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Analysis of the opportunities offered by mobile learning tools to improve students' academic performance

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Abstract

Education systems around the world are changing rapidly to keep up with the latest technology and pedagogical innovations that have become a strategic topic for many educational institutions. The study determines the impact of M-learning tools on the non-technical learners' achievements in Information Science and offers recommendations to educators for improving M-learning. The proposed tool had a positive impact on the students' academic achievements. The results of students actively used mobile Web 2.0 technology are statistically significantly higher in comparison with students studying the traditional way The results obtained can be used in the development of an improved program for the rationalization of the educational process for students so that their academic achievements can reach a new level.

Keywords: academic achievements; digitalization; M-learning; motivation; Web 2.0.

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1. Introduction

Mobile Learning - Empowers learners with mobile technology and the web (Ozdamli & Cavus, 2011). It is imperative that M-learning elements are properly managed for M-learning to be successful and for its implementation to be effective (Naciri et al., 2020).

Furthermore, M-learning features should be set up, with the methods of M-learning application and duration planned in advance. Hence, deeper theoretical research is needed to better understand the main reasons why mobile learning can be used effectively (Qureshi et al., 2020). M-learning's main features include ubiquity, portable size of mobile tools, as well as mixed, individual, innovative, collaborative, and instantaneous information (Romero-Rodríguez et al., 2020). Today's students are digital natives who are growing up with digital technology. They are technologically savvy because they think and process information differently than their predecessors (Venter, 2017). They are confidently embracing new technologies such as the Internet, video games, mobile technology, and other tools of the digital age (Bolton et al., 2013).

1.1. Conceptual or Theoretical Framework

Education systems around the world are changing rapidly to keep up with the latest technology and pedagogical innovations and are making careful preparations to meet the expectations of digital natives for 21st century learning (Raja Hussain, 2015; Sailin & Mahmor, 2017). Therefore, modern educators should contribute to the development of students' thinking skills through the use of appropriate digital technologies and innovations in teaching methods (Jimoyiannis et al., 2013). Teaching and learning must move from a traditional teacher-centered approach to a more constructivist and student-centered one. This aspect of education promotes broad knowledge formation through existing learning experiences that support self-directed learning (Sailin & Mahmor, 2018). In keeping with current developments, Web 2.0 technology has become a major interest in pedagogical innovation. Educational technology researchers argue that instructors should consider integrating Web 2.0 tools into the classroom to support constructivist and meaningful learning (Sailin & Mahmor, 2017).

Web 2.0 can make learning more meaningful by engaging students in group work (blogs and wikis) where they can create their learning content (Davies & Merchant, 2007). To implement Web 2.0 technology in the educational process, teachers must have the appropriate knowledge, skills, and experience with this technology. Available studies suggest that while instructors have a positive perception of and interest in Web 2.0 integration, they should more get practical experience in using Web 2.0 tools in the classroom (Yuen et al., 2011).

1.2. Related Research

Digital pedagogy refers to the accumulation of knowledge by instructors through training planning that develops problem-solving skills and higher-order thinking (Milton, 2013). Also, in this context, it improves the ability to critically analyze and reflect through the creation and editing of publications on the Internet. It means that it is important for instructors to continuously improve their teaching approaches to keep up with current technology. Instructors should provide their students with an interactive and meaningful learning experience and therefore be creative and innovative in designing their curriculum and methods (Greenhow et al., 2021). As digital natives, students are constantly interacting with technology (Bolton et al., 2013). This allows them to improve their learning potential by using the Internet, and teachers will have more motivation and responsibilities to get their students interested in this learning format (Venter, 2017). The available literature suggests that the biggest challenge for today's educators is their ability to practically and meaningfully incorporate technology into their learning activities (Crawford et al., 2020).

To have and apply teaching skills to teach in the rapidly changing educational landscape of the 21st century, teachers need to have good knowledge of technological pedagogical content (Ertmer & Ottenbreit-Leftwich, 2010) or knowledge of digital pedagogy (Garbuio et al., 2018). The integration of digital pedagogy using Web 2.0 tools into the educational process is an example of a new pedagogical strategy that educators can use, as it provides a good opportunity for the accumulation of knowledge and higher-level cognitive abilities through digital creativity, online collaboration and sharing (Jimoyiannis et al., 2013; Sailin & Mahmor, 2017).

