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Literature review: The role of learning management system (LMS) in improving the digital literacy of educators

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ABSTRACT

This literature review is conducted based on an empirical phenomenon that describes the use of technology in the education sector due to the demands of increasingly advanced developments. It aims to explain the role of using a learning management system (LMS) in increasing the digital literacy level of educators who use LMS to support the learning process. It adopted the PRISMA analysis technique. The results of the literature review show that efforts to increase educators' digital literacy may come from their own will (internal) or others' encouragement or help (external). In addition, the learning management system in the learning process may also be one way to increase educators' digital literacy through the intense interaction between educators and using the learning management system.

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INTRODUCTION

The development of technology, information, and communication today brings various conveniences to the technology users. Fulfilling people's information and communication needs can be done anywhere, anytime, quickly, and in real time. Afandi et al., (2016) describe this change as "the world is flat", referring to a situation where, due to technological advances, the world is no longer limited by national borders and time zones.

The education sector has formidable challenges and opportunities in using technology for learning (Khotimah et al., 2020). The old education system only focused on teachers, books, and memorization methods, which were too monotonous, causing learning to be boring for students. The current learning using technology may complete the learning process and help adapt to students' different learning abilities, thus improving learning outcomes (Ambarwati et al., 2022). Technology, communication, and information use in education have enormous impacts. There are tendencies in learning, including (1) a shift in the learning system from teacher-centered to student-centered; (2) the popularity growth and development of open and distance learning; and (3) the broader range of learning resources available (Hermawanto et al., 2013).

One form of using technology in education is seen through online learning. The online learning implementation in Indonesia is set out under the National Education System Law No. 20 of 2003

CHAPTER VI Article 31(2) on Paths, Levels and Types of Education, stating that the purpose of distance learning is to provide educational services to groups who cannot attend face-to-face or regular training (Undang-Undang Republik Indonesia Nomor 20 Tahun 2003, 2003). Accordingly, it can be concluded that the government supports online learning in education as long as education quality remains priorities.

Online learning shows several characteristics, such as (a) interactivity, (b) independence, (c) accessibility, and (d) enrichment (Herayanti et al., 2017). Moreover, online learning also has other characteristics such as (a) content that is relevant to the learning objectives, (b) the use of teaching methods such as presenting examples and exercises to improve learning, (c) the use of media elements such as text and graphics to convey learning material, (d) possible direct teacher-centered learning (synchronous learning) or independent learning (asynchronous learning), (e) increase of understanding and skills related to learning objectives both at individual and group learning improvement level (Clark & Mayer, 2016).

Online learning in the education sector may now be built and developed on various Learning Management System (LMS) platforms that are accessible on the Internet. Essential features of an LMS include assignments, discussions, quizzes, and rooms for uploading learning materials that teachers may use to support the learning process (Herayanti et al., 2017). Similarly, the research by Simanullang & Rajagukguk (2020) explained that the Moodle-based learning platform supports multiple learning activities, namely (1) videos, (2) discussion forums, (3) chats, (4) ways to upload materials and (5) quizzes. Educators are expected to be able to create an innovative, effective, efficient, and flexible learning environment by using LMS.

As human resources in education, educators play a critical role in supporting educational goal attainment. No matter how complex and perfect, the use of facilities, technology, and media does not guarantee the attainment of educational goals if not balanced with the abilities of the educators and educational staff supporting them. Educators must master learning technology, especially information technology, and be able to develop it further in daily learning (Permatasari, 2014). Muniroh & Muhyadi (2017) emphasize that the quality and extent of learning outcomes are mainly determined by the teacher's competence, sensitivity, and motivation. The previous explanations illustrate that educators' quality is a critical and essential factor in attaining educational goals.

Non-technical factors (equitable mastery of technology, lack of online learning experience, high internet costs, the perception that technology is not suitable for children, and so on.) that teachers and students have when using online learning systems are inseparable from the digital literacy that teachers have (Putro et al., 2020). Digital literacy can be interpreted as an individual's ability to use digital technology that includes access, selection, understanding, analysis, verification, evaluation, distribution, production, participation, and collaboration of new information and knowledge (Raharjo & Winarko, 2021). Research shows that the average digital literacy level of teachers who were the target of the research is in the excellent category; however, several indicators demonstrate that they require increasing digital literacy knowledge so that teachers may optimize the learning process more easily by using digital technology (Nada & Indrawan, 2023). Besides that, teachers' ICT skills in Indonesia are also not distributed evenly due to gaps in infrastructure and quality of education in various regions of Indonesia (Rahman et al., 2020).

Many relevant studies have examined learning management systems (LMS) in the learning process at both the school and, education and training levels. However, most of them focus on efforts to optimize student learning outcomes. For example, the research conducted by Rakhmawati et al., (2022) developed a learning management system to support the early childhood learning process during the COVID-19 pandemic era. Next are the development of a smartphone-based LMS for mathematics learning in high school (Putra et al., 2020), the development of an LMS to help manage learning in an integrated manner in one system at a university (Sam & Idrus, 2021), and the development of an LMS to help organize education and training as well as assessing employee competency in a company (Putri, 2018). Many of these focus on the learning process for students, although LMS users are not only students but also educators who play an essential role as learning facilitators. This study aims to describe the role of using a learning management system (LMS) in increasing the digital literacy of educators who use LMS to support the learning process. The contribution of this research certainly produces references that compare several articles to find research results related to educational digital literacy with the help of the use of a learning management system.

METHOD

This research is a literature review adopting the PRISMA analysis technique. The literature review uses the database from the "google scholar" site. The keywords used in the search process were "development of learning management systems" and "influence of educators' digital literacy", which were limited only to journal articles indexed as SINTA 1, 2, 3. The articles were also limited to those of the last 6 (six) years, between 2017 and 2022. These limitations are a way to focus article publication and increase the accuracy of information searches (Akbar & Biyanto, 2022). The present study was conducted in August and December 2022. Before its use, each article was evaluated based on the criteria in Table 1, as follows:

Table 1. Criteria for Inclusion and Exclusion

No.	Criteria for Inclusion and Exclusion	Criteria for Exclusion
1	Research Articles Related to Using Learning Management Systems and Digital Literacy in Education.	Research Articles Unrelated to Using Learning Management Systems and Digital Literacy in Education.
2	SINTA 1, 2, 3 - Indexed Articles Research Carried out in Indonesia Articles Published Between 2017-2022.	Not any SINTA 1, 2, 3 - Indexed Articles Research not Carried out in Indonesia Articles not Published Between 2017-2022.

After being evaluated based on the abovementioned criteria, the data and information obtained from the selected articles were combined to get new data and concepts or a deeper understanding of the role of learning management systems in educators' digital literacy.

RESULTS AND DISCUSSION

Results

The selection results found 9 (nine) articles written in the last 6 (six) years that met the criteria as these discussed the use of learning management systems and digital literacy in the education sector. The selected articles were then read and analyzed. Afterward, the articles used as data for this study are presented in Table 2 below.

Table 2. Data Source Articles for Literature Review

No.	Author(s) & Publication Year	Titles of Articles	Article Category	Topics of Articles
1	Garad et al., (2021)	The Role of E-Learning Infrastructure and Cognitive Competence in Distance Learning Effectiveness During The COVID-19 Pandemic.	SINTA 1	E-Learning Infrastructure, Individual Knowledge, and Competencies
2	Herayanti et al., (2017)	Pengembangan Media Pembelajaran Berbasis Moodle Pada Matakuliah Fisika Dasar. (Development of Moodle-Based Learning Media in Basic Physics Courses)	SINTA 1	Moodle-Based Learning Management System Development
3	Wahjusaputri & Nastiti, (2022)	Digital Literacy Competency Indicators for Indonesian High Vocational Education Needs	SINTA 1	Competency Factors and Indicators For Improving Digital Literacy 4 Competencies
4	Listiaji & Subhan, (2021)	Pengaruh Pembelajaran Literasi Digital pada Kompetensi Teknologi Informasi dan Komunikasi Calon	SINTA 2	Analysis of the Role of Digital Literacy in the Information Technology and

No.	Author(s) & Publication Year	Titles of Articles	Article Category	Topics of Articles
		Guru. (The Impact of Digital Literacy Learning on Prospective Teachers' Information Technology and Communication Competencies)		Communication Competencies among Students as Prospective Teachers
5	Novitasari & Fauziddin, (2022)	Analisis Literasi Digital Tenaga Pendidik pada Pendidikan Anak Usia Dini. (The Analysis of Early Childhood Education Educators' Digital Literacy)	SINTA 2	Digital Literacy of Early Childhood Education (PAUD) Educators Through Four Indicators: Accessing, Selecting, Understanding, and Distributing Information
6	Septyanto et al., (2020)	Pengembangan E-Learning Berbasis Website menggunakan Metode Waterfall. (The Development of Website-based E-Learning Using Waterfall Method)	SINTA 2	Development of a Website-Based E-Learning System
7	Setyaningsih et al., (2019)	Model Penguatan Literasi Digital melalui Pemanfaatan E-Learning. (Digital Literacy Reinforcement Model through E-Learning Use)	SINTA 2	Digital Literacy Reinforcement Model Using E-Learning
8	Nahdi & Jatisunda, (2020)	Analisis Literasi Digital Calon Guru SD dalam Pembelajaran Berbasis Virtual Classroom di Masa Pandemi COVID-19. (The Analysis of Virtual Classroom-based Prospective Primary School Teachers' Digital Literacy During COVID-19 Pandemic Era)	SINTA 3	Analysis of Students as Prospective Primary School Teachers' Digital Literacy in Virtual Classroom Learning due to the COVID-19 Pandemic
9	Tobing et al., (2021)	Strategi Pengelolaan Pembelajaran Berbasis Teknologi (Multiplatform) di Masa Pandemi COVID-19. (The Strategies for Technology-Based Learning [Multi-Platform) Management During The COVID-19 Pandemic Era)	SINTA 3	Technology-Based Learning Management (Multi-Platform)

Discussion

Implementing a learning management system in the education sector has become necessary at various levels of education, from primary school to higher education (Garad et al., 2021). However, there are often obstacles that may hinder the implementation process. One of the efforts to overcome the limitations existing in the implementation process of the learning management system is the need for support from the government in the form of funds to procure teleconference applications and to organize training and workshops. This suggestion is based on the research results showing that the readiness level of higher education to adopt online learning is determined by the learning experience of each human resource (Garad et al., 2021). Several points mentioned above indicate that there is a need to implement a learning management system in the education sector, as demonstrated by educational institutions. However, the lack of knowledge and skills hindered the implementation process.

