From Users to Technological Mediators: Experiences of pre-service teachers incorporating VR and AR technologies in their initial teaching strategies[*,**]

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Abstract. Many universities, that are forming future teachers had realized massive investments on technological infrastructure and the modification of curricular grids, in order to develop and improve the digital competences in education. The aim of this document is to exhibit the principal intervening conditions – both facilitating and hindering – which are present when these pre-service teachers begin to incorporate virtual reality (VR) and augmented reality (AR) technologies on their initial teaching strategies during their supervised internships. For this purpose, eleven semi-structured interviews were conducted with third-year pedagogy students from a Chilean university, which were analyzed on a descriptively and relationally level using the procedures of the Grounded Theory. The discoveries have shown a dimmed perception of the benefits obtained using technologies on terms of innovation for the students; at the same time disappointment and critic are noticed regarding the real contribution of technology in promoting quality learning. The data highlight the value and necessity of specific training to integrate technology in the classroom, as a transition from being a user to being a technological mediator.

Keywords: Pre-service teachers, Digital Competences in education, VR, AR, University teacher formation, Grounded Theory.

1 Introduction

One of the most difficult requirements to achieve for pre-service teachers, is to be capable to design learning experiences with higher quality rather than those they experienced during their own schooling. This qualitative requirement is not only necessary for classroom innovation, as nowadays there is a greater availability of interesting resources that can aid in achieving the intended learning objectives and, consequently, improve school effectiveness.

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One of these new resources are technologies, despite that they're widely used daily, they still do not have a further uptake in the educative field, since they need to have appropriate mediators. Incorporating technology in the classroom does not simply mean placing the students in front of sophisticated electronic devices or replacing the blackboard with a touch screen [1]; it goes much further than that. There is a wealth of available research that provides various effective approaches for this harmonious integration [2] [3] [4], ranging from the efficient use of technology [5] to different lists of strategies that meet diverse student needs. Findings indicate a positive correlation between digital competencies and TPACK competencies [6], and comprehensive frameworks have been made available to the community, illustrating how different countries and regions are understanding the necessary digital teaching competencies for successful integration of technology in the school setting [7] [8].

However, in certain opportunities successful narratives that come from studies collide with the shy voice of pre-service teachers, the ones who are still learning the use of technologies for educational purposes. This omission of reality sometimes has been criticized [9], since any succeed in technology-based model requires, the previous knowledge, experiences, and beliefs of teachers. It also must be considered the access that they historically had to these sources and how is the quality of their first implementation experiences in real academic contexts [10].

The present research was aimed to visualize how the pre-service teachers experience the process of the incorporation of technology into their educational practices. It is important to recognize this phenomenon from those who are living the experience of learning-to-teach-progress, since their results could be considered meaningful for making decisions regarding possible modifications or adjustments to the curriculum implemented in their university-level training programs.

The general objective of the research was to describe and analyze the narratives of pre-service teachers when they begin to incorporate technologies into their initial teaching strategies. The specific objectives were as follows: a) to describe the experience of integrating AR and VR technologies for the first time in designed learning strategies; b) to identify the intervening conditions (both obstructive and facilitating) for the successful implementation of these methodologies; and c) to describe and analyze the notions, assumptions, and beliefs of pedagogy students as they transition from being users to becoming technological mediators.

2 Strategies and research methods

2.1 Assignment and design of the research

All pre-service teachers belonging to a Technology for Learning course were given the same assignment: they had to design a 60-minute learning experience for twenty 4th and 5th grade students, incorporating AR or VR at some point. The experience had to be related with each learning objective for each grade level. The subjects covered were Spanish language and communication, mathematics, social sciences, natural sciences, and socio-emotional development. VR headsets and high-speed internet-connected tablets were provided for all students. In addition to designing their own

proposal, each teacher had to assist in implementing a colleague's lesson. As a result, each of them gained the experience of implementing at least three technology-mediated classes. The pre-service teachers were interviewed after the conclusion of these interventions.

To describe and analyze the conditions experienced by pre-service teachers during their process of incorporating technology into their pedagogical practice, a qualitative descriptive-relational research based on the Grounded Theory by Glasser & Strauss [11] and Strauss & Corbin [12] was conducted. This methodology, was defined by its authors as an inductive method for developing theoretical models [13], used in this case to describe and explain reality as experienced by its participants, with the aim of generating conceptual models that deepen the understanding of the research subject.

The methodology involves steps directly related to participant selection, data collection, and data analysis, which are carried out concurrently rather than sequentially, until theoretical saturation is achieved [14].