To meet the demands of the 21st century and promote meaningful learning, it is important for educators to understand how to use technology to help students gain quality and practical knowledge that can be applied in real life (Ertmer & Ottenbreit-Leftwich, 2010). Instructors need to prepare their students to become effective 21st century professionals. Over the years, Web 2.0 technology has penetrated many areas of our lives, including education. Web 2.0 technologies are usually associated with various Web platforms that emphasize user-generated content, sharing, and collaboration (O'Reilly, 2005). Web 2.0 has evolved from a place where users passively receive information provided by a small group of experts (Web 1.0) to collaborative reading and writing on the platform (Web 2.0) that expand users' communication capabilities and allow content to be co-created and shared through participatory practices (Jimoyiannis et al., 2013).

Web 2.0 technologies are gaining popularity in the educational process. Technologies such as social media applications, blogs, wiki, web-based presentation tools, and online mind mapping tools have become important learning approaches (Davies & Merchant, 2007). Web 2.0 can potentially create a more interactive and responsive learning environment in which students are proactively engaged in the learning process through knowledge creation and assessment (Richardson, 2009). Moreover, Web 2.0 capabilities promote proactive learning and stimulate students' thinking abilities because they can regularly compare and respond to their own contributions or ideas in relation to those of their peers (Sailin & Mahmor, 2017).

M-learning requires availability of mobile tools, regardless of time and place, with special software installed for implementation of interdisciplinary and modular approaches to learning (Kuznetsova, 2011). The key components of M-learning are the learner, instructor, environment, content, and the assessment (Biswas et al., 2020). Under the new teaching approaches, students are at the center of all teaching and learning activities. M-learning is based on the students' interests, experiences, and needs. As the M-learning principles suggest, the pedagogical approach puts the student at the center of the learning process (Makoe, 2010). The student plays a proactive role, from goal setting to the assessment phase.

In a traditional learning environment, teachers transmit information to students from classical sources - books, lectures, methodological materials. The main role of the teacher was the role of an expert providing information to students. While the latest technologies provide students with more accessible information and expand opportunities for self-study (Ozdamli & Cavus, 2011). With the transition to new media formats, the instructor's role has changed from that of an expert to that of a presenter of borrowed expertise. With the advent of Web 2.0 and social media, a lot has changed again. Under these circumstances, the instructor's role must change from presenting expert knowledge to being a moderator of opposing positions (Chung et al., 2019). In modern education, thanks to technology, the role of an instructor is gradually shifting to the role of a consultant. In this role, teachers should be able to effectively guide students; motivate for independent work and achievement of educational goals; offer opportunities to achieve these goals related to the specific context in which the learner finds himself (Khatoon et al., 2019).

Decisions related to the content of the training course must be made jointly with all participants in the process: students, teachers, parents, etc. In order for teachers to achieve the desired results (Talan, 2020). The course content should allow the user to quickly find the necessary information. Decisions related to the content of the training course must be made jointly with all participants in the process: students, teachers, parents, etc. In order for teachers to achieve the desired results and should be supported by visual representations, videos, and other multimedia elements. The detail and amount of content provided to students depends on the pedagogical needs of the students (Shahzad et al., 2021).

To have a positive experience, the learning environment should be properly designed. The environment is where students get their information. Online learners should have access to all resources, including learning outcomes and assignment requirements. Students attending face-to-face classes can receive content in class and online through mobile technology (Shahzad et al., 2021). The environment should enhance interaction between students and faculty. Social interaction may be improved by using wikis, social media, or blogs. This environment should be accessible on cell phones, laptops, and other mobile devices. Through portable devices, M-learning removes geographical boundaries, creating a collaborative learning environment where individual and group interaction in learning occurs (Uzunboylu & Ozdamli, 2011).

Assessment is an important component of meaningful M-learning (Ennouamani et al., 2020). Mobile technology can assess and report student progress to instructors. Therefore, students should be assessed using databases, software. Students must also evaluate themselves and others. This provides the snippets needed to accurately assess a student's knowledge, skills, creativity, etc. Assessment should be consistent with students' abilities by offering a troubleshooting tool and setting up a guidance that builds on success (Hamidi & Chavoshi, 2018). The assessment should help students dispel any doubts about the course and, at the same time, learn a little more about it. If the course has been designed to a high standard, then it will be able to provide active feedback so that the student can assess their level of mastery of the new material. The feedback should not discourage the learner and make the learner feel that he or she knows nothing. Upon completion of the course, the good mood is very important to the student along with the grade.

1.3. Purpose of the Study

The study determines the impact of Web 2.0 technology (as an M-learning tool) on achievements of non-technical students learning Information Science and provides effective recommendations for improving M-learning.

Tasks that had to be solved during the study:

- use tests to assess the academic achievements among students in the control and experimental groups;
- offer recommendations to educators for improving M-learning.