Besides being a necessity in the digital era, another reason for implementing a learning management system became important in the learning process is because its features can be developed according to user needs. It is highly possible to develop web-based e-learning to support the learning process. To preserve the use of e-learning websites, it is necessary to maintain them routinely, develop their functions according to user needs, and strengthen their security (Septyanto et al., 2020). The need for the use of technology in the education sector is also increasing due to the spread of the COVID-19 pandemic in the past years. Several matters must be addressed to adapt the learning process to the COVID-19 pandemic, including technology-based or cross-platform learning management. With the support of multiple platforms, hopefully, learning will become easier and more effective for both teaching staff as teachers and students as the teaching and learning subjects (Tobing et al., 2021).

Considering the rapid use of technology in the education sector, in addition to building quality online learning infrastructure, it is also necessary to improve information and media literacy skills not only for students but also for teachers as facilitators and support from teaching staff (Garad et al., 2021). Therefore, teachers' skills and abilities in dealing with technology must align with the existing needs. Novitasari & Fauziddin (2022) study analyzing the digital literacy of Early Childhood Education (PAUD) educators shows that the average digital literacy of educators at the PAUD level is in the fairly good category; however, digital literacy knowledge to use digital devices needs to be improved so that it can help the learning process and development of early childhood. Apart from that, Nahdi & Jatisunda (2020), in their research conducted on prospective primary education teachers, found that half of the research respondents encountered difficulty using the internet for various activities, including helping with the learning process.

To improve digital literacy, educators must be able to measure the extent of their digital literacy level. There are four competency factors and 28 indicators to improve digital literacy competency. Educators can use these indicators to measure the extent of their digital literacy level (Wahjusaputri & Nastiti, 2022). After knowing the extent of their digital literacy, educators can hopefully determine their future self-development steps to improve it. The indicators are described in Table 3. Other factors, such as curiosity and self-determination, also positively and significantly influence digital literacy (Rini et al., 2022). It can be noted from the results of this study that improving educators' digital literacy may come from their own will (internal) or others' encouragement or help (external) (Wahjusaputri & Nastiti, 2022).

Table 3. Competence Factors and Digital Literacy Indicators

No.	Indicator	Sub Indicator
1	Operation Skills	Browsing and Searching
		Evaluating Data
		Managing Data
		Filtering Data and Information
		Ability to use technology
		Solving Technical Problems
		Programming
		Upload and Download Files/Apps to the Internet
		Able to Store Information and Content Data in Digital Media
		Able to Backup or Store Data in Several Places
2	Thinking Skills	General Knowledge and Functional Skills
		Information Processing and Management
		Critical Thinking in Processing Information
		Interpreting Information and Digital Content
		Developing Digital Content
		Creativity
		Analysis of Data and Information
3	Collaboration Skills	Teamwork
		Interacting through Digital Technology
		Sharing through Digital Technology
		Ability to Communicate
4	Awareness Skills	Ethics in Technology
		Understanding Hoaxes
		Balance Attitude Toward Technology
		Understanding and Awareness of ICT Roles

No.	Indicator	Sub Indicator
		Legal Literacy
		Understanding Personal Security
		Understand Device Security

Using a learning management system in the learning process may also be a way to improve educators' digital literacy. Lecturers and students may automatically gain better teaching and learning experiences using information technology due to using a Moodle-based LMS in the learning process (Herayanti et al., 2017). Another study by (Setyaningsih et al., 2019) found a model for strengthening digital competence through online learning, which includes the elements of communication and collaboration in the form of active participation in learning and research activities. Furthermore, the influence of digital literacy on the prospective educators' ICT competencies also plays a role in teaching information literacy about ICT integration policies in the learning process (Listiaji & Subhan, 2021).

CONCLUSION

A learning management system (LMS) can be used to help increase the educators' digital literacy level through intense interaction between educators and the learning management system. Using LMS in the learning process will increase educators' digital literacy levels. As interaction occurs between the educators and the LMS, the educators will be required to use technology frequently from accessing, selecting, analyzing, verifying, evaluating, distributing, and producing to collaborating on new information and knowledge to be conveyed to students.

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The use of the TikTok application and its effect on students' learning behavior

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ABSTRACT

This study took samples at public high schools (SMAN) Barru district, South Sulawesi which aims to examine the level of use of the TikTok application on student learning behavior and at the same time analyze whether the use of the TikTok application has a significant effect on student learning behavior at SMAN Barru Regency. The research approach used is quantitative with a correlation type of research. The population in this study amounted to 108 students with a sample of 52 students selected using the Slovin technique. The data collection technique used a questionnaire. The data collected were then analyzed using descriptive statistical analysis techniques and inferential statistical analysis. The results of this study are (1) the results of the One Sample T-test test on the use of the TikTok application (X) obtained a value of 68.4% in the high category. (2) The results of the One Sample T-test test on learning behavior (Y) obtained a value of 70.3% in the good category. (3) the results of the Pearson product-moment correlation test obtained 0.410 indicate that there is a strong enough relationship. It is known that r count 0.410> r table 0.273, the Pearson correlation in this study is positive and the significance value is 0.00 <0.05, so there is a significant relationship (4) the results of the simple linear regression test show that the regression coefficient value is 0.395, so that every 1% increase in discounting, learning behavior increases by 0.395. The conclusion is that the use of the TikTok application has a significant effect on the learning behavior of students at SMAN Barru Regency, but based on the results of the coefficient of determination test obtained by R square 0.168, it was found that the level of influence was still low, namely 16.8%.

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INTRODUCTION

Developments in this era of globalization are skyrocketing with the latest technological innovations (Galuh, 2017). With so many social media that have sprung up with different versions and functions that make people now curious and want to try using various kinds of social media. One of the social media that is widely used by teenagers today is TikTok social media. TikTok social media is media with an audio-visual scope, a medium that can be seen as well as heard (Susilowati, 2018). The TikTok application is one of the social media that has many features that students can use in various ways such as finding information, adding relationships, and other

things. This can affect various aspects of students' learning behavior at school, both in terms of habits and knowledge. Learning behavior is a way or action that contains an attitude towards the implementation of learning techniques carried out by students at certain times and situations. The utilization of TikTok, especially in the field of education, has been explored in various kinds of research while showing its potential as an effective educational medium. TikTok's ability to disseminate information quickly means that it can be used by users for educational purposes, for example for public health education, as seen in the case of cycling safety, where didactic posts on TikTok received more engagement than on YouTube (Witte et al., 2023). Similarly, English teachers in Indonesia have used TikTok for storytelling, and found the platform's interactive features useful for engaging learners, despite challenges with content length (Damayanti et al., 2023). However, there are interesting uses of TikTok in educational contexts, for example, TikTok has been used to improve critical thinking skills in Islamic Religious Education (Tanjung et al., 2023). The platform's short video format has been identified as both a strength and a limitation, depending on the content and educational objectives (Aziz & Dali, 2023; Damayanti et al., 2023). In summary, TikTok's role in a wide variety of sectors of life ranges from enhancing learner engagement and creativity in education (Aziz & Dali, 2023) to being a medium for health information and math education (Aziz & Dali, 2023; Olsson et al., 2023; Hasanah & Pujiastuti, 2022). Its ability to adapt to various educational needs, including during the COVID-19 pandemic (Febrianti et al., 2022), and its appeal to Gen Z users underscores its potential as a versatile educational resource (Dasoo, 2023). However, the need for further support and consideration of content length and pedagogical strategies is evident (Damayanti et al., 2023).

The relationship between the TikTok Application and Learning Behavior is interesting to study more deeply because of the ability of this application to quickly adapt to the various needs of students. Some similar studies that allude to this such as the discovery of the effect of social media use on the learning behavior of Islamic religion and ethics subjects of SMA Negeri 5 Bengkulu Utara students, where the results showed that the contribution of social media use in influencing learning behavior was 21.6% (Kurniawan, 2022). The use of TikTok also has a significant effect on teenagers' self-confidence in Sampang Regency, namely 54.5% (Adawiyah, 2020). As for its relationship with learning achievement, it was also found to have a significant effect on TikTok (Marini, 2019). Based on the above background and several previous studies, this study will conduct research with four problem formulations: First, how high is the intensity of using the Tiktok application for students at SMA Negeri 4 Barru, second, how good is the learning behavior of students at SMA Negeri 4 Barru, third, is there a positive and significant relationship between the use of the Tiktok application and the learning behavior of students at SMA Negeri 4 Barru, fourth, is there a positive and significant relationship between the use of the Tiktok application and the learning behavior of students at SMA Negeri 4 Barru. This research contributes to changes in learning behavior with the use of the TikTok application.

METHOD

This study uses a quantitative approach, quantitative research is defined as a research method based on the philosophy of positivism, used to research on certain populations or samples (Sugiyono, 2019) Data collection uses research instruments, and data analysis is quantitative or statistical, with the aim of testing predetermined hypotheses. The type of research used is correlation research, which aims to see the relationship between one variable and another. The research location is SMA Negeri 4 Barru, this school is one of the schools in Barru Regency, Cilellang Village, Mallusetasi District. The time used in the implementation of this research is 1 month (adjusted to the needs of the research). The population of this study were students in grades X, XI, and XII at SMA Negeri 4 Barru. The average number of students who use the Tiktok application is 108 people with a sample using the Slovin technique with an error rate of 10%. Slovin formula for determining sample size n: number of samples, N: total population, e2: error level in Formula 1.

$$n = \frac{N}{1+Ne^2} \quad (1)$$

$$n = \frac{108}{1+108(0,1)^2} = \frac{108}{1+(108)(0,01)} = \frac{108}{2,08} = 51,9$$

The results of the sample calculation using the Slovin formula above are 52 respondents. The data collection techniques that will be used in this study are Questionnaire (questionnaire)**.** In this study, a closed questionnaire was used, namely the questions given to respondents already had answer choices. So this type of questionnaire respondents are not allowed to express their opinions. Instrument measurement using a Likert scale. The Likert scale is used to measure the attitudes, opinions, and perceptions of a person or group of people about social phenomena. The Likert scale has two forms of statements, namely positive and negative statements. Positive statements are scored 5, 4, 3, 2, 1, while negative statements are scored 1, 2, 3, 4, 5. The answer form of the Likert scale consists of strongly agree, agree, doubt / neutral, disagree, and strongly disagree.