2.2 Participants and strategies for data production.

The participants in this research are third-year students of the Elementary Education program at a university located in Santiago, Chile. The originally considered inclusion criteria were as follows:

- Students that put into practice a pedagogical intervention, meaning that they design learning experiences for schoolchildren based on a previously given learning objective.
- Students who are currently taking or have completed the subject ‘’Technologies for Learning’’, where they specifically learned how to use Virtual Reality (VR) and Augmented Reality (AR) in the school setting.

Table 1 displays the final composition of the participants: 11 students (8 females and 3 males), all of whom met the previously mentioned inclusion criteria.

Table 1. Characteristics of the informants

Assigned Name	Age	Gender	Occupation
Inf01	23	Male	College Student
Inf02	35	Female	College Student
Inf03	23	Female	College Student
Inf04	26	Female	College Student
Inf05	22	Male	College Student
Inf06	20	Female	College Student
Inf07	21	Female	College Student
Inf08	46	Female	College Student
Inf09	21	Female	College Student
Inf10	23	Female	College Student

Inf11	26	Male	College Student

The information collection and subsequent analysis were implemented in a parallel and recursive manner [15]. Contact with the participants was made via email, indicating the purpose of the meeting and the general topic of the conversation. The interviews were scheduled during the students' regular class time, so there was no need to allocate separate conversation spaces outside their normal schedule. At the beginning of each interview, the informed consent form was read and signed, with one copy being retained by the interviewee. The interviews were recorded in digital audio, transcribed using word processing software, and subsequently analyzed.

The data was collected through face-to-face individual semi-structured interviews. This strategy was chosen to ensure privacy and trust, in order to overcome potential anxieties or social desirability biases that can sometimes arise in collective techniques. Similarly, through open-ended questions, it allowed for the collection of more extensive information based on the interviewee's narrative [16]. A thematic guide was designed, which included a semi-structured outline that inquired about the process of incorporating VR and AR technologies into lesson designs. Additionally, questions were asked to delve deeper into emerging topics related to technologies and the experience of assuming the role of a mediator between technology and students. It is important to note that the flexible structure of the thematic guide allowed for the inclusion of new topics as theoretical saturation was needed regarding emerging data from the initial interviews.

2.3 Data analysis.

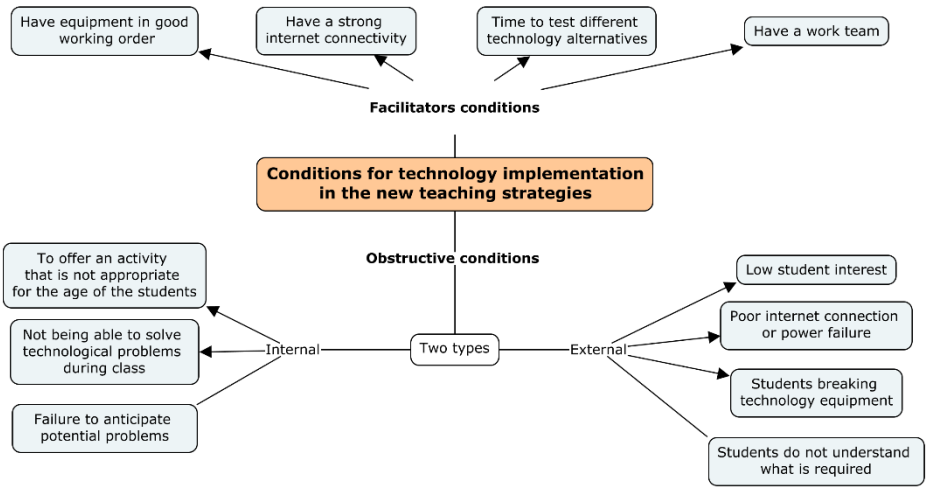
The data were analyzed using the open, axial, and selective coding procedures established by Grounded Theory [17] [18] [19]. The interview transcripts were examined based on the research's guiding questions, extracting concepts and phrases that allowed for the coding of the most relevant paragraphs. In first instance, open coding was conducted, identifying categories and subcategories (what topic is being discussed - what is being said about that topic). For this stage, the qualitative data analysis software NVivo was used. Subsequently, through the identification of relational patterns among the data, new guiding questions and hypotheses were generated, which were investigated and verified through additional interviews. The contrast between the different guiding questions and the new information allowed for the creation of axial coding models. Finally, a selective coding scheme was generated, which is a graphical representation of a representative model of the central phenomenon that emerged from the data analyzed at a descriptive and relational level.