2. Method and Materials

To examine the impact of M-learning tools on the non-technical learners' achievements in Information Science, a quasi-experimental study was conducted. A quasi-experiment explores cause-and-effect relationship between independent and dependent variables in a well-controlled context.

2.1. Research Model

Students in the control group learned in a traditional way by attending lectures and classes at the university, while the experimental group used mobile Web 2.0 technology.

Information Science was chosen as the technical discipline for non-technical students majoring in "Environmental and Natural Resource Management", "Marine Biology and Aquaculture", and "Ecobiotechnology".

The authors declare that the work is written with due consideration of ethical standards. The study was conducted in accordance with the ethical principles approved by the Ethics Committee of Far Eastern State Technical Fisheries University. All participants gave their written informed consent. During the experiment, students were advised to follow instructions:

1. Avoid oversized learning resources, use only key content. The display sizes of mobile devices are less than those of PCs and some other devices. Thus, focus your M-learning on the core content of the course. Focusing on the core resources, adjust the design of the instructions to fill in any missing information and address questions.

2. Keep your visual representations simple. Some images look fine on a PC screen, but not on a small screen. When using mobile devices, avoid images with poor quality. If this cannot be done, they can be included into a downloadable PDF file. You can also use image editing tools to optimize images.

3. Check your course before you start. Until you are sure that your E-learning course content has been tested for compatibility with all devices, do not run it.

4. Remember to be flexible when designing the layout. One way to design M-learning is to ensure that the layout design is adjustable. Make sure it is more flexible for different screen sizes. You can design your layout using HTML5-compatible output or using development tools for your design process.

5. Choose your interactions wisely. When choosing how to interact, you need to consider different screen sizes. Your interaction should work perfectly with the screen size of any device. For example, pages with frequent drag-and-drop can make interaction difficult for mobile users. You can solve this problem by reducing the drag-and-drop frequency. Always think about your interactions early in the design phase and choose the best fit for all mobile devices.

6. Make a single-column design. Instead of adding content tables or sidebars in a separate column, you can add everything in one column. Mobile users often scroll up and down, so adding multiple columns can make it difficult for them to learn.

7. Add the necessary section breaks. The reason why section breaks are important when designing M-learning is to ensure that students read each section of your course. Section breaks will help you minimize the rate at which students view some important sections of your E-learning course. You can break up your content by adding relevant colorful visual representations or charts.

Hopefully, this simple guideline will help you in your M-learning design and improve its overall effectiveness.

2.2. Participants

The study was conducted among third-year students of the Far Eastern State Technical Fisheries University.

140 participants were chosen, from which 70 students were randomly placed in the experimental group and 70 students were randomly placed in the control group. The mean age of the participants is 20 years.

2.3. Data Collection Tools

The measurement scale tools adopted in this study included a pre-test and a post-test. The pre-test and post-test were developed by three instructors who have taught Information Science for many years to non-technical students majoring in "Environmental and Natural Resource Management", "Marine Biology and Aquaculture", and "Ecobiotechnology". The pre-test was designed to assess students' prior knowledge. It consisted of 10 multiple choice and 10 true/false questions, with a top score of 100. The test also included 10 multiple choice and 10 true/false questions, with a top score of 100. Two experts said that the tests were adequate to assess student performance for this module.

2.4. Data Analysis

The reliability of the tests was checked with Cronbach's alpha. Scale for interpreting the values of Cronbach's alpha, according to Mallery and George (2000):

> 0.9 - excellent;

> 0.8 - good;

0.7 - acceptable;

0.6 - doubtful; and

> 0.5 - poor.

Cronbach's alpha values on the pre-test and post-test were 0.88 and 0.90, respectively, suggesting acceptable internal consistency (Cortina, 1993). ANCOVA was conducted to investigate efficacy and relevance and to identify differences between the two pre-survey groups. The validity of the obtained data was calculated using the Shapiro-Wilk test.

There are several study limitations. The first aspect is that the study does not provide for a long-term experiment. This may be done in future studies. The second aspect is the issue of expanding the sample to attract more students, which may provide an opportunity to improve the quality and accuracy of the research results. Speaking about the sample, such external factors were also not taken into account: different styles of teaching, level of academic performance, gender, position, etc.

3. Results

3.1. Analysis of academic achievements

The result of Shapiro-Wilk test was 0.97 (p=0.23). This can be considered an appropriate distribution of data. To reveal the homogeneity of the variance, a Levene test was performed (F=3.11, p>0.05). The data show that the difference in variance between the two groups was small (F=0.26, p>0.05), and one-tailed ANCOVA can be performed due to the uniformity of the regression slopes. To examine the impact of M-learning tools on the academic achievements of non-technical learners, analysis of covariance (ANCOVA) was used to exclude the difference between the prior knowledge of the two groups. ANCOVA treated the pre-test score as the predictor variable (or control variable) of the post-test score and then determined whether the adjusted post-test score had intergroup differences after adjusting for the pre-test score.

