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A pedagogical model to develop teaching skills. The collaborative learning experience in the Immersive Virtual World TYMMI

María Graciela Badilla Quintana [a,*], Sandra Meza Fernández [b]

[a] Universidad Católica de la Santísima Concepción, Unit of Educational Computing and Knowledge Management, Faculty of Education, Alonso de Ribera Avenue, 2850, Campus San Andrés, Concepción, Chile
[b] Universidad de Chile, Faculty of Philosophy and Humanities, Capitán Ignacio Carrera Pinto Avenue, 1025, Ñuñoa, Santiago, Chile

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ABSTRACT

The initial training of quality teachers is seen as a key to improving the learning outcomes of students in Chile. The TYMMI project is one of the initiatives being developed to provide a space for simulation for teaching practices in immersive virtual environments in Second Life and Open Sim. Initial Teachers Training belong to the School of Education at the Universidad Católica de la Santísima Concepción, participated during 2014 in the implementation of challenges, based on a pedagogical model and teaching strategies such as role play and problem-based learning. Through direct observation and blogs, the results show that participants have an important domain in the pedagogical and technological interaction. Despite the perception of the technical difficulties of using platforms, students emphasize that the experience has been supportive along their teaching practices, and it has allowed them to reinforce subject content, which poses a very motivating intellectual and technological challenge.

1. Introduction

Despite the efforts of the Chilean Government to strengthen the teaching profession (MINEDUC, 2011), and thus the quality of initial training as a key to improve the results of students' learning , the assessment knowledge and skills graduates of teacher education programs have not been successful. There is a consensus about the strategic importance of the initial training of teachers under the assumption that this could have an effect on the academic achievement of students in the scholar system (Sotomayor, Parodi, Coloma, Ibañez, & Cavada, 2011). In this context we must add the great heterogeneity and diversity of students, a challenge that to which teachers must respond appropriately. Several countries are aware of this situation, and thus they have been reforming their educational systems. Tedesco (2011) suggests that awareness has been raised about the enormous complexity and difficulty of changing the patterns in the functioning of educational systems.

The Information and Communication Technologies (ICT) are powerful tools that facilitate the teaching and learning processes in the new digital era. Monterroso and Escutia (2014) indicate that higher education in the twenty-first century cannot be conceived without the use of such technologies. It is a challenge for teachers to implement educational innovations, the use of the advantages they offer to optimize learning, promoting collaborative and cooperative learning, and the development of new skills and cognitive skills of students who are going to face their professional future.

The emergence and characteristics of new technologies such as virtual worlds offer the prospect of promoting student learning and commitment, if they are properly applied in educational contexts (Warburton, 2009). Jerónimo, Andrade, and Robles (2011) indicate that 3D world scenarios favor the inclusion of teaching strategies such as role play, problem-based learning and case studies.

The main research question guiding this research focuses on respond "Which is the contribution of Immersive Virtual Worlds in developing pedagogical and technological skills from the perspective of students in Initial Teacher Training?" This research involves the implementation of activities to simulate pedagogical practices in Immersive Virtual Worlds (IVW), specifically in *Second Life* and *Open Sim* through an island called TYMMI, where students exert an active role in generating different teaching strategies and activities that recreate those common scenarios in everyday classrooms. These spaces are designed thanks to the contributions of the project *Fondecyt 11121532: Technology and Pedagogical Models in Immersive Worlds*, funded by the *National Commission for Scientific and Technological Research, CONICYT –*

* Corresponding author at: Universidad Católica de la Santísima Concepción, Unit of Educational Computing and Knowledge Management, Faculty of Education, Alonso de Ribera Avenue, 2850, Campus San Andrés, Concepción 4070129, Chile. Tel.: +56 41 2345360.

E-mail addresses: mgbadilla@ucsc.cl (M.G. Badilla Quintana), smeza@uchile.cl (S. Meza Fernández).

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Chile, in order to complement classroom teaching and strengthen vocational training of Initial Teacher Training students at the Universidad Católica de la Santísima Concepción.

2. Immersive Virtual Worlds

Higher education in the twenty-first century cannot be conceived without ICT. It poses a challenge for teachers to implement pedagogical innovations and use of the advantages they offer to optimize learning, promotion of collaborative and cooperative learning, and the development of new skills and cognitive skills of students throughout their academic careers toward their professional future.

Through the use of software developed to implement Immersive Virtual Worlds, ICT have contributed to education by finding new ways to deliver content to students in an engaging, playful and dynamic manner. One of the main features of the IVW is the possibility of social interaction in real time and manipulation of objects in the virtual world, allowing the feeling of being in a space of freedom and creativity in a controlled environment, with real changes.

Over the last years, Second Life and Open Sim have been used for professionals as a virtual environment in order to see their utility in different fields (Chena, Wardenb, Tai, Chen, & Chao, 2011). The educational field has been tested too. It has shown how the classroom can be transformed into a digital space and how students can take different appearances when they become an avatar.

A virtual world is known as a digital multimedia online environment inspired in reality, where users can interact with each other through avatars, understood a feature of Second Life is to be a cross-platform software with three-dimensional features, with unique settings, easy to remember, it can run on Linux, Macintosh and Windows. It was developed by Linden Lab, a U.S. private corporation, in 2003 (www.secondlife.com). The following benefits of Second Life can be remarked by Hundsberger (2009, p. 8):

- *Three-dimensional format.* This makes the user experience more immersive and comprehensive than traditional textual scenarios based on interrelation and static images.
- *Active student role through manipulating their avatar roles*. The role of the teacher and the student is redefined. Students are responsible of exploring and immersing themselves in the process.
- *Collaborative relationship* among students by means of the training environment itself.
- *Learning as a game*. Students move through different three-dimensional (3D) places, explore and learn while enjoying their experiences.

