on the aspect related with the know-how, that is, the abilities and skills.

**Research in the workplace.** On the relationship that emerges between research and the respondents’ workplace, in this case in the context of Elementary Education, 1st, 2nd, 3rd and 4th grade, those interviewed expressed that immersing into research is very useful for understanding their context, for careful thinking about the way they carry out their teaching practice, for identifying the problems that arise with greater certainty, and for generating actions that improve it.

They also stated that having children with different characteristics and learning styles in their groups, along with the formative research they are
learning in the master, has enabled them to apply diagnoses more accurately. For example, 15% said they know and use Honey and Alonso’s questionnaire to assess learning styles; and based on the results, they perform different activities and strategies that enable their students to build knowledge, both individually and collaboratively.

Another aspect that they highlighted is the importance that research represents in their teaching practice is related to the values and attitudes. As they mention, some of the behaviors identified in the children should be understood from theory, and based on it, find solutions to improve students’ behavior. One of the respondents said that "in the classroom, conflicts and situations arise and need to be documented, to find a solution to such conflict, and improve our practice", this means, from the first semester, in their opinion, the professional focus of the master becomes meaningful because they set up a link between the theoretical referents they are studying and the situations and events that they face every day with their students, and make the best decisions to solve them.

Link between postgraduate studies and research development. The next category of analysis was defined on the relationship identified between their graduate studies and the development of the research process. 100% of the respondents affirm that there is an explicit link between postgraduate studies and the development of the research in their teaching practice. In general, they emphasize that search of information in references, both bibliographic and electronic has increased. They, also mention that they have thought more deeply about their teaching practice, how they do it and what for. Thus, they analyze their work with their students with a different perspective, which makes them more committed to their profession.

Another respondent also confirms the relationship between postgraduate studies and the development of research, identifying this process has been very useful to her. In this sense, she argues the following: "I had some idea of what a master is, but it exceeded my expectations because somehow I have learned a lot, as with the coming reforms, I have better understanding of the information, better understanding of the reality by digging into theory and by contextualizing it into my teaching practice. It got me involved with new ways to work, which are focused more on learning than on teaching".

Finally, another contribution from the subjects is recovered, in which she states that it has been important to study the master as she mentions that "a while ago, I graduated from the bachelor of Elementary Education, but eventually it is forgotten. If one researches, one makes use of it, but not very often; with the master I have realized how important is to research, to share experiences, to improve practice and to develop a better job compared to previous years. Research becomes a habit, and those who benefit the most are my students". Her participation confirms the importance of continuous training, to be updated and to generate new learning spaces for her students.
Development of research in Virtual Learning Spaces. In this section, it is important to define Virtual Learning Spaces (VLS), which, it has been conceptualized as "the set of environments of synchronous and asynchronous interaction, where, based on a curriculum, the teaching-learning process carried out, through a learning management system" (Lopez Rayon, Stairs and Ledesma, 2002, p.3). For this reason, the dynamic nature of the environment is reiterated, and in turn, their complexity, as the subjects are the ones that generate learning, both individually and collaboratively when creating knowledge networks from their contributions.

Use of Moodle Platform. One of the Virtual Environments in which Virtual Learning Spaces are developed in the institution under study is the Moodle platform, which is "an environment that allows the development of training activities through the network, integrating different basic tools in the same interface, in a way that different users can perform all the activities of the training process from the same environment" (Hernandez and Medina, 2015, p. 3).

In the interviews, the students expressed that they have had successful experiences in the use of Moodle; they refer some courses to be updated. For example, a student says "once I was working on a platform; by taking an online course, I had the opportunity to communicate with colleagues from other states, such as Oaxaca and Chiapas. The topic was given, there was a lot of participation in discussion forums, where we shared children’s similarities and differences and where and the problems presented in different contexts allowed me to share my experiences and improve my work and encourage learning in my students". Another student also tells her experience in the use of Moodle to take a course and she mentions, "we connected when possible, each one according to their times, we participated in forums and we submitted tasks; although we were not in the same space, we were by a common goal". She specifies the advantages of working asynchronously, adapting to time available, and the flexibility offered by an educational model that makes use of technological tools.

100% of the students emphasize that working in the Moodle platform is one of the strengths of the master's program, as it is useful to enrich and broad knowledge covered in the sessions; in this sense, a student assures the following: "we have classes that allow us to relate to forums, emails, specific websites and complement information in a collaborative way".

Regarding the use of Moodle, the students point out that one of the tools that favors the development of research is working with forums, for the presentation of different points of view on a particular topic, as well as the confrontation and argumentation of positions, which favors the construction of knowledge and development of research. A student argues that working in forums "allowed the creation of study circles to share materials like
experiences and problems, giving different alternatives of solution”; based on this experience, an example of the construction of Virtual Learning Communities, where each one of the members has knowledge to share, and in turn, also receives comments from their peers.

Overall, the respondents agree on the importance of forums on the platform to participate actively in spaces oriented to the presentation, argumentation and discussion of problems that arise in their context with their students, proposing some alternative solutions and implementing strategies to improve the teaching-learning process, so they recognize it as a space for both professional and personal growth that benefits the development of research.

In relation to the link of research with Virtual Learning Spaces, a student affirms that "research creates a habit, it becomes a skill, things become easier and doubts clear, I think that in Virtual Learning Spaces you can create a connection with others who are researching the same, and collaborative networks are created". This process has been experienced with her classmates, but also with some of her coworkers.

One of the technological applications that have been useful to set up communication between the master’s students from the view of Information and Communication Technology is the use of WhatsApp, the most informal practice used by respondents. They say that they have formed a group of postgraduate students to externalize questions about the activities and tasks requested by their teachers, as well as to share data and information on articles or topics useful to work in their contexts.

Another tool used by students, to strengthen the development of research in virtual learning spaces and the use of technology is the Digital Library, where they consult the databases of Eric and Scielo, to find articles on topics of their interest and problems identified in their context; in this regard, one respondent states that "there is the virtual library, it has been very positive, since sometimes is not possible to attend a public library, and now it is very easy to find the book on a subject I am interested in the virtual library, I can search by author, and I also find a short summary about the book"

Interviews with master students confirm the importance of the use of Virtual Learning Spaces to strengthen research; in this sense, one of the participants assures that "research is not only done in a book or in a library, with Information and Communication Technology one can search for information on the internet, find information to solve a problem that arises in my context with my students"; however, the use of technological resources still empirical: based on the results, it is important to strengthen their use, and provide the necessary tools to optimize their use.
5. Discussion and conclusions

Interestingly, the results obtained from both quantitative and qualitative analysis, on the use of virtual learning spaces to encourage the development of research in students in the first semester of the Master of Education, allowed assessing both the strengths and areas of opportunity in terms of technological tools as well as the subjects involved in this process.

Both quantitative and qualitative results are contrasting, as they clearly show the differences between teachers and students on the interest and appropriation of Information and Communication Technology. On one hand, the use of Information and Communication Technology by teachers is null, and on other hand, it is limited. Based on the findings from qualitative data, the importance given to Technologies by the students as a tool to strengthen their postgraduate studies, and so, the development of the research process by means of the use of the resources provided by the institution, and informal technological tools such as WhatsApp.

One of the first relevant findings from the qualitative results is that one of the teachers does not use the Moodle platform as a space to promote Virtual Learning Spaces oriented towards research, although it is an institutional demand. Two of the teachers upload materials both in PDF and Power Point for students to prepare themselves for the classroom session, and to enrich the issues discussed in class; however, only one teacher uses tools that strengthen collaborative work with students, like the use of forums to discuss issues and deeply analyze some of the topics covered in class, as well as the development of Wikis on any subject.

Regarding the qualitative findings, it is relevant to note the interest shown by students with the use of Information and Communications Technology in general, as well as use of Moodle, which strengthens the development of investigative skills when searching for information in electronic media, to communicate with peers both synchronously and asynchronously, to share information and point of view by using tools such as the forum, to work collaboratively through Wikis, also to use other technologies such as WhatsApp to set up a network of communication and collaboration as a group.

Clearly, Learning Spaces are no longer limited to classroom spaces. It is increasingly common to find Virtual Learning Spaces, where communication between teachers and students, both synchronously and asynchronously is favored; however, it is a reality that most teachers belong to the group of digital immigrants and most students in the group of digital natives, therefore it represents a challenge for teachers to break schemes and to work from new spaces to respond to current educational demands.

It should be noted that the results show a first approach to context of study, however, the findings confirm the importance of using virtual spaces today. Additionally, it opens doors to further analysis on this issue, analyzing
groups in more advanced semesters, as well as other contexts in similar conditions, and generate a comparison to further design strategies of improvement to increase the use of Virtual Learning Spaces.

References


Professional Practice in Higher Education: A Case Study in Faculty Training and Development in Brazil

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Abstract: One of the most important debates is currently focusing on specifying the training that university teachers must receive for their professional practice. Improving it in higher education is extremely important not only for the scientific production generated by university but also for the adequacy of the training that future graduates will be offered; professionals facing an increasingly demanding labour market with new needs. University teachers training, thus, should be a priority in academic policies due to their influence and the role played in the evolution of society, as well as being the basis of the quality of Higher Education. This research, a case study in the State of Goiás (Brazil), is focused on a sample of practicing university teachers from different fields of knowledge, and has as main objective to know the characteristics of the training received for their professional practice, both in the field of scientific education and their educational role and ability to transfer knowledge. The methodology used has been mixed, not experimental and descriptive, with the help of instruments for data collection and analysis of quantitative and qualitative nature (questionnaires, interviews, monitoring, checklists, documentary analysis, etc.). The results confirmed the initial hypothesis, which stated that university teachers’ current training is primarily scientific and technical, and has gaps in the teacher training required today for a more effective work in the classroom. In this area teachers often use teaching methodologies supported by previous experiences with traditional features. Finally, to optimize this situation, different strategies for university teachers’ training are proposed seeking to improve both their reflection and teaching practice.

Key-words: Faculty Training, Teaching Experiences, Pedagogical Resource, Scientific Instruction, Teaching Methods, Classroom, Instructional Strategies.

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1. Introduction

At the end of the XX Century the Brazilian educational system was reorganized upon the endorsement of the Law of Directives and Bases of National Education Nº 9.394, in use since 1996 (Lei Diretrizes e Bases da Educação Nacional, 1996). After this Law was passed, the statistical data of the educational census of Brazilian higher education, published between 1995-2000 by The National Institute of Pedagogic Studies of Culture and Education Ministry, revealed that specialist academic teachers predominated in the private higher education institutes (INEP, 2001). With effect, the initial education of an academic teacher in Brazil consists of a post-graduate specialization degree called *Latu-sensu* in academic environments. According to the present Law of Directives and Bases of National Education, the *Latu-sensu* degree is a Post-Graduate degree, whereas according to the preceding *Parecer* 977 Law from 1965 it was considered as a Refresher Course (Conselho Nacional de Educação, 1965). Therefore, this is a very important educational process in Brazilian Higher Education. The aim of this current article is to study Brazilian academic teachers’ education, with regards to both its scientific and pedagogic scope in order to determine the characteristics of their professional practice and the methodology they use during teaching activities.

Teacher training must be understood as a set of activities that allow teachers to develop abilities and aptitudes in order to improve their performance and action in the academic environment (Nicholls, 2001; Gomez-Galan and Mateos, 2002; Postareff, Lindblom-Ylänne and Nevgi, 2007; Galvão, Reis and Freire, 2011; Ek, Ideland, Jönsson and Malmberg, 2013; Ryan and Ryan, 2013; Gomez-Galan, 2014; Morina, Cortes-Vega and Molina, 2015). Thus, the kind of pedagogic and scientific education that the *latu-sensu* post-graduate program offers to academic teachers during their initial education towards developing their didactic methodology should be questioned. The main purpose and central element of this work is to study the education model achieved in the higher education level processes. From the perspective of a Brazilian academic teacher, they do acquire scientific and technical competence in some of their fields of knowledge during their post graduate education, but according to Cunha (2001), they lack a wider view on how to integrate their knowledge to meet society’s needs and also on how to master pedagogic resources which can expose their methodological needs. From the problem studied the assumption is drawn that *latu-sensu* post-graduate courses do not contribute in an effective and adequate way to the scientific and most of all, pedagogic education of the Brazilian academic teacher.

2. Methodology

According to what was previously exposed, different goals have been pursued in this study that condition the structure of the theoretical and field
research. They are to a) describe the education of academic teachers and their pedagogic organization in the national and international context, from a historical perspective to the present; b) understand the legal organization of the *latu-sensu* post-graduate course as the initial pedagogic educational step of the Brazilian academic teachers; c) demonstrate that economic market interests regulate education processes; and d) acknowledge the influence of traditional and technical education in the attitude of teaching staff with *latu-sensu* post-graduate training. In parallel with these main goals, distinctive secondary goals dependent of the main ones are pursued. They are to verify if academic teachers who have finished their *latu-sensu* post-graduate course consider themselves trained for research and instruction through assessment; to understand the professional profile of the Brazilian academic teacher who graduated under these circumstances; to identify the contributions of the *latu-sensu* post-graduate program in an academic teacher’s educational practices; to analyze the curricular directives of the *latu-sensu* post-graduate courses offered in Brazilian higher education institutions; and to suggest changes to the curricular structure of the *latu-sensu* post-graduate course in order to improve the scientific and pedagogic education of Brazilian academic teachers.

