

DESIGNING A READING COMPREHENSION APP USING DESIGN-BASED RESEARCH FRAMEWORK

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ABSTRACT

Microlearning has increased its popularity for course designs in eLearning environments due to short attention spans and time constraints. The objective of this designed-based research is to describe the multiple iterations of design, development, and revision of a general framework for creating a microlearning reading mobile application. First, we present the components from the perspective of users and for the execution of a software architecture that allows a modular approach. Understanding the pedagogical features of mobile learning: personalization, authenticity, and collaboration are included as part of the IPAC framework to create it. This app was developed in different phases: Analysis and exploration, design and construction, evaluation and reflection, redesign and reconstruction and final critical reflections. The findings link design-based research (DBR) as a methodology that allows engaging in theory building and development of reading applications. It also reveals engagement in reading skills, satisfactory usability ratings and a rise in students' awareness towards new types of texts.

KEYWORDS

Microlearning, Usability, Mobile Technology, Design-Based Research, Reading Comprehension

1. INTRODUCTION

Critical reading is necessary for university students to develop skills that will make their academic work easier since reading does not receive enough attention in primary and secondary education. Several studies in Latin American contexts claim that university students lack strategies that allow them to understand a text and cannot organize information into summaries or different texts (Garcia, Nájera & Téllez, 2014).

In Colombia, in recent years, national tests administered to students have revealed significant weaknesses in critical reading in both languages (Spanish & English). Only 1% of students were top performers of levels 5 and 6 in the Programme for International Student Assessment (PISA) reading test. Based on these needs, a framework to develop mobile applications was defined to create a reading comprehension app called *Entrelíneas* due to the unavailability of Spanish/English technological mediations for undergraduate students who pursue this learning outcome (Vásquez et al., 2019).

As a response to this issue, a technique called microlearning in which people learn with small chunks of information during short periods was applied (Hug, 2007; Jomah et al., 2016). Micro-learning has three objectives: 1) reduce the quantity of information the students need to access by organizing it into bite-size pieces, 2) redefine the learning process and the environment in which the students learn, and 3) motivate the students to personalize the way they learn (Trowbridge, Waterbury & Sudbury 2017; Mohammed, Wakil & Nawroly, 2018). The type of text that matched with microlearning characteristics was aphorisms because of the challenges implied based on its concise content and short length, that might involve students in more complex reading comprehension strategies such as inferences. The inference procedures become especially relevant in textual understanding (Shihab, 2011). Aphorisms are defined as "a concise statement of a principle, a short, pointed sentence expressing a wise or clever observation or a general truth" (Morson, 2003, p.409).

The aphorisms help students interpret topics critically, recognizing the relationship with their historical, social, and cultural context (Hui, 2019; Lobo, 2017). Recently, researchers have adapted new eLearning methodologies for new users using microlearning. New generations of students prefer to access information digitally, use visual representations, and receive short chunks of data (Zhang & West, 2020). Some research has found that students can remember content learned using microlearning strategies longer than traditional approaches (Mohammed et al., 2018). The following example illustrates the type of aphorisms that students find in *Entrelíneas* app: *Beauty is worse than wine, it intoxicates both the holder and beholder. (Aldous Huxley.)* Mobile apps are convenient, low-cost, and downloadable global information and communication technology pieces that are innovative (Islam & Mazumder, 2010). Apps suit different purposes, and their characteristics can become tools to mediate in different scenarios, such as learning and teaching critical reading in Spanish and English. To design it, three pedagogical features of mobile learning distinguish from the sociocultural theory perspective were implemented: personalization, authenticity, and collaboration. These are part of the IPAC framework, which gives opportunities for learners to control their learning process. It also provides contextualized tasks in collaborative networked environments (Bano, Zowgui & Kearney, 2017). There are also pedagogical affordances involving planning, imagination, and creativity. This opportunity serves as the basis of usability testing (Burden & Atkinson, 2008) and creating learning objectives.

This paper defines a new view of the dimensions that influence the satisfaction of micro-learning students. From that point, it presents a DBR framework for developing mobile applications that use microlearning in an eLearning environment, focusing on course design and technology dimensions to influence students and try to improve engagement and decrease dropout. It also attempts to answer the following research questions:

1. What are the characteristics of a framework design for a reading comprehension microlearning mobile application?
2. What is the students' performance after using the reading comprehension microlearning mobile application?

