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Effectiveness of Physics Mobile Learning in Generation Z: A Literature Review

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Abstract: Today, the using of mobile learning tools are much needed. One of those mobile learning is physics mobile learning. This study aims to analyze the effectiveness of using physics mobile learning in physics learning in generation z students. The analysis was carried out on journal articles that have implemented physics mobile learning. The research subjects consisted of twenty five journal articles selected from the Scopus Index database, Web of Science (WOS), Google Scholar, or ERIC from 2012 to 2022. The data have already been analyzed related to improved orientation aspects, and research methods. The results of data analysis indicate that the use of mobile physical learning can have a positive impact on enhancing the different abilities of students, such as HOTS abilities, diagrammatic and argumentative representation skills, and students' conceptual understanding. According to our analysis of the development of physics mobile learning, students consider these apps to be an interesting and useful addition to traditional teaching, as they allow them to easily access multimedia resources and learn almost anywhere and anytime. This means that more research is needed to develop mobile learning physics in other physics concepts used and improved orientation aspects.

Keywords: Literature review, Physics application, Physics mobile learning

INTRODUCTION

The ubiquitous feature of mobile devices enables learning beyond the traditional space. With this widely adopted learning trend, studies have shown that too much information or poor multimedia content design leads to unnecessary cognitive load and ultimately reduces learning effectiveness practice (Salonen et al., 2005. Therefore, the lack of well-designed learning elements and teaching strategies is likely to overload learners' working memory. Therefore, in order to improve learning efficiency in mobile learning, the presented learning contents need to be readjusted and restructured based on appropriate cognitive theories.

The past forty years have shown a growing link between technology and education. One of the consequences of this linkage is that the inclusion of technological elements in daily learning activities has grown at an increasingly high rate, along with an improvement in the ability and availability of technology. have of technology. While in the 1970s or early 1980's the necessary technology resources were available to only a limited number of educational institutions and students, today virtually the entire world has access to the Internet is efficient and connected. As a result, in recent years, the use of computers in education has grown significantly as the capabilities of computers and their availability from school to university have grown. In addition, the global spread of wireless technology has brought about a shift from computer-based learning to web-based learning to mobile learning (Vavoula & Karagiannidis, 2005). Ease of access to telecommunications technologies, as well as the more or less affordable cost of mobile personal devices and communication connections, has led to the rise of so-called mobile learning (mLearning) (Caudill, 2007; Prieto et al., 2014), compared to MOOCs (massive open online courses) has advanced personalized, quasi-pervasive, and lifelong learning for new educational needs (Kellogg Company, 2013). All these circumstances also facilitate the development of learning under conditions in which students actively contribute to the design of their own virtual learning environment for new educational requirements, where a school or university is no longer the sole center of information. In addition, students' interest in mobile technology as well as their expertise in the use of these devices can be used as a powerful tool to enhance learning enjoyment. and facilitate their access to learning resources.

The influence of the rapid development of information technology on world education is inevitable in today's globalization era. Global needs require the education world always adapt to technological developments in an effort to improve the quality of education, especially by adapting the use of ICT to the world of education, in particular is in the learning process (Ma'ruf et al., 2020). Therefore, the need to change human psychology of the 21st century requires a great change in the national education, which we know that our education is the legacy of the old educational system that the content is the memory of meaningless facts. Trends of change and innovation in the world of education will continue to unfold and evolve as we enter the 21st century today. These changes include: easier finding of learning resources, more options for using and using media, the growing role of media and multimedia in learning activities, time more flexible learning, using computer-aided learning media, using television/video media, mobile learning, e-learning, online curriculum, library. Trends of change and innovation have very broad implications in the world of education, namely changes in innovation programs and learning technologies, changes in learning and learning, more control student learning and requires the integration of media into learning activities. This change in demand makes the educational world demand innovation and creativity in the learning process as many people are proposing educational reform, especially in physics, but very few people talk about the problem solving in the process of learning and teaching in accordance with the world requirements of the 20th century. In various studies, it has been said that education is the indicator of the glory of the nation, just as teachers play an important role in the upbringing of students. Therefore, teacher learning is an important indicator of academic success. At the dawn of the 21st century, the teacher/lecturer as the primary learning resource is considered insufficient, the teacher's learning resource must be integrated with other learning resources, specifically can be print, audio, audiovisual, and computer learning resources. There is even a need to use mobile phones for mobile learning.