In 3D environments, the visual and kinesthetic aspects are present continuously, because individual differences are evident in the ways of learning and user participation (Iribas, 2008).

The Open Simulator project, dating back to 2007, was conceived as an open source program, which means that everyone can use it freely. It is a 3D application server that can be used to create a virtual environment (virtual world) that can be accessed through a variety of clients, on multiple protocols (viewers). Each developer can create their own world according to their needs, as the basic software can be extended or adapted in a modular fashion to accommodate custom configurations.

2.1. The potential of virtual worlds in education

Virtual environments, especially those with multiple simultaneous users, have become known for their usefulness: promoting constructive learning (De Lucia, Francese, Passero, & Tortora, 2009; Jamaludin, Chee, & Ho, 2009), collaborative learning (Jarmon, Traphagan, Mayrath, & Trivedi, 2009), improving critical thinking (Herold, 2010), allowing developing technological skills (González & Blanco, 2011), and they are considered as a didactic resource for teaching as well (Rodríguez & Bañados, 2011).

The potential of virtual worlds today are that learning processes do not take care of the demands that the work environment are requested to education professionals, so the creation of three-dimensional educational settings could generate an additional advantage to the traditional methodologies, allowing users to interact in simulated work environments. Checa (2011) states that teachers become a facilitator in the metaverse, abandoning their traditional role as mere transmitters of concepts or content. Outside the virtual world classroom teachers act as a guide providing clues to solve encountered problems, and they are the companions of student, thus guiding processes within the metaverse. According to Pellas (2014) instructors and monitors should be encouraged to discern the students' engagement with artifacts in this environment, learning materials, and study through collaborative – interactive workflow.

Some of the advantages of using virtual worlds for education are the multiple possibilities for distance education in a way which can help the feelings of isolation, loneliness and isolation students may experience during the distance-learning process (Poveda & Thous, 2013). According to Cheng (2014) active learners mostly valued the ease of use and usefulness of SL whereas verbal students were mostly satisfied with the communication and identity features in SL. Besides, the study also identified some practical problems with the use of SL in education including insufficient teaching and learning time, limited mode of communication with instructor and inadequate equipment for running SL.

2.2. Empirical findings about simulating classroom behavior

Numerous sites exist about immersive educational projects for example N.I.C.E: Narrative-based Immersive Constructionists/Collaborative Environments, University of Illinois at Chicago; Dryad, Stanford University; MASSIVE: Model, Architecture and System for Spatial Interaction in Virtual Environments; The University of Nottingham; DIVE: Distributed Interactive Virtual Environment, at the Swedish Institute of Computer Science; VirtUAM, Opensim and virtual reality as network training system in education at Universidad Autónoma de Madrid; and SimAULA, focused on teacher training for primary education based on practices in 3D virtual world, led by the Open University of Catalunya, Coventry University, the University of Salerno, University of Sofia and the Greek school Ellinogermaniki Agogi. More than a 90 educational institutions offer college courses with support in three-dimensional environments: Laurea University of Applied Sciences, Finland; Indiana University, University of Denver, The University of Akron, Montclair State University, University of South Florida; all of USA; The University of Nottingham, United Kingdom; Chihlee Institute of Technology, Taiwan; Dongguk University, Republic of Korea; Madrid Open University, Spain; University of Silvaner, Panama; University of Western Australia, Monash University, University of New England, all of Australia; University of Wales, Wales; Tecnológico of Monterrey, México; The Abyss Observatory, Japan, between others. Despite this empirical research on the use of virtual worlds within teacher education seems limited.

Social networks and the virtual world offer a wide range of educational opportunities which make them conductive for learning scenarios in which students can further explore, meet other residents, socialize, participate in individual and group activities, as well as participating in the creation of environment (Griol, Callejas, & López, 2011).

Metaverses generate a number of positive reactions in the teaching of subjects where it was applied, allowing its classification as an efficient online teaching resource, considering student motivation and participation in the course dynamics.

In Spain, there are two experiences at Rey Juan Carlos University. Garrido and Rodríguez (2013) testing the OpenSim platform as a tool in teaching French to 108 tourism students. Main results obtained by the assessment shows that the process of language acquisition is positive. Rodríguez and Bañados (2011) highlight a significant improvement (92.3%) in the academic tutoring using SL, with 20 students of the Degree in Advertising and Public Relations online. Authors found a marked activation of communication between teacher–student (48% more) and student motivation perceived on the participants. Through their own observations, they rated the forum experience as positive. Another experience was a case study developed using OpenSim at the Universidad Autónoma de Madrid. 85 students for a degree in modern languages, economics or engineering were motivated toward language learning and to reinforce their comprehension skills (listening and reading) in VirtUAM platform combined with game-like applications. Main results are remarkable confirming that in all experiments the post-test score is higher than the pre-test score, and thus students learn when they use the game-like application.