This research has two data analysis techniques, namely descriptive analysis and prerequisite analysis. Descriptive analysis is a way of collecting and processing research data without concluding (Misbahuddin & Hasan, 2022). The analysis prerequisite test consists of several, namely the validity test which is an analysis to measure whether the questionnaire items are valid or not using the product moment person correlation method. Then the reliability test is to find out the consistency of the data we take whether it is consistent or not. When the data is consistent, it can be continued to the next test (Adibah, 2014). The third Normality Test aims to test whether the distribution data follows/approaches the normal distribution or not. In addition, there are several tests used to determine the formulation of the problem including hypothesis testing which is often called the one-sample test. The one-sample t-test or one-sample test is an analytical technique to compare one independent variable. The purpose of partially testing the significance of two independent variables on the dependent variable is to measure separately the contribution made by each independent variable to the dependent variable (Siregar, 2017). Furthermore, the Product Moment Correlation Test/R Test, test aims to determine the direction of the relationship, the strength of the relationship, and the significance of the strength of the relationship between variable X and variable Y (Roflin & Zulvia, 2021). Then simple linear regression is carried out to evaluate the effect of variable X on variable Y (Sugiyono, 2019). Next, the F test is to determine the effect of independent variables simultaneously on the dependent variable, whether the effect is significant or not (Priyatno, 2013). Finally, the coefficient of determination (R^2) is used to measure how well the regression line fits the actual data (goodness of fit). The coefficient of determination measures the percentage of total variance in the dependent variable Y which is explained by the independent variables in the regression line (Reza et al., 2021).

RESULTS AND DISCUSSION

Results

Answering the formulation of the first problem regarding how high the intensity of use of the Tiktok application is for students at SMA Negeri 4 Barru, the results of the One Sample T-test test were obtained. The results of this test show the t value of the variable (X) when compared to the t table value with dk = n-1 (52-1 = 51) with a significance level of a = 5% (0.05), the t table is 1.675. The calculated t value is -23.211 < 1.675 t table, then H0 is accepted and Ha is rejected. However, it is known that the value (2-tailed) is 0.000 <0.05, so H0 is rejected and Ha is accepted.

Based on the formulation of the second problem regarding how good the learning behavior of students at SMA Negeri 4 Barru is, the results of the One Sample T-test test show the calculated t value when compared to the t table value with dk = n - 1 (52 - 1 = 51) with a significance level of α = 5% (0.05) obtained t table of 1.675. The calculated t value of -17.659 < 1.675 t table, then H0 is accepted and H1 is rejected. However, the (2-tailed) value of 0.000 <0.05 indicates that H0 is rejected and H1 is accepted. Based on descriptive hypothesis testing, the results show that the level

of learning behavior of students at SMA Negeri 4 Barru is 70% of the specified criteria. This means that the learning behavior of students at SMA Negeri 4 Barru is included in the good category.

Based on the formulation of the third problem, regarding whether there is a positive and significant relationship between the use of the Tiktok application and the learning behavior of students at SMA Negeri 4 Barru. The results obtained from the correlation table provide information about the relationship between variable X and variable Y. The correlation coefficient value is 0.410 with a significance value (2-tailed) of 0.003. Because the significance value <0.05, which means that there is a significant correlation between the use of the Tiktok application (X) and the learning behavior variable (Y), because the significance of 0.000 <0.05, H_0 is rejected and H_a is accepted. This means that there is a positive and significant relationship between the use of the TikTok application and the learning behavior of students at SMA Negeri 4 Barru. The above statement is also reinforced in the Interpretation Table for the Correlation Coefficient, namely 0.26 - 0.50, so there is a sufficient level of relationship between the use of the Tiktok application and the learning behavior of students at SMA Negeri 4 Barru.

Based on the calculated r-value Pearson Correlation Sig. (2-tailed): It is known that the calculated r value for the relationship between the use of the Tiktok application (X) and the learning behavior variable (Y) is 0.410> r table 0.273 at the 5% significant level, it can be concluded that there is a relationship between the use of the Tiktok application (X) and learning behavior (Y). Because the r count or Pearson correlation in this analysis is positive, it means that the relationship between the two variables is positive or in other words, the increasing use of the Tiktok application will also increase learning behavior.

Based on the formulation of the fourth problem, how does the use of the Tiktok application affect the learning behavior of students at SMA Negeri 4 Barru. In this study, the authors analyzed variables X and Y. The simple linear regression equation above can be interpreted as follows, α = 35.142 means that if variable x, namely the use of the Tiktok application = 0, then the value of variable Y Learning Behavior will show a level or equal to 35.142. Thenβ = variable X has a regression coefficient of 0.395 which means that the variable coefficient for using the Tiktok application has a positive regression direction, where every time variable X increases by 1%, variable Y will increase by 0.395.

The simple linear regression coefficient value is positive (+), so it can be concluded that the use of the TikTok application (X) has a positive effect on learning behavior (Y). So the regression equation is Y = 35,142 + 395X. It is known that the significance value (Sig) of using the Tiktok application (X) is 0.003 because of the sig value. 0.003 <0.05, it can be concluded that H_0 is rejected and H_a is accepted. With a significance level of a =5% (0.05) obtained f count 10.087> f table 4.03, it can be concluded that the use of the Tiktok application has a significant effect on the learning behavior of students at SMA Negeri 4 Barru. So, the use of the TikTok application has a positive and significant effect on student learning behavior. The magnitude of the influence of using the TikTok application is 16.8%, while 83.2% is influenced by other factors not included in this study.

Discussion

Use of TikTok Application at SMA Negeri 4 Barru

TikTok application is one of the social media that has many users spread all over the world. This social media has many functions so that its users are fairly high, such as finding information, getting entertainment, sharing facilities, and online communication. The use of the Tiktok application can be measured by looking at the type of media used, frequency of use, and duration and intensity of use (Puspita, 2024). Based on descriptive hypothesis testing, the results show that the level of use of the Tiktok application by students is 68% of the specified criteria. This means that the use of the Tiktok application by students at SMA Negeri 4 Barru is included in the high category. This measurement of usage intensity includes various aspects such as daily frequency, duration of each usage session, and the type of content most frequently accessed. This high level of use can be interpreted in several forms of interpretation. First, the high usage of TikTok indicates that the platform is very attractive to learners, possibly due to its ability to provide different types

of content relevant to their interests. Second, the high frequency and duration of use may reflect that TikTok has become an integral part of learners' daily lives, serving not only as a source of entertainment but also as a tool for seeking information and communicating with peers.

This study also found that the use of TikTok at SMA Negeri 4 Barru can be categorized as a significant activity in the daily routine of students. This is in line with the findings of Nguyen & Diederich (2023) which emphasizes the importance of content that can encourage viewers to engage in knowledge sharing and negotiation, and who state that Tiktok's appeal to Generation Z and its capacity to make learning interesting and interactive aligns with the characteristics of today's students (Syah et al., 2020). In addition, the high use of TikTok among these students may be influenced by several external and internal factors. External factors could include the availability of internet access and adequate technological devices, while internal factors include personal interest and the desire to stay connected to social trends. The availability of interactive features and diverse content may also be a major driving factor that makes learners use the app more frequently.

Learning Behavior of Students at SMA Negeri 4 Barru

Learning behavior is a way or action that reflects the attitude towards the implementation of learning techniques carried out by students at certain times and situations (Maryani et al., 2018). Good learning behavior includes various aspects such as perseverance in completing assignments, concentration during the learning process, regularity in managing study time, and activeness in participating in teaching and learning activities (Rachman et al., 2021). Based on the explanation above, learning theory according to Robert Gagne emphasizes that learning contributes to the adaptations needed to develop logical processes. Therefore, the development of behavior is the result of learning from the cumulative effects of learning (Hasanuddin, 2017). This means that good learning behavior is the result of a continuous and structured learning process, where learners gradually develop effective learning skills and strategies.

Overall, good learning behavior at SMA Negeri 4 Barru is the result of various interrelated factors, including motivation, regularity, perseverance, and support from the surrounding environment. By overcoming existing challenges and utilizing technology wisely, learners' learning behavior can be continuously improved to achieve more optimal educational outcomes.

The Relationship between the Use of TikTok Application and the Learning Behavior of Students at SMA Negeri 4 Barru

The correlation coefficient of 0.410, although indicating a moderate relationship, is still relatively moderate. This means that although there is a positive relationship between TikTok use and learning behavior, this relationship is not very strong. Several factors could explain this phenomenon such as the use of TikTok that contributes positively to learning behavior is most likely related to the consumption of educational or informative content. Learners who utilize this platform to access tutorials, study tips, or videos that support the subject matter may show better learning behavior. TikTok also has interactive features that can increase learners' engagement in the learning process. For example, short videos that are engaging and easy to understand can help students understand difficult concepts in a fun and interactive way.

The Effect of TikTok Application Use on Student Learning Behavior at SMA Negeri 4 Barru

This study shows that the use of the TikTok application among students of SMA Negeri 4 Barru is quite high, which is 68%, and has a positive influence on their learning behavior. However, the effect is only 16.8%, indicating that TikTok has not become a dominant factor in improving students' learning behavior. Although there is a positive correlation between TikTok use and learning behavior, this relatively small contribution indicates that the app is not the only or even the main factor influencing learning behavior.

This 16.8% effect could mean that while TikTok has the potential to influence learning behavior, many other factors are more dominant and should be considered. Such factors may include teaching quality, family support, school facilities, and learners' intrinsic motivation. Therefore, while TikTok may serve as an additional tool that provides certain benefits, such as quick access to information and educational content, its role is still limited. This finding is

supported by research by Kurniawan (2022) which found that the use of social media contributed 21.6% to the learning behavior of Islamic religion and ethics subjects at SMA Negeri 5 Bengkulu Utara. This percentage is slightly higher than the influence of TikTok in this study, suggesting that social media in general can have varying impacts depending on the context and use. Research Adawiyah (2020) which showed a significant effect of Tiktok use on adolescents' self-confidence of 54.5% also highlights that Tiktok's influence may be stronger on certain aspects, such as psychological or social, rather than directly on learning behavior. This increased self-confidence could indirectly affect learning behavior, but the direct effect may be more complex and influenced by many other factors.