Over the past decade, technology has evolved beyond mobile or handheld devices. However, trends have emerged from these definitions highlighting four central concepts of mobile learning namely pedagogy, device technology, context, and social interaction. Consistent with these structures, Sharples et al. (2009) tentatively defines mobile learning as "the process of learning through conversations in multiple contexts between people and personal interactive technologies".

Because mobile learning is a relatively new area of research, few studies have looked at and analyzed as a whole the research on mobile learning. Key assessments of mobile learning in education include a critical analysis of mobile learning projects by Frohberg et al. (2009) because they focused on six criteria: context, control, tool, communication, subject, and purpose. Using a framework for systematically analyzing and locating mobile learning projects. Frohberg et al. (2009) reported a review of 1469 publications to ultimately analyze 102 publications. They found that while mobile devices were primarily for communication, they found no association with research related to communication or collaboration, and most of the research supported new learners. This is the case because it is easy to teach something to a novice at a practical level of understanding and that this new knowledge can be statistically measured to demonstrate an effective science of teaching effort. Hung & Zhang (2012) performed a study on mobile learning research trends from 2003 to 2008. Text mining techniques were used to provide basic bibliographic statistics, frequency trends, rate of subjects, priority of subjects by country, and preference for each subject by journal. The researchers found that (1) articles on mobile learning increased from 8 articles in 2003 to 36 articles in 2008; (2) effectiveness, evaluation and personalized systems are the most popular areas of research; and (3) Taiwan did the most research on mobile learning. Hwang and Tsai (2011) conducted a study on mobile and ubiquitous learning research trends from selected journals between 2001 and 2010. They found that the number of articles published from from 2005 to 2010 is nearly four times higher than that of 2001 to 2005. The sample of groups selected for the study is classified as follows: higher education (59), primary school students (1), and middle school students (17). Only a few studies selected teachers (6) and working adults (6) as research samples. Their research found that most of the research was not related to any learning area, but focused mainly on studying students' motivation, perception and attitude towards learning. mobile. Contributing countries are 23, with Taiwan having the highest number of publications (51). Liu et al. (2014) reviewed studies on mobile learning in K12 from 2007 to present. They found across 63 studies from 15 peer-reviewed journals that the research was primarily exploratory and focused on understanding the educational benefits of using mobile devices in teaching practice. A survey of 114 articles from mLearn 2005, 2007 and 2008 conducted by Wingkvist & Ericcson (2011) investigated and compared the research methods and research objectives of these articles. The articles reviewed were evenly distributed among the research methods studied, with one exception. There are very few papers that use basic research, allowing the researcher to investigate problems for which possible methods or solutions have not yet been identified. Regarding research objectives, articles describing the study were well presented, but there was a lack of peer-reviewed articles. These authors say that one challenge for mobile learning research is to stop, go back, and reflect on research findings to avoid known pitfalls. They also say that a head start would be given if the research built on previous research rather than reinventing the wheel every time a new mobile learning initiative kicks in. However, they caution that much of the research conducted describes how the real world works and is often presented as the result of small-scale research. This raises questions about the generalizability of the study. Previous studies have provided an overview of how mobile learning plays out in education. However, these studies do not provide valuable insight into specific content areas.

METHODS

This study aims to analyse the effectiveness of using physics mobile learning in physics learning in generation z students. This study also explains the improved orientation aspects, and research methods from 2012 to 2022.

Data Collection

Many journal articles in this research area were searched and only relevant articles were selected. To carry out the search and research selection, the literature search was conducted using both an electronic search of databases and manual searches of specific journal articles to ensure a more exhaustive scope. These journal articles were retrieved from an electronic by searching for the publications whose titles, abstracts, or keywords met the logical conditions. Manual searches were conducted in journal articles that include a focus on mobile learning. In both the electronic and manual searches, the following search terms were used: “physics,” “mobile learning,” “application,” and “mobile application,”. We also added science, teachers, prospective teachers, and all the relevant combinations of these terms in the topics of the articles within the list that served as the primary sources for the relevant literature. After selection, the keywords, title, abstract, and careful reading a full text of the articles in the first phase, articles that did not that do not fit the topic was discarded.

The data extraction process was primarily defined by the design of a data extraction form that accurately collects information from selected studies. The contents of the data extraction form contained the following information: (a) the title of the journal, (b) year of publisher, (c) the publisher journal, and (d) the journal index database.