Ferry et al. (2005) showed the effect of a computer mediated communication tool for improving literacy instruction skills. The simulation enabled the students to be involved in scenarios requiring a series of increasingly complex teacher interventions. Results showed that learners effectively analyzed situations by slowing or accelerating learning situations, and by revisiting them. Gao, Noh, and Koehler (2008) who examined quantitative differences in turn-taking during role-playing activities between a face-to-face activity and a SL activity. No differences were revealed in the amount of communication; however, in SL, students took more turns, and had more concept-related discussions.

Exploring the possibilities of integrating virtual worlds in pre-service teacher training, some authors reported positives outcomes. Girod and Girod (2008) focused on a simulation where teacher education students were assigned to teach six virtual K-12 students and then measured learning outcomes in order to adjust their next lesson. The authors found that the simulation had a positive, significant effect on the treatment group's abilities to connect their teaching to learning outcomes. Mahon, Bryant, Brown and Kim developed a qualitative research proposing educational simulation created within SL involving 20 undergraduate pre-service teachers enrolled in a teacher education course. Despite some students found the simulation too chaotic to enhance their learning, most of them did report that they learned something about classroom management techniques from the experience specially, gaining more experience managing student behavior. Cheong, Yun, and Chollins (2009) utilized SL as a venue for teaching practice for 150 students who were required to teach a lesson to their peers. Self-reports by the participants showed they believed SL to be a viable method to help them practice their teaching skills outside of the standard classroom.

3. Setting the TYMMI project

Strategically TYMMI has been implemented in Second Life and Open Sim virtual worlds. The other component is a Learning Management System (LMS) to the cataloging of resources and educational planning, which consists of a support platform for preliminary processes and post-teaching activities. In order to keep record of the activities, it has linked TYMMI students from Open Sim with in Moodle LMS (version 1.9) through the installation and configuration of a component called Sloodle (version 1.2).

3.1. A Conceptual and Technological Model for Teaching in Immersive Worlds, TEDOMI

The architecture to support pedagogical work in immersive environments developed by TYMMI project covers in one of the design phases a Conceptual and Technological Model for Teaching in Immersive Worlds, TEDOMI. This suggests the interaction of a set of processes with technology components to enhance the simulation focused teaching practices in 3D environments (see Fig. 1).

The process component proposes groups of actions that teachers could consult, to planning and/or implementing educational activities, ensuring an appropriate approach to use of the resource and meaningful curricular context. The technology component comprises: (1) computer systems that support teachers in the consultation, design and planning, and (2) the spaces created in immersive world's platforms where resources are available for use and teaching practice with this type of technology.

In these classroom environments a number of teaching resources have been implemented, whiteboards, projectors and computers. Once the technological spaces were enabled, technological readiness sessions with students of pedagogy were performed. With the idea of immersing users within environments and potential problems in the process of usability, it was given special emphasis to the technical requirements, the time used in sizing, the drawbacks of access and navigation, as well as formal aspects of the island; spaces such as distribution and objects, among others. The training lasted four hours and it was developed during 2013.

3.2. A pedagogical model for teaching in Immersive Virtual Worlds

Based on the previously described benefits of immersive environments for teaching, the educational model proposed focuses on building scenarios or situations that allow future teachers to make decisions and build meaningful learning experiences. This construction is manifested in the resolution of problems that students must solve, where the working variables are changed regularly. The working premise is: the greater the number of simulations performed, the greater expertise in developing training solutions will be acquired.

Therefore, a pedagogic model for work in immersive environments is proposed, which is based on the interaction process to be performed by participants with the elements that are made available for the development of the experience.

The variables that provide students are grouped into three categories as shown in Fig. 2.

A. Scenario: It is the context that the student should face, which is defined by the following elements:

- *Learning objectives*: students are placed in a referential situation in which they must perform. Class type (''normal'' class, cross-activity, extracurricular activities or training activities for parents, etc.), learning objectives, minimum content, etc.
- *Area*: refers to the spatial definition in which the student will have to perform. These spaces can be recreated in the immersive environment (a classroom, an organic farm, a factory, a field trip, field trip, between others).
- *Students*: are the particular group with which trainees will have to work. They are the recipients of the action of teaching.
- *Time*: consist in the time needed to fulfill the goal.
- *Task*: refers to the specific requirement that will be given to each student.