1.1 Reading Framework Components

The students' side shows the components that the mobile application should implement. They build from gamification to encourage participation and adherence to the app, which has previously demonstrated effectiveness (Caro-Alvaro et al., 2017). Some strategies include reward systems, use of levels, and immediate feedback such as success messages when challenges are accomplished (Atkins et al., 2017). The components of this side of the architecture are the following:

- -Microlearning activities: this is the core of the mobile application. Activities may include short videos, readings, or any concise bite-sized information the student can learn (Bothe et al., 2019).
- -Players challenging: this is where gamification is shown the most and implements the leaderboards strategy or point systems (Atkins et al., 2017).
- -Discussion: this component has the purpose of engaging interaction between students. Previous research, such as the one presented in (Saade & Huang, 2009), has proven the impact on learning processes when students are encouraged to participate in online forums.
- -New content co-creation: the purpose of this component is to encourage students to create their content to share as a micro lesson. Previous work has also shown the importance of allowing students to develop and design content, as shown in (Nahar & Cross, 2020), who proposed a Student-Staff Partnership (SSP) to encourage students to participate in the process.
- -User progress: it allows the students to see their progress in the points system and can provide feedback about their performance.
- -Tutorials: this component provides users with digital content for help without interacting with educators.
- -Data Analytics services layer: it allows designers to build their own data analytics services or select one of the many services available.

2. METHOD

We followed the design-based research (DBR) methodology which is a flexible and systematized methodology that describes design research as a socially constructed and contextualized process (Bannan-Ritland, 2016; Papavlasopoulou et al., 2019). This approach, characterized by three iterative phases: (1) analysis and exploration, (2) design and construction, and (3) evaluation and reflection, includes software design, professional development, and collaborations between research faculty and active participants (Edelson, 2002; Cochrane et al, 2017). (See Table 1).

2.1 Sample

28 Colombian undergraduate students between 16 to 20 years old participated. They had reading difficulties. The group used the app *Entrelíneas* for four weeks and they signed the informed consent forms for the study.

3. RESULTS

To answer the research questions, we listed different abstract software components that could be implemented. A microlearning framework and the DBR approach to design the application effectively were demanded since educators' participation was necessary.

The findings revealed the potential of the tool. It is not intended to prove that through applications, students will have a very marked advance. However, the *Entrelíneas* application might increase the level of engagement towards these activities. Learners are more attracted when they work digitally (Ciampa, 2014; Stephen, 2020). The gamification process is emphasized. It is a recent concept that encourages learners to be active participants. Challenge, competition, and cooperation tasks can enhance motivation (Glover, 2013; Su & Cheng, 2015; Jayalath & Esichaikul, 2020). *Entrelíneas* application was designed taking into consideration, a previous DBR work that has exposed the importance of process of gamified mobile learning and the articulated pedagogical, administrative, and technical intervention in formal higher education (Jong, et al., 2021).

4. CONCLUSION

Teachers and instructional designers may need to consider DBR as a methodology because it has shown to be a helpful tool for building mobile applications for research purposes due to it allows the construction of a technological solution to reading comprehension. Given that the methodology works with cycling phases, we designed several versions of the framework and the mobile application prototype to test with users. Land & Zimmerman (2015) have used several iterations to achieve expected results. Another study (Wong et al., 2011) used what the authors called a micro-cycle (Leinonen et al., 2016), incorporating DBR to design several learning applications. Our work used five phases, which were essential to evaluate how effective it was to develop a framework design for a reading comprehension microlearning mobile application, determine the perception of the usability and measure students' performance after using the app. Some of the implications of this DBR are related to the credibility, confirmability and dependability applications which were crucial to obtain authentic results, triangulate the information from the instruments and organize the qualitative feedback accurately (Pool & Laubscher, 2016).

Table 1. App design phases

Phases	Analysis and exploration	Design and construction of the app	Evaluation and reflection	Redesign and reconstruction of the app	Final evaluation and critical reflections
Purpose	Observation, definition, gap, identify pedagogical features, affordances for reading	Ideate / prototype Apps components and modules selection	Testing /improvement	Implementation of challenge and creative mode	Refining adjustments Socialization and Teacher training
Instrument	iPAC rubric to evaluate 25 apps Pretest to evaluate current reading levels	Framework component design for a demo app 3 levels of reading comprehension selection Selection of aphorisms Categorization of aphorisms per level of complexity	App implementation Usability test 1 Focus group 1	International advisor iPAC framework adoption	Post test Usability test 2 Focus group 2
Credibility	International validity from extensive trials in Australia and the UK		Extensive time of the app implementation		Detailed feedback from students Authentic responses from participants
Dependability		Aphorism's coding			Usability coding
Confirmability			Member checking		Triangulation Member checking

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