Data Analysis

This section describes the selected journal articles for this study. A total of 50 journal articles were reviewed based on the selected. In article screening, we read all the article abstracts, noted the research objectives, and then made an assessment that the effectiveness of implementing physics mobile learning was a feature of the research article. In addition, the criteria for selecting our articles include aspects of skill orientation developed through physics mobile learning, and research methods carried out. Only 25 out of 50 journal articles were selected for further review for obtaining guidelines for analyze the effectiveness of using physics mobile learning (see Figure 1).

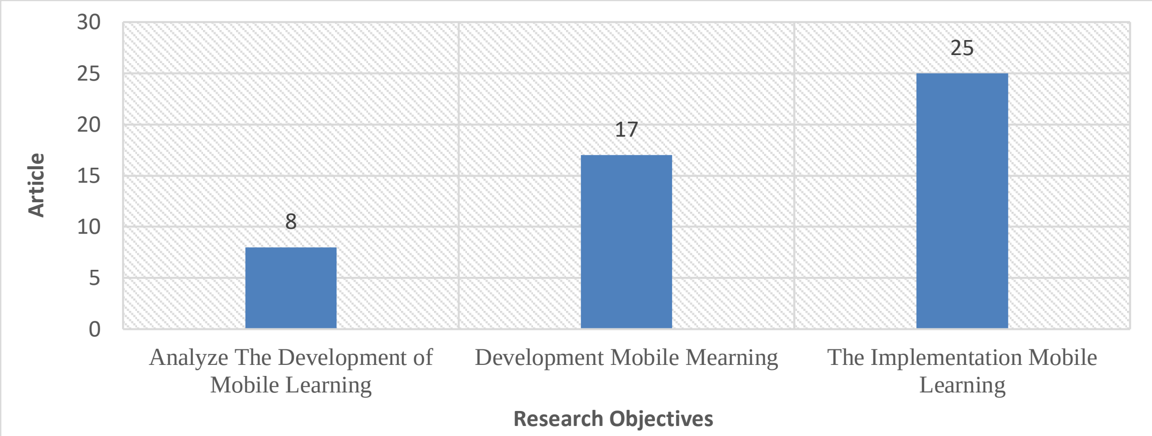

Figure 1. Categories of reviewed journal

FINDINGS AND DISCUSSION

Improved Orientation Aspects

Consistent with our review of the effectiveness of using mobile physics in physics learning among Generation Z students, we interpreted the results in terms of research objectives. The results of the analysis carried out obtained 10 aspects that were developed through the application of physics mobile learning, which is shown in Figure 2.

Figure 2 shows that physics mobile learning is widely applied to improve students' understanding of concepts. Meanwhile, other aspects that are also widely applied are to increase student interest in learning, higher order thinking skills (HOTS), creative thinking skills, and problem solving skills. Descriptive information related to the reviewed of article journals along with details of the result is shown in Table 1.