Furthermore, although TikTok is proven to be able to disseminate information quickly and can be used for educational purposes, such as in the case of cycling safety or improving critical thinking skills in Islamic Religious Education (Tanjung et al., 2023; Witte et al., 2023). However, this potential is not yet strong enough to significantly change learning behavior without support from appropriate pedagogical strategies and better integration in the education curriculum. Thus, although TikTok shows potential as an additional tool in education, its influence of only 16.8% on learning behavior shows that this application cannot be used as the main medium to improve students' learning behavior. To maximize TikTok's potential in education, there needs to be a more structured integration with traditional learning methods and support from various other factors that are more dominant in influencing learning behavior. Educators and policymakers should see TikTok as one of many tools that can be used to support the learning process, not as a single solution.

While these platforms enable non-formal learning and knowledge construction, content creators must create content that encourages viewers to pay attention to the content (Nguyen & Diederich, 2023). TikTok has appeal to Generation Z and can make learning engaging and interactive. This resonates with the characteristics of modern learners, which makes it an ideal medium to convey complex concepts in an engaging way (Syah et al., 2020). TikTok can capture learners' attention with short, engaging videos. This social media can convey information quickly and effectively allowing learning to take place informally, which allows learners to learn new ideas outside the typical classroom environment and can improve their learning behavior again. The use of interactive features on TikTok social media can be used as a means to engage learners and encourage them to actively participate in learning. It can be used to encourage discussion and cooperation, which is an important part of constructivist learning. In summary, TikTok's potential in education is multifaceted, encompassing content dissemination, student engagement, and informal learning. To maximize its potential, educators should consider the platform's unique features, audience demographics, and the balance between educational and entertaining content. The effectiveness of the platform as an educational tool relies on the thoughtful creation and curation of content that is appropriate and motivates students.

CONCLUSION

Based on the analysis that has been described in this article which discusses the effect of using the Tiktok application on student learning behavior at SMA Negeri 4 Barru, the following conclusions can be drawn: The results of the One Sample T-test variable (X) use of the Tiktok application, show a criterion of 68.4%. Thus the variable use of the Tiktok application based on the classification table 68.01-84.00% is in the high category; The results of the One Sample T-test of the variable (Y) learning behavior, show a criterion of 70%. Thus the learning behavior variable based on the classification table 68.01-84.00% is in the good category; There is a positive and significant relationship between the use of the Tiktok application and learning behavior. The Pearson correlation test results obtained 0.410 based on the Interpretation of Correlation Coefficient table 0.40-0.599 indicates that the relationship is quite strong. Based on the significance value sig. (2-tailed) between variable x and variable y, there is a significant relationship. r count of 0.410> r table, in this study it is positive, it means that the increasing use of the Tiktok application

increases learning behavior and with every 1% increase in the use of the Tiktok application, the level of learning behavior of students at SMA Negeri 4 Barru increases by 0.395.

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Development of digital learning media based on the GlideApps website on geography subjects endogenous power material

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ABSTRACT

The research was driven by the limited implementation of technology and the lack of interesting geography learning media on endogenous material. Abstract and complex material requires media to visualize events resulting from endogenous forces. Based on these problems, the right form of technology utilization is the media website GlideApps supported with images and animations. The research aims to produce a website-based learning media and a proper application of endogenous materials. This type of research is Research and Development with a 4-D development model, namely: Define, Design, Development, and Decimate. This media validation test is based on assessing media expert validators and material experts. Evaluation of product validation results by media expert validators was 98.75% (valid), and material experts 80% (valid enough). In addition, implementation was carried out for subject teachers and students, and the results showed a positive response because the media presented material that was more interesting, easily accessible at any time, and made learning not boring supported by various features so that it increased the enthusiasm and activeness of students in participating in learning activities.

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INTRODUCTION

21st-century learning is an implication of the development of society and increasingly modern information and communication technology. The electronic learning system (e-learning) can facilitate students in the implementation of learning the use of this will make it easier for students to obtain learning information through various online media and easily accessible using devices owned by students (Sulaiman, 2020). Based on the 2013 Curriculum, the learning process adopted by Indonesian Education as contained in the National Education System Law No.20 of 2003 article 1 is a student-centered learning process, where students are required to actively find solutions to problems encountered related to the learning process (Undang-Undang Republik Indonesia Nomor 20 Tahun 2003, 2003). For this reason, technology and learning innovation deliberately take a direct and creative role in helping to explore learning problems in the 21st century, one of which is in Geography learning.

Geography learning requires media innovation that can encourage and increase students' motivation in learning activities. The media serves to direct different information and involve

students in their minds psychology, and real activities so that learning occurs (Arsad & Rahman, 2017). It is still found that learning carried out by educators still relies on conventional learning models and the media used tends to be boring. This is in line with research (Mahmudah & Pustikaningsih, 2019), where 60% of teachers are still focused on using conventional learning approaches. Meanwhile, in the current digital era, educators need to utilize technological updates that can support learning activities, as well as make learning activities more interesting for students (Wulandari et al., 2019). One of the utilization of digital technology updates can be applied in GlideApps website-based learning media.

The GlideApps website is a website https://www.glideapps.com/ which can be used for independent application development that is integrated with Google Sheets (Rahmawati et al., 2020). GlideApps can be developed by anyone because making the application does not take much time and is free. GlideApps in its development makes it easy to create applications visually (without code) and utilize Google Sheets for data sources. The developer only needs to enter the material into the Google Spreadsheet then inputted into https://www.glideapps.com/ and the material will appear. The development of application-based learning media on the website is by the utilization of technological developments supported by various features in it, such as being able to add various types of text, images, video, audio, diagrams, locations, and other content.

Geography is one of the subjects that explore geosphere phenomena with complex aspects of region, space, and ecology. Geosphere phenomena include the atmosphere, lithosphere, hydrosphere, anthroposphere, and biosphere. Based on the analysis of the 2013 curriculum, lithospheric material is contained in Basic Competency 3.5 with the achievement of analyzing the relationship between humans and the environment as a result of lithospheric dynamics (Kurniawati et al., 2019). There are several sub-subjects in lithosphere material, one of which is endogenous energy. Endogenous energy is an event that occurs inside the earth that results in changes in the skin of the earth and its character that makes the earth's surface uneven (Sukandarrumidi et al., 2019).

The results of the needs analysis conducted on X IPS class students using a closed questionnaire totaling 30 students found that 80% chose digital learning media compared to using PowerPoint Point and according to students learning media is important to increase motivation in learning. The applied media becomes a supplement or intermediary for educators in learning and helps students to understand the material, to obtain good learning outcomes and interest in learning (Mardhiah & Akbar, 2018). The results of teacher observations still use PowerPoint media and there is still a lack of innovation in the use of technology in delivering material, especially endogenous energy material. The learning process that is adapted to technological developments, namely utilizing mobile learning, has practicality and makes it easier for students to understand learning (Rahmat et al., 2019). Mobile learning is one of the technology-based learning models, especially mobile devices and internet networks so that information is obtained quickly (Efriyanti & Annas, 2020). Therefore, there is a need for learning media that can make students understand the process of events and can improve critical thinking skills, such as the development of the GlideApps website learning media.

Similar research has been conducted by Viola et al., (2021) which states that the use of the GlideApps website media in learning activities can improve learning outcomes and a very good response is shown by students to the media. And there was an increase in learning outcomes from the results of paired t-test data, the average post-test score (74) was higher than the pretest (64). Similar research by Nisa et al., (2022) with interactive learning based on the GlideApps website states that the use of web-based interactive learning media can increase students' activeness in the learning process and learning activities become interactive and interesting. The previously developed GlideApps website-based learning media has not paid attention to aspects of practicality, the material is too much, and there is no innovation such as animation that can facilitate student understanding of the material. Deficiencies in the previously developed GlideApps website media can be improved by paying attention to the practicality of the material to be delivered and providing animations about the material being taught. It is hoped that the GlideApps website media developed by researchers can be recognized by many educators and can be used as a media reference for learning activities.

Based on these problems, it is necessary to develop the GlideApps website as a newer Geography learning media and adapt to events that occur in the surrounding environment. The use

of media is expected to create learning activities to are more interesting, dynamic, and interactive so that students have the motivation to learn. Based on the problems and needs, the research "Development of Digital Learning Media Based on GlideApps Website on Geography Subjects Endogenous Power Material" was conducted. The purpose of the research is to produce digital learning media products based on the GlideApps website equipped with animation and can be used in supporting learning activities. The contribution of this research is of course providing more interesting geography learning material through GlideApps.

METHOD

This research method is a research and development (R&D) method, with the 4-D development model, which consists of four stages, namely define, design, develop, and disseminate (Thiagarajan et al., 1974). The model selection was based on the suitability of the model with the developed media. The 4-D development model stage has the advantage of a systematic sequence of activities in solving learning problems related to a learning media (Arywiantari et al., 2015). The target/objective of this research is Xth-grade high school students. The research subjects consisted of the following: (1) subjects for needs analysis consisted of 30 grade X students and 1 Geography teacher, (2) validation test subjects by media experts and material experts, (3) test subjects and media implementation were carried out by 36 grade X students and 1 Geography teacher in Table 1.

Table 1. 4-D Development Stage

No.	Stage	Activity
1	Define	a. Front-end Analysis • Needs analysis of Students of SMA Negeri 10 Malang Class X IPS • Geography Teacher Interview SMA Negeri 10 Malang b. Learner Analysis • Analysis of Field Conditions (observation) of Geography Learning Activities at SMA Negeri 10 Malang c. Task Analysis • Analysis of Basic Competency and Core Competencies on the Dynamics of the Lithosphere, and its Impact on Life d. Concept analysis • Analysis of Endogenous Energy Material based on Reliable Sources and References e. Specifying Instructional Objectives • GlideApps Website Media Development Objectives based on Initial Analysis to Concept Analysis
2	Design	a. Preparation of Questions • Preparation of Practice Questions on Endogenous Energy b. Media selection • GlideApps Website Media Selection based on Needs Analysis c. Format Selection • GlideApps Website Media is in the form of a Link and can be Downloaded Into an Application Supported by Several Animations d. Initial Design • Designing Storyboards, Displays, and Media Material Content based on Needs Analysis • GlideApps Website Media Design
4	Develop	a. Expert Appraisal • Conduct Product Validation to Expert Validators, Namely Media Experts and Material Experts b. Development Testing • Testing and Implementation of GlideApps Website Media in Class X F SMAN 10 Malang which Amounted to 36 People and was Accompanied by a Geography Teacher

No.	Stage	Activity
		c. Response Questionnaire • Spread the Response Questionnaire to Teachers and Students Related to the GlideApps Website Media that has been Implemented
5	Disseminate	a. Packaging • Package GlideApps Website Media in the Form of Links which can be Easily Accessed b. Dissemination and Adoption • Dissemination of the GlideApps Website Media to Geography Teachers or Distribution via Social Media

(Maydiantoro, 2021)

The research was conducted at SMA Negeri 10 Malang in class X with as many as 36 students in one class and one Geography teacher selected using a purposive sampling technique based on certain considerations with the aim that the data obtained can represent the population representative (Lenaini, 2021). Data collection techniques are obtained by conducting validation using an assessment questionnaire instrument and responses. The assessment questionnaire was used to validate the GlideApps website media by media expert validators and material expert validators. Response questionnaire to obtain response data from teachers and students.