Table 1 shows the ANCOVA results regarding student achievements. The adjusted mean and standard error for the experimental group were 74.71 and 3.45, and for the control group: 65.9 and 3.59. This suggests that there was a significant difference between the test results of the two groups (F=10.84, p<0.05).

Table 1. ANCOVA results for student academic achievements

Group	N	Value	SD	Adjusted mean	SE	*F*	*η2*
Control group	70	66.44	19.75	66.89	3.59		
Experimental group	70	75.14	12.43	75.15	3.45	10.84*	0.62

* p < 0.05.

Members of the experimental group scored better on the final test (74.71) than members of the control group (65.9). This suggests that Web 2.0 M-learning technology can improve the performance of non-technical learners. Moreover, the effect (η 2) of the learning achievements was 0.62, meaning a small to medium effect (Cohen, 2013).

4. Discussion

Compared to the traditional approach to learning, digital learning tools can lead to better achievements among non-technical learners. It can be assumed that students were more interested in working with interactive course content and learning resources, as well as to receive quick feedback from instructors. One study focusing on Web 2.0 technologies in teaching and learning made it clear that students were able to demonstrate that they were becoming more confident in choosing, using, and integrating digital pedagogy (Sailin & Mahmor, 2018). Student engagement and participation were assessed through a variety of learning activities, including discussions and co-teaching presentations. This is consistent with previous research findings suggesting that integrating Web 2.0 into teaching and learning provides an authentic learning experience for students when preparing to integrate technology into their future practices (Jimoyiannis et al., 2013).

When studying the impact of Web 2.0-based learning on student academic achievement and critical thinking skills, the experimental group (who used problem-based learning with Web 2.0 tools) performed significantly better than the control group (who used traditional methods) (Hursen, 2021). Similarly, a problem-based learning method based on Web 2.0 tools has proven useful and effective in the context of developing critical thinking in students (Tawafak et al., 2018).

Research findings regarding the impact of coursework delivered using Web 2.0 tools in the Light-Matter Interactions section of a science course on students' academic achievements and independent learning are as follows (Kırıkkaya & Yıldırım, 2021). Classes prepared with Web 2.0 tools had a positive impact on the academic achievements of students in the experimental group and their independent learning relying on technology. The authors concluded that the significant difference between the post-test scores of the experimental and control groups is attributed to a better Web 2.0 app performance based on the experimental group's academic achievements. Gender was found to have no significant effect on the academic achievements and independent learning among students in each group (Kırıkkaya & Yıldırım, 2021).

A study that examined the impact of individual and collaborative Web 2.0 technologies on student achievements and self-regulation compared to the traditional approach to learning found that collaborative and individual Web 2.0 technologies have a significant impact on academic achievements and self-regulation compared to the traditional approach (Jena et al., 2018). A quasi-experimental design was used to conduct the experiment. SlideShare, Wiki, WhatsApp, and YouTube were used as individual Web 2.0 technology, and similar tools such as SlideShare, Wiki, WhatsApp, and YouTube were used for collaborations. Reliance on interactive methods makes Information Science professionally relevant for future biologists, and therefore expands the range of knowledge, skills, and abilities necessary for future professional activity (Yushchik, 2021).

5. Conclusions

The most obvious contribution of this study is its insight into the impact of Web 2.0 M-learning technology on student achievements. Data analysis made it clear that students of the experimental group scored better on the final test (74.71) than members of the control group (65.9). The proposed tool had a positive impact on the students' academic achievements. There was a statistically significant difference between the experimental and control groups to the advantage of the experimental group relying on Web 2.0. Overall, M-learning tools provide better resources to non-technical students.

This study also contributed to the comprehension of how instructors can best learn to develop digital pedagogy in their teaching practices. The research findings suggest that institutions of higher education should consider including pedagogy for Web 2.0 technologies as a separate subject of instructor training programs. Such a move will help them learn innovative teaching strategies, which, in turn, will enhance their confidence in using digital pedagogy in teaching. To address this issue, effective and simple recommendations have been made to improve M-learning.

6. Recommendations

The findings may be relied upon when developing an action plan to streamline the learning process for students, so that their academic achievements may be improved in an effective way. Future research might focus on the positives and negatives of various M-learning tools, expand the sample, conduct longer experiments, and examine the impact of this type of learning on students' achievements in other disciplines.

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