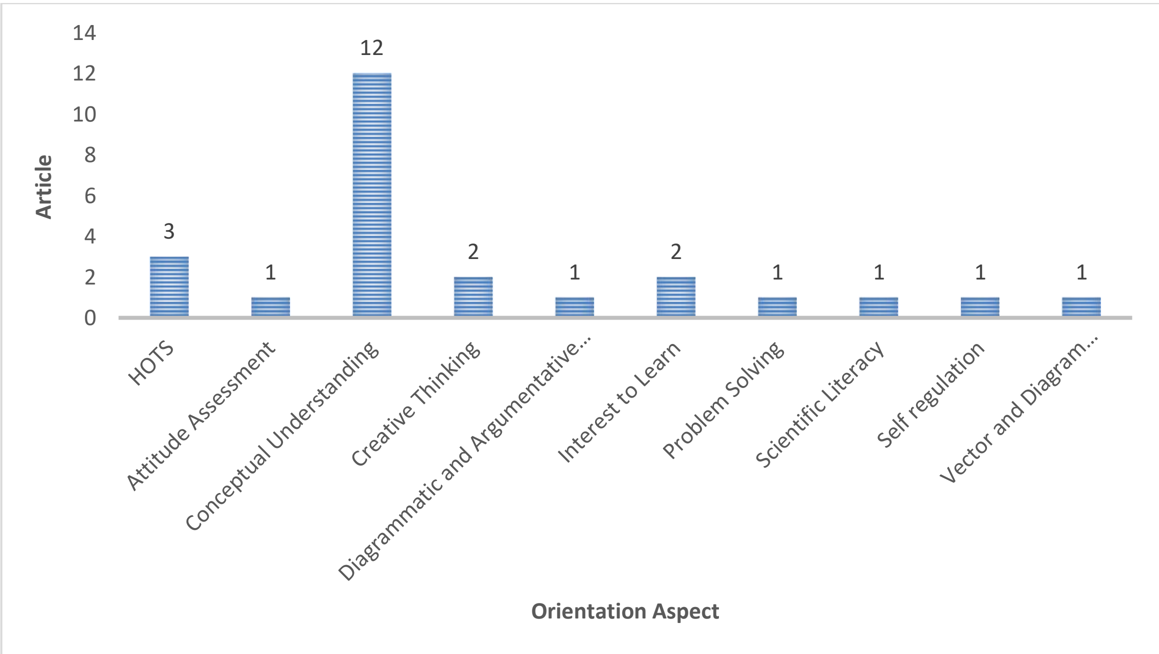

Figure 2. The results of the analysis carried out obtained 10 aspects that were developed through the application of physics mobile learning

Table 1. Descriptive information related to the reviewed articles journal

Author	Year of Publisher	Title	Aspect Oriented
Tuada & Suparno	2021	Increasing Student's Hots Using Mobile Technology And Scaffolding Approach On Sound Wave Material	HOTS
Wirjawan et al.	2020	Development Of Smartphone App As Media To Learn Impulse-Momentum Topics For High School Students	Conceptual Understanding
Pratidhina et al.	2019	Developing Computer Program As A Learning Resource On Gas Law Topics For High School Students	Conceptual Understanding
Dasilva et al.	2019	Development Of Android-Based Interactive Physics Mobile Learning Media (IPMLM) With Scaffolding Learning Approach To Improve HOTS Of High School Students	HOTS
Saputra & Kuswanto	2019	The Effectiveness Of Physics Mobile Learning (PML) With Hombobatu Theme To Improve The Ability Of Diagram Representation And Critical Thinking Of Senior High School Students	Diagrammatic and Argumentative Representation Skills
Abdillah et al.	2020	Tsunami Understanding Media: Android-Physics Mobile Learning To Improve Problem Solving-Skills And Natural Disaster Preparedness	Problem Solving
Carreño et al.	2022	Interest In Physics After Experimental Activities With A Mobile Application: Gender Diferences	Interest to Learn
Yadiannur & Supahar	2017	Mobile Learning Based Worked Example In Electric Circuit (WEIEC) Application To Improve The High School Students' Electric Circuits Interpretation Ability	Conceptual Understanding
Husna & Kuswanto	2018	Development Of Physics Mobile Learning Based On Local Wisdom To Improve Vector And Diagram Representation Abilitie	Vector and Diagram Representation Ability
Zhalgasbekova et al.	2018	Creating And Using Mobile Physics And Mathematics Applications In The Learning Process As One Of Teaching Methods To Increase The Quality Of Student's Knowledge	Conceptual Understanding
Demir & Akpinar	2018	The Effect Of Mobile Learning Applications On Students' Academic Achievement And Attitudes Toward Mobile Learning	Conceptual Understanding
Fayanto et al.	2019	The Implementation Of Multimedia On Physics Learning Based On Direct Instruction Model In The Topic Of Light	Conceptual Understanding
Liana & Nursuhud	2020	Problem-Based Learning Approach With Supported Interactive Multimedia In Physics Learning: Its Effects On Critical Thinking Abilty	Conceptual Understanding
Johnson & Ramganesh	2011	Effect Of Self-Regulatory Strategies With Interactive Multimedia On Problem Solving Ability Of Higher Secondary Students In Physics	Self regulation
Marnita & Ernawati	2017	The Use Of Interactive Multimedia (Macromedia Flash) To Increase Creative Thinking Ability Of Students In Basic Physics Subject	Creative Thinking
Apriyanti et al.	2017	The Effectiveness Of Using Multimedia In Teaching Physics To Gauge Student Learning Outcomes In The Senior High School In Indonesia	Conceptual Understanding

