Microcosmos® 3.0 Perception of Teachers in Outdoor Hybrid Playing Based on Mobile Learning for Natural Sciences

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Abstract. Mobile learning (mlearning) is a potential option in the teaching process of Natural Sciences. Therefore, the aim of this research is to analyze the perception of high school teachers on the potential integration of mobile learning based on the use of Microcosmos® 3.0. The results show that teachers are highly interested in mobile learning, partially know how to use it, despite access limitations, and are positively willing to train and participate in this new learning methodology. They admit that there are benefits of Microcosmos® 3.0 for learning Natural Sciences, especially chemistry, biology, entomology and anatomy; however, they accept that the challenges are somehow difficult, but can be improved by its constant use. Likewise, they admit a high level of satisfaction and usefulness for the reinforcement of contents and that continuity in the coming years will depend on the fulfillment of some of the suggestions made. Future studies will seek a more exhaustive follow-up and will include students as part of the sample.

Keywords: Natural sciences · Mobile learning · Teachers · Hybrid playing · High school

1 Introduction

Mobile learning (mlearning) is proposed as an alternative for blended learning, combining technological resources content, networks, flexibility and availability of communication and teaching [1]. Mobile learning has had a positive impact during the pandemic, demonstrating the integration of pedagogical strategies as a viable option that has facilitated the visualization of content and strengthened communication; however, it has been shown that its prolonged use has produced technostress, fatigue and reduced interest in educational games [2]. This indicates that although virtuality with the use of mobile learning has had multiple benefits, it also evidences important challenges to be addressed, thus achieving a balance between educational quality and student health.

This is an opportunity to know the hybrid models of mlearning that allow flexible access to information by balancing virtual activities with face-to-face activities, thus

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promoting a more inclusive and participatory didactic [3]. This mobile hybridization is exhibited in its application as a tool for teaching mathematics [4, 5], improving the development of students' academic performance and cognitive competencies, while at the same time improving teachers' skills in the face of Information and Communication Technologies.

In addition, mobile resources have implied an active and direct introduction in a place that involves multiple factors, including institutional, ethical, support, evaluation, administration, interface design, technological and pedagogical factors [6]. The ludic element is added to the educational factor, since ludic has served as an integral teaching tool for the stimulation and formation of competencies and social and intellectual skills [7].

In fact, games have been imbued in mobile learning, producing greater understanding of the content, creating a creative environment and in general, positively influencing learning [8], in such a way that its purpose is qualified with the notion of Mobile game-based learning, defined as a pedagogical method based on the use of portable technology that allows immersive learning experiences [9]. Regarding the perception of teachers about mobile learning in primary school staff is in agreement with the mobile learning interventions, but they denote it as a future need that should lead to the learning of new digital didactic skills [10], however in secondary level is low in general, women and group with more than 15 years of experience showed more positive attitudes towards mobile learning [11], in addition to the above-mentioned perception of teachers from secondary education, they agree on the positive value, but emphasize the lack of familiarity in its use [12].

Its hybrid modality of mobile learning through games has also involved important benefits, among them, its efficient use for language learning [13], for history and cultural heritage [14], and for science, technology, engineering and mathematics [15].

Hybrid modality is rarely utilized in Natural Sciences; however, there are cases within the previous scientific literature oriented towards this subject from the digital modality, among them, Kidney Rush, a game applied in biology classes for learning the urinary system [16], an adaptation of Kahoot! to biology classes, thus facilitating learning, interaction and communication between classmates and teachers [17]. The association of mobile playful learning with augmented reality is also noted, significantly increasing the understanding of biodiversity [18]; and finally, it is also observed its implication for teaching blood circulation, complemented through gamification [19].

This study is original and innovative since it explores the application of the hybrid modality in mobile learning with playful components. To this end, it delves into the case of Microcosmos® 3.0® 3.0, a game made by Coworking Startups of the Salesian Polytechnic University, a venture that was developed over 2 years, which was systematized as shown below.

2 Methodology

This is a preliminary study that seeks to know the interest and knowledge of teachers about hybrid mobile learning coupled with playful components in the field of Natural Sciences. The general objective is to analyze the perception of high school teachers on the potential integration of mobile learning based on the use of Microcosmos® 3.0 in the teaching process. The specific objectives are: 1. To examine the teachers' apprehension of the premises of mobile learning; 2. To record the teachers' evaluation regarding the suitability of the application of the Microcosmos® 3.0 experience; and finally, 3. To contrast the first follow-up of the playful experience based on Microcosmos® 3.0 to reinforce the content in Natural Sciences.

Three phases were established in the methodological process to meet the objectives. In the first phase, the survey was used as the main data collection tool, organized in two sections with a total of 28 pre-questions. The first section referred to sociodemographic data has 6 questions, while the second has 21 questions with 5-level Likert scaling - totally agree, agree, neither agree nor disagree, disagree, totally disagree - oriented to knowledge, learning methods, devices, financing and preparation on the use of mobile learning, leaving an open question on new considerations and proposals from the teacher.