The methodology used, therefore, reaches the goals of the study and confirms the validity of the assumption. According to several authors, particularly Teddlie and Tashakkori (2009), Marconi and Lakatos (2010), Cohen, Manion and Morrison (2011) or Bryman (2015), on whose work the field research was based, after an exhaustive bibliographic analysis of the problems it is possible to establish an initial theoretical reference model that helps to determine the changeable elements and elaborate a general plan of study and research. For that reason, the main platform of this research was a scientific literature review, a process of bibliographic and documental research whose main resources were books, scientific articles and legal documents related to the education of academic Brazilian teachers. Of special importance are the results of contributions from Cunha (1989 and 1996), Oliveira (1995), Behrens (1998), Carvalho (2000), Garrido (2002), Demo (2004), Dias da Silva (2005), Gatti (2010), Lima and Donizete (2015), and Silva, Fabro and Duarte (2015). In this manner, regarding the education of the academic teacher, it is considered that the best analysis involving opinions and contributions from others is the analysis of an international environment. Therefore, the work from Wilson, Floden, and Ferrini-Mundy (2001), Samuelowicz and Bain (2001), Beck and Kosnik (2002), Knight (2002), Akerlind (2003), Cochran-Smith and Zeichner (2005), Norton, Richardson, Hartley, Newstead and Mayes (2005), Wilson (2006), Sikes (2006), Postareff, Lindblom-Yläne and Nevgi (2008), Gunn and Fisk (2013), Gunersel and Etienne (2014), Postareff and Nevgi (2015) or Kauppila (2016) should be highlighted.

In this particular case the work was completed by undertaking theoretical work based on all these scientific contributions related to the study objective, in addition to an analysis of official documents, such as the ranking of Brazilian
higher education (INEP, 2001 and 2013) and the curricular directives of 50 *latu-sensu* post-graduate courses in different areas of knowledge (e.g. biology, human sciences, experimental sciences and social sciences) offered by 25 higher education institutions.

The second stage of the research was achieved from the information obtained, which consisted of fieldwork based on the descriptive ex-post-facto method. This involved using standard techniques of opinion study and observation control whose main instruments were questionnaires, lists of controls and interviews. The opinion study sample consisted of 117 academic teachers, 93 of which were from the Catholic University of Goiás State and 24 were from the State University of Goiás State, all of them possessing a *latu-sensu* post-graduate degree. In addition, 40 teachers from the Catholic University of Goiás State who were still undertaking their post-graduate courses were included in the study sample. The observation study included 15 teachers who took part in the State University of Goiás State’s University Program for Educational Staff from the Pedagogy graduate course.

### 3. Results

The results obtained from both the theoretical work and from the field work (experimental and theoretical research) can be briefly summarized as follows:

a) In the first stage of the study, according to the results, the education in Brazil is influenced by the North American educative model, independent of all the Humanistic-Christian European influence developed since the Medieval Age and brought to Brazil with the arrival of the Europeans. The first Law of Directives and Principal from 4.024/1961 did not standardize Brazilian Post Graduate programs until 1965, when Post Graduate programs were organized based on the North American model, under *Parecer* No 977 (Conselho Nacional de Educação, 1965) aiming to provide the academic teacher with scientific training. The Agreement of Washington influenced the organization of the Law of Directives and Fundamentals No 9.394/96 (Lei Diretrizes e Bases da Educação Nacional, 1996), which organizes curricula according to market demands, reducing costs associated with higher education and transferring Education responsibilities from the public to the private sector. The result of this was an increase in the value of the *latu-sensu* courses, which became a post-graduate course instead of a refresher course. The present Law of Directives and Fundamentals consider post-graduation as the preparation for higher education teaching; therefore, specialization is the minimum requirement for this. This explains how the academic education of higher education teachers lays within the same fundamental principle according to what was shown in this study.

b) Experimental research has been able to determine the professional profile of teachers and the complete characteristics of the *latu-sensu* post-
graduate program. This research concludes that the education offered is not sufficient to enable the teachers to adapt didactic methodologies to the needs of the student. In addition to the demand of teachers, it was observed that the teaching methods are based on inductive, expositive techniques, with a very limited use of resources (the blackboard and photocopied sheets being the most used techniques). Nevertheless, there is a clear intention to establish pedagogic attitudes and to show interest for the student’s learning by motivating interaction, but such processes have only been achieved from experience and not from acquired education. Lastly, the points previously described were validated with the verification of scientific-pedagogic education described in the curricular directives of latu-sensu post-graduate courses offered by Brazilian higher education institutions (as stated before, 50 different curricular directives from 25 institutions from Brazil were analyzed).

Some of the main data obtained in this part of the study are presented schematically:

First Part. Professional Profile of Specialist Academic Teachers

<table>
<thead>
<tr>
<th>Service Years</th>
<th>Amount of Teachers</th>
<th>Xi</th>
<th>Pi</th>
<th>Percentages</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 years</td>
<td>80</td>
<td>5</td>
<td>0.68</td>
<td>68%</td>
</tr>
<tr>
<td>10 years</td>
<td>10</td>
<td>10</td>
<td>0.09</td>
<td>9%</td>
</tr>
<tr>
<td>15 years</td>
<td>10</td>
<td>15</td>
<td>0.09</td>
<td>9%</td>
</tr>
<tr>
<td>20 years</td>
<td>6</td>
<td>20</td>
<td>0.05</td>
<td>5%</td>
</tr>
<tr>
<td>25 years</td>
<td>11</td>
<td>25</td>
<td>0.09</td>
<td>9%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>117</strong></td>
<td>100</td>
<td></td>
<td><strong>100%</strong></td>
</tr>
</tbody>
</table>

Table 1. P.I.D. - Professional Profile of Specialist Academic Teachers: Service Years on the Academic Teaching Profession.

Regarding the time of service in the academic teaching profession, 68% of the teachers examined have 5 years of academic teaching experience, 9% have 10 years, 9% have 15 years, 5% have 20 years and 9% have 25 years.
Degrees Completed: 88% of the examined teachers are specialists, 10% have a master’s degree and 2% have a doctorate degree.

**Table 2. P.I.F.- Post-Graduation Degree Completed.**

<table>
<thead>
<tr>
<th>Specialization</th>
<th>Amount</th>
<th>Percentages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Masters</td>
<td>12</td>
<td>0,10%</td>
</tr>
<tr>
<td>Doctorate</td>
<td>02</td>
<td>0,2%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>117</td>
<td>1,00%</td>
</tr>
</tbody>
</table>

**A.T.C.1 - Scientific-Pedagogic Attitudes of the Teacher in the Classroom: Exposition Methods**

<table>
<thead>
<tr>
<th>Method Types</th>
<th>Amount of Classes</th>
<th>Percentages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deductive Methods</td>
<td>61</td>
<td>81%</td>
</tr>
<tr>
<td>Inductive Methods</td>
<td>14</td>
<td>19%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>75</td>
<td>100%</td>
</tr>
</tbody>
</table>

**Table 3. A.T.C.1 - Scientific-Pedagogic Attitudes of the Teacher in the Classroom: Exposition Methods.**

About the Exposition Method: Teachers used the deductive method in 81% of the classes and the inductive method in only 19% of the classes.

**A.T.C.2 - Scientific-Pedagogic Attitudes of the Teacher in the Classroom: Didactic Resources**

<table>
<thead>
<tr>
<th>Resource Type</th>
<th>Amount of Classes</th>
<th>Percentages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Photocopy of texts, blackboard and chalk-pencil</td>
<td>43</td>
<td>58%</td>
</tr>
<tr>
<td>Slides and overhead projector</td>
<td>28</td>
<td>37%</td>
</tr>
<tr>
<td>Video Projection</td>
<td>4</td>
<td>5%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>75</td>
<td>100%</td>
</tr>
</tbody>
</table>

**Table 4. A.T.C.2 - Scientific-Pedagogic Attitudes of the Teacher in the Classroom: Didactic Resources.**

Regarding didactic resources: Teachers used photocopies of texts, blackboard and chalk in 58% of the classes, slides and overhead projectors in 37% of the classes and video projectors in only 5% of the classes.
### A.T.C.3 – Scientific-Pedagogic Attitudes of the Teacher in the Classroom Regarding Contents Outline Planning

<table>
<thead>
<tr>
<th>Contents Arrangement</th>
<th>Amount of Classes</th>
<th>Percentages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduction, body and conclusion</td>
<td>56</td>
<td>75%</td>
</tr>
<tr>
<td>Introduction and body</td>
<td>15</td>
<td>20%</td>
</tr>
<tr>
<td>Introduction and conclusion</td>
<td>4</td>
<td>5%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>75</strong></td>
<td><strong>100%</strong></td>
</tr>
</tbody>
</table>

Table 5. A.T.C.3 - Scientific-Pedagogic Attitudes of the Teacher in the Classroom

**Contents Outline Planning**: Teachers properly organized contents to be offered in 75% of classes, making an introduction, development thereof and concluding with a summary of the gist studied, but in 20% of the classrooms only an introduction and a general development were made without establishing the most important endpoints, and in 4% of them a long introduction was offered as well as general conclusions without having analyzed the contents.

### A.T.C.4 – Scientific-Pedagogic Attitudes of the Teacher in the Classroom. Contextualization of Contents

<table>
<thead>
<tr>
<th>Contextualization of Contents</th>
<th>Amount of Classes</th>
<th>Percentages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Only subject-related</td>
<td>11</td>
<td>15%</td>
</tr>
<tr>
<td>Contextualization with other scientific knowledge areas</td>
<td>42</td>
<td>56%</td>
</tr>
<tr>
<td>Contextualization with other scientific areas, life experiences and social and current issues</td>
<td>22</td>
<td>29%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>75</strong></td>
<td><strong>100%</strong></td>
</tr>
</tbody>
</table>

Table 6. A.T.C.4 - Scientific-Pedagogic Attitudes of the Teacher in the Classroom. Contextualization of Contents

**Contextualization of Contents**: in 15% of classes teachers focused solely on content related to their subject; however, some connections were established with other scientific areas of knowledge in 56% of them as well as authors’ quotes in a broad context; in 29% of them teachers went beyond and contextualization was carried out not only with other scientific areas but with their own life experiences and / or general current issues or social problems, giving more practical sense to their teaching.
### A.T.C.5 – Scientific-Pedagogic Attitudes of the Teacher in the Classroom. Didactic Techniques Used

<table>
<thead>
<tr>
<th>Didactic Techniques Used</th>
<th>Amount of Classes</th>
<th>Percentages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Expository Sessions (Lectures)</td>
<td>73</td>
<td>97%</td>
</tr>
<tr>
<td>Guided Study</td>
<td>2</td>
<td>3%</td>
</tr>
<tr>
<td>Debate</td>
<td>0</td>
<td>0%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>75</td>
<td>100%</td>
</tr>
</tbody>
</table>

Table 7. A.T.C.5 - Scientific-Pedagogic Attitudes of the Teacher in the Classroom. Didactic Techniques Used

*Didactic Techniques Used:* in 97% of classes teachers employed only expository sessions (lectures), 3% of teachers conducted studies leading to the development of student self-learning; on the other hand, in the selected sample no classroom was found where the debate was used as a teaching technique.

### A.T.C.6 – Scientific-Pedagogic Attitudes of the Teacher in the Classroom. Care over Learning in Class

<table>
<thead>
<tr>
<th>Care over Learning</th>
<th>Amount of Classes</th>
<th>Percentages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interest in learning in class</td>
<td>53</td>
<td>71%</td>
</tr>
<tr>
<td>Disregard for learning in class</td>
<td>22</td>
<td>29%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>75</td>
<td>100%</td>
</tr>
</tbody>
</table>

Table 8. A.T.C.6 - Scientific-Pedagogic Attitudes of the Teacher in the Classroom. Care over Learning in Class

*Care over Learning in Class:* in 71% of classes teachers showed interest in checking how their students’ learning and / or motivation were producing; in 29% of the classrooms they remained indifferent.

### A.T.C.7 – Scientific-Pedagogic Attitudes of the Teacher in the Classroom. Teachers Readiness during the Lesson

<table>
<thead>
<tr>
<th>Teachers Readiness during the Lesson</th>
<th>Amount of Classes</th>
<th>Percentages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Remain seated during the lesson</td>
<td>32</td>
<td>43%</td>
</tr>
<tr>
<td>Remain standing all the time</td>
<td>37</td>
<td>49%</td>
</tr>
<tr>
<td>Move around the classroom</td>
<td>6</td>
<td>8%</td>
</tr>
</tbody>
</table>
Teachers’ Readiness during the Lesson: in 43% of classes teachers remained seated during the lesson, while 49% were standing but in the same location (next to the desk and/or on stage). Only 8% of teachers observed moved throughout the classroom (and enhanced interaction with students).

**A.T.C.8– Scientific-Pedagogic Attitudes of the Teacher in the Classroom. Time Allocation**

<table>
<thead>
<tr>
<th>Time Allocation</th>
<th>Amount of Classes</th>
<th>Percentages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Remains with the same activity during the lesson</td>
<td>69</td>
<td>92%</td>
</tr>
<tr>
<td>Deals with several activities during the lesson</td>
<td>6</td>
<td>8%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>75</strong></td>
<td><strong>100%</strong></td>
</tr>
</tbody>
</table>

*Table 10. A.T.C.8 - Scientific-Pedagogic Attitudes of the Teacher in the Classroom. Time Allocation*

Time Allocation: in 92% of classes teachers carried out the same activity throughout the time; only 8% of the observed teachers worked in various activities.

Second Part. Characteristics of Latu-Sensu Post-Graduation Attended by Academic Teachers

**P.I.L. - Description of Fields of Study in the Latu-sensu Post Graduation**

<table>
<thead>
<tr>
<th>Fields of Post-Graduation</th>
<th>Amount of Teachers</th>
<th>Pi</th>
<th>Percentages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Human and Social Sciences</td>
<td>78</td>
<td>0,67%</td>
<td>67%</td>
</tr>
<tr>
<td>Natural and Applied Sciences</td>
<td>39</td>
<td>0,33%</td>
<td>33%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>117</strong></td>
<td><strong>1,00%</strong></td>
<td><strong>100%</strong></td>
</tr>
</tbody>
</table>


Fields of Post-Graduate Study: 67% attended Human Sciences courses and 33% attended Biological Sciences courses.
Table 12. Duration of Latu-Sensu Post Graduation.