The research data analysis used qualitative descriptive and quantitative descriptive analysis techniques. Qualitative descriptive data is obtained based on data on suggestions and criticisms given by expert validators with the results of media development, as well as questionnaires of teacher and student responses to the GlideApps website media. Quantitative descriptive data is obtained from the assessment of the GlideApps website learning media by validators. The instrument used in collecting data in this study was a questionnaire. The assessment in the questionnaire uses a Likert scale (1-4 scale), including 4 (very good), 3 (good), 2 (not good), and 1 (very bad) (Sugiyono, 2022).

The assessment results obtained from the validators were then calculated and analyzed to determine the validity level of the media, using calculations according to Formula 1 (Akbar & Holid, 2013).

$$Vp = \frac{TSe}{TSh} \times 100\% \quad (1)$$

Description:
Vp: validity of the expert validator
TSe: total empirical score (expert assessment results)
TSh: total maximum score

The data obtained from the media and material expert validators were then analyzed using descriptive statistical analysis techniques to determine validity by giving a score for each item with the answers Very Good (4), Good (3), Less Good (2), and Very Less Good (1), adding up the total score of each validator, and finding the average score.

The data obtained were then interpreted and concluded based on the validity criteria. The results of the criteria listed indicate the level of validity of the learning media that has been developed. The validity level criteria are in the following Table 2.

Table 2. Criteria for Interpretation of the Validity Test Score

No.	Validity Percentage	Criteria for Validity	Description
1	85.01 – 100.00	Valid	Valid or can be Used without Revision
2	70.01 – 85.00	Fairly Valid	Moderately Valid or Usable with Minor Revisions
3	50.01 – 70.00	Less Valid	Less Valid, Recommended not to be Used Because it Needs Major Revisions
4	01.00 – 50.00	Not Valid	Not Valid or Should not be Used

(Akbar & Holid, 2013)

RESULTS AND DISCUSSION

Results

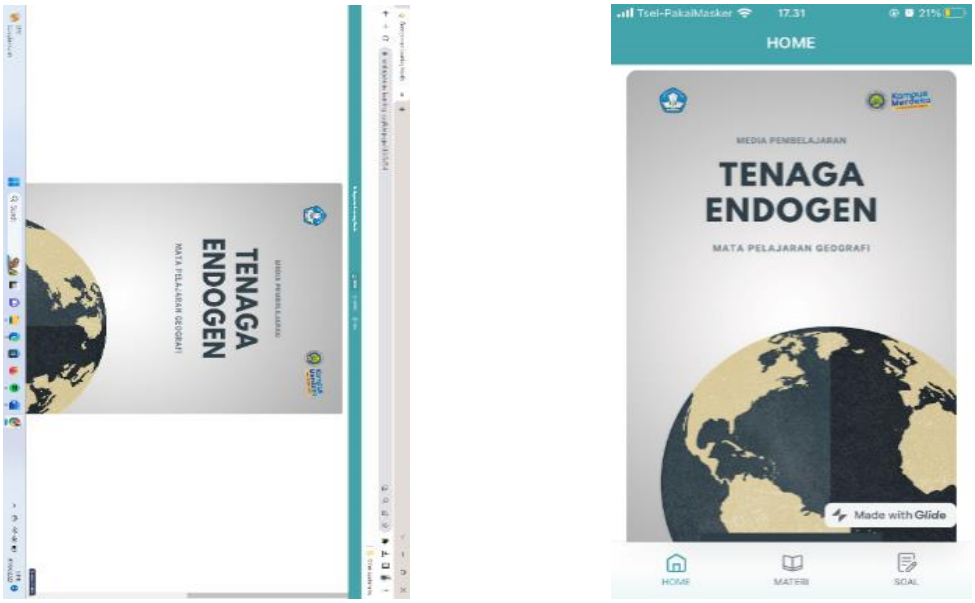
Learning Media Products

The research "Development of Digital Learning Media Based on the GlideApps Website on Geography Subjects Endogenous Power Material" which has been carried out using the 4-D development model produces the final development product in the form of an application. The final result of the development product contains endogenous energy material on basic competency 3.5 with three sub-materials accompanied by animated events and also practice questions. The results of the validation test with recommendations given by expert validators have minor revisions as in Table 3.

Table 3. Media Differences Before and After Revision

No.	Media Revision		Description
1			Added the Definition of Endogenous Energy: Endogenous Energy is the Dynamics within the Lithosphere as a Result of Physical and Chemical Processes, in the Form of Pressure on the Rock Layers Forming the Lithosphere or Magma Activity. Endogenous Energy is Divided Into Three Types: Tectonism, Volcanism, and Seism Or Earthquake. The Three Types of Endogenous Energy are Complemented by Illustrations of The Process of Occurrence of These Events.
	Figure 1. Before Revision	Figure 2. Aftet Revision	
2			Adding Animation Hints: Watch the Following Animation!
	Figure 3. Before Revision	Figure 4. After Revision	

The product is packaged in the form of a web link and can be downloaded easily to provide easy access to media, interesting media, easy-to-understand material, and clear content presented (Aisyah et al., 2022). The media can be accessed in the form of a website or downloaded into an application on a smartphone. The initial appearance of the GlideApps website media contains three main menus, namely the home menu, material menu, and question menu in Figure 2.



A B

Figure 2. Initial Display of Learning Media on Website (A) and Smartphone (B)

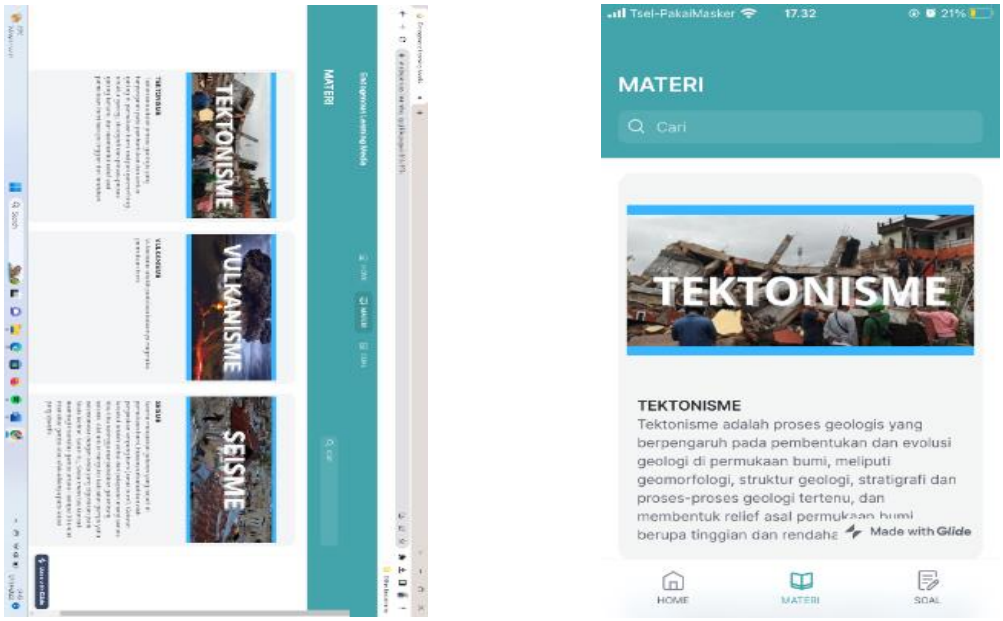
The menu page contains the cover, introduction to the material, about the application, and application instructions. The cover contains the material icon, the material contained in the media, and the name of the media maker/writer. The introduction to the material contains an explanation of the endogenous energy material that will be discussed in full in the media. The application contains the use of GlideApps website learning media in the Geography learning process at school. And equipped with instructions for using the GlideApps website media to operate it as found in Figure 3.

A B

Figure 3. Media Home Page on Website (A) and Smartphone (B)

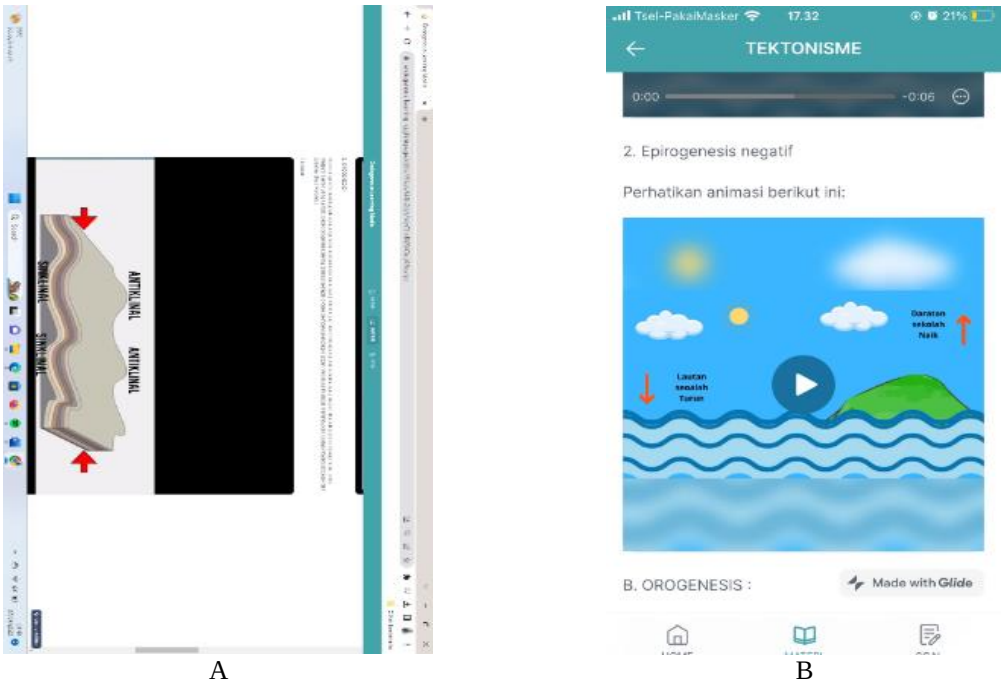
The material page contains material content from the basic competency 3.5 subchapter, namely endogenous energy material. Endogenous energy is a force that comes from within the earth and results in changes in the skin or surface of the earth (Amin, 2014). The material contained in the media is tectonism, volcanism, and seism or earthquake in Figure 4. The explanation of the material is adjusted to the sources and references from Geography books, as well as articles that have been trusted for their validity. In addition, each material is also accompanied by images and animations

about the process of events in Figure 5, where the use of images and animations has a good effect in increasing interest producing satisfactory grades, and achieving learning objectives (Sunami & Aslam, 2021).



A B

Figure 4. Media Material Page on Website (A) and Smartphone (B)

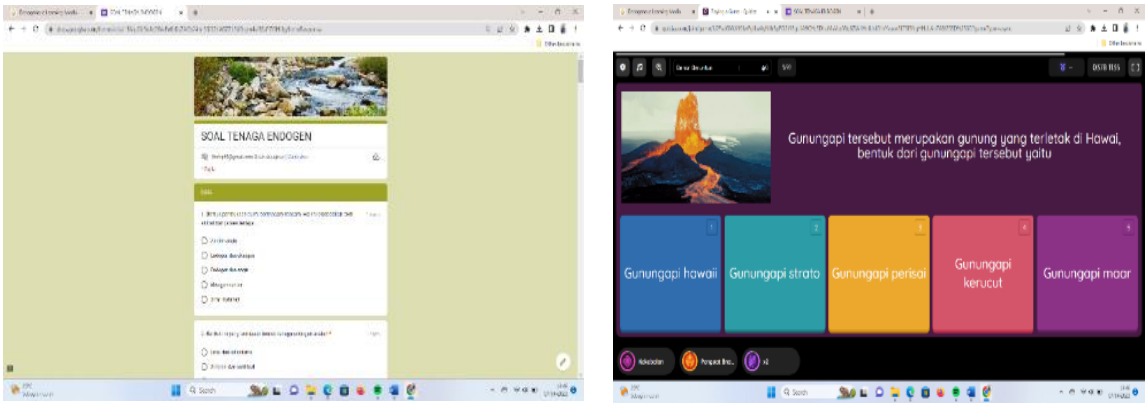


A B

Figure 5. Animation on Material in Website (A) and Smartphone (B)

The question page contains practice questions and quizzes on endogenous energy material Figure 6. Exercise questions consist of 25 questions that are adjusted to the achievement of basic competency 3.5 Exercise questions using the help of Google Forms Figure 7, as an alternative to making evaluations that have ease, speed, practicality, and efficiency (Mardiana & Purnanto, 2017). The quiz consists of 20 questions with the use of the Quizizz platform Figure 7, to increase the enthusiasm of students which includes response, attention, concentration, willingness, and awareness to increase knowledge about the material (Asria et al., 2021).

Figure 6. Problem Page



A B

Figure 7. Practice Questions and Quizzes Google Forms (A) and Quizizz (B)

GlideApps website-based digital learning media is suitable for use in Geography learning activities after validation by validators, as well as media revisions. Supported by an attractive design that is adjusted to the material in it. The material contained in the media is brief and clear by the curriculum and valid references. The media is also supported by elements of images and animations of events based on the material, namely tectonism, volcanism, and seism. In addition, there are tools for evaluation, namely practice questions using Google Forms and quizzes using Quizizz.

Media Product Validation

GlideApps website-based digital learning media on Endogenous Energy material that has been developed has gone through the validation stage. Product validation is carried out by two expert validators including media experts and material experts to get suggestions and recommendations from expert validators and find out whether the media that has been developed needs improvement or not. Not only in Indonesia, the use of GlideApps has also been carried out by Nor (2021) who developed a student final project assessment application in Malaysia using GlideApps to be flexible and efficient.

Validation by media experts contains three aspects, namely software engineering aspects, visual communication aspects, and usefulness aspects. Based on the validation assessment by media experts, a percentage of 98.75% is obtained in the valid category or can be used without revision in Table 4. The suggestions and recommendations given by media expert validators to make the media more practical are shown in Table 5.

Table 4. Results of Media Validator Assessment

No.	Suggestions and Recommendations	Assessment Item	Score
1	Software Engineering Aspects	9 Item	36
2	Visual Communication Aspect	8 Item	32
3	Usability Aspect	3 Item	11
Total		**20 Item**	**79**
Percentage			**98.75%**
Category		Valid or can be Used without Revision	

Table 5. Media Expert Suggestions and Recommendations

No.	Suggestions and Recommendations
1	Addition of Learning Instructions
2	Adjust the Display to Make it More Informative

The material expert validation contains four aspects, namely material aspects, question aspects, language aspects, and implementation aspects. The results of the material expert validators obtained a percentage of 80% in the category of valid enough or can be used with minor revisions in Table 6. The suggestions and recommendations given by the material expert validators are in Table 7.

Table 6. Results of Material Validator Expert Assessment

No.	Suggestions and Recommendations	Assessment Item	Score
1	Material aspect	9 Item	31
2	Problem aspect	6 Item	18
3	Language aspect	2 Item	6
4	Implement ability aspect	3 Item	9
Total		**20 Item**	**64**
Percentage			**80%**
Category		Fairly Valid or can be Used with Minor Revisions	

Table 7. Suggestions and Recommendations of Material Experts

No.	Suggestions and Recommendations
1	Addition of Understanding of Endogenous Energy
2	Shorten and Clarify the Content to Make it More Interesting
3	Correct Some Sentences in the Material that are Less Effective and Wrong Writing

Validators of digital learning media products based on the GlideApps website have been carried out by two expert validators. Results from media experts obtained a percentage of 98.75% (valid) and from material experts 80% (quite valid), along with suggestions and recommendations for improvement. Similar research was also conducted (Aprilia et al., 2023), GlideApps web-based media scored 94% and was classified as very good and effective in improving science literacy. Based on the results of media product validation GlideApps website-based learning media is feasible and valid to be applied in Geography learning activities on endogenous energy material.

Media Testing and Implementation

The learning media was tested and the implementation that had been validated and revised was carried out to Geography teachers and students of class X F SMA Negeri 10 Malang. The trial of students in one class amounted to 36 students. The trial and implementation procedures were carried out in Geography learning activities by utilizing digital learning media based on the GlideApps website and then providing feedback on the products developed. Assessment of media products is

done by filling out a research questionnaire in the form of a response questionnaire by both educators and students. The results of educators' responses, suggestions, and comments are in Table 8.

Table 8. Results of Teacher Respondent Assessment

No.	Item Assessment	Score
1	GlideApps Website Media has an Attractive Appearance	3
2	The Material Presented in the GlideApps Website Media is by the Curriculum and Basic Competencies and Core Competencies Geography Subjects	4
3	The Suitability of the Material Presented with the Learning Objectives to be Achieved	4
4	GlideaApps Website Media can be Accessed Independently by the Teacher	4
5	GlideApps Website Media Makes it Easier for Teachers in the Learning Process	4
6	The Ability of GlideApps Website Media to Increase Student Learning Motivation	3
7	GlideApps Website Media is Effective in Facilitating Student Understanding of the Material	3
8	GlideApps Website Media Helps Deliver Material to More Interesting	4
9	The Satisfaction Felt After Using the GlideApps Website Media	3
10	GlideApps Website Media is Fun to Use in Learning Activities	3
Total Score		**35**
Percentage		**87.50%**
Suggestion: Some Concepts are not Correct so there is A Need for Improvement The Test Questions Still do not Stimulate Students to HOTS Comments: The Animation Displayed is Interesting so it is Quite Helpful in Student Understanding		

The results of the Geography teacher response assessment showed a product assessment percentage of 87.50%. Educators gave a positive response to the GlideApps website media because learning media that is tailored to the current situation is more acceptable to foster a sense of desire for students to learn it (Syafiudin et al., 2016). Media can meet the needs and characteristics of students as an intermediary for messages from concrete to abstract. The thinking ability of students who are still at the concrete operational stage according to Piaget states that students build knowledge concepts through concrete objects (Ali & Asrori, 2014).

The results of the trial and implementation of the GlideApps website learning media to students of class X F SMA Negeri 10 Malang to find out responses and responses using a questionnaire. The results of students' responses after the implementation of learning media on endogenous energy material as in Table 9.

Table 9. Student Respondent Assessment Results

No.	Assessment Item	Score	Percentage Value
1	The GlideApps Website Media has an Attractive Appearance	121	84.03%
2	The Material Presented in the GlideApps Website Media is Clear	117	81.25%
3	The GlideApps Website Media can be Accessed Easily	116	80.56%
4	The GlideApps Website Media Makes it Easy to Understand the Material	116	80.56%
5	The ability of the GlideApps Website Media to Increase Learning Motivation	112	77.78%
6	The Display of Images or Animations in the GlideApps Website Media is Clear	111	77.08%
7	The GlideApps Website Media Helps Deliver Material to More Interesting	118	81.94%
8	The Satisfaction Felt After Using the GlideApps Website Media	109	75.69%
9	The GlideApps Website Media is Fun to Use in Learning Activities	115	79.86%
10	The Media can be Used Repeatedly	122	84.72%
Total Score and Percentage		**1157**	**80.35 %**

The results of student respondents obtained an average percentage of 80.35% and gave a positive response to the GlideApps website learning media. Based on Table 9 the response points

with the highest percentage of 84.03% are found in assessment item 1. The GlideApps website media has an attractive display design supported by the use of images and animations so that the media looks attractive to students. In addition, the low average percentage value is on assessment item 6 of 77.08%.

Discussion

This is related to the term user friendly, which means that the product or media can facilitate the user so that the user feels comfortable in using the media (Aziz et al., 2013). In this statement, the media still has shortcomings because students have difficulty displaying some animations because they need an adequate device. The utilization of the GlideApps website is felt to make students more efficient, because the media can be used to study either at home, during holidays, or approaching exams, as well as material and image and animation support. Animation aims to visualize the subjects taught so that the material is easier to understand (Höffler & Leutner, 2007). The utilization of animation in learning media provides benefits, namely learning becomes more interesting, motivates students, and presents and provides a clear explanation of the material.

The utilization of technology-based media is expected to be able to produce intensive communication between students and educators. The internet is evidence of the development of technology that is widely used today and can support when teaching and learning activities (Cholid et al., 2016). Website-based learning media can break the static atmosphere create an effective, interesting, and interactive learning process, and be able to motivate students to learn. In addition, with digital website media, students will train their digital skills, such as digital literacy which is a skill in using digital-based devices, analyzing and processing information to obtain information, and increasing critical thinking in solving problems (Kurniawan et al., 2023).

The GlideApps website has advantages that make the learning media display resemble an Android display. The media contains endogenous energy material supported by animations, images, and quizzes that can produce innovative and interactive learning media. GlideApps presents media with interesting and diverse functions, thus increasing student motivation to understand the content of the material (Minan & Ekohariadi, 2022). Even so, there are still complaints from users such as the level of security, there are images or animations that do not appear, and so on where researchers try their best to fix the problem completely. Apart from the existing problems, users are very enthusiastic and interested in using GlideApps startup in learning activities, especially endogenous energy material.

CONCLUSION

Based on the results of the study, it is concluded that the digital learning media product based on the GlideApps website on endogenous energy material is included in the category worthy of use in Geography teaching and learning activities. The results of the media expert validator are 98.75%, the category is valid and can be used without revision. The results of the material expert validator are 80%, the category is quite valid and can be used with minor revisions. In addition, according to the results of the response assessment from teachers, 87.50% and students 80.35%, showed a positive response to the learning media. From the development of this media, it is hoped that future researchers will display images or animations so that the size is not too large so that they can be displayed and pay attention to media security. Educators are also expected to be able to develop and utilize web-based media well so that it can be utilized for learning activities and improve student learning outcomes.

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ASABI App: Mobile learning media for learning procedure texts in the seventh grade of junior high school

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ABSTRACT

The purpose of this study was to describe the use and benefits of using the ASABI application in learning procedure texts in junior high school. The research was developmental research using the Hannafin and Peck model. The data was taken from Junior High School 12 of Bandar Lampung. The results of this study indicated that 89% of respondents agree that the ASABI application provides benefits in learning procedure text. The ASABI application can be used in learning procedure texts in junior high school. There was an increase in learning motivation in students themselves. The advantages obtained from the ASABI application include 1) a more attractive appearance and ability to increase enthusiasm for learning, 2) easy to use, 3) the material is easier to understand, 4) more practical and economical, and 5) equipped with evaluation questions accompanied by feedback. The use of the ASABI application in procedural text learning was not only providing benefits for students but also for the educator.

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INTRODUCTION

Since 2013, the curriculum applied in all schools in Indonesia is the 2013 Curriculum. Even though there is a new curriculum, there are still many schools that apply the 2013 curriculum. This is held according to Minister of Education and Culture Regulation No. 22 of 2016. Based on rules, the process of learning in school is designed to be interactive, inspirational, entertaining, challenging, pushing participation actively, and depends on ability, interest, development of the physique and psychological students, available room, and enough room for initiative, creativity, and independence (Kemendikbud, 2018). This demands students can think creatively, be more active in thinking and acting, and innovate. Besides that, the curriculum of 2013 pushes teachers to be innovative in electing and defining learning sources, as well as planning meaningful learning and appropriate times for students. Teachers nowadays must have adaptive skills and study in the 21st century.

A part that teachers must master in this era is maximizing skills in IT. These steps can be implemented through the innovation of media learning. The utilization of contemporary learning media in the learning process can awaken urge and new interest, increase motivation and stimulate

curiosity to learn, and even have a positive effect on student's psychological (Indriyani, 2019). Various types of learning media in the 21st century like e-learning, learning video, learning audio even mobile learning-based learning media. Mobile learning applications can be used as tools to support activity in class and make students have better and independent life skills (Azwar et al., 2018), as possibly implementing sustainable learning (lifelong learning) and increasing the level of student's participation in the classroom and outside the classroom (Ardiansyah & Nana, 2020). Therefore, the development of Android applications as mobile learning media is necessary.

The development of Android-based mobile learning media is also done by looking at data from Android users in Indonesia. In 2022, there were 192.15 million smartphone users in Indonesia (Pusparisa, 2020). This amount is calculated to continue increasing until 89.2% of the Indonesian population owns and uses an Android cell phone in 2025 (Pusparisa, 2020). The use of devices and Android phones is motivated by lots of different needs. Started from education, work, economy, society, etc. (Aeni et al., 2022). This indicated that the development of Android-based mobile learning media has great potential, according to the needs of the times. An example of developing mobile learning is the development of Android applications with software such as Construct 2. Construct 2 is a game editor based on HTML 5, which has features that are easy to use for people who are first-time developers of 2D games (Subagio, 2014). Construct 2 has the strength to be suitable for various platform devices; the programming language is easy; has integrated physical function, and can be easily developed. The development application is done with the method of drag-and-drop (Muhtasyam, 2018), and the project can be converted to an Android application using the PhoneGap website (Widaningrum et al., 2020). Therefore, Construct 2 is suitable for the development of mobile learning media.

One of the mobile learning media that can be developed with Construct 2 is the ASABI application. ASABI was developed to answer the problem identified during the investigation which was done at SMP N 12 Bandar Lampung. The previous research gave information from problem learning, like learning which is still a natural lecture, monotonous, and less interesting. The other fact shows that students' books as learning sources used by students do not suit the student's characteristics. This causes a lack of motivation for students, so there are still lots of students who have not yet reached the Minimum Completeness Criteria.

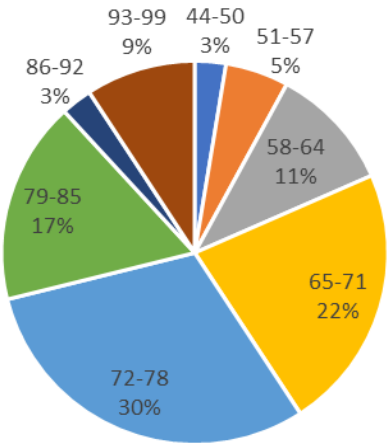

Figure 1. Diagram of Student Scores for Procedure Text

Based on preliminary research which is depicted in Figure 1, as many as 41% of students in the seventh grade of SMP N 12 Bandar Lampung have not yet fulfilled the minimum passing score of 72 on the material procedure text, specifically for basic competencies examining the structure and writing procedural text. This becomes a problem because almost half of the students do not fulfill the minimum score for that competency. After a thorough analysis, it was discovered that the cause of the failures is 1) the learning techniques used are less varied; 2) the limited number of books that can be made into learning resources; 3) the available learning resources are less attractive; 4) lack of availability of media and learning resources that are more diverse and can be used as support for

learning procedural text; and 5) unavailability of the internet to facilitate learning. Besides those problems, there are opportunities such as the whole seventh graders who own Android devices. This can be an opportunity to develop media learning through mobile learning. From the need analysis, it was concluded that it is needed to develop media learning following students' needs, especially in mobile learning media.

Based on that data, previous research has tried to develop applications for mobile learning that can be operated using the student's Android phone. The application was developed using Construct 2 software. The development of a mobile learning application that will be operated using students' devices is a way to facilitate learning procedural texts. Apart from that, the product produced in the form of an Android application is also expected to be a solution to the problem of device addiction that occurs among teenagers. The resulting application must be able to become a mobile learning media that helps students master the procedural text material being taught.

The development of mobile learning with Construct 2 of the course is not yet widespread in Indonesia, whereas Construct 2 can produce mobile learning applications which are very helpful for learning (Koderi et al., 2019; Nuqisari & Sudarmilah, 2019; Widaningrum et al., 2020). Nuqisari & Sudarmilah (2019) successfully developed an application that uses Construct 2, an Android-based game education app for learning solar systems that can be used on phones and computers to support the learning process. Koderi et al., (2019) developed an Android application for learning the Arabic language with a score efficiency of 49.04462. Widaningrum et al., (2020) succeeded in developing an educational game, Math & Trash, which increases awareness of the importance of mathematics subjects and protecting the environment. However, no one has developed media for mobile learning that uses Construct 2 for studying languages in Indonesia yet.

Based on preliminary research, this research tried to develop mobile learning media in the form of an Android application using Construct 2 software to facilitate the learning of procedural texts in junior high schools, especially basic competencies examining the structure and writing of procedural text. The application developed must be suitable for student characteristics. The ASABI application developed is also adapted to student's circumstances and needs so that it contains 1) procedural text material, 2) student activities as a process of material consolidation, and 3) practice questions as an assessment of students' understanding of the structure and linguistic rules of procedural texts. After the development process is complete, it is necessary to explain the use of the ASABI application in Indonesian language learning activities. Therefore, this research will discuss the use of ASABI as a mobile learning media for learning procedural texts in junior high school. This research contributes to improving English language subjects on procedure text topics.

METHOD

This research is a type of research and development (R&D). This research design uses research and development methods from modifications to the Hannafin and Peck model. There are three main steps used in this research, namely: 1) needs analysis; 2) design and planning; and 3) development and implementation which is depicted in Figure 2 (Hannafin & Peck, 1988).

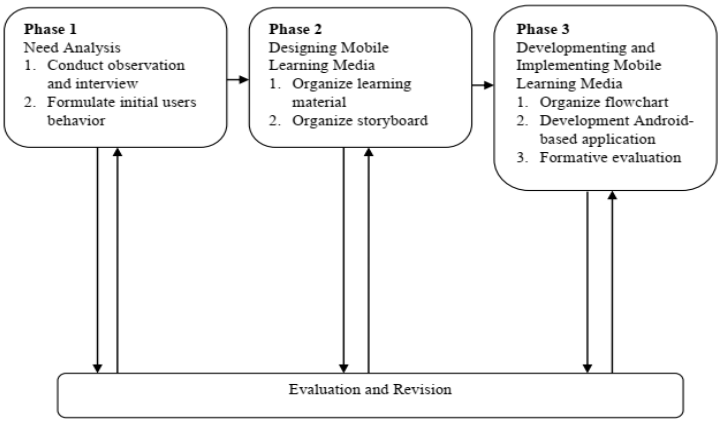

Figure 2. Modification of Hannafin & Peck Model

At the needs analysis stage, interviews and observations were carried out to obtain data on conditions in the field. This stage is also carried out to map existing problems in the field as well as opportunities for problem-solving solutions. This activity also succeeded in identifying that the problems that occurred included 1) the learning techniques used by teachers are less diverse, 2) there were fewer books available for being learning resources, 3) the available learning resources were less attractive, 4) there were fewer media and source studies available that are more diverse and can be used as supporter learning text procedures, and 5) there was no internet for facilitating learning. Opportunities found were students who have Android devices as learning support.

At the design stage, android-based mobile learning media was designed. The first step was to compile the material that is used as material in the developed media. The second step was compiling a storyboard as a reference for developing the media. The third step was the background image design process assisted by Adobe Photoshop. The material contained in the media was adapted from the Indonesian language book for seventh graders published by the Ministry of Education and Culture. The material was developed and evaluation questions were added in the form of multiple-choice and essays. Multiple-choice questions were obtained from the results of question development by researchers. The essay questions come from YouTube in the form of a video of the procedure for making temporal. The selection of questions was based on the consideration of highlighting local culture in Lampung and the student's lack of knowledge regarding making typical Lampung food. The preparation of material and evaluation questions were adjusted to basic competency to examine the structure and writing procedural text in seventh-grade Indonesian language learning. The material contained in the ASABI application included 1) types of procedural texts, 2) structure of procedural texts, 3) linguistic aspects of procedural texts, and 4) provisions for writing procedural texts. At the development and implementation stage, there were three steps carried out. The first step taken was organizing a flow chart as a reference for developing the Android application. The second step was to develop an Android application by giving commands according to the flow chart that had been prepared. The third step was exporting and building an Android application using Construct 2. The next implementation step was validating and testing by experts, practitioners, and students.

Development of ASABI app done with add object and command use Construct 2. The commands given follow an organized flow chart. After development, the ASABI app was exported to make documents with the .rar extension. Application made/executed through the making process using the Phonegap website. After processing it, the application with extension .apk will made and ready to be installed on Android phones. When the application is ready for installation, it will go through the validation and testing process. The test takes were individual tests, small group tests, and big group tests. The experiment was done on a teacher and 32 students from the seventh grade of SMP N 12 Bandar Lampung. After that, an evaluation of the experiment was carried out, looking for deficiencies, and analyzing whether the application developed could be used and was useful for learning Indonesian Language in seventh grade.

The targets of this research were teachers and students of seventh grade at SMP N 12 Bandar Lampung. The research was carried out at SMP N 12 Bandar Lampung. Data collection used interview techniques, observation, and distribution of questionnaires. Data was collected using questionnaires, interview guides, and observation sheets. Interview guides and observation sheets were used to find out about procedural text learning that had been carried out at SMP N 12 Bandarlampung and mapped problems and opportunities that could be used to develop products. Questionnaires were used for the expert validation process and to find out responses from students and teachers regarding the applications that have been developed. The questionnaire used for expert validation uses a Likert scale with ratings of 1 (very inadequate), 2 (not feasible), 3 (quite feasible), 4 (decent), and 5 (very feasible). The assessment sheet for practitioners/educators and students uses the Guttman scale, namely yes and no choices. Data were analyzed using data reduction and verification techniques. At the data reduction stage, the data that has been collected is then sorted to obtain data that suits the goal of this research. The results of data reduction are presented in the form of diagrams and explanatory sentences. At the data verification stage, the data is verified to find out the benefits and impacts of using the ASABI application. From this stage, the benefits of the application being developed are concluded. The questionnaire data used to determine the feasibility

of the application media being developed was analyzed using a score percentage formula and criteria were determined based on the following Table 1 (Ernawati & Sukardiyono, 2017).

Table 1. Validation Results Percentage Criteria

No.	Score in Percent (%)	Eligibility Category
1	< 21 %	Very Not Feasible
2	21 – 40 %	Not Feasible
3	41 – 60 %	Feasible Enough
4	61 – 80 %	Feasible
5	81 – 100 %	Very Feasible

RESULTS AND DISCUSSION

Results

This research succeeded in developing a mobile learning media in the form of an application called ASABI. ASABI is an Android-based application that functions as learning media for procedural text material in junior high schools. This application supports mobile learning-based learning but it can also be used in learning that takes place in the classroom. This application was created to provide learning media according to students' needs and circumstances when learning procedural texts. The use of this application was also expected to improve student learning outcomes. This application contains material, student activities, and evaluation questions that highlight elements of local wisdom, namely Lampung culture. Trials carried out on one teacher and 32 students indicate that this application can be used on Android devices with the Android 4.0 (Ice Cream Sandwich) to Android 11.0 (Red Velvet Cake) operating system without experiencing failure or problems. The following is a display of the ASABI application which has been tested and the results of the ASABI application trial on teachers and 32 class VII students which is depicted in Figure 3.

Figure 3. Application Display

Content in the Application

Table 2. ASABI Application Content Assessment

No.	Indicator	Many Respondents Agree	Percentage
1	Use of Language that is Easy to Understand	32	97
2	Language Free of Bias or Multiple Interpretations	33	100
3	Suitability of Material to Regional Culture	30	91
Percentage Average			**96**

Table 2 shows that of the 33 respondents consisting of teachers and students who were sampled in this research, as many as 96% assessed that the ASABI application had content in language that was easy to understand, was free of bias, and had material that was compatible with regional culture. Thus, it can be concluded that in terms of content, the ASABI application is easy to use and has material that is appropriate to regional learning and culture. These results show that ASABI is very suitable for use as an Indonesian language learning medium.

Learning Design

Table 3. Assessment of ASABI Application Learning Design

No.	Indicator	Many Respondents Agree	Percentage
1	Applications can Stimulate Creativity	28	85
2	Applications can Spur Collaboration	29	88
3	The Application Helps in Practice and Evaluation	31	94
Percentage Average			**89**

Table 3 shows that of the 33 respondents consisting of teachers and students, 89% thought that the ASABI application could stimulate creativity, spark collaboration, and help with training and evaluation. From these results, it can be concluded that in terms of learning design, the ASABI application can increase interest in learning, generate creativity and collaboration, and help in implementing learning evaluations. These results show that ASABI is very suitable for use as an Indonesian language learning medium.

Appearance

Table 4. Assessment of ASABI Application Appearance

No.	Indicator	Many Respondents Agree	Percentage
1	The Application is Easy to Operate	28	85
2	The Application Appearance is Simple and Attractive	28	85
3	The Design of the Application Display is not Difficult	28	85
Percentage Average			**86**

Table 4 shows that 33 respondents consisting of students and teachers assessed that in terms of appearance, the ASABI application has a simple and attractive appearance, makes the application easy to operate, and the design of the application display is not difficult. It can be concluded that in terms of appearance, the ASABI application has a simple and attractive appearance so that it does not make it difficult for application users. These results show that ASABI is very suitable for use as a learning media.

Graphics, multimedia, and navigation

Table 5. Assessment of Graphics, Multimedia, and Navigation of ASABI Applications

No.	Indicator	Many Respondents Agree	Percentage
1	The Attractiveness of the Application Display	26	79
2	Color Selection	29	88
3	Navigation Buttons Work Fine	30	91
4	Audio Compatibility	30	91
5	Application Programs can Operate Properly	33	100
Percentage Average			**90**

Table 5 shows that 33 respondents consisting of students and teachers assessed that in terms of graphics, multimedia, and navigation, the ASABI application has attractive graphics and color choices, the navigation buttons can work well, the audio selection matches the appearance of the application, and the application can operate well without any problems. It can be concluded that in terms of graphics, multimedia, and navigation, the ASABI application has attractive use of graphics, navigation, and multimedia buttons, does not make it difficult for users, and can operate well without causing problems for the application when operated. These results show that ASABI is very suitable for use as a learning medium.

The trial was carried out by using the ASABI application in learning procedural texts. A trial was carried out to obtain valid data regarding the use of the ASABI application in learning the Indonesian language in junior high schools. This application was tested for learning the structure and linguistic rules of procedural texts. The trial process is carried out like normal learning by following the guidelines that have been made by the teacher in the lesson plan for learning competencies examining the structure and writing procedural text. The following is an overview of the trial implementation of the ASABI application, adapted to the steps in the lesson plan in Table 6.

Table 6. Text Procedure Learning Implementation Plan Using the ASABI Application

No.	Education Level	Learning Activities	The ASABI Application Menu Used
1	Initial Activity: Orientation	• The Teacher Greets and Asks how the Students are doing. • The Teacher Checks the Students' Attendance.	-
2	Apperception	• The Teacher Engages Students to Connect the Learning Material or Activities that Students' Experiences with Previous Material/Activities will be carried out.	-
3	Motivation	• The Teacher Provides an Overview of the Benefits of Studying the Material that will be Studied in Everyday Life. • The Teacher Conveys the Learning Objectives. • The Teacher Asks Trigger Questions.	“Kompetensi” menu and “Tujuan Pembelajaran” Menu
4	Core Activities: Stimulation	• The Teacher Invites Students to Observe the Procedure Text in the ASABI Application.	Procedure Text Entitled "Membuat Batik Tulis"
5	Problem Statement	• The Teacher Invites Students to Read the Procedural Text Entitled "Membuat Batik Tulis". • The Teacher Asks Students Questions such as the Following Questions. 1. What is the Content of the text you have Read? 2. Do you Know the Difference Between the Procedure Text you have Read and Other Texts? 3. What is the Special Feature of the Procedure Text that You have Read?	Procedure Text Entitled "Membuat Batik Tulis"

No.	Education Level	Learning Activities	The ASABI Application Menu Used
6	Collection of Problems	• The Teacher Directs Students to Discuss Together the Structure and Linguistic Rules of the Procedural Text they have Read. Material Regarding the Structure and Linguistic Rules of Procedural Texts can be Read in the ASABI Application.	Display of Material Rules and Linguistic Characteristics of Procedural Texts.