3 Descriptive and relational results.

3.1 Descriptive results: Intervener conditions.

The interviewees identify various conditions that affect the process of implementing technologies into classroom strategies. They are classified into facilitating and limiting conditions, as illustrated below:

Fig. 1. Conditions for technology implementation in the new teaching strategies *(Made by the author)*



The interviewees consider that there are more conditions that hinder the implementation of technologies in the classroom than conditions that facilitate it. They struggle to find facilitating conditions as catastrophic thoughts about the future arise recurrently.

"I'm afraid about students realizing that I do not know everything they know (...) I have seen many students that use technological equipment better than me, and that can work against me. What would happen If students spent their time on the screen seeing things that are much more interesting to them than my classes?" (Inf02. p.12).

"The use of technology is always a Russian roulette: from one moment to another you can lose connection and your connectivity ends automatically'' (Inf08. p4).

Despite the above, the interviewees consider that, along with having basic technological conditions of technological implements and internet connection, belonging to a work team contributes to lowering anxiety regarding the success of their intervention.

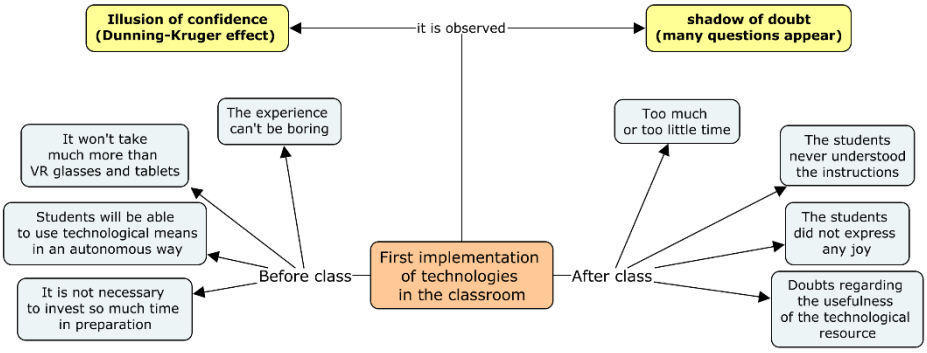
"When the equipment's are in good condition and you know that nothing wrong could happen, no matter what, I always comment my activity with the other teacher. She immediately tells me what could and could not result, because she knows the class very well and knows how they could react''. (Inf05. p.10).

"Every time that I implemented VR headsets or tablets, I asked for help to one or two teachers, but indeed, I do not ask them for help. I invite them to my classroom to make them learn how to use technology, and in a certain way they still end up helping me''. (Inf01. p.20).

3.2 Descriptive results: The experience of VR and AR implementation for the first time.

The interviewed students go through the VR and AR implementation experience in two contradictory moments, which are attempted to be reflected in the following graphic organizer (Table 3):

Fig. 2. Before and after the first implementation of technologies in the classroom. *(Made by the author)*



Prior to implementation, pre-service teachers express having experienced an excessive confidence based on the fantasy that everything technological is inherently educational. This directly manifested in dedicating a low amount of time to preparing materials, software, and calculating the necessary time for the activity to be fully developed. There is a fantasy that technology cannot be boring. The illusion of confidence experienced prior to implementation could be related to the so-called Dunning-Kruger effect [20] [21], characterized by a cognitive bias in which people with low skills for a task overestimate their ability. This effect is measured by comparing self-assessment with objective performance. Although we do not have an evaluation of the intervention's outcome in terms of achieving learning objectives, the students' narrative itself leads to infer this possible bias.

''The activity looked very simple on paper. The app I was using is very intuitive, and I thought the children would follow the proposed path" (Inf11. p.6)

‘’I mentally rehearsed everything that was going to happen, but nothing turned out as expected... (...) At one point, I realized that the students were not understanding anything of what I was saying" (Inf02. p.15)

‘’At one point, I noticed that the class was very quiet. Everyone had their VR headsets on... (...) but many of them, instead of watching the bee's journey, were watching a roller coaster video" (Inf11. p.6)

On the other hand, once their first intervention using technology was completed, the interviewees express a certain degree of frustration as the students' reaction was not as enthusiastic as they had anticipated. Doubts begin to arise regarding its usefulness, the cost-benefit calculation, and initial reflections on the true role of the teacher and the impact of technology on achieving the proposed learning objectives.