Author	Year of Publisher	Title	Aspect Oriented
Ma'ruf et al.	2020	Investigation Of Student Difficulties In Basic Physics Lectures And Readiness To Implement Physics Problem Solving Assisted By Interactive Multimedia Android In Indonesia	Interest to Learn
Záhorec et al.	2014	Impact Of Multimedia Assisted Teaching On Student Attitudes To Science Subjects	Attitude Assessment
Sadaghiani	2012	Controlled Study On The Effectiveness Of Multimedia Learning Modules For Teaching Mechanics	Conceptual Understanding
Kearney, M	2004	Classroom Use Of Multimedia-Supported Predict–Observe–Explain Tasks In A Social Constructivist Learning Environment	Conceptual Understanding
Widodo et al.	2020	The Effectiveness Of Gadget-Based Interactive Multimedia In Improving Generation Z's Scientific Literacy	Scientific Literacy
Moore	2018	Efficacy Of Multimedia Learning Modules As Preparation For Lecture-Based Tutorials In Electromagnetism	Conceptual Understanding
Muhomi & Mbise	2017	Development Of Multimedia Teaching Aids For Selected Physics Sub-Topics From The Topic Of Simple Machine In Tanzanian Secondary Schools	Conceptual Understanding
Eveline et al.	2019	Development Of Interactive Physics Mobile Learning Media For Enhancing Students' HOTS In Impulse And Momentum With Scaffolding Learning Approach	HOTS
Hakim et al.	2017	Interactive Multimedia Thermodynamics To Improve Creative Thinking Skill Of Physics Prospective Teachers	Creative Thinking

Numbers in the tables are not to be repeated in verbal descriptions, either before or after the tables or figures.

Research Methods

The most dominant research methodology used in the examined studies was 4D model, accounting for approximately 10 of 25 the studies (see Figure 3). The 4D models are considered the most appropriate for the development and implementation of physics mobile learning. The 4D model consists of four phases i.e. define, design, develop, and disseminate. The define phase includes front-end, learner, task, and concept analysis. The front-end analysis is done to gather the necessity of media. It is done by interviewing teachers and students about the desired learning media. Based on the task and concept analysis, the learning objective is specified. After doing some analysis, physics learning media is designed according to the purpose. The development phase involves expert assessment and field testing. The review process is also carried out by field practitioners. After going through several review processes, the application was revised according to suggestions from experts and practitioners until it was ready for field testing.

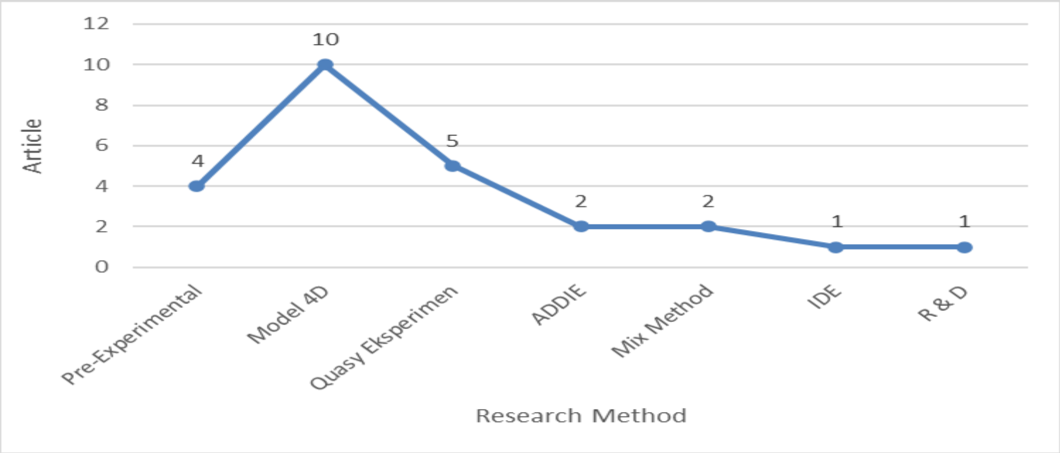

Figure 3. several research methods applied to the journal articles reviewed

Based on Figure 3, In addition to the 4D method, there is several research methods applied to the journal articles reviewed, such as ADDIE, IDE, Quasy Experiment, Pre-experimental, etc.

CONCLUSION

This study explores the effectiveness of the implementation of physics mobile learning based on the aspects of abilities and skills developed in physics mobile learning and the research methods used from the 2012 to 2022 article reviews. The results of data analysis indicate that the use of mobile physics learning can have a positive impact on enhancing the different abilities of students, such as HOTS abilities, diagrammatic and argumentative representation skills, and students' conceptual understanding. According to our analysis of the development of physics mobile learning, students consider these apps to be an interesting and useful addition to traditional teaching, as they allow them to easily access multimedia resources and learn almost anywhere and anytime. This means that more research is needed to develop mobile learning physics in other physics concepts used and improved orientation aspects.

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