Duration of the post-graduation course: Out of 117 teachers, 51% attended a post-graduate course lasting 12 months, 21% attended a course lasting 24 months, 15% attended a course lasting 18 months and 13% attended a course lasting 6 months.

Table 13. Scientific Monograph Preparation: Requirements and Justification.

Requirement of Monograph Preparation and its Justification: 81% answered “Yes” and 19% answered “No”.

In all items, with regard to the inferential analysis, after calculating the Chi square test \( \chi^2 = \sum \frac{(f_o - f_e)^2}{f_e} \) and contingency coefficient at the junction of nominal and scale variables (gender, age, degree, courses taught, service years, professional status, political affiliation, religion, marital status, parental status, national origin), no significant differences in knowledge.

4. Discussion and conclusions

The research process confirms the legitimacy of the proposed study hypothesis. Brazilian academic teachers receive basic scientific education in the latu-sensu post-graduate program necessary for their teaching practice, but they receive almost no pedagogic education that could be useful during their
teaching work. In the same manner, the pursued aims were also achieved. Regarding scientific education, it is believed that technical-scientific abilities are globally acquired from the education received. Compared to the pedagogic education that is highly limited, conditioned by traditional and technical educative concepts, and is based on their own existence.

Based on the results achieved, the present study also obtains other distinctive contributions. For instance, it is established that pedagogic abilities must be developed in the post-graduate course considering that: a) academic teachers must use their scientific abilities in order to teach the students to investigate and not only to transmit information in the classroom; b) other competences such as ethic, moral, social, political and interpretative competences are also important in the education of teachers; c) in order to improve the learning of students dialogue in the classroom should be valued; and d) the post-graduate curricular directives suggest that subjects such as *Methodology of Scientific Research*, *Psychology of the Learning Process* and *Philosophy of Education* (with ethical and communicative content) should be incorporated with the aim of improving the reflection and the pedagogic practice of the teacher.

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University Educational Opportunities to Adults 50 Years of Age or Older: Fundamental Reasons and Characteristics

Zobeida González-Raimundi a

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Abstract: Venturing inside the study of the phenomenon of university education for adults in Puerto Rico, particularly after the decade of the 1980s, lets us obtain answers to many questions that are born out of observation of the marked presence of adults in the classrooms on the island. In response to that, a lot of universities started academic programs that are aimed at adults. This theme of university education for adults in the island has, during the last decade, peaked the interest of a few researchers, who have approached it from different perspectives. One study that looked into the experience of being a university student who has 50 years or more of age during their bachelor’s degree, from a phenomenological standpoint is what gave rise to this essay. The author performs a very deep analysis of the starring role the adult students, who were interviewed individually (nine participants) awarded two issues: university education as a resource to serve human beings better; and, the example they embody, specially to their family members, by reaching their academic goals.

Key Words: Higher Education, Adult University Student, Bachelor’s Degree, University Education, Phenomenology.

1. Introduction

Even when universities in Puerto Rico establish nontraditional educational programmes targeted to older adults, studies show that these programmes were developed without having explored in a deep level several
aspects such as: feelings, life experiences, perceptions, beliefs, descriptions and opinions of the older adult population, regarding what it means to them to be a university student (González-Raimundí, 2015). This way, the field work that looked into the experience of being a university student who has 50 years or more of age during their bachelor’s degree is what gave rise to this article. The study performs an analysis of the starring role the adult students who were interviewed individually. The descriptive, analytical and refocusing processes in the interpretation of answers given by a participant, in the interviewing technique, lets the investigator extrapolate those matters that permeate throughout the entire interview, as well as noticing those common concepts in all interviews when various participants take part. This researcher implemented the modality of: re-focusing in the interpretation, to complement the modality of: extension of the analysis, both suggested by Wolcott (1994), as guides to carry out the interpretation of the answers to the formulated questions in the individual interviews that took place. This enabled her to observe that with a much higher frequency, and in response to diverse key questions, the totality of the informants featured the importance granted to services rendered and to serve as a role model to their families and communities.

The interpretation of the answers given to these matters, intends to show how significant they were to those interviewed. Some of these answers proved unexpected by the researcher, given that they did not fit the theoretical framework, however they were categorically expressed with the fluidity and the spontaneity that is enabled in the phenomenological focus of a best informant free of preconceived notions by the researcher. However, when interpreting said answers, the researcher is to consider the applicability of the postulates of Malcolm S. Knowles (Knowles, Holton & Swanson, 2001) and Abraham Maslow (Maslow, 1991) and other scholars of that topic, whose works, life experiences, learning process and expectations as an adult university student over 50 years old, was revised (Wolcott). Offer service: fundamental objective when studying at the university.

2. Objectives and methodology

Upon deeper analysis of the expressions of the participants in relation to the two fundamental reasons that motivated them to go back or to join the university in the first place, the researcher hopes to achieve the next objectives: a) describe the meaning of the answers offered directly by the participants in light of their feelings, experiences, perceptions, beliefs and descriptions with regard to the situation at hand; b) comprehend the reality that lies underneath the reasons given by the participants, as protagonists of the experience, to make the choice in question; and, c) learn about the factors that motivate people that are 50 years of age or older to achieve their
bachelor’s degree in Puerto Rico, and how they bring meaning to this experience.

As to the methodology, the study that inspired this essay was of qualitative character, grounded in a phenomenological approach and took place during an academic semester in three universities of Puerto Rico. These universities had academic programs focused on the adult student. The sample for this study: nine students (informants) -three from each university-, 50 or over, was selected by invitation, through a memorandum posted in the bulletin boards of the campuses. All the informants were required to complete a brief questionnaire about social, academic and demographical data, in addition to answering 13 guide questions in individualized interviews.

3. Phenomenological study

As is the case in every investigation with a phenomenological approach, this study enables the researcher to describe what she sees. Nevertheless, her main interest is not to capture the physical aspect of what she sees, but its essence. According to Riestra (1997), this enables the descriptive analysis of the phenomenon, without alteration, to capture its fundamental structures, which constitutes its true nature. Husserl (1976, p. 225), establishes that through phenomenology one searches to “describe experiences in relation to its essence”. Researching the experiences of adults 50 years of age or older as university students in Puerto Rico, in their bachelor’s degree, from the phenomenology prism, implies one ventures in the university environment where said experience occurs, to comprehend the meaning the participants bring to it. To feel well prepared to offer service: fundamental objective when studying at the university1.

Since the 1940s, the notion of education being a continuous and permanent process that extends throughout the entire life of a human being (Porrata Doria, 1940) has been a clear one. On the other hand, university education is perceived as the summit of the formal educational process that was started in the pre-school level. The university remains the place where the student is exposed to multiple experiences, not only inside the classroom but outside as well, much of which enables the student to acquire and/or develop the requisite knowledge and skills that train him as a professional in his chosen field. This is the true purpose of the university, according to the general opinion of the common folk. The expressions of two participants,

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1 Terminology: Below are the terminology and the definitions that will be used for the purpose of his essay: a) service = make the necessary knowledge and skills readily available to all those who need it, with free or in-job training, b) experience = all living incident had by an adult 50 years of age and older as a university student in Puerto Rico, c) adult student = a person who forms part of a nontraditional educational program targeted to older adults in a university in Puerto Rico, or a person who has all the requirement to participate in a similar program, d) participant or best informant = adult student chosen for this study.
about their need to acquire technical skills, showcase the importance of the university’s role as an educational institution: “I had to innovate; you have a degree and you cannot do your job right. You have to keep up: the environment, globalization, technology; so you have to keep pace” (González-Raimundí, 2015) (Participant No. 2 of the institution C [P2C]).

“Many things have changed since I went to school and technology has been a challenge for me, I have had to do things that I did not do before: reports, presentations, there’s the internet, we did not have that before” (P1A).

However, the learning process is not limited to the acquisition of technical skills and knowledge, but is intrinsically related with the social and moral development of the individual (Freire, 1971; Mellado Parsons, 1984). This way the fundamental difference between universities and other educational institutions, which only provide technical and theoretical knowledge specific to a given job, is established: the university is called upon to provide the means to gain critical thinking to its students. The expression given by one of the participants, about what it meant to he to be a university student is overwhelming.

The most important meaning is that it allows me to have and use my critical awareness, that I can give my opinion, not only believe what a professor or a book tells me… it means to me to change the way that people think. (P3C).

The university then becomes the place where individuals transform into integral beings, well-versed in many different ways: physically, mentally, spiritually and emotionally. It shall then provide channels in which the individual may discern and pass critical judgment on different matters. One who sets aside prejudice, ties to preconceived notions or dictated instructions, with a universal projection towards everyone and everything around him: this person is a true academic. The academic “shall expose himself… to diverse schools of thought, cultures and perceptions about the human being and his environment… through the wide gamut of professors, students… and intra and extracurricular experiences… , with which he amplifies his vision…(of the world)” (González-Raimundí, 2009). For that reason, the academic does not cease to be once his structured education is over; he will continue to be one as long as he lives and maintains a universal vision about his surroundings and his personal improvement.

In relation to the university’s mission statement, various participants expressed that while they have not yet finished their degree, they went through several changes in their lives, among these: the way in which they perceived what happened to them, their interest in matters to which they did not care for (prior to being university students), their relationship with co-workers and/or family members, their way of thinking towards trivial and important matters alike and their analysis towards global events.

The expressions of two participants are very revealing towards changes they have experienced in the wake of their entry in the university and they
confirm that their university experience in general enables them to have gradual and sustained development in comprehending intricate matters of the human being: “I have a different perspective of what my kids and my employee do, I can understand the people that surround me better, I can be a better human being, better supervisor, better colleague and a better mother” (PIA).

I have learned so much in the year and a half that I have been enrolled in the university, and I apply it when dealing with my daughters. If knew then what I know now, I would have thought different in many aspects, in things that had happened in my office. Concerning my job, I can see things better, I can understand things better; I can see the meaning of things, things that I did not care for before. Now I prioritize many things in my job; I have analyzed myself and I believe that I have changed (P2C).

The researcher recognizes the vital importance of the two functions that shall guide the university. Nevertheless she understands that the main function of the university is the transformation of the people that attend as students, making them the best human beings they can be. The person, as far as their professional role goes, is limited a set number of years by different factors; their skills and knowledge about different fields of human knowledge are subject to change for various reasons like technology, culture and scientific development. Nevertheless, the role of being human extends throughout the lifetime of an individual. That should be where the resources of a university are aimed towards. The expressions of the former president of the University of Puerto Rico, Jaime Benítez, support the opinions of the researcher, by clarifying that the most important aspect that the university student should develop is the capacity to be a person, be human (Benítez, 1962):

It is worth noting that the true profession, to which all others should be submitted to, and that which without all others are not worth much without, is the profession of being human, people that are eager to learn, create, to be generous with others and demanding with himself (p.66).

When analyzing this approach: the vital functions that should guide universities, all over the world, it is paramount to remember Jaime Benítez’s expressions, specifically in relation with the main purpose that the university of Puerto Rico was chasing, in the first half of the 20th century, particularly analyzed in light of events in which Puerto Rico was immersed, in the first half of the 21st century (Benítez, 1962):

The main objective of this university should be to make men free in their spirit, men that do not surrender the creative potential of their soul to anything in this world- not to flattery, to social cliché, to not be prejudice, to not have ambition, to not threaten, to not have power – to do nothing in this world (p. 197).
Concurrent with Benitez’s words, Ríos González (2006), when working with the subject of the learning of adult university students, hypothesized that the education of the adult was based on his needs, his freedom and his responsibility as a social entity. The expressions of a best informant of the investigation, when referring to the development he had reached in as an adult student in one of the private universities of the country, can attest that these words from Jaime Benitez in relation to the main objective of the University of Puerto Rico can and should be replicated in every university: Before… I used to be more restrained, more conformist, did not question things, I assumed they just were that way; now there is kind of this ability to question why? … Now, there is no amount of money that can buy my peace, no Bill Gates that can tell me: ‘Come work for me because you are going to earn as much as you want, but is has to be under my terms’ (P3C).

On the other hand, the opinions given by another participant clearly encases her point of view about the three goals the university is committed to fulfilling, reaffirming her reason to go to the university: These courses like Psychology, Ethics, are social themes, in order to be able to understand why these things happen, why this person has a given attitude. These courses help us look beyond what a career can be; they cover moral values, and that is extremely important to me. We have to know how to express ourselves before a crowd, and be ready for a moment in our lives in which we are going to come across a given situation in which we need to use psychology or apply ethics in our jobs. These options that are given to us by the university are fascinating for feeding us as human beings (P2B).

Next up are some quotes by the participants in the investigation, in which they expressed the importance they assigned to servicing other people, this being one of the main reasons to want a university degree after 50 years or more of age, considering that this will train them accordingly in all aspects and enable them to give better service, in contrast to the level of readiness they had prior to going to the university. “More than those (colleagues, young students) approaching me for inspiration, I have been an instrument, and I have felt good because I have been able to help them… I am completely ready to apply my knowledge and happy to know that I can pass it on to my colleagues” (P1A). “I have obviously felt good because I have been an asset to them (my colleagues)” (P3A). “I do not know if I will be a teacher, counselor or what, but I will be something in which I can help others, and that is fulfilling… When I thought about the university, I thought about being able to help when needed, I like being able to help others, I liked to be approached” (P2B). “I was happy about returning [to the university], a place where I look at the progress to improve my intellectual level and help my family, my kids, to be able to educate them in a more efficient manner… I want to continue to my doctorate, continuing to get ready for my family, my kids…, I want to be able to provide the best, the best way towards education,
and I think that the best way to approach all of this is to get my education, so I can be tool to them” (P3B). “Colleagues approach me all the time and ask me for ideas, how can I make this better, they give me their work for me to look over before they turn it in” (P3B).