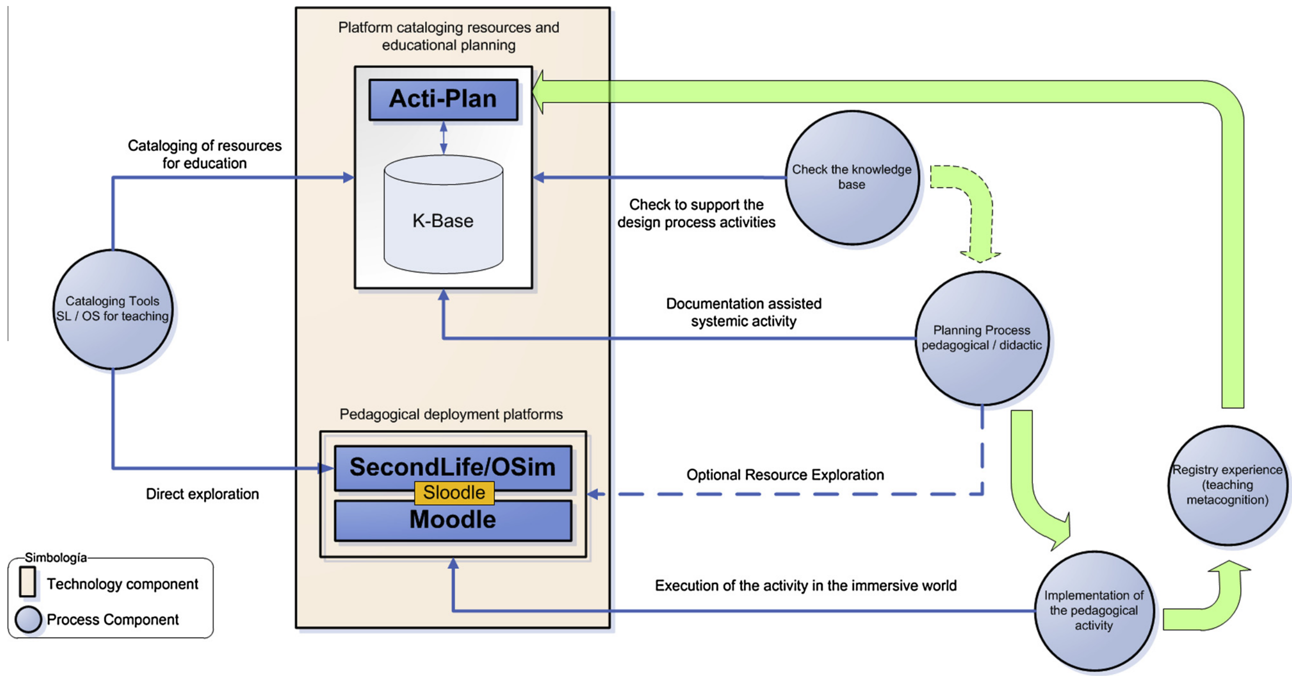

Fig. 1. TEDOMI as a Technological Model for Teaching in Immersive Worlds. (Source: Badilla, Prats, Careaga, Gacitúa & Vásquez, 2014).

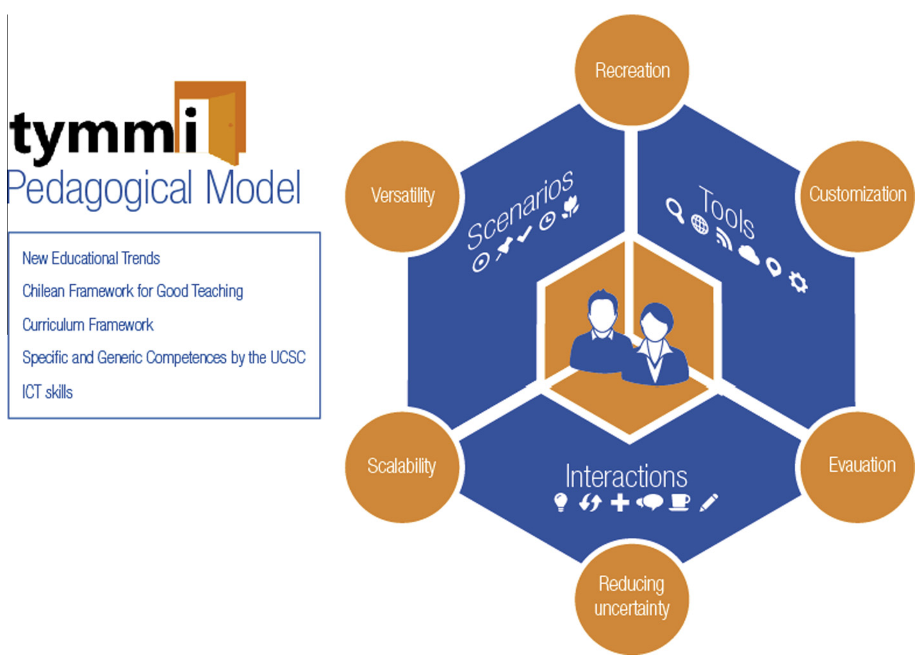

Fig. 2. Pedagogical model work in Immersive Worlds (by own elaboration).

B. Thread Tools: These are sources or instruments that will be provided to participants to unfold on stage. These may be:

- *Documents*: those resources that students need to develop their work. Advice, planning guidance and support resources.
- *Software*: programs that build solutions, Internet access, tutorials, etc.
- *Sources of Inspiration*: space in the immersive environment where students find resources of inspiration for the development of their work. These are multimedia resources such as videos, reference websites, blogs, Facebook groups, Twitter conversations and support texts, among others. The idea is to determine what type of material the student opts to use for learning.
- *Products*: The product is the implementation of the planned action. Throughout evidence, it is manifested that the student must submit for evaluation and reflection of their work. All evidence must be labeled, classified and be part of the Inspiration Phase, with the idea of feeding the system with new resources.

C. Interactions: in the development of the activity, participants should conduct exchanges of information with other agents that are both inside and outside the environment. It is very important for it to develop tools and skills to search for information and communication.

- *Teachers*: guiding student work and guide in solving problems.
- *Couple*: other students who perform or have performed work of a similar nature.
- *Students*: participate in learning actions developed by the participants.
- *Referrals*: participants who contribute or have contributed materials and resources that enable or produce inspiring results.

The work between scenarios, tools and interactions is done in an educational way through *Challenges* (*Reto* in spanish*)*, which from lowest to highest complexity, lead students to live experiences and build different types of solutions and tangible, such as product planning, classroom experiences, conversations or activities, among others. This evidence will help give strength to the work environment proposed by TYMMI.