The survey has obtained a construct validation from Yusri, Goodwin and Mooney (2015) [20] applied in Indonesia. Although 7 years have passed since its first use, the pandemic has made it available as an alternative for the learning process in Ecuador [21]. The survey was applied between February 10 and March 25, 2022 to a non-probabilistic sample of 85 High School teachers living in Azuay, Ecuador. The information collected was coded using Excel, leading to the next phase.

For the second phase, a specialized workshop was held for Natural Science teachers from local schools on the use and management of Microcosmos® 3.0. It is worth mentioning that Microcosmos® 3.0 is defined as a social enterprise developed by Coworking Startups of the Salesian Polytechnic University and Sociedad de Divulgación Científica Quinto Pilar; and it is a mobile application used with 50× optical zoom lens adapted to the cell phone camera, complemented with a glass slide and coverslip, a dropper with distilled water and a user's guide with fun challenges [22].

This training was carried out for 3 h on April 26, 2022 with the participation of 8 high school teachers to present Microcosmos® 3.0, addressing the functionality of the device and testing different challenges that the students would later use. The 10 challenges proposed were aimed at capturing images, i.e., 3 photos for beginners: tissue, skin and species; 4 photos for intermediate level: feathers, leaves and flowers; and 3 photos for advanced level: liquids, fruits and insects. These challenges were done by the teachers for a later use in the classroom.

At the end of the training, an in-depth interview was conducted with the participants. This data collection instrument consisted of 5 open-ended questions regarding their experience, vision and possible applicability (Fig. 1).

Fig. 1. Picture of Microcosmos® 3.0

The last and third phase of the process is conducted as a pilot test for teachers on their autonomous management to understand satisfaction, reinforcement and continuity for the next school year. For this purpose, an open face-to-face interview was also held with the 8 teachers participating in the training. The interview consisted of 5 questions applied on May 16, 2022 at “La Asunción” School in Cuenca, Ecuador, and answers were coded descriptively, allowing a glimpse on the use of Microcosmos® 3.0 in the classroom. Some challenges.

3 Results

3.1 Mobile Learning Premises of Teachers

According to the sociodemographic data reflected in the survey (n = 85), 58 (68.2%) were women and 27 (31.8%) were men. In terms of age, 43 (40%) respondents were between 41–50 years old; 29 (34.1%) were between 31 and 40 years old; 11 (12.9%) were between 51–60 years old; 8 (9.4%) were between 21–30 years old; and 3 (3.5%) were over 60 years old. Regarding the highest educational degree, 48 (57.1%) have a master’s degree; 33 (39.3%) have a bachelor’s degree; 2 (2.4%) do not have a degree and one (1.2%) has a PhD. With respect to educational experience, the data is almost equally distributed with 23.5% between 15–21 years; 20% between 0–7 years; 18.8% between 8–14 years; 17.6% between 22–28 years; 12.9% between 12–14 years; and 7.1% between 29–35 years. Regarding the sociodemographic information, the subjects taught in High School are distributed as: natural sciences have 31 (36.4%) teachers; physical education, social sciences and English have 10 teachers (11.8%); mathematics and language and literature have 9 (10.6%) teachers, and finally, cultural and artistic education have 6 (7%) teachers.

Regarding the specific section referring to the premises of perception connected to mobile learning, first of all, the level of knowledge teachers have of this pedagogical method is evaluated, evidenced in 5 questions. In the first one, the majority 68.3% - 58/85 of teachers know what mobile learning is; in turn, 82/85 teachers are willing to knowing more about its application strategies in the classroom; 72/85 teachers describe it as beneficial for the professional development of their students. In addition, teachers agree and strongly agree regarding its ease of use (56.5%) and time savings (64.7%).

Contrary to the willingness of teachers to learn and apply this technology, there is some hesitation regarding the preference for conventional learning over mobile learning, with 48.2% of teachers indicating neither agreement nor disagreement, but mostly in favor of conventional learning (34.2%) over mobile learning (17.6%). However, facing this dichotomy, mobile learning is seen as an alternative for the future, with 64.7% of teachers agreeing.

At the same time, the interest of teachers in learning about mobile learning in workshops, courses and training seminars in both online and face-to-face modalities was also assessed. A total of 75.3% agree with receiving this training online, while 68.2% would like to receive it in person. This information suggests that teachers are seeking to take advantage of the situation to know more about this methodology.

Regarding the potential problems that may arise when using mobile learning, two indicators are established: technological and financial. Regarding the first indicator, teachers admit that they do not know how to use the cell phone properly (82.4%); therefore, it will be difficult to use it for mobile learning; they also consider that the cell phone they currently have does not have the capacity, speed or enough applications for the teaching-learning process (37.7%). Regarding the second indicator, which is connected to the financial one, only 36.5% agree to buy a new cell phone and pay for applications related to mobile learning; meanwhile, there is also some resistance to expand the Internet plan, 49.4% would not do so.