“We as adults have to raise our voices because we have the experience, the education, the input of our lives, all of which we are eager to share with the puertorican society” (P1C). “The meaning (that the expression “being a university student”) has (...) is more than a status, what I can bring to the table; that is the meaning that my education has for me. I aspire to work in counseling, with addicts, white collar which is what I really want to do. I want to serve, the same way others have done for me… the institutions should offer (adults) careers that, even though they might be longer, would enable us to feel better prepared and with greater probability to become an asset to society as a whole” (P3C). “Which academic courses should be recommended to contribute to the improvement of society by achieving that people learn to preoccupies themselves on others and not by selfish. I propose that the main aspect that should be tended to should be the human aspect given that it is much more important to the person than any other knowledge they may gain; human beings should occupy themselves in each other through selfless service” (P3C).

By reinforcing the analysis (Wolcott, 1994) of the three vital functions attached to the university and the opinions of the participants about the importance that university education confers, we can infer that every best informant noted that one of the fundamental purposes from which they decided to join or go back to university, as adults with 50 years or more of age, was to achieve a university degree that made them better prepared for their chosen field. Their expressions arose in a spontaneous manner, the way it happens often in a semi structured interview, through body and verbal language and in different parts of the session.

The answers given by the informants show that they knew very well the utility of the knowledge they were acquiring and the value of the university experience in general, where they agreed with Malcolm Knowles’ first premise of the andragogy model: the need of knowing what it feels like being an adult. If the adult understands why he needs to learn something, and the advantage he will gain from the knowledge, he will be more willing to start the learning process (Knowles et al, 2001). The answers also coincided with what Daggett (2005) establishes with regards to the pertinence of knowledge: that which the student finds significant, he will be willing to learn.

This conception about the importance of a university career supports what Castillo Ortiz (2000) exposed, he states that the academic curriculum should equip the students with the necessary tools to perform successfully within the workforce. In this sense the adult student starts his university experience with the defined objective to gain, by all means provided by the university, the skills and knowledge aimed at his specialty, the development
of the capacity for critical thinking and the transformation of each individual into an integral person with the final goal of feeling prepared to provide better service. The university allows students to flourish and develop the necessary skills and capacities that a human being is able to develop.

On the other hand, according to this researcher, the adults need to provide service justifies itself: to the adult providing service gives them great satisfaction which makes them feel happy because he realizes he is doing what we as humans are called to do. This can be construed as the need of self-esteem that, according to Maslow (1991), is felt by humans. He establishes that, when a person realizes that his actions are useful and necessary, he experiments a sensation of self-worth which heightens his self-esteem. The best informants hope that, after they obtain their university degree, they will be better prepared to provide quality service which will redound in respect and acknowledgement in the puertorican society.

In relation to the emphasis of the best informants, adults of 50 years of age or older, in preparing to provide service, this is consistent with what is established by various researchers in Puerto Rico, who point that the adults possess very particular characteristics in terms of their goals or expectations, either personally or professionally (Ramos Rodríguez and Vázquez Rodríguez, 1992; Castillo Ortiz, 2000; Torres Nazario, 2003).

The researcher considers pertinent to mention that various informants from this study expressed that their availability to serve, once they had their grade was not conditioned by the economic remuneration, because their main motivation was not a high salary, and they were willing to serve for free, if it were necessary. This fact is corroborated by the expressions of one of the best informants on the study: “I do not believe that I will get a higher salary because of my bachelor’s degree, I am not doing it with that purpose, getting more money is not a motivation for me to finish my degree” (P1A).

The importance that is brought to the forefront by the adults in Puerto Rico to the presentation of services is evident, exemplified by community leaders who are in charge of hundreds of social welfare projects in Puerto Rico. An example of this is the voluntary service that, through multiple initiatives, thousands of adults in Puerto Rico take part in, with the non-profit American organization, founded in 1958: AARP. The mission of this organization is to “enhance the quality of life for all as we age” (AARP, 2015, p. 7). The volunteers that serve in this organization, one of which is this researcher, have the experience and compromise to make a real social transformation in the country and its quality of life. These initiatives benefits the entire community, but are aimed particularly in attending all matters related to adults 50 years or more of age. Some of these matters are: personal and community development, financial security, health, care giving, life reimaging and the upholding of any laws that may apply to the said population, as well as raising awareness to people about the fundamental role that these adults plays in the transformation stated above (AARP, 2015).
4. Model

The second issue stated by all of the informants in the study was another one of the main objectives by which they aspired to reach a university degree: to serve as an example to their families and their communities and show that “it is never too late” to make the choice to go after the life-goals that you have set. As to the particular mention of serving the family by example, understanding this is logical, given that a constant mention, across all interviews, was the pivotal role played by the family in attending university. The adult of 50 years or older, which is tasked with taking care of his family, feels this is his primary responsibility, and that other goals, among these academic goals, are contingent to meet the primary responsibility. For this reason, as an adult student, he incorporates his family in this university experience and feels the duty of giving his all until he reaches his goal with the highest possible academic level, which in turn will give them a good example.

In terms of the clarification of the best informants about serving as an example to their communities, the researcher understands that for adults 50 years or older in Puerto Rico, it is imperative to show new generations from their communities that when there is genuine interest in its members, they can reach all the goals they set for themselves.

These adults, most of whom belong to the generation called the baby boomers, have had to face great challenges in all facets of life, mainly economic challenges, that exceed in difficulty and quantity those who have been faced by the generations that came after them. The next quotes reflect what has been established, in a direct manner; in these, the best informants consider various factors that would establish them, as examples: “My son got a master’s degree; the same way that I feel proud of him, me getting a bachelor’s degree, so my kids can feel proud that his dad also made it” (P3A). “It is great to let your kids that are at a university level know about your progress and have them feel satisfied, and bring home good grades” (P1B). “I want to be an example to my daughters and granddaughters; I will send them a copy of my diploma” (P3C). “I hope my daughter can see a change in me” (P1C). “Looking at it from the outside, I have heard a lot of conversations about young adults and I think us older adults can serve as role models in the different issues that the youth can find curious” (P3B). “My community can see in me an example that adults can study” (P1A). “We adults want to be an example and inspiration for the youth; we need to have opportunities to continue to shine and contribute to the university, government and society” (P1C). “I have learned to serve the youth as a role model, they look at me as an aged individual, with experience and they come up to me anywhere in the university. For me, it is something good that I can still share my perception as
a student, that he can come and ask me things because they see me as a mature and experienced person” (P3B).

Extending the analysis of this issue (Wolcott, 1994) enabled this researcher to auscultate about the possible reasons that make a person feel like they are role models to others.

Another reason is that, as other participants have indicated, being in university is a reason for pride, which denotes that, even when they have not yet obtained the degree they aspired to, they considered the fact that they were on their way to getting this goal an achievement, which was a correct action. The researcher interprets that when a person considers that he/she is acting correctly and feels pride because of it, believes that he can serve as an example to other that want to follow the same path.

On the other hand, all of the best informants expressed themselves in term of the satisfaction they felt for being part of the university students in Puerto Rico. A few of them encouraged the older adults, through the interviews, to continue studying, as is reflected in the next quote: “Those people that have the desire to study and feel inhibited, that take advantage of this opportunity, that seeing themselves accomplishing academic life, is more than an achievement that they can use for their personal benefit” (P1B).

Another reason various participants understood that they should be taken as role models was that they considered they had to accomplish great personal sacrifice to go back to the university lifestyle, as older adults charged with personal and professional responsibilities. Nevertheless, if they could overcome such difficulty, they considered that other people could follow their example, knowing that it is possible to study past 50 years of age. An example of the expressions of the participants regarding this situation is the following: When a professor says… “You have to do this, this and this for next week”; then comes the next professor: “I need you to do this, this and this for next week”; ‘come on: You guys think that I do not have anything else to do?’ These people think that we are full time students… I have to go work, I have a family and kids… the fact that you are in an adult programme does not change anything, they are going to ask the same thing from you… Let us do this, if it is too much work, let us split it up (P2A).

5. Conclusions

This essay revolved around the importance that all the participants brought to the study of the university education for adults in Puerto Rico, mainly in two matters: reach a university career as a means to better prepare themselves to bring service, and to serve as an example to their families and their communities. This researcher understands that these matters hold a relationship, in terms of the reasons that motivate them, according to the definition that Abraham Maslow established for the self-esteem concept. Maslow (1991) identifies the self-esteem as: the acknowledgement, the
attention, the importance, the dignity or the appreciation that make the human being feel confidence, courage and strength about himself. In that aspect, all the participants exhibited through their answers, a lot of which was aforementioned, a high level of self-esteem. To them, being university students implied feeling self-pride for what they had done and by recognizing that they were getting ready to gain the knowledge, skills and the university experience in order to be a better human beings, which denotes that they possessed a high level of self-esteem. By doing so, they understand they could provide service of the highest quality, be it at their jobs or by volunteer service. Regarding the importance they assigned to being role models to their families and communities, this researcher considers that when a person feels that he can be an example, it is because he recognizes his worth and his capacity and are worthy of emulating. That way, they have earned the respect and acknowledgement of the society from which he is a part of.

References


Teaching Cognitive and Metacognitive SRL Strategies in the Science Class: An Experimental Design to Determine Effect on Academic Achievement

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Abstract: The purpose of the study was to investigate the effect of teaching cognitive and metacognitive SRL strategies on the academic achievement of seventh grade students through an experimental design with a pre and posttest and a comparison group. The Reciprocal Causation Model based on Bandura’s social cognitive theory and Zimmerman’s Model of Self-Regulation were used as the theoretical framework. The intervention provided to the experimental group (Group A; \( n=15 \)) consisted of the direct and explicit instruction of cognitive and metacognitive SRL strategies. The intervention in the comparison group (Group B; \( n=15 \)) consisted of self-directed learning. The effect of the intervention was determined by running a \( t \)-test to compare pre and posttest results. A significance level of .05 was established for each of the four hypotheses. The results from the \( t \)-test (.032) from the posttest of the experimental group and the comparison group show that the differences found were statistically significant. Moreover, a Cohen’s \( d \) coefficient of 0.82 was obtained, which represents a large effect size. This finding suggests that the direct and explicit instruction of cognitive and metacognitive SRL strategies has a greater effect on the academic achievement than self-directed instruction. Contrarily, the results from the \( t \)-test (.112) that compared the sample means (\( \bar{x} \)) obtained from the pre and posttest of the experimental group (Group A) indicated that the differences found were not statistically significant. However, a Cohen’s \( d \) coefficient of 0.58 was obtained, representing a moderate effect size. This finding could suggest that the complexity of the design requires additional controls to be put into place. With regards to the comparison group (Group B), and according to student responses in the SRL strategy

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use logs, it was evidenced that these strategies were used infrequently. Recommendations for future investigations are provided.

**Key-Words:** Self-Regulation, Self-Regulated Learning (SRL), Cognitive Strategies, Metacognitive Strategies, Direct and Explicit Instruction, Self-Directed Learning.

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1. Introduction

The skills and competencies required for personal, academic, and professional success in the 21st century have caused a paradigm shift in educational environments. The onslaught of information and the variety of media devices used by all and sundry are a reminder that the source of obtaining said information is not solely dependent on the teacher figure anymore. Thus, classroom environments that tend to be linear in nature, although predominant in education, do not satisfy these new paradigms. The end result is a classroom environment in which instruction is mostly content-based without effectively teaching and modeling the strategies that will empower students to become self-regulated learners (Kumi-Yeboah, 2012; Moos and Ringdal, 2012; Dignath and van der Werf, 2012).

It is possible to model and teach self-regulation strategies to students as part of the teaching-learning process through direct and explicit instruction (Nilson, 2013; Vassallo, 2011; Mayer, 2011; Zumbrunn, Tadlock, and Roberts, 2011). Teaching students to become self-regulated learners requires teachers to understand how it is that students learn in order to model the strategies effectively and appropriately. By the same token, the learning environment has to be conducive to the enhancement and development of self-regulatory abilities in students (Germeroth and Day-Hess, 2013; Vassallo, 2011; Kistner, Rakoczy, Otto, Dignath, Büttner, and Klieme, 2010). Therefore, although it is important to teach the content of a particular subject, the educational process is enhanced through the direct and explicit instruction of cognitive and metacognitive SRL strategies (Moos and Ringdal, 2012; Velayutham, Aldridge and Fraser, 2012). In addition to modeling SRL strategies, a support system in the form of teacher feedback in all instances of the teaching-learning process, meaning before, during, and after instruction, will promote the development of SRL competencies in students (Mayer, 2011; Vassallo, 2011; Schunk, 2009; Campbell, 2009). Such feedback should focus on student performance, opportunities for improvement, student strengths, and the value of the task at hand. It is important to note that teaching SRL strategies should not be incidental or independent of the content, but instead, as an integrated part of the course or subject matter (Lovett, 2013; Schunk, 2009). Teaching SRL strategies should be taken one step further in that they
should be taught in such a manner so as to be transferable and used in a variety of contexts, assignments, and tasks.

Students that show higher levels of self-regulation tend to be actively engaged and involved in their own learning process, make constant decisions related to their learning activities and take responsibility for their own learning. Studies that have explored the topic of self-regulation have suggested that successful students use cognitive and metacognitive strategies more often and more effectively than students with lower levels of academic achievement (Moos, 2011; Kistner, Rakoczy, Otto, Dignath, Büttner, and Klieme, 2010). Furthermore, the ability to self-regulate is accompanied by other factors that affect academic outcomes, such as motivation and self-efficacy (Schunk and Usher, 2011). Self-regulation models offer the opportunity to promote the development of cognitive and metacognitive abilities in students to become proactive, strategic, independent, self-directed learners (Davis and Nietzel, 2011; Vassallo, 2011).