The experience of each challenge has duration of two hours each, in which the following actors participate: students and the TYMMI team constituted by a moderator, a technical specialist and two observers. The challenges are organized from the lowest to the most complex, to lead students to live experiences and build different types of solutions and tangible products such as planning, classroom experiences, conversations or activities, among others.

It is demonstrated that student's engagement is being increased when learners are able to interact and create objects within a virtual environment (Herrington, Oliver, & Reeves, 2003). The activities in which the students were engaged in consisted of developing, designing and evaluating tools or technological artifacts, for example by constructing Prezi presentations or artifacts to connect LMS as Moodle, or Web sources as Youtube. Also they attending in collaborative activities that can be implemented according to the related interests or objectives of each challenge; manipulating training materials based on SL functional characteristics to teach, and migrating learning materials from other sources.

Planning activities can be very time consuming for participants if there is no appropriate assistance and instrumentation. To strengthen this process the platform allows them to plan their activities in an assisted manner, reducing the time spent on this task and increasing the quality and effectiveness of the design of the activities. This process is supported by ACTI-PLAN, software for cataloging and planning educational resources, specifically pedagogical planning functionality, where the teacher can define the context of the curriculum, steps for the development of the activity, learning strategies and technological resources to use (Badilla & Lara, 2013). Depending on the planned activity, the student runs the pedagogical action in selected deployment platform: Second Life or Open Sim, considering the possibility of integration with Moodle. Each pedagogical activity had duration of two hours.

This article included the ideas and experiences of challenges implemented on both platforms during six months, which were designed to strengthen specific skills related to educational planning, instructional design and performance in virtual environments (see Table 1).

In this context the following research objectives are proposed:

1. To validate the pedagogical model through practices in immersive learning environments to enhance the training of students within Initial Teacher Training.
2. To acknowledge the contribution of Second Life and Open Sim in developing pedagogical and technological skills from the perspective of students in Initial Teacher Training TYMMI involved the project.

Table 1
Pedagogical challenges created to teach in Immersive Virtual Worlds.

N°	Theme	Objective
1	To know the Immersive Virtual World	Its main goal is to use technological tools in an Immersive Virtual World and explore the Moodle environment and its task components
2	Activating asked questions	Focused in reflecting on the importance of activating questions to link prior learning experiences of students with the content they learn in a particular subject
3	Learning significantly with concept maps	Oriented to be able to represent mindsets synthetically, about relevant topics for students, taking children rights as one example, to promote the implementation of cross-educational activities in the classroom
4	Thinking with images in IVWs	Students have to create an object through the use of basic geometric figures available in the IVW and relate it to basic geometric concepts (eg. faces, angles, types of triangles and vertex).
5	Proposing learning strategies with Geogebra software	Students have to submit a teaching strategy in the area of geometry aimed at developing the skills of understanding and application of measurement to a primary level.
6	Developing Math Skills	The objective is to present a single teaching strategy that allows the development of mathematical skills in students, supporting their proposal with some software choice

4. Methodology

This research develops under a positivist and interpretative paradigms, with a descriptive and exploratory quantitative–qualitative approach. The role of the researcher is active. It is a cross-sectional investigation, since the TYMMI project has duration of three years, during which the experiences of simulation teaching practices are performed. Specifically, these preliminary results are obtained in the progress of pedagogical activities developed during the second year of the project, between January and June 2014.

4.1. Instruments of data collection and analysis procedure

There are three data collection instruments. The first is a **Spread sheet for challenge observation**, which aims to collect information about student performance during challenge development. The spread sheet consists of several statements grouped in relation to seven domains of teaching practice, Criteria and Descriptors. The domains are: Preparation for teaching, Creating an environment for learning, teaching for student learning, teacher professionalism, Implementation of cross-educational activities, Virtual World-Avatar, and Avatar–Avatar Interaction. The first four correspond to the domains of the *Framework for good teaching* proposed by the Ministry of Education in Chile (MINEDUC., 2008). The four performance levels related to the descriptors observed are: *Unsatisfactory, Basic, Proficient and Outstanding*. The values assigned to each of the categories are: 1–2 points; 3–4 points, 5–6 points, and 7–8 points, respectively.

Unsatisfactory competence means that the student no meets the condition for that level, Basic competence demonstrates knowledge in the condition to this level, or how to integrate it in Immersive Virtual World; Proficient competence demonstrates knowledge in the condition to this level, and knows how to integrate it in Immersive Virtual World; and finally Outstanding competence demonstrates knowledge in the condition to this level, and know how to integrate it in Immersive Virtual World, besides gather other conditions that make it stand.

The second instrument is a **Survey of Perception** of teaching practice, designed for the student, concerning technical and Pedagogical Aspects perceived as important after the completion of the challenges through an open question-answer format (see Table 2).

The third instrument is a **Student log book**, which aims to collect the perceptions of students in Initial Teacher Training in relation to the development of the proposed activities and their pedagogical and technological development.

The design of the virtual environment was validated by users and judgment of peers, while the data collection instruments were validated by experts in education and technology from Chile, Spain and England.

The method of data analysis from the first instrument was using descriptive statistic. Data analysis of the second instrument was developed using the technique of quantitative content analysis. The analysis of the student observations at the end of each challenge was performed by counting various issues or items of significance in a predetermined unit coding for analysis. The procedure is to read each transcript initially two or three times, with the aim of creating categories that will be part of each variable and dimension. At this stage, in some cases the words are converted into categories, as far as possible based on the data codes which are searched for. Here, while a comparison is made constant, several concepts or categories arise. In other cases, where opinions seem to be emerging from the data, coding using short phrases are considered more appropriate.

