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Pedagogical strategies based on inverted classroom - Integration of ICT in naval technologies at the Escuela Naval de Suboficiales A.R.C. Barranquilla

Estrategias pedagógicas basadas en aula invertida – Integración de las TIC en las tecnologías navales de la Escuela Naval de Suboficiales A.R.C. Barranquilla

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ABSTRACT

This study explored the interrelation between technology and education, focusing on the implementation of the flipped classroom model in the framework of technology-supported subjects. The convergence between these two fields was analyzed, not only for its contemporary relevance but also for its constant potential in the future. The methodology used was applied research, which facilitated an effective integration of Information and Communication Technologies (ICT) in the conception and development of academic activities. The results obtained showed acceptance and commitment on the part of the students when content was provided to them through multiple formats and platforms. It was concluded that the versatility and accessibility of ICT, applied appropriately, could enhance the students' learning experience. This study, therefore, provided a valuable contribution to understanding how emerging technologies could be effectively utilized in the educational context.

Keywords: educational sciences, multimedia teaching, educational resources, educational technology.

JEL Classification: M15; I23

RESUMEN

En este estudio se exploró la interrelación entre tecnología y educación, centrando la atención en la implementación del modelo de aula invertida en el marco de asignaturas apoyadas en tecnología. Se analizó la convergencia entre estos dos campos, no solo por su relevancia contemporánea, sino también por su potencial constante a futuro. La metodología empleada fue la investigación aplicada, que facilitó una integración efectiva de las Tecnologías de la Información y Comunicación (TIC) en la concepción y desarrollo de actividades académicas. Los resultados obtenidos evidenciaron una aceptación y compromiso por parte de los estudiantes cuando se les proporcionó contenido a través de múltiples formatos y plataformas. Se concluyó que la versatilidad y accesibilidad de las TIC, aplicadas de manera adecuada, podían potenciar la experiencia de aprendizaje de los estudiantes. Este estudio, por lo tanto, proporcionó un aporte valioso para entender cómo las tecnologías emergentes podían ser aprovechadas de manera eficaz en el contexto educativo.

Palabras clave: ciencias de la educación, enseñanza multimedia, recursos educacionales, tecnología educacional.

Clasificación JEL: M15; I23

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INTRODUCTION

The National Navy of Colombia has the A.R.C. "Barranquilla" Naval School of Non-Commissioned Officers as a training school for naval non-commissioned officers. In this entity, Colombian sailors are trained in different naval technologies, among which the following stand out: Naval Technology in Maritime Administration, Naval Technology in Electronics, Naval Technology in Electromechanics, Naval Technology in Oceanography, Naval Technology in Hydrography, Naval Technology in Naval Health and Naval Technology. All the specialties are in charge of teaching the different techniques and procedures for the work performance of the N.C.O.s who study each one of them.

In this context, the "Classroom dynamics based on inverted classroom" strategy is articulated with technology-based strategies. The purpose is to approach the theoretical and practical concepts from the playfulness or gamification of contents, which are contemplated in the phases of the acronym VELERO, in this way: Visualization, Empowerment, Gamification, Evaluation, Learning Outcomes, and Omnidirectional. This strategy is presented in phases of application, in which each phase complements the previous one, a decision that provides the teacher with a broad spectrum of the evaluative process in each of the topics covered in the classroom.

According to Bharathi et al. (2016), the greatest challenge facing technology-based educational innovations implemented in the classroom is discovering the characteristics and properties contributing to each content. The success or failure of a given task, game, or application will depend on this precision since not all technology is efficient for all content (Almeida et al., 2023; Oliveira et al., 2022). On the other hand, teachers' motivation to appropriate information and communication technologies in their academic processes should be proposed (Tsai et al., 2020; Zainuddin et al., 2019). Then, this motivation must become part of institutional practices since these practices contribute little if teachers do not have the skills to use appropriate technologies in interactions with their students (Quintero, 2022).