2. Problem

According to the results of the standardized tests submitted by the Department of Education of Puerto Rico corresponding to the 2010-2011 school year, and up until the 2013-2014 school year, it was possible to identify a decrease in the academic achievement of middle school students in the content area of science. The data were obtained from the report titled “Perfil Escolar del Departamento de Educación de Puerto Rico” of the 2010-2011, 2011-2012, 2012-2013, and 2013-2014 school years (DEPR). The statistics included in the report provide information on the number of students that performed at the proficient and advanced levels in science in the fourth, eighth, and eleventh grades. At the elementary level, 68%, 66%, 68%, and 67% demonstrated proficient and advanced levels of performance in science during the 2010-2011, 2011-2012, 2012-2013, and the 2013-2014 school years, respectively. The results corresponding to proficient and advanced performance for middle school were significantly lower: 27% in 2010-2011; 27% in 2011-2012; 29% in 2012-2013, and 26% in 2013-2014. In eleventh grade, 46% of the students tested reached proficient and advanced levels during the 2010-2011 school year; 44% for the 2011-2012 test administration; 43% for the 2012-2013 school year, and 48% performed accordingly during the 2013-2014 school year. Based on these results, and although it is evident that academic achievement must be improved across the board, the priority is clearly to increase the level of performance and the academic achievement of middle school students in their science class.

In addition, the personal and academic difficulties that middle school students face in adjusting to new environments upon entering their adolescent years, requires the implementation of effective teaching models and strategies in the classroom. In an effort to attend to and deal with the problem under
investigation, the development of SRL strategies presents itself as a viable alternative to improve the academic achievement of seventh grade students in the science class. The investigation contemplated two interventions with the purpose of developing cognitive and metacognitive SRL strategies in seventh grade students during the science class: the direct and explicit instruction of cognitive and metacognitive SRL strategies in the experimental group (Group A; \(n=15\)), and self-directed learning in the comparison group (Group B; \(n=15\)).

3. Objectives and Research Hypotheses

3.1 Objectives

This study was designed to investigate how the direct and explicit instruction of SRL cognitive and metacognitive strategies affected the academic achievement of seventh grade students in the science class when compared to self-directed instruction. A variety of cognitive and metacognitive strategies were considered in the development of the resources and instruments for the experiment. These strategies were: a) strategies for the management and organization of information; b) strategies for the interpretation and representation of information; c) self-monitoring strategies; d) self-evaluation strategies; e) self-reflection strategies, and f) teacher feedback. The strategies were aligned to the content of the seventh grade science course, as per the curriculum adopted by the Department of Education of Puerto Rico. Thus, the classroom activities incorporated content, as well as strategies for the development of cognitive and metacognitive self-regulation skills in students. Both the experimental and the comparison group participated in the administration of the pre and posttest and received the instructional resources that were developed for the study.

3.2 Research Hypotheses

Four research hypotheses were established with a significance level of .05. Each one included a null hypothesis and an alternative hypothesis.

First hypothesis: \(H_0\): There are no statistically significant differences between the sample means (\(\bar{x}\)) of the scores obtained from the pretest of the experimental group and the comparison group (\(p \geq .05\)).

\(H_a\): There are statistically significant differences between the sample means (\(\bar{x}\)) of the scores obtained from the pretest of the experimental group and the comparison group (\(p \geq .05\)).

Second hypothesis: \(H_0\): There are no statistically significant differences between the sample means (\(\bar{x}\)) of the scores obtained from the posttest of the experimental group and the comparison group (\(p \geq .05\)).
There are statistically significant differences between the sample means ($\bar{x}$) of the scores obtained from the posttest of the experimental group and the comparison group ($p \geq .05$).

Third hypothesis: $H_0$: There are no statistically significant differences between the sample means ($\bar{x}$) of the scores obtained from the pre and the posttest of the experimental group ($p \geq .05$).

$H_a$: There are statistically significant differences between the sample means ($\bar{x}$) of the scores obtained from the pre and posttest of the experimental group ($p > .05$).

Fourth hypothesis: $H_0$: There are no statistically significant differences between the sample means ($\bar{x}$) of the scores obtained from the pre and the posttest of the comparison group ($p \geq .05$). $H_a$: There are statistically significant differences between the sample means ($\bar{x}$) of the scores obtained from the pre and posttest of the comparison group ($p > .05$).

4. Literature Review

During the process of self-regulation, individuals transform their mental abilities, behavior, and feelings into actions that are geared towards the attainment of personal and academic goals (Silver, 2013; Kumi-Yeboah, 2012; Zimmerman and Schunk, 2011; Schmitz and Perels, 2011; Peters and Kitsantas, 2010; Schunk, 2009; Zimmerman, 2008). It is a dynamic, contextual, and multidimensional process that involves the attitude, the behavior, the affective states, and the cognitive and metacognitive development of the learner. The prevailing contextual factors are also influential in self-regulation. The interaction of these elements plays a significant role when students are faced with the need to use their cognitive and metacognitive abilities, which, in turn, are manifested in actions conducive to the regulation of learning.

The effective use of cognitive and metacognitive SRL strategies helps students improve their academic achievement across all disciplines and subjects, and promotes independent lifelong learners that are able to engage in strategic decision making. (Davis and Nietzel, 2011; Kistner, Rakoczy, Otto, Dignath, Büttner, and Klieme, 2010). In today’s setting, self-regulation is pointedly relevant for academic success because: 1) information is constantly exchanged through a variety of media at an alarming rate and at all times; 2) teachers are not always present, especially during after school hours when students are expected to continue with the learning experience through extracurricular activities, homework, and others; 3) it grants students responsibility for their own learning, and 4) it provides the chance to adapt and respond to the particular context and needs of any given occasion or instance (Kumi-Yeboah, 2012; Schmitz and Perels, 2011). Hence, the role of teachers is to guide students to become self-regulated learners.
Students that have not developed their self-regulation abilities tend to set inappropriate goals, implement self-monitoring processes that are ineffective, and do not establish a well-thought out plan. They exhibit limited cognitive and metacognitive controls and limited skills for academic success. The need to enhance their abilities sets the stage for the adoption of teaching models that include the instruction of cognitive and metacognitive strategies to promote SRL in students. However, it has been found that teachers do not engage in SRL strategy instruction due to, either a lack of training on matters regarding self-regulation, or because of the amount of extra work and time that planning for SRL instruction entails (Kistner, Rakoczy, Otto, Dignath, Büttner, and Klieme, 2010). Educational programs that have included interventions for the development of SRL strategies have, for the most part, been successful because they incorporate activities and educational tasks that give students the opportunity for decision-making and gradually grant independence and autonomy. Moreover, they promote self-evaluation, peer assessment, and they allow for instances in which collaborative activities are carried out. Self-regulation is enhanced through the creation of educational environments where high levels of cognitive and metacognitive activities prevail (Kistner, Rakoczy, Otto, Dignath, Büttner, and Klieme, 2010).

Academically successful students use an array of acquired SRL strategies that they adjust depending on the context of the situation, such as: setting goals; planning; determining when it is appropriate to reward themselves; organizing information; transforming information; keeping a record of their activities, results, and outcomes; the use of think alouds and other verbal learning protocols; the elaboration of information; explaining; analyzing the task; choosing strategies; monitoring their own progress; judging and evaluating their work and their learning, and keeping themselves motivated (Ambrose, Bridges, Lovett, DiPietro, and Norman, 2010). It is possible to teach self-regulation processes through direct and explicit instruction or through indirect methods (Dignath and Büttner, 2008; Schunk, 2009; Germeroth and Day-Hess, 2013). Research has shown that indirect instruction is the least effective, even though it is the predominant method used for the development of SRL strategies (Moos and Ringdal, 2012). Indirect instruction occurs when teachers structure the environment for opportunities to use the SRL strategies, but does not teach or model them.

Many theories and approaches support the use of self-regulation models as part of the learning process. Although there are differences among models, they share certain elements. They agree that the individual: 1) is a proactive learner; 2) can exert control over his/her own learning; 3) is capable of controlling the environment, and 4) establishes goals, implements strategies, monitors progress, and makes adjustments during this cyclical process before, during, and after the learning experience (Campbell, 2009; Clark, 2012). This study was based on Bandura’s social cognitive theory and Zimmerman’s self-regulation model (Dignath and Büttner, 2008). The social cognitive theory
contemplates the learning experience as a series of events that are influenced by the interaction of personal, social and behavioral factors, also known as the Triadic Reciprocal Causation Model (Moos and Ringdal, 2012; Zimmerman and Schunk, 2011; Schunk and Usher, 2011; Moos, 2011). This perspective tries to explain the relationship between social and cognitive events that individuals depend on for adaptation and change, so the learning process is an area of interest to this theory. According to the social cognitive theory, learning is not only a reflection of personal factors, but also a reflection of the reciprocal roles of social factors and behavior (Zimmerman and Schunk, 2001). Social processes, such as modeling, verbal persuasion, and observation of what is going on in the environment, leads to self-evaluation and to making adjustments whenever necessary (Zimmerman and Schunk, 2001). According to Bandura’s theory, the development of self-regulation abilities occurs in four levels: 1) observation; 2) emulation; 3) self-control, and 4) self-regulation (Peters and Kitsantas, 2010).

Zimmerman’s cyclical model of self-regulated learning suggests that the process occurs in three cyclical and dynamic phases: 1) the forethought phase; 2) the performance phase, and 3) the self-reflection phase (Bembenutty, 2011). During forethought, students exhibit their disposition to engage in learning by analyzing the task, awarding value to the task, establishing goals, and developing a plan (see Figure 1). In the performance phase, students implement the plan and selected strategies. During self-reflection, the student reflects and thinks about the process, evaluates the final product, and makes the decisions needed to improve the learning experience (Germeroth and Day-Hess, 2013; Silver, 2013; Kumi-Yeboah, 2012; Bembenutty, 2011; Kistner, Rakoczy, Otto, Dignath, Büttner, and Klieme, 2010; Schunk, 2009).

Self-regulatory abilities are manifested in the cognitive and metacognitive strategies that students use for learning. Teaching students to outline, summarize, interpret, and organize information in tables, graphs, and

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**Figure 1. Zimmerman’s cyclical model of self-regulated learning. Source: Zimmerman (2008).**
other forms of representation, enhances cognitive strategies. Cognition is also strengthened when students are taught to practice and learn information through repetition, mnemonics, by creating mental images, by formulating questions about the information, and by studying with others (Germeroth and Day-Hess, 2013). Self-monitoring, self-evaluation, and self-reflection are SRL metacognitive strategies that are reinforced through rubrics, logs, checklists, assessment instruments, effective modeling, progress reports, compelling feedback, verbal protocols, technological supports, and the identification of errors in the learning process, among others (Germeroth and Day-Hess, 2013; Bannert and Reimann, 2012; Schmitz and Perels, 2011; Mayer, 2011). Continuous self-monitoring allows the student to revise performance and progress, to make adjustments, and to calibrate learning. (Kumi-Yeboah, 2012; Schmitz and Perels, 2011). Self-evaluation can come from the learner or as a result of the feedback given by others, and involves the formulation of value judgments about performance and quality of work that is usually based on comparing results to a standard that, on occasion, could be the student’s previous results (Lovett, 2013). On the other hand, self-reflection supports the development of metacognitive abilities, allows for the validation of the learning process and has the potential to increase motivation and self-efficacy.

Research suggests that academic success is highly dependent of the effective use of SRL strategies on the part of the student. In studies with students from K-12, results have indicated that direct and explicit instruction of SRL strategies helps improve academic achievement (Kistner, Rakoczy, Otto, Dignath, Büttner, and Klieme, 2010). Studies related to SRL have explored a variety of topics such as: the perception of teachers with respect to their role in the development of SRL strategies, assessment, and their epistemological beliefs (Davis and Nietzel, 2011; Nash-Ditzel, 2010; Dignath and Büttner, 2008). Results show that teachers maintain control of all aspects related to the teaching-learning process, including the strict adherence to content instruction and the use of assessment as an evaluation method. In addition, research suggests that students with the greatest academic success have high levels of cognitive and metacognitive development. The instruction of SRL strategies coupled with effective modeling techniques for prolonged periods of time and sound feedback are more effective than other teaching methods, especially for the development of metacognition (Nash Ditzel, 2010; Dignath and Büttner, 2008). Students that excel at self-regulation exhibit high levels of self-efficacy, the inclination to invest time and effort towards learning, high organizational skills, the ability to establish priorities accordingly, and the ability to recognize when it is time to ask for help. Students that do not exhibit self-regulation abilities have low self-efficacy levels, poor time management skills, a lack of interest in engaging in learning tasks, and an unwillingness to make the effort to do so (Usher, 2009). Some activities that help students engage in SRL are: the use of diaries; planning for
the task at hand; the use of a variety of resources to aid in the learning process, and the assertive management of the environment, among others (Campbell, 2009).