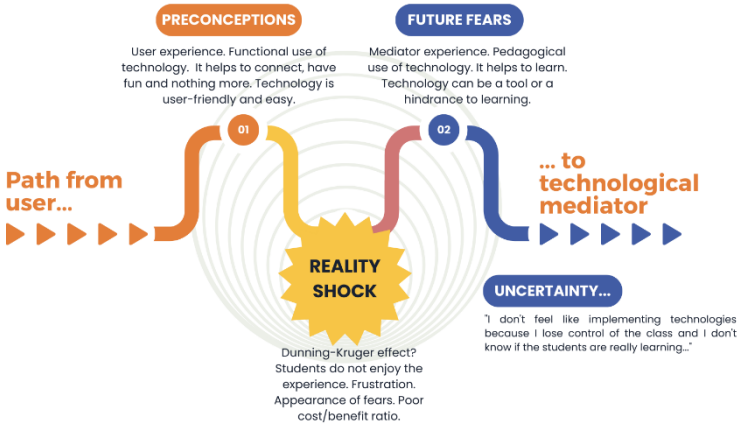
"I'm not sure if technology really contributed as I had thought. None of my students said, 'Teacher, that class was great,' they just left the room without saying anything. I thought they would be more excited." (Inf08. p.20)

"I put in a lot of effort to prepare and clean the tablets, the headsets, to charge them and have the apps ready for use. I spent a lot of time on that, and I'm not sure if the sacrifice was worth it, as maybe it would have been easier to achieve the same thing with a printed worksheet." (Inf10. p.16)

3.3 Relational Results: The Transition from User to Technological Mediator and Reflections on the Role of the Teacher.

The following is a preliminary outline of selective coding, aiming to gain a deeper understanding of the studied phenomenon. This framework attempts to synthesize the notions, assumptions, and beliefs of the pedagogy students in their transition from users to technological mediators. There is a sense of mourning and clash with reality as they realize that they now face the challenge of proposing learning experiences that rely on the autonomous work of students with technological means. This provokes uncertainty and anxiety as it implies "losing control" momentarily over the proposed activities. This loss of control (for example, allowing autonomous technological workspaces for students) is perceived as a threat to the very essence of their teaching role, which is characterized by constant control. Insecurities and ghosts of their initial interventions emerge as they realize that perhaps the Dunning-Kruger effect operated within them unconsciously. Figure 3 illustrates this dichotomy.

Fig. 3. Selective encoding: from users to technological mediators. *(Made by the author)*



The clash with reality adds to the inherent stress of the teaching profession. Unlike the pedagogical work they are learning, prospective teachers assume that technologies are easy to implement because they are more accustomed to them.

''When I saw that we would start incorporating technologies, I said, 'Great, this is my thing', but then I realized that it's not just a matter of arriving and implementing." (Inf02. p.16)

''I thought that using VR would make students more engaged in their learning (...) I have VR headsets at home, and sometimes I entertain myself with them, but I saw that they could not last more than 3 to 5 minutes with the headsets on. Technology needs to be complemented with several other things." (Inf01. p.7)

''I do not know if I will use technology in future practices. It's a lot of work and a lot of responsibility! What happens, for example, if a student break one of the tablets or VR headsets? They'll charge me for it, and I do not have the money to replace anything that gets broken. That's why I prefer paper, because if it gets damaged, it is just only that and nothing happens." (Inf9. p.20)

''Planning and preparing the material, setting up the room and the equipment, and making sure nothing gets lost. Monitoring what the students are doing... phew... it's a lot of things for one class. (...) Imagine If that class was scheduled for mid-morning, between breaks... you do not even have time to go to the bathroom." (Inf05. p.19)

The interviewees acknowledge the need not only to be familiar with the technologies but also to learn about experiences on how to incorporate them in large classrooms with many students.

''I would like someone to tell me the secret of how to work with many students and many technological devices at the same time. Some people told me it was like in a science laborato-

ry... but there, test tubes are only used as containers, not to find music or video games." (Inf04, p.22)

''I want to learn how to use technology well now, because I know that soon, schools will rely solely on them, and then no one will teach us." (Inf09, p.18)

4 Conclusions and discussion.

Based on the conducted analyses, the following hypotheses are presented as conclusions, with the intention of future verification through a deeper examination or an expanded sample:

H1: From an educational perspective pathway, the incorporation of technologies into the lesson plans of pre-service teachers without prior training can lead to early disappointment with this learning tool.

H2: The initial technological implementations in the classroom create additional stress in the teaching process for future educators; this implies that progressive experiences of integration should be provided, starting from small groups to larger ones.

H3: Paying attention to the previous experiences of future educators with technology is a necessary condition prior to training in digital teaching competencies and before developing the knowledge proposed as necessary by some pedagogical models (e.g., TPACK).

H4: If future educators do not have a well-integrated and theoretically worked out understanding of the transition from being users to becoming technological mediators, the clash with reality can be pedagogically traumatic.

The first experience with the integration of technologies regarding the design of learning experiences can be a pivotal moment for present and future teaching careers.

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