4.2. Participants

The sample of this research is constituted by 18 female students of second and third year of the Initial Teachers Training program to the Universidad Católica de la Santísima Concepción. Seven students participated in the SL platform, and eleven in OS. The method of sample selection was by invitation, with the inclusion criteria of being a student of the career, having completed at least one of the ongoing subjects and/or professional practice, and having participated in the processes of technological readiness of the island TYMMI.

Other two important parameters for students' participation in this project were:

(i) The implementation of the online sessions (from the overall 6 months).
(ii) The utilization of Second Life and Open Sim as an alternative platform in order to complete the entire online challenges that were finally implemented.

5. Results

5.1. Challenges observation results

These results emerge to develop the first objective, which focused on the implementation of a methodological model working in classrooms in SL, also it is possible to observe the performance showed by the students for accessing to these resources.

In Challenge 1 it was observed that 100% of participants *Proficiently* achieved a way to perform the outlined activities in the indicators in this domain, such as: walking fluently by IVW, moving from one place to another within the estimated time, teleports to other places according to instructions given, fly smoothly, takes its offset within an estimated time, use the chat efficiently, use educational resources available on the island, building appearance, displays Internet activities from the island, constructs geometric figures, interact socially, educationally and technically with their peers and the modeler and the caller asks questions about the use of resources and objectives of the activity (see Figs. 3 and 4). However, 71% of participants have a *Basics* domain level in the use of communication tools such as chat and microphone. 86% failed to socialize in learning activities using

Table 2
Technical and pedagogical questions of the Survey of Perception of teaching practice.

Open questions
1. Did you like the challenge? Use a positive adjective representing the strength of the challenge, and one negative to allow improve it
2. What activities would you add to the challenge?
3. What activities would you had eliminated the challenge?
4. What is your opinion about the moderator? Refer to the strengths and weaknesses of their performance.
5. Resources available on the island, did they were sufficient to understand and/or run the challenge?
6. Do you consider that the activities you did in this challenge will contribute to improve your professional performance? Briefly discuss why.
7. Were you able to access the island TYMMI?
8. What technological difficulties emerged during the activities?

Fig. 3. Activities developed by trainee teachers at TYMMI in Second Life.

Fig. 4. Activities developed by trainee teachers at TYMMI in Open Sim.

communication tools available on the platform, nor interact with peers to achieve the objective of the activity or help. 100% of participants obtained an *Outstanding* level in adding their appearance to objects available in the IVW.

In Challenge 2, 83% of participants had a level of mastery in the interaction with their peers to achieve the objective of the activity and provide assistance if required. 67% were categorized in the *Basics* domain when asking partners questions about the use of resources and the goal of the activity. The domains assessed as *Competent* and *Outstanding* were framed in 100% of avatar–avatar interaction, the pedagogical and social interaction with the facilitator to achieve the objective.

In the Challenge 3, 100% of participants we qualified as *Outstanding* in avatar–avatar interaction. 83% reported in the IVW via microphone and chat. The observed difficulties related to the implementation of working standards within and outside the classroom, and 50% have an *Unsatisfactory* qualification. It is noted that the difficulties seen in earlier challenges were solved in the past (challenge 3) and 100 % of students achieved the objectives.

In the Challenge 4, 60% of students achieved using educational resources available on the TYMMI island. Regarding to the domains *Preparing to teach* and *Creating an enabling environment for learning*, 100% of students achieve to understand the relationship of the contents of the sub-sectors with reality, knowing different styles of student learning, and organizing time efficiently in relation to the activities of the class.

In the Challenge 5, 100% of students use educational resources available on the island TYMMI, and are also able to deploy from Internet activities to TYMMI.

Results of the Challenge 6 show 100% of students interact socially with their peers to request and provide assistance if required, interact technically with peers to achieve the objective of the activity, interact with their peers on the instructions given by the moderator to achieve the proposed objective for the activity; and interact socially and pedagogically with the moderator to achieve the objective of the activity.

A general analysis shows that the total average of the challenges is equal to 4.6 points (on a scale of 1–8) as shown in Table 3. This means the average performance of the students in the challenges is in the *Basic Competency* category. It is observed that the challenge with a lower average, is the number 1 ($M = 3.2$ points) in which students performed at a level of *Proficient*; while the challenge with the highest level of performance was number 6 ($M = 7.3$ points), corresponding to the level of performance *Outstanding*.

5.2. Results of the Student log book

Personal reflections of student teachers expressed the following views on the strengths and weaknesses to the challenges. These

Table 3
Performance levels of the Initial Teachers Training observed by SL challenges.

N°	General mean
Challenge 1	3.2
Challenge 2	3.3
Challenge 3	4.3
Challenge 4	5.0
Challenge 5	4.7
Challenge 6	7.3
Total mean	4.6

findings indicate that students consider the simulation experiences lived as *relevant to their future work* as teachers: "I learned and I reinforced new techniques to present content, thanks to the different presentations of the partners, taking into account their views and strategies to use" (Challenge 2, Student 2).

Participants also consider that activities in challenges are developed with some *technological difficulties*, stating that "the only difficulty was technical problems" (Challenge 5, Student 1), "the development of the activity was a bit slow, especially for technical problems" (Challenge 3, Student 7), "the problem came at the end when defining the link in the panel which creates the room where the challenge is to be developed" (Challenge 2, Student 6), "I can say that I found it enriching and enjoyable; it also emphasized what activating questions are" (Challenge 2, Student 16).