METHODS

Research problem

The different digital tools that support educational processes are diverse and offer advantages to learning from visual, auditory, and sensory scenarios. These take novel elements for their presentation that attract the attention of students in general (Fu, 2020; Zhao et al., 2021). In this sense, videos, animations, and podcasts are the tools that contribute most to the retention of students' attention, given their friendliness and fluency in presentation (Conroy & Kidd, 2022; Halabi, 2021; Hurst, 2019; Kenna, 2022; Valverde, 2016).

On the other hand, Cabero (2016) argues that, in any process of conducting content mediated by information and communication technologies, emphasis should be placed on the characteristics of the implemented resource. In that order, the attitudes of the recipients towards the media (students) and the analysis of the context in which the educational experience is immersed constitute an essential factor in the success of the experience (Dixit et al., 2021; Samsor, 2021; Woyo et al., 2020).

Therefore, the educational innovation VELERO is relevant to the educational processes conducted at the Naval NCO School since its population, academic infrastructure, and teachers' competencies are articulated with the objectives of the contents in order to achieve their fulfillment. Given this scenario, what characterizes technology-mediated training?

Purposes of the proposal

The purpose of this innovation is to design and implement a strategy for conducting and validating academic content based on games and technology-based classroom dynamics, using the Virtual Learning Environment of the Public Force (avafp.blackboard.com) in order to achieve a thematic immersion in the part of the grummets. The objectives pursued with this educational innovation are the following:

- Design ICT-based tools that dynamically allow content presentation, establishing challenges among students, available in the Virtual Learning Environment of the Public Force.
- To implement an interactive evaluation that integrates students into their processes of verifying contents and fulfilling objectives set in the subject.
- Characterize the process of presentation and evaluation of contents based on ICT-based tools.

Materials, sample and procedures

The educational innovation "Classroom dynamics based on inverted classroom" is framed in the type of applied technology research. This type of research is about processes that offer alternative solutions, based on information and communication technologies, to problems that arise in educational environments.

a) Characteristics of the students involved

Gender: Currently, male students are accepted as regular grummets, given the guidelines of the naval command,

since it is a national call for admission.

Population: The students of the different technologies offered by the ENSB are young people from all over Colombia, ages between 16 and 20. They belong to the socioeconomic strata 1, 2, and 3 of each of the Departments of Colombia.

Academic performance level: The grummets students, in order to opt to study the different naval technologies available from the ENSB, must keep a high score, given the various competencies of each naval technology, and with the facility that students remain all day aboard the school; which means that they have enough time and space to be able to address the studies inside the naval institution optimally.

Level of knowledge: Students who are accepted by the national call in the process of linking the new contingents of grummets each time must be baccalaureate graduates and must undergo a knowledge test in the admission process.

b) Group attitude towards the development of subjects

In each of the different naval technologies, the students learn teamwork since they will be the ones who will crew and operate the different afloat units of the National Navy, and it is of great importance to develop collaborative skills in all situations that arise on board.

Difficulties encountered: In implementing the innovation strategy "Classroom dynamics based on inverted classroom," there have been no implementation difficulties since the institution provides different technological resources. Likewise, there are no environmental inconveniences or additional considerations in its implementation.

c) The way in which class sessions are conducted

In the development of each of the class sessions and based on the inverted classroom model, in which students previously see explanations and readings, the following activities are carried out:

a. Content viewing. Student grummets watch different content in the form of magazines, audio podcasts, and videos.
b. Educational challenges. Students, through play in the classroom, participate in dynamic activities that induce "learning by playing".
c. Dynamic evaluation. At this point, the evaluation process becomes much more dynamic, since the grummets students are evaluated in a learning and collaboration session.

d) Time associated with implementation

The educational innovation called "Classroom dynamics based on inverted classroom" is applied during an academic semester of 16 weeks, in the subjects Applied Computer Science and Information and Communication Technologies.