Investigations have been conducted to study the instructional process related to the following topics on SRL; how peer groups influence SRL, and how behavior factors play into self-regulation (Kistner, Rakoczy, Otto, Dignath, Böttner, and Klieme, 2010). These studies have concluded that self-efficacy and motivation play a determinant role in the development of SRL skills. (Sartawi, Alsawaie, Dodeen, Tibi, and Alghazo, 2012). Results have also pointed gender differences: girls exhibit greater levels of intrinsic motivation and goals that are oriented towards the mastery of a given task, while boys are more performance oriented and depend more on extrinsic motivation. Self-efficacy and motivation determine, to an extent, the scope of the use of SRL strategies in students, and as a result, their academic achievement. Another aspect of interest emphasized in research is that when SRL strategies are taught through direct and explicit instruction, academic achievement increases (Kistner, Rakoczy, Otto, Dignath, Böttner and Klieme, 2010). Successful students are organized and tend to: use SRL strategies with greater frequency; verify and manage information effectively; evaluate the content of the information, and ask for help (Rytkönen, Parpala, Lindblom-Ylänne, Virtanen, and Postareff, 2012). If learning is considered malleable, more effort will be put into the process; if it is seen as a fixed ability, there is an unwillingness to engage in the process, which can adversely affect academic achievement. In general, in experimental groups with interventions based on the direct and explicit instruction of SRL strategies, improvement in student work was observed along with an increase in academic achievement (Tuckman and Kennedy, 2011;). They have provided evidence that point to SRL strategies as effective in increasing self-efficacy, knowledge, and academic achievement. In general, results from research confirm that the use of SRL strategies correlates positively to academic achievement (Eilam, Zeidner, and Aharon, 2009).

4.1 Direct and explicit instruction

SRL models provide teachers with a perspective that allows them to visualize their students as proactive and strategic learners, and themselves as professionals that are able to reflect on their practice, that are able to adapt and revise their pedagogical styles in order to better accommodate student needs accordingly (Zumbrunn, Tadlock and Roberts, 2011; Moos 2011). Consistent with Bandura’s social cognitive theory, studies have demonstrated that direct and explicit instruction of cognitive and metacognitive SRL strategies, when taught systematically, is positively correlated to academic achievement (Germeroth and Day-Hess, 2013; Nilson, 2013; Clark, 2012; Zumbrunn, Tadlock, and Roberts, 2011; Peters and Kitsantas, 2010; Kistner, Rakoczy, Otto, Dignath, Böttner and Klieme, 2010; Schunk, 2009;
Zimmerman, 2008). This type of instruction combines personal factors, such as: cognitive processes; metacognitive processes, the affective and motivational state of the learner (Bannert and Reimann, 2012; Moos, 2011; Zimmerman and Schunk, 2011; Schunk and Usher, 2011). During the learning process, the teacher specifies when SRL strategies can be used, how they are used, what the benefits of one strategy over another are depending on the situation and context, and when to make adjustments in order to enhance their benefit (Kumi-Yeboah, 2012; Moos and Ringdal, 2012; Vassallo, 2011; Davis and Nietzel, 2011). The task of guiding students through the process of the development of self-regulating abilities requires effective modeling skills on the part of the teacher, which includes support and awarding gradual independence as the student starts to show mastery (Zumbrunn, Tadlock, and Roberts, 2011). The incorporation of self-regulation strategies into the teaching process is more effective in getting students to transfer these skills to new contexts and study disciplines than teaching these strategies in isolation (Silver, 2013; Bannert and Reimann, 2012; Schunk, 2009).

Part of the direct and explicit instruction of SRL strategies should include self-monitoring skills through a variety of instructional resources, such as: modeling; scaffolding; collaborative work; assessment; formative feedback, and gradually granting the opportunity for decision making in matters related to the task at hand (Kumi-Yeboah, 2012; Clark, 2012). Assessment and formative feedback are powerful communication devices that provide valuable information to students about their progress and how to strengthen their self-monitoring and self-evaluation skills. The probability of developing SRL strategies in students and guiding them to become independent learners increases when the teacher provides explanations, offers demonstrations, provides direct and explicit instruction on cognitive and metacognitive strategies, and provides activities for collaboration and decision making (Clark, 2012; Davis and Nietzel; 2011). When students use SRL strategies they become proactive learners. In particular, metacognitive strategies allow for effective decision-making and provide an awareness of the learning process (Silver, 2013). Feedback should be high quality and should stress performance over the final product, thus allowing students to identify the cognitive and metacognitive strategies that could potentially become part of their repertoire of successful learning strategies (Hattie and Yates; 2014; Clark, 2012; Moos, 2011; Mayer, 2011; Ambrose, Bridges, Lovett, DiPietro and Norman, 2010). Therefore, assessment activities and effective feedback are strong learning tools when they promote self-monitoring, self-reflection, and self-evaluation at the same time that they advance the development of self-regulation abilities in students. Consequently, students that learn to use SRL strategies effectively and with purpose, will, in turn, improve their academic achievement (Moos, 2011; Zimmerman and Schunk, 2011; Kistner, Rakoczy, Otto, Dignath, Büttner, and Klieme, 2010).
4.2 Self-Directed Instruction

In self-directed instruction, students are able to: 1) establish learning goals; 2) locate and access learning resources; 3) adopt strategies and activities pertinent to the learning goal; 4) monitor and evaluate the results and outcomes of their learning, and 5) reflect on the strategies implemented during the learning process, and 6) make adjustments, if needed. (Kim, Olfman, Ryan and Eryilmaz, 2014; Avdal, 2013). Self-directed learners display a proactive attitude, responsibility, and autonomy towards learning. This implies that the learner controls the learning process, be it individually or through the interaction with others. Students that engage in self-directed learning exhibit: high levels of self-efficacy; control over their learning; high motivation; organization; independence towards their learning; effective use of cognitive and metacognitive strategies; goal-oriented attitudes, and the ability to transfer knowledge to new situations. They are empowered, they are active and proactive in their learning, can make decisions regarding their own learning, which translates to high levels of academic achievement. Contrarily, those that do not possess the skills for successful self-directed learning exhibit poor time management, poor organizational skills, very little responsibility, low levels of motivation, and little overall academic discipline. According to literature, self-directed learning can be enhanced and is contingent on taking into consideration the variables that influence the development of a self-regulated learner, along with adequate classroom management skills that include well-structured learning environments and thoughtful planning by the teacher. (Kim, Olfman, Ryan and Eryilmaz, 2014; Avdal, 2013).

5. Method

5.1. Research Design

The research design implemented in this study was an experimental design with a pre and posttest and comparison group (see Figure 2) which is appropriate when the investigator looks to establish causal inferences (Shadish, Cook and Campbell, 2002). In this investigation, the causal inferences were related to the effects of teaching cognitive and metacognitive SRL strategies on the academic achievement of seventh grade students in the science class. This design allows the researcher to consider a cluster sample in which it is possible to randomly assign the experimental group and the comparison group. Two interventions were chosen for the study: 1) the direct and explicit instruction of SRL strategies in the experimental group (Group A), and 2) self-directed instruction of SRL strategies in the comparison group (Group B). The time allotted to the interventions was approximately 10 weeks. The independent variables were the two teaching methods, and the independent variable was academic achievement, and was measured based on the scores of the seventh grade science pre and posttest developed by the research team.
Figure 2. Diagram of an experimental design with pre and posttest and comparison group. (Source: Shadish, Cook and Campbell, 2002).

6. Instruments

A total of nine instruments were developed: 1) a specifications table that guided the development of the pre and posttest; 2) a pre and posttest based on the contents of the first semester of the seventh grade science course, as per the curriculum of the science program of the Department of Education of Puerto Rico; 3) a student manual that included information about cognitive and metacognitive strategies and activities that were aligned to the seventh grade science curriculum; 4) a teacher’s manual that was used as the guide in the intervention provided in the experimental group; 5) a cognitive and metacognitive strategy use log that was administered to the participants in the comparison group; 6) a guide used to train the science teacher; 7) a validation instrument for the specifications table and for the pre and posttest; 8) a validation instrument for the teacher’s manual, and 9) a validation instrument for the student’s manual. Possible threats to validity were identified and controls were put into place to minimize their effect on the results of the investigation (Shadish, Cook, and Campbell, 2002). Some of these controls include actions towards minimizing threats due to maturation, instrumentation, history, testing, and statistical power, among others.

7. Participants

As previously mentioned, the sample was a cluster sample with random assignment of groups. Cluster samples, even though they rely on the use of intact groups, are convenient in experimental methodologies because they are representative of the population (Vogt, 2007). The selection of a cluster sample implies that all of the members of the group are included in the sample. The sample was a probability sample made up of two groups of seventh grade students from a public middle school, located in the western region of Puerto Rico. A total of 30 students (N=30) comprised the total number of participants, 15 in each group (n=15).
participating school was based on the following criteria: 1) the results in the science section of the standardized test corresponding to middle school had to be similar to the statewide results; 2) the school had to have, at least, two seventh grade groups in its organization, and 3) the participants had to be officially enrolled in the seventh grade. Therefore, schools that performed at proficient and advanced levels on the science test were not considered for the study. Other criteria for exclusion from the study were those with only one seventh grade group and schools that did not have a regular curriculum to service its students, such as pre-vocational centers. A total of eight schools from one of the districts from the western region qualified to participate in the study.

8. Procedure

To start the investigation, the research team complied with all of the documentation required by the IRB and the Department of Education. Investigation forms and protocols, letters, applications, and the required IRB, RCR, and HIPS certifications were among the documents submitted. Once the authorization to carry out the research project was received, the research team started to identify the schools on the western part of the island of Puerto Rico that qualified to participate in the study. A total of eight schools from the district that was selected met the criteria for participation. Letters were sent to each one, and three schools answered. Two of the schools sent letters that indicated their availability to participate in the study. A third school expressed availability through a phone call. The research team decided to consider the two schools that sent letters. The first school to answer was used for the pilot test, and the second school was chosen for the experiment. In each phase of the study, parent consent forms and student assent forms were filled out and returned to the research team. Likewise, orientations were provided to all the participants, teachers and students, both during the validation phase and the experimental phase of the study. Guarantees were provided for confidentiality, voluntary participation, and the chance to withdraw from the study without the fear of being penalized.

Validation phase. The first phase of the study involved the validation of instruments and the pilot test. The four instruments that were validated included: 1) the specifications table that was used to guide the development of the pre and posttest; 2) the pre and posttest based on the contents of the first semester of the seventh grade science course, as per the curriculum of the science program of the Department of Education of Puerto Rico; 3) the student manual that included information about cognitive and metacognitive strategies and activities that were aligned to the seventh grade science curriculum, and 4) the teacher’s manual that was used as the guide in the intervention provided in the experimental group. The panel of experts that validated each of the four instruments consisted of three seventh grade science
teachers, one science facilitator, and one expert in the field of education with a doctorate’s degree in curriculum development. The instruments were validated based on the criteria provided in the validation forms that, in turn, were designed based on Lawshe’s model for measuring content validity (Lawshe, 1975). A CVI value of 1.00 was obtained for each instrument. Thus, no substantial changes were required. In addition, the reliability coefficient (Cronbach’s alpha) of the pre and posttest was obtained from the results of the administration of a pilot test to 15 seventh grade students that had completed the first semester of the science course. A Cronbach’s alpha, $\alpha = .731$ was obtained, which is considered satisfactory and denotes reliability of the test. It was decided that no item would be eliminated from the test because such an action would not result in a significant increase of Cronbach’s alpha.

**Experimental phase.** With regards to the experiment, the teacher who participated in the study was a middle school science teacher with a valid teaching license emitted by the Department of Education of Puerto Rico. The two groups were randomly assigned to either the experimental group (Group A) or to the comparison group (Group B). The participants in both groups took the pretest and received a student manual for the development of cognitive and metacognitive SRL strategies. The experimental group (Group A) used the student manual as part of the direct and explicit instruction of SRL strategies. In previous studies, the direct and explicit instruction of SRL strategies has correlated positively to academic achievement, especially when the instruction incorporated opportunities for the development of metacognitive strategies (Kistner, Rakoczy, Otto, Dignath, Büttner and Klieme, 2010).

The teacher provided instruction in the direct and explicit instruction modality based on the directives in the teacher’s manual that served as the script to follow during the intervention provided to the participants of Group A. A total of nine, 30-minute instructional lessons were designed for the 10-week time frame during the first semester of the academic school year. The topics included in the manual were related to the following cognitive and metacognitive strategies: 1) self-monitoring and self-evaluation; 2) self-reflection and teacher feedback; 3) note-taking and study techniques; 4) mnemonic techniques; 5) how to outline; 6) how to design graphic organizers; 7) how to design tables; 8) how to plot graphs, and 9) how to make representations, diagrams, and illustrations. The comparison group (Group B), on the other hand, used the student manual for the self-directed instruction intervention. This means that the participants in Group B did not receive direct and explicit instruction on SRL strategies. In addition to the student manual, the students in the comparison group (Group B) completed a strategy log on four occasions during the 10-week intervention. The purpose of the log was to maintain a record of the cognitive and metacognitive strategies used by the comparison group during the experiment.
Throughout the experiment, the research team visited the teacher and made follow-up visits to coordinate, to retrieve documents, to provide assistance when needed, to confirm the implementation of the interventions, and to keep the experiment on track. At the end of the 10 weeks, which was near the end of the first semester, the posttest was administered in both groups and the strategy use log was administered one last time in the comparison group (Group B). It is important to note that evaluations regarding the contents of the student manual were also administered, both in the experimental group (Group A) and in the comparison group (Group B).

The data considered in the analysis were the scores obtained from the pre and posttest administered to both Group A and Group B, the strategy use log results, and the evaluation results. The results from the statistical analysis, based on the $t$-test that compared the sample means ($\bar{X}$) of the pre and posttest, were used to either retain or reject each of the four hypotheses of the investigation. A final written report that included the findings, the conclusions, and the recommendations was submitted. Upon completing the study, the research team requested the IRB to close the investigation in accordance with standard procedure.

9. Results

9.1. Descriptive results and statistics

A total of 30 students took the pre and posttest for a 100% participation. For the pretest administered in the experimental group (Group A), the minimum score was 27, and the maximum score was 73 (see Table 1). The scores with a frequency ($f$) of one were: 27; 33; 43; 47; 50; 53; 63; 67, and 73. The scores with a frequency ($f$) of two were: 40; 57, and 60. In the comparison group (Group B), the minimum score was 27. The maximum score was 63. The scores with a frequency ($f$) of one were: 27; 47, and 57. The scores with a frequency ($f$) of two were: 37; 40; 43; 50; 53, and 63.

<table>
<thead>
<tr>
<th>Scores</th>
<th>Pretest Group A</th>
<th>Pretest Group B</th>
</tr>
</thead>
<tbody>
<tr>
<td>f</td>
<td>%</td>
<td>Cumulative %</td>
</tr>
<tr>
<td>27</td>
<td>1</td>
<td>6.7</td>
</tr>
<tr>
<td>33</td>
<td>1</td>
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<tr>
<td>40</td>
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<td>13.3</td>
</tr>
<tr>
<td>43</td>
<td>1</td>
<td>6.7</td>
</tr>
<tr>
<td>47</td>
<td>1</td>
<td>6.7</td>
</tr>
<tr>
<td>50</td>
<td>1</td>
<td>6.7</td>
</tr>
<tr>
<td>53</td>
<td>1</td>
<td>6.7</td>
</tr>
<tr>
<td>57</td>
<td>2</td>
<td>13.3</td>
</tr>
<tr>
<td>60</td>
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<td>13.3</td>
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<tr>
<td>63</td>
<td>1</td>
<td>6.7</td>
</tr>
<tr>
<td>67</td>
<td>1</td>
<td>6.7</td>
</tr>
</tbody>
</table>
For the posttest administered in the experimental group (Group A), the minimum score was 43, and the maximum score was 80 (see Table 2). The scores with a frequency \( f \) of one were: 43; 53; 57; 70; 77, and 80. The scores with a frequency \( f \) of two were: 50; 63, and 67. Three participants obtained a score of 47. In the comparison group (Group B), the minimum score was 13. The maximum score was 77. The scores with a frequency \( f \) of one were: 13; 37; 47; 57; 60 and 77. The scores with a frequency \( f \) of two were: 23; 40; 50, and 67.

### Table 1. Pretest frequencies for the experimental group (Group A) and the comparison group (Group B).

<table>
<thead>
<tr>
<th>Scores</th>
<th>( f )</th>
<th>%</th>
<th>Cumulative %</th>
</tr>
</thead>
<tbody>
<tr>
<td>43</td>
<td>1</td>
<td>6.7</td>
<td>6.7</td>
</tr>
<tr>
<td>47</td>
<td>3</td>
<td>20.0</td>
<td>26.7</td>
</tr>
<tr>
<td>50</td>
<td>2</td>
<td>13.3</td>
<td>40.0</td>
</tr>
<tr>
<td>53</td>
<td>1</td>
<td>6.7</td>
<td>46.7</td>
</tr>
<tr>
<td>57</td>
<td>1</td>
<td>6.7</td>
<td>53.3</td>
</tr>
<tr>
<td>63</td>
<td>2</td>
<td>3.3</td>
<td>66.7</td>
</tr>
<tr>
<td>67</td>
<td>2</td>
<td>3.3</td>
<td>80.0</td>
</tr>
<tr>
<td>70</td>
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<td>6.7</td>
<td>86.7</td>
</tr>
<tr>
<td>77</td>
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</tr>
<tr>
<td>80</td>
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<td>6.7</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Total 15 100

Note: \( N=30 \): Group A, \( n=15 \); Group B, \( n=15 \).

### Table 2. Posttest frequencies for the experimental group (Group A) and the comparison group (Group B).

<table>
<thead>
<tr>
<th>Scores</th>
<th>( f )</th>
<th>%</th>
<th>Cumulative %</th>
</tr>
</thead>
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<tr>
<td>43</td>
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<td>57</td>
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<td>63</td>
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<tr>
<td>80</td>
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<td>6.7</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Total 15 100

Note: \( N=30 \): Group A, \( n=15 \); Group B, \( n=15 \).

Table 3 provides the descriptive statistics for the pretest. In the experimental group (Group A), the sample means \( (\bar{x}) \) was 51.33 and the median \( (Mdn) \) was 53.00. Also, multiple modes were identified \( (Mo) \): 40, 57 and 60. The standard deviation \( (s) \) and the variance \( (s^2) \) for the experimental group (Group A) was 12.938 and 167.381, respectively. The range was 46, with a minimum of 27 and a maximum of 73. In the comparison group (group B), the sample means \( (\bar{x}) \) was 46.87 and the median \( (Mdn) \) was 47.00. Multiple modes were identified \( (Mo) \): 37, 40, 43, 50, 53 and 63. The standard deviation \( (s) \) and the variance \( (s^2) \) for the comparison group (Group B) was...
10.113 and 102.267, respectively. The range was 36, with a minimum of 27 and a maximum 63.

<table>
<thead>
<tr>
<th></th>
<th>Pretest Group A</th>
<th>Pretest Group B</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>15</td>
<td>15</td>
</tr>
<tr>
<td>Means</td>
<td>51.33</td>
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</tr>
<tr>
<td>Standard Means Error</td>
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<tr>
<td>Median</td>
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<td>47.00</td>
</tr>
<tr>
<td>Mode</td>
<td>40&lt;sup&gt;a&lt;/sup&gt;</td>
<td>37&lt;sup&gt;a&lt;/sup&gt;</td>
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<tr>
<td>Standard Deviation</td>
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<tr>
<td>Variance</td>
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<td>102.267</td>
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<tr>
<td>Range</td>
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<td>36</td>
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<tr>
<td>Minimum</td>
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<td>27</td>
</tr>
<tr>
<td>Maximum</td>
<td>73</td>
<td>63</td>
</tr>
</tbody>
</table>

Note: <sup>a</sup> There are multiple modes, Mo.

Table 3. Descriptive statistics calculated from the scores obtained from the administration of the pretest.

Table 4 provides the descriptive statistics for the posttest. In the experimental group (Group A), the sample means (\(\bar{X}\)) was 58.73 and the median (Mdn) was 57.00. The mode (Mo) was 47. The standard deviation (s) and the variance (s²) for the experimental group (Group A) was 11.756 y 138.210, respectively. The range was 37, with a minimum of 43 and a maximum of 80. In the comparison group (group B), the sample means (\(\bar{X}\)) was 46.27 and the median (Mdn) was 47.00. Multiple modes were identified (Mo): 23, 40, 50, and 67. The standard deviation (s) and the variance (s²) for the comparison (Group B) was 17.930 and 321.495, respectively. The range was 64, with a minimum of 13 and a maximum of 77.

<table>
<thead>
<tr>
<th></th>
<th>Posttest Group A</th>
<th>Posttest Group B</th>
</tr>
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<tr>
<td>N</td>
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<td>Means</td>
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<td>Standard Means Error</td>
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</tr>
<tr>
<td>Mode</td>
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<td>23&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Standard Deviation</td>
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<td>17.930</td>
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<tr>
<td>Variance</td>
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<td>321.495</td>
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<tr>
<td>Range</td>
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<td>64</td>
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<tr>
<td>Maximum</td>
<td>80</td>
<td>77</td>
</tr>
</tbody>
</table>

Note: <sup>a</sup> There are multiple modes, Mo.

Table 4. Descriptive statistics calculated from the scores obtained from the administration of the posttest.
The Shapiro-Wilk normality test was performed to determine the normality of the distribution of the scores from the pretest. For the experimental group (Group A), a significance value of .967 was obtained. For the comparison group (Group B), the obtained value was .843 (see Table 5). Because these results are higher than the significance level established by the research team, .05, it was determined that there were no statistically significant differences between the groups. Thus, the null hypothesis was retained. Likewise, Levene’s test for equality of variances was performed. The significance level obtained for Levene’s test was .297. Again, because the value obtained was higher than the significance value established by the researchers, .05, it was determined that there were no statistically significant differences between the groups. Therefore, the null hypothesis was retained. The results from these tests tend to indicate that, because there were no differences, the scores were normally distributed within the population, that the variances are homogenous, and that the population from which the different samples were drawn were equal.

<table>
<thead>
<tr>
<th>Test</th>
<th>Sig. Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shapiro-Wilk Normality Test</td>
<td></td>
</tr>
<tr>
<td>Group A</td>
<td>.967</td>
</tr>
<tr>
<td>Group B</td>
<td>.843</td>
</tr>
<tr>
<td>Levene’s test for equality of variances</td>
<td>.297</td>
</tr>
</tbody>
</table>

Table 5. Results of Shapiro-Wilk normality test and Levene’s test for equality of variances.

6.2 Inferential results and statistics

The first hypothesis compared the sample means (\( \bar{x} \)) from the scores of the pretest administered to the experimental group (Group A) and the comparison group (Group B). The \( t \)-test provided a level of significance of .301, so the null hypothesis was retained (see Table 6). It was concluded that there were no statistically significant differences between the sample means (\( \bar{x} \)) obtained from the pretest scores in both groups. Because of this, it is assumed that, both groups were homogenous in terms of knowledge of the subject matter prior to the interventions. For the second hypothesis, a significance level of .032 was obtained after running the \( t \)-test to compare the sample means (\( \bar{x} \)) from the posttest scores obtained from both the experimental group (Group A) and the comparison group (Group B). Based on this result, the null hypothesis was rejected (see Table 6). It was concluded that the differences obtained were statistically significant. Moreover, a Cohen’s \( d \) coefficient of 0.82 was obtained, to ensure that the Type I Error was minimized. This value represents a large effect size, meaning that the intervention carried out in the experimental group (Group A), the direct and explicit instruction of cognitive and metacognitive SRL strategies, had a greater effect on the academic achievement of seventh grade students in their
science class than self-directed instruction. It was also possible to compare the sample means ($\bar{x}$) obtained from the administration of the pre and posttest within the same group. The third hypothesis compared the sample means ($\bar{x}$) from the scores obtained from the pre and posttest of the experimental group (group A). In this case, the results from the $t$-test (.112) indicated that the differences found were not statistically significant (see Table 6). Therefore, the null hypothesis was retained. A Cohen’s $d$ coefficient of 0.58 was obtained, which represents a moderate effect size. When the sample means ($\bar{x}$) were observed, it is noted that there were gains. However, these gains cannot be attributed to the intervention in and of itself. This finding could suggest that the complexity of the research design requires additional controls to be put into place, especially those related to the duration of the intervention and the teacher training phase. As for the fourth hypothesis, the $t$-test yielded a level of significance of .113 (see Table 6). Based on this result, the null hypothesis was retained, meaning that no significant differences were found. It was concluded that the intervention in the comparison group (Group B), self-directed instruction, had no effect on the academic achievement of the seventh grade students in their science class. When the sample means ($\bar{x}$) were observed, it is noted that there were no gains whatsoever between the administration of the pretest and the administration of the posttest.

<table>
<thead>
<tr>
<th>Hypothesis</th>
<th>Sample means ($\bar{x}$)</th>
<th>$t$ Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Group A (pretest): ($\bar{x}$), 51.33</td>
<td>Group B (pretest): ($\bar{x}$), 46.87</td>
</tr>
<tr>
<td>2</td>
<td>Group A (posttest): ($\bar{x}$), 58.73</td>
<td>Group B (posttest): ($\bar{x}$), 46.27</td>
</tr>
<tr>
<td>3</td>
<td>Group A (pretest): ($\bar{x}$), 51.33</td>
<td>Group A (posttest): ($\bar{x}$), 58.73</td>
</tr>
<tr>
<td>4</td>
<td>Group B (pretest): ($\bar{x}$), 46.87</td>
<td>Group B (posttest): ($\bar{x}$), 46.27</td>
</tr>
</tbody>
</table>

Table 6. Sample means ($\bar{x}$) and $t$-test results for each of the four hypotheses.

In addition to the administration of the pre and posttest, data were also collected from the responses provided by the participants in the comparison group (Group B) in their SRL strategy use logs. This instrument was administered on four occasions during the intervention in order to gather information on the use and frequency of the SRL strategies that were included as part of the intervention. It was observed that, according to the responses recorded by the participants, the strategies that were most frequently used were those that are part of their daily routine and those that did not require higher levels of cognitive and metacognitive ability (see Table 7). Hence, in general terms, participants reported engagement in learning activities that did not require a greater investment of time and effort than what they normally engage in on a day to day basis, such as: 1) paying attention to the observations of the teacher; 2) taking organized notes; 3) taking notes during class time; 4) keeping a record of their performance in their notebooks; 5) revising their work, and 6) using memorization techniques to study.
SRL strategies most frequently used  

<table>
<thead>
<tr>
<th>Strategy</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>I paid attention to the observations of the teacher (M)</td>
<td>88</td>
</tr>
<tr>
<td>I took notes in an organized manner (C)</td>
<td>77</td>
</tr>
<tr>
<td>I took notes during class (C)</td>
<td>73</td>
</tr>
<tr>
<td>I kept a record of my performance in my notebook (M)</td>
<td>72</td>
</tr>
<tr>
<td>I revised my work (M)</td>
<td>67</td>
</tr>
<tr>
<td>I used memorization techniques (C)</td>
<td>50</td>
</tr>
</tbody>
</table>

Note: M refers to metacognitive strategies; C refers to cognitive strategies

Table 7. SRL strategies most used by students according to strategy use logs (Group B)

Contrarily, the strategies that were identified in the SRL strategy logs as being used less frequently were those that require a greater investment of time and effort on the part of students (see Table 8). They also require higher levels of cognitive and metacognitive development. The metacognitive strategies that the participants did not use frequently were: 1) correcting and improving their work, and 2) engaging in self-reflection of their work. By the same token, the comparison group participants (Group B) did not use higher order cognitive SRL strategies, such as: 1) using abbreviation techniques to study; 2) preparing illustrations, diagrams, drawing, graphs, tables, graphic organizers, and outlines; 3) using abbreviation techniques, rhymes, acrostics, acronyms, and acronym sentences to study; 4) reading the course material every day and practicing the class material out loud, and 5) consulting and studying with others.

SRL strategies used less frequently  

<table>
<thead>
<tr>
<th>Strategy</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>I corrected and improved my work (M)</td>
<td>48</td>
</tr>
<tr>
<td>I engaged in self-reflection of my work (M)</td>
<td>47</td>
</tr>
<tr>
<td>I used abbreviation techniques to study (C)</td>
<td>43</td>
</tr>
<tr>
<td>I prepared illustrations, diagrams, and drawings of the material (C)</td>
<td>32</td>
</tr>
<tr>
<td>I prepared graphs from the material (C)</td>
<td>30</td>
</tr>
<tr>
<td>I consulted with others whenever I had doubts</td>
<td>27</td>
</tr>
<tr>
<td>I prepared tables from the material (C)</td>
<td>25</td>
</tr>
<tr>
<td>I prepared graphic organizers from the material (C)</td>
<td>22</td>
</tr>
<tr>
<td>I prepared outlines from the material (C)</td>
<td>18</td>
</tr>
<tr>
<td>I made acronym sentences from the material (C)</td>
<td>17</td>
</tr>
<tr>
<td>I made acronyms from the material (C); I practiced the material out loud (C)</td>
<td>15</td>
</tr>
<tr>
<td>I studied with other people; I made rhymes from the material (C)</td>
<td>13</td>
</tr>
<tr>
<td>I made acrostics of the material (C)</td>
<td>12</td>
</tr>
<tr>
<td>I read the course material every day (C)</td>
<td>8</td>
</tr>
</tbody>
</table>

Note: M refers to metacognitive strategies; C refers to cognitive strategies

Table 8. SRL strategies less used by students according to strategy use logs (Group B)
In both groups, participants were given the opportunity to evaluate the student manual in two different ways. First, they evaluated each of the topics included in the manual, and secondly, they provided an overall evaluation of the student manual as a learning resource. With regards to the topics covered in the manual, significant differences can be observed between the responses of the participants in the experimental group (Group A) and those provided by the participants in the comparison group (Group B). The participants from the experimental group (Group A) considered that the topics were important (96%) and that the information helped them in their studies (88%). They also expressed that the information was presented in an organized manner (90%) and that the activities were clear (84%). Finally, 91% of the participants from the experimental group (Group A) reported that they learned about the topics presented in the student manual (see Table 9). The participants in the comparison group (Group B) reported less exposure and less interaction with the student manual. Although most of them considered the topics important (81%), only 46% thought that the information helped them in their studies; 58% considered that the information was presented in a clear manner, and 53% thought the activities were clear. Only 46% reported learning about the topics contained in the manual. It is worth noting that, in the comparison group (Group B), some participants did not provide answers in certain instances. They expressed that they did not feel comfortable providing an answer because they had neither read the information, nor tried to complete the activities in the manual.

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Group A (%)</th>
<th>Group B (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>C</td>
<td>P</td>
</tr>
<tr>
<td>The topics are important.</td>
<td>96</td>
<td>4</td>
</tr>
<tr>
<td>The information helps me in my studies.</td>
<td>88</td>
<td>12</td>
</tr>
<tr>
<td>The information was presented in an organized manner.</td>
<td>90</td>
<td>10</td>
</tr>
<tr>
<td>The activities were clear.</td>
<td>84</td>
<td>16</td>
</tr>
<tr>
<td>I learned about the topic.</td>
<td>91</td>
<td>9</td>
</tr>
</tbody>
</table>

Note: C, Complies; P, Partially complies; NC, Does not comply; NR, Did not respond.
N=30: Group A, n=15; Group B, n=15

Table 9. Results for the evaluations on the topics covered in the student manual.

The difference in terms of the exposure and interaction with the manual between groups is further confirmed by the overall evaluations on the student manual administered to the participants (see Table 10). In the experimental group (Group A), 80% of the participants read the manual, and 73% had a chance to work on the exercises, whereas in the comparison group (Group B) the results were 20% and 40%, respectively. Most of the participants in the experimental group (Group A), considered that the information helped them
in their studies, whereas 67% reported that they understood the information contained in the manual. However, of the 15 participants in the comparison group (Group B), only 54% indicated that the information helped them in their studies, and 40% expressed that they understood the information in the manual. Again, these results show that the participants in the experimental group (Group A) had more exposure to and interaction with the SRL strategies when compared to the participants of the comparison group (Group B). Finally, when asked if they would recommend the manual for other students to use, 87% of the participants from the experimental group (Group A) expressed that they would recommend the manual, as opposed to only 73% from the comparison group (Group B).

<table>
<thead>
<tr>
<th>Criteria</th>
<th>% Group A</th>
<th>% Group B</th>
</tr>
</thead>
<tbody>
<tr>
<td>I had the chance to read the manual.</td>
<td>80</td>
<td>20</td>
</tr>
<tr>
<td>I had the chance to work on the exercises.</td>
<td>73</td>
<td>40</td>
</tr>
<tr>
<td>This information helps me in my studies.</td>
<td>87</td>
<td>53</td>
</tr>
<tr>
<td>I understood the information in the manual.</td>
<td>67</td>
<td>40</td>
</tr>
<tr>
<td>I would recommend this manual for other students to use.</td>
<td>87</td>
<td>73</td>
</tr>
</tbody>
</table>

N=30: Group A, n=15; Group B, n=15

Table 10. Results for the student manual evaluations.

10. Conclusions

Growing concerns in Puerto Rico over the low performance levels in the middle school science standardized test call for the identification of methods that have the potential to improve academic achievement. A study was designed in order to determine if teaching cognitive and metacognitive SRL strategies had an effect on the academic achievement of seventh grade students in the science class. The study used an experimental design with a pre and posttest and comparison group. The two interventions were: a) the direct and explicit instruction of cognitive and metacognitive self-regulation strategies in the experimental group (Group A), and b) self-directed learning in the comparison group (Group B). SRL has been hailed as a viable process to improve academic achievement in a variety of educational scenarios. The development of self-regulation abilities through the instruction of cognitive and metacognitive strategies promotes self-directed strategic students that are proactive and independent learners (Davis and Nietzel, 2011; Vassallo, 2011). Studies on self-regulation suggest that there is a positive correlation between self-regulation levels and academic achievement, and that high SRL is a predictor of academic success (Germeroth and Day-Hess, 2013; Nilson, 2013; Kumi-Yeboah, 2012; Zimmerman and Schunk, 2011; Schunk and Usher, 2011; Moos, 2011; Zumbrunn, Tadlock, and Roberts, 2011; Tuckman and
Kennedy, 2011; Kistner, Rakoczy, Otto, Dignath, Büttner, and Klieme, 2010; Peters and Kitsantis, 2010; Eilam, Zeidner, and Aharon, 2009; Zimmerman, 2008). Therefore, cognitive and metacognitive self-regulation strategies can be and should be incorporated as part of the teaching-learning process.

The cognitive strategies considered in this study were related to how students study and learn the information provided in the seventh grade science course, strategies for the management and organization of information, and strategies for the interpretation and the representation of information. The metacognitive strategies considered were related to self-monitoring, self-evaluation, self-reflection, and teacher feedback. Both the experimental group (Group A) and the comparison group (Group B) had access to the learning resources and activities developed for the study. The intervention in the experimental group (Group A), the direct and explicit instruction of cognitive and metacognitive SRL strategies, is a method of instruction that presents itself as a viable alternative to improve academic achievement, especially for middle school students. The intervention in the comparison group (group B), self-directed instruction, presupposes that students have highly developed cognitive and metacognitive skills along with high levels of motivation and self-efficacy.

With regards to the first hypothesis, results from the Shapiro-Wilk normality test and Levene’s test suggest that there were no significant differences between the sample means ($\bar{x}$) from the scores of the pretest of the experimental group (Group A) and the comparison group (Group B). The null hypothesis was retained, which means that the sample was normally distributed and homogenous. The second hypothesis compared the sample means ($\bar{x}$) from the scores obtained from the posttest of the experimental group (Group A) and the comparison group (Group B). The significance level obtained from the $t$-test was lower than the significance level established by the research team. Thus, the null hypothesis was rejected. According to these results, the intervention in the comparison group (Group A) had a greater effect on the academic achievement of the seventh grade participants in science and was more effective than the intervention in the comparison group (Group B). This result confirms the results of other studies that have found that the direct and explicit instruction of SRL strategies can improve the academic achievement of students (Kistner, Rakoczy, Otto, Dignath, Büttner, and Klieme, 2010; Eilam, Zeidner, and Aharon, 2009). Therefore, when students are exposed to SRL strategies and presented with the opportunities to interact with and use these strategies, they are in a better position to increase their academic achievement as opposed to allowing them to develop the strategies on their own without necessarily being ready to do so.

The third hypothesis compared the sample means ($\bar{x}$) obtained from the scores of the pre and posttest administered to the experimental group (Group A). According to the results, the null hypothesis was retained. Upon
calculating Cohen’s $d$, it was determined that the effect of the intervention was moderate, which leads to conclude that, although there was a moderate effect suggesting that the intervention was effective, it was also quite probable that greater controls needed to be put into place in order to observe a greater effect as a result of the intervention. The fourth hypothesis compared the sample means ($\bar{X}$) obtained from the pre and posttest administered to the comparison group (Group B). According to the results from the $t$-test, the null hypothesis was retained, and it was concluded that the intervention provided to the comparison group (Group B), self-directed learning, had no effect on the academic achievement of the seventh grade students. Therefore, it was deemed as not effective when compared to the direct and explicit instruction of cognitive and metacognitive SRL strategies.

The participants in both groups also completed evaluation forms. The results provide evidence to sustain that the participants in the experimental group (Group A) were exposed to and interacted with the SRL strategies to a greater degree when compared to the comparison group (Group B). This data reaffirms the conclusion that when seventh grade students are exposed to and given the opportunity to interact with SRL strategies through a variety of activities and tasks that are incorporated into the educational process in the science class, it is possible to observe an increase in their academic achievement. Under the guidance of the teacher, the participants in the experimental group (Group A) read the student manual, worked on the activities, and understood the information on cognitive and metacognitive strategies. The comparison group participants (Group B) reported only a limited amount of interaction with the student manual. Thus, it is possible to conclude that, when complemented with additional educational resources that integrate SRL opportunities, the direct and explicit instruction of SRL strategies helps improve academic achievement. On the other hand, a limited exposure to and little to no interaction with SRL strategies may account for the fact that the impact of the intervention in the comparison group (Group B) on academic achievement was not observed.

The results of the strategy use logs completed by the participants in the comparison group (Group B) reinforce these conclusions. According to the responses, it was evident that there was limited use of the strategies in the comparison group (Group B), there was limited exposure to the strategies and, for the most part, participants were not inclined to invest the time and effort towards learning. The strategies used in the comparison group (Group B) were identified as the basic strategies that students ordinarily implement to get by on a day to day basis, such as: note taking, recording their test results, and memorization techniques. Most reported that they did not engage in the use of the SRL strategies that require a high level of cognitive and metacognitive development. These results suggest that in self-directed learning, much depends on the initiative of the student and the ability to effectively use SRL strategies in order to observe an effect on academic achievement, effect that
was not observed in the comparison group (group B). It was evidenced that the direct and explicit instruction of cognitive and metacognitive SRL strategies has a greater effect on the academic achievement of seventh grade students in their science class than self-directed learning. Moreover, self-directed learning has no significant effect on academic achievement unless the student exhibits a high degree of cognitive and metacognitive development. Also, teachers play an essential role in the development of cognitive and metacognitive abilities in students, particularly when reinforced through effective modeling techniques. This, in turn, depends on teacher training programs that promote modeling as part of the instructional process, the development of educational resources, and the use of effective feedback systems to strengthen metacognition in students. Finally, it is possible to develop a profile of the characteristics of students that are self-regulated and that exhibit high levels of cognitive and metacognitive development. The adoption of SRL-based educational scenarios imply: 1) the development of pertinent learning materials that include SRL strategies; 2) the development of instruments, activities, and learning tasks based on SRL; 3) teacher training programs on effective modeling techniques; 4) the adoption of SRL strategies as part of the curriculum, and 5) access to opportunities for the development of SRL strategies.

Recommendations can be made for the field of education and for future studies. For the field of education, it is important to observe that SRL appears to be a viable tool to deal with the problem of low academic achievement in the seventh grade science course. Therefore, the adoption of the direct and explicit instruction of cognitive and metacognitive strategies as part of the seventh grade science curriculum and instructional process through the establishment of public policy, the identification of educational resources, and the allocation of financial resources to enable and facilitate teacher-training programs is recommended. These programs should emphasize effective modeling of cognitive and metacognitive strategies, lesson planning based on SRL strategies, the development of SRL activities in the classroom, and effective feedback techniques. For future investigations, other teaching models and methods that explore SRL should be considered. Also, it is possible to carry out studies with different designs that incorporate greater controls in terms of teacher training, the time allotted to the interventions, the experimental design itself, and the inclusion of students in the validation of instruments, among others. Finally, the use of other research methodologies is to be considered.

In conclusion, self-regulation is the process through which learners transform their mental abilities into academic performance skills (Zimmerman, 2010). This study explored the effect of cognitive and metacognitive self-regulation strategies as seen from the perspective of an active, dynamic process that can be maximized to improve academic achievement. The development of cognitive and metacognitive abilities is
strengthened by putting in the time and the effort, and through effective models that incorporate SRL strategies as part of the instructional process. With the challenges brought on by contemporary educational scenarios, the direct and explicit instruction of cognitive and metacognitive SRL strategies presents itself as an effective tool to attend to the academic needs of the seventh grade student in the science class, in order to learn to learn, especially as part of the skills that are emphasized for success in the 21st century.

References