Another aspect is that students mentioned how *interesting* it was to work in Second Life. "The activity was interesting, especially because we all have different perspectives on how we apply the activation questions in the development of a class, which can change according to the subjects and contents, while some require more reflection, others are more directed to check learning directly" (Challenge 2, Student 10). "I found Challenge 3 very interesting, because we watched some videos that would guide us in what we should make, which was to develop a concept map collaboratively but where we must agree with our colleague and put forward our ideas" (Student 4), "the application is a reminder of the challenge: apply, research, and select, depending on what is requested" (Challenge 6, Student 3).

The experience of *co assessment* was quite valued as feedback that enables student to improve their practices and know their strengths and weaknesses. In this aspect they reported that: "The option of co evaluation was very stimulating and beneficial" (Challenge 4, Student 13), "All the resources we use for feedback served much like voting tool, since it served to evaluate the activity and helps us know how to go about the challenges to feedback the teacher does" (Challenge 5, Student 5).

Another relevant aspect of the activities was the importance and enthusiasm shown by the participants to perform the *role play*: "I played the role of a teacher, I hope trying to successfully teach or pretend to teach my audience about geometric figures" (Challenge 5, Student 15).

Participants also considered the experience as *innovative*, noting that "that delved into experiences that do not know, because we never participated in a virtual island before" (Challenge 1, Student 2), "I seem to develop an activity like this with real students would be quite innovative, it may be difficult at the beginning, but then the students easily may adapt their behavior to the operation of the tool. It would be very easy for them to create many other figures, shapes, in addition to volume, angles and rotational movements" (Challenge 4, Student 2).

In relation to feedback and input from the moderator and teachers (teaching practices), the Initial Teachers Training students value positive their contribution because: "The teacher feedback is very objective and critical, which is very good to keep improving as future teachers" (Challenge 5, Student 11).

5.3. Results of the survey on perception of teaching practice

The analysis of the student's points of views at the end of each challenge was made considering five dimensions: Pedagogical Aspects, Immersive Worlds, Technological and Educational resources, Technological aspects and Moderator (the instructor of the challenge) (see Fig. 5).

Regarding the *Pedagogical Aspects* dimension, it is possible to note that the aspect with more sub categories created, as it was more addressed by the informant subjects.

Positive features shown are: capabilities acquired by students, reinforcements of thematic content, challenge, motivation and teamwork in performing these activities.

- *Capacity:* This category shows that participants consider different pedagogical skills being acquired with such practices.
- *Reinforcement of contents:* Students can reinforce the contents worked on other subjects by exercising them in the IVW and to be developing in their role as teacher.
- *Challenges:* It was stated that the challenges made were appreciated as an intellectual and technological challenge in these activities.
- *Motivation:* Participants of the challenges indicate that such experiences have been motivating in the practice of teaching through the IVW avatar.
- *Teamwork:* Students point those they we allowed them to work in teams, which has been a contribution to the activity.

About the *Immersive Virtual World* two subcategories may be mentioned: positive aspects and its potential as a teaching tool.

- *Teaching tool:* participants believe that SL and OS are technological tools that support them in their activities of teaching practices, in order to strengthen their professional skills for the future.
- *Positive aspects:* the positive aspects are related to the proposed activities considered as: entertaining, challenging, dynamic, interesting, eye-catching, creative, enriching and enjoyable.

Regarding the *Technological and Educational resources* dimensions, there are also two sub categories, which are:

- *Sufficient resources:* referring to both the quantity and quality of them for the activities presented in challenges such as whiteboards, chat, hyperlinks, layout objects themselves, multifunctional tools to present slides, abacus, calculators, magnetic letters, device that collects the votes of participants, Sudoku, among others.
- *Resources needed:* It was noted that the resources that are available in IVWs are sufficient and necessary for the fulfillment of the objectives of each challenge.

Finally, the dimensions of *Technological aspects* and *Moderator* or *Instructor* appear which contain two sub categories respectively:

- *Technical difficulties:* mainly related to the use of audio (no audio, squeaks and coupling, between others), chat situations (reading instructions are lost when reading and writing at the same time, failure to identify individuals who is behind the names of the avatars) and sometimes they have not been able to watch the videos (viewers were not updated); plus some problems with connectivity, browsers and graphic cards. They may also mention the difficulty in attending the challenges, as they were developed in the evening, absences were frequent.

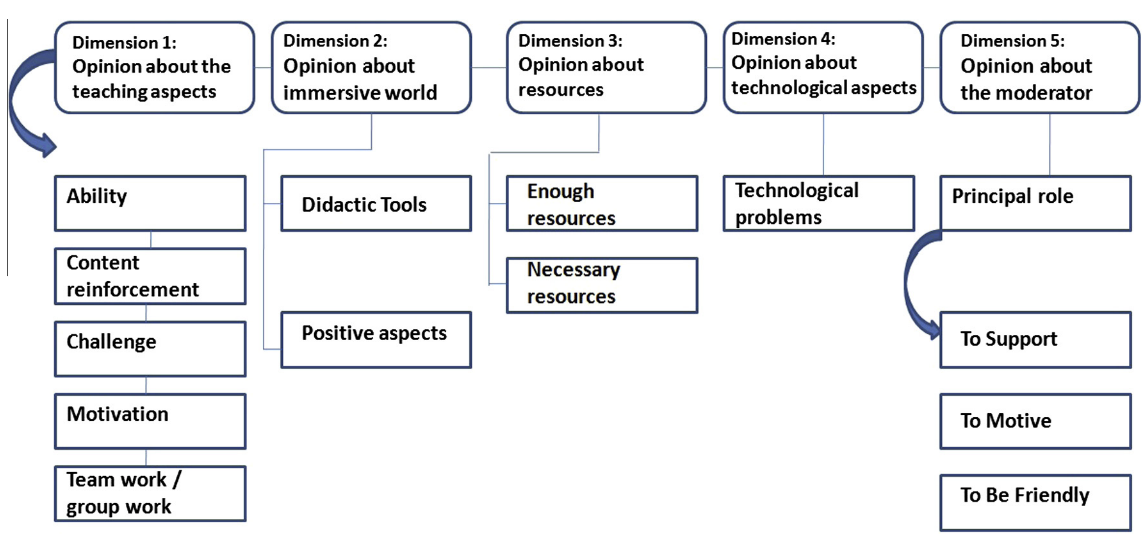

Fig. 5. Hierarchical map dimensions and variables of the perception survey of teacher performance.

- *Key role:* all the participants noted the importance of modeling, perceived as: always attentive, motivating, dynamic with great handling and domain of spaces, activities and subjects addressed in the challenges.

6. Conclusions and discussions

Responding to the main question, results from the present study suggest some interesting implications for educational practices for future teachers through collaborative learning systems. One resource to help improving the quality of education is supported by the technology of IVWs. It is believed that by incorporating innovative methodologies in the teaching–learning process, students will gain the asset of using technologies as teaching resources in the first place, and secondly, to better integrate them in their careers.

The TYMMI project proposes a pedagogical model to create spaces where students simulate their teaching practices. The model presented focuses on building scenarios or situations that allow the future teachers to make decisions and build meaningful learning experiences, as well as Khan and Black argue (2014).

There is a new generation of students, who are more familiar to technologies and this should be reflected in the learning and teaching with technology through collaborative interaction in virtual worlds and social networks. Students considered that the proposed pedagogical challenges have been a support in their teaching practices. In this sense the results are according to Mahon, Bryant, Brown, and Kim (2010) who argue that the simulations were useful for being an exciting learning experience, in addition to putting students in situations that forced them to think and act like teachers.

This findings bring on positive implications for learners, based on collaborative learning experience through the emerging learning systems allowing the students to strengthen their teaching skills. Virtual environments poses a very motivating intellectual and technological challenge to the pre-service teachers. It is noted that the technical and usability difficulties observed in the first challenges were solved to the extent of empowering spaces and working methodologies. The systematic use of resources facilitates the development of interactions, the fulfillment of the tasks and provides the satisfaction of achievement to both the team project, and the students involved.

Among the authors with whom agree are Occhioni (2013) and Maderer, Gütl, and Al-Smadi (2013) who consider that SL contributes to the motivation of students in the learning process, not only at the university but also in school. In the experience developed at UCSC, students point out that IVW may be an element to motivate, helping to reduce the use of distracting elements.

Regarding the implementation of SL in the education we agree with Hernández, Ponce, Hernández, and Ortega (2013) and Teoh (2011–2012), who stated that the platform itself does not present major difficulties, but rather, they belong to external causes such as laboratories and Internet capability. These represent a major problem in the UCSC laboratories, because most computers are being using by programmed classes, and the internet connection is poor. This was an important element during the simulations due to the characteristics of the equipment in which the activities were implemented. Conclusions are also consistent with Prats, Gandol, and Ferreira (2010) regarding that virtual environments offering to teachers and students technologies such as Second Life, are a challenge and it is impossible to incorporate them into the university without a prior training which include technological, pedagogical, didactic and socio-critical aspects.

Despite the perception of the technical difficulties of using the platforms and in addition to availability of time to perform these activities aside from school hours, students stress that the experience has been supportive in their teaching practices, and it has allowed them to reinforce content subjects, which poses a very motivating intellectual and technological challenge.

It is recognized that the current study was limited by the quantity of students enrolled. This in turn limited the range and quality of data that it is able to gather, and it is no representative to the performance of all students of the program.

In this context a future action is the need to include simulation activities in regular teacher training programs, specifically in the progressive and professional practicum, as well as in the ICT subjects. The idea is to institutionalize the permanent use of these technologies to support the processes of teaching practices. Furthermore, researchers have identified the need to include other cohorts from different pre-service teacher education programs to engage with the virtual environments.

Future implications about this research are regarding to explore mechanisms to further engage users in thinking process proposed by the *Pedagogical challenges*, as a way of extend and enhance their links between the theory and classroom practice. To achieve this it is proposed to explore another thematic and new teaching sequences for the Challenges, which incorporate the theory of the activity, new approaches for collaborative learning and problem-based learning. Currently, all problem situations to which students are faced every challenge, are supervised by the strategic team that is part of the didactic model. It seems interesting incorporating *intelligent agents* to automate typical situations or problems, allowing for example, that students solve conflicting problems classroom.

The initial use of virtual worlds showed that both SL and OS are equally effective providing suitable environments for teaching practices. Based on the experience, it has been decided to continue using free environments such as OS, and possibly others will be explored as Wonderland.

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