The last section of this questionnaire evidences the preparation and participation of teachers in mobile learning. In summary, there are nuances between both. Teachers want to participate (68.2%) but do not feel fully prepared to offer quality education (54.1%), this assertion shows some uncertainty about the limitations such as the responsible and practical management of mobile phones; the lack of money for buying the device; the lack of full internet coverage in areas of Ecuador; and the negative effect on health.

3.2 Application Suitability of the Microcosmos® 3.0 Experience

Understanding the different perceptions and comments observed in the questionnaire applied to teachers regarding mobile learning, an adapted training on this type of learning Microcosmos® 3.0 was carried out, where the main characteristic is the hybridization process between the face-to-face modality with the online modality in the teaching-learning process, presenting below a summary of the experience, suitability and possible applicability by 8 High School teachers interviewed (Fig. 2).

Fig. 2. High school teacher using Microcosmos® 3.0 during training.

First of all, the learning experience related to Microcosmos® 3.0 was taken into account, being valued as excellent and good, specifying it as a useful, playful tool that helps to learn science. One of the teachers emphasizes its practicality, which helps to magnify structures of living and inert beings, improving the understanding and analysis of the students.

The teachers then participated in the extra challenges, allowing them to learn about the difficulties they had when using them. Half of the participants were only able to complete the medium level challenges, due to problems in focusing the camera, accuracy, lack of pulse and time. All of them admitted that the experience can be applied to the subjects they teach, particularly chemistry, biology, entomology and anatomy, including topics such as the study of invertebrates, fungi, solid compounds, mineral structures, molecular geometries, morphology and physiology. Complementing the information, they were consulted about improvements of Microcosmos® 3.0, in which the teachers responded that the device should be made of a fragile clip material, should include illumination and access to more workshops that specialize in its application, or, audiovisual instructional material.

3.3 Follow-Up of the Playful Experience Based on Microcosmos® 3.0 to Reinforce Learning in Natural Sciences

In this last phase, the teachers had 20 days to experiment autonomously the playful experience with their group of students. It should be mentioned that since this is an exploratory proposal, this research focused only on the teachers and on the first follow-up out of 5 follow-ups proposed between 2022–2023 that would give continuity to the project.

Going back to the results of this first follow-up with the 8 teachers participating in the training, 123 Microcosmos® 3.0 were donated, of which 78 were given to high school students belonging to “La Asunción” School in Cuenca, Ecuador; the rest will be distributed in the next courses. The results obtained from the interviews focused on the satisfaction, reinforcement and continuity of its use, showed the following information:

1. During 20 days of experimentation by teachers, Microcos-mos® 3.0 was used on an average of 6 days; however, it was applied only in one class with students.
2. The level of satisfaction was high. It is estimated that 6/8 teachers are satisfied with the possible applicability in Natural Sciences.
3. They consider that it can be used to reinforce classroom learning, especially for direct observation of species; it provides creativity and development of soft skills; identification of structures; active learning and a partial substitution of the microscope in some activities.
4. Only half of the teachers admit that they could apply it in the next term. In order to apply it, they mention that the quality of the device's material must be improved and a strategy must be found so that students do not lose the device.

In short, this third phase shows that most teachers are satisfied with Microcosmos® 3.0, and consider a series of advantages regarding its application in the classroom. However, for its use, changes should be made to improve the material of the device, increase the magnifying glass, and add an striking color, basically, interaction needs to be remodeled.

4 Conclusions

After reviewing the three phases established in the methodological procedure, which correspond to the three objectives, it can be summarized that in the first objective, teachers have a high interest in mobile learning, partial knowledge, but still prefer conventional learning. Despite this, they are willing to being trained and to learn and participate in this new learning methodology.

Regarding the second specific objective, they understand the multiple benefits of Microcosmos® 3.0 for learning Natural Sciences, particularly chemistry, biology, entomology and anatomy; however, they accept that the challenges posed contain a certain level of difficulty and that it takes time to internalize the use.

Lastly, the third specific objective, which involves satisfaction, reinforcement and continuity of the use of Microcosmos® 3.0 by teachers, indicates that although it supports the observation of fine structures through an alternative experience, its use will depend on the changes to be made in the device.

Overall, some factors that hindered the use of Microcosmos 3.0 were lack of familiarity with the device and time to develop the play experience.

To conclude, there are different limitations in this study, among them, the short time for its implementation, the initial resistance to implement new teaching-learning methodologies and the lack of knowledge about mobile learning; therefore, future research must include the students' perception of the device; incorporate online games connected to the experience through platforms such as Genially; provide information from the 4 remaining follow-ups; and improve the properties of the device.

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