RESULTS

Relevant aspects of the proposal from the use of ICTs

The materials used in the implementation of the strategy called "Classroom dynamics based on inverted classroom" are varied and range from laptops or personal computers to mobile devices and access to the Internet, through which access is gained to the content covered in the classroom, and to the explanations and web portals used in the proposal. This consisted of six phases that operationalize the innovation and are as follows:

Phase 1. Visualization

In this initial phase, academic content was presented to students in magazines, which dynamically display the information instead of the traditional and flat form offered by PDF documents (see figure 1). Likewise, classes were observed in digitized audiovisual media, which allows the repetition of the explanations at any time the students require it (Li et al., 2021; Reed et al., 2023; Varkey et al., 2022; Wegener, 2022). Similarly, explanations were presented in audible format by listening to PodCasts, which offer -through orality- a scenario conducive to learning

by audible means, a fact contrasted in the literature (Afouras et al., 2020; Heilporn et al., 2021; Wang et al., 2021).

Figure 1.

Viewing content in different media

Source: Own elaboration

This presentation of content in various media offered students the possibility of experiencing a much more sensory learning experience. It also allowed them to use most of their digital resources, such as tablets, cell phones, and computers, a situation that, in addition to generating more dynamic classes, allowed students to use their daily technology in the service of their educational process.

Phase 2. Empowerment

Empowerment is the most potent phase presented by this innovation since, by experiencing their learning in the first person, each student appropriated the contents in a personalized way. This generated a sense of belonging to themselves, giving great value to the responsibility and fulfillment of their objectives, one of the pedagogical values of the experience that were corroborated in the literature (Dwivedi et al., 2019; Sandanayake, 2019; Wong et al., 2020).

This empowerment was reinforced by presenting content to the grummets students in various formats. This strengthens self-managed learning and allows students free access to content on public domain portals, a feature highlighted in previous studies (Bouilheres et al., 2020).

Figure 2.

Resources in various formats to empower

Source: Own elaboration

Phase 3. Gamification

In the educational innovation "Classroom dynamics based on inverted classroom," the game was implemented through the educational portal EducaPlay, which allowed students to learn based on interaction with multimedia content. This participation allowed them to be in healthy competition when establishing "educational challenges," which makes the learning process a space for reflection and healthy interaction. These interactions have proven to be very helpful in previous research (Vanbecelaere et al., 2020; 2020B).

Figure 3.

Games created for VELERO Innovation

Source: Own elaboration

In this item, the impact produced by implementing the game in the classroom requires further analysis since these tools and their preparation in academic situations could advance the digital divide in the classroom. Another possible result could be the deepening of the already-established gaps (Yordanova, 2019).

Phase 4. Evaluation

The evaluation process was complex because there were a large number of variables to take into account. These range from motivation to the actors' disposition in the process. In this aspect, the educational innovation "Classroom dynamics based on inverted classroom" presented a flexible evaluation process adjusted to the contents seen in the class. Its interactive and public nature added a touch of versatility typical of ICT-mediated evaluations (Rivas et al., 2021; Wang et al., 2020). Figure 4 below shows this process, which takes into account the topics addressed in the class sessions.

Figure 4.

Dynamic evaluation with ICT - Plickers

Source: Own elaboration

Phase 5: Learning Outcomes

Learning outcomes, being observable and evaluable, are directly related to what the student should achieve when taking content in the classroom. In this regard, the educational innovation "Classroom dynamics based on an inverted classroom" focused on the skills and concepts that the grummets should obtain when studying the content, such as describing the technological risks when using the different technologies. From this point of view, there are learning results in terms of word processing when manipulating electronic spreadsheets and when curating content with slideshow presenters, among others.

Phase 6. Ominidirectionality

The educational innovation "Classroom dynamics based on inverted classroom" proved to be a strategy that applies to the different subjects or contents students must approach in their Naval Military training process. Initially, it was implemented in the subjects of Applied Informatics and Information and Communication Technologies, subjects seen in the Naval Technology in Electronics and Naval Technology in Physical Oceanography, with support in the Virtual Learning Environment of the Public Force.

Mediations associated with information and communications technology ICTs

The following are the technological mediations used in educational innovation based on the inverted classroom model:

Use of Magazine Managers: As a contents manager in magazine format (not only PDF), the portal calameo.com is used, where the textual contents are found.

Use of educational podcast - Audio in the classroom: The SoundCloud portal is a repository of audio explanations.

Use of video tutorials: The YouTube portal is used as a repository of video explanations.

Implementation of Game activities in the classroom: Games built on the topics covered in each course are used. The educational challenges built for the subject are carried out in this space.

Figure 5

EducaPlay Portal where the educational games are hosted

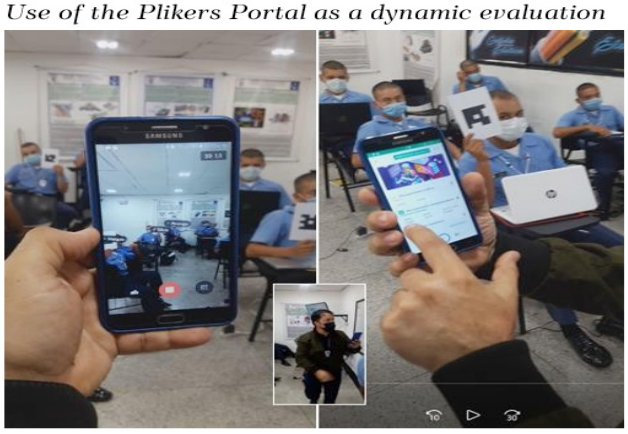
Source: Own elaboration.
Note: the picture appears in its original language.

Implementation of dynamic evaluation

The dynamic evaluation was implemented through the use of QR codes, which allows the dialogic participation of students in the classroom. This decision was positively valued, making it the spearhead of educational innovation. The results suggest the importance of improving the design of educational assessment in mixed models in a systematic way (Lacka et al., 2021; Shamir-Inbal and Blau, 2021; Tabatabai, 2020).

Figure 6.

Use of the Plikers Portal as a dynamic evaluation



Source: Own elaboration

Table 1.
Student performance on dynamic assessments

Subject / Report	Percentage of hits
Digital skills	29
ICT Risk Theories	76
Spreadsheets - Theories	65
Excel Calculations - Applications	74
Word Processing	76
Operating Systems - Theories	84

Source: Own elaboration

The results in the table above come from the Plickers application in real-time in the classroom. In this way, it was possible to appreciate that the students have, in general, adequate knowledge about the risks of technology (76%), word processing (76%), and computing in general (84%), which allows evidencing a positive knowledge and acceptance of the applied activities.

CONCLUSIONS

The results obtained in the content transmission process, facilitated by ICTs and the resulting interactions, evidenced varied positions. It was notorious for the acceptance of the integration of classroom dynamics with evaluative purposes that enhanced group work. The interaction in the activities demanded dialogue and the consideration of different points of view regarding specific situations of each activity. Likewise, student motivation was significantly increased after implementation. Interaction with mobile and computing devices allowed students to present information in multiple formats and media, including auditory, visual, and audiovisual.

Through the creation of materials in various formats, it was possible to build an extensive repository of documents (bibliographic material in the cloud), audiovisual content (explanatory videos), and audio content (thematic podcasts). All these resources enriched the transmission of content in applied informatics. In this way, the specific objectives established in the educational innovation project and the search for academic quality were achieved.

On the other hand, the process of incorporating information and communication technologies at the Escuela Naval de Suboficiales A.R.C. Barranquilla made it possible to determine that the design, implementation, and evaluation of the activities were based on the improvements observed in the students' diction when explaining what they had learned. The results indicated a favorable trend toward the students' more efficient use of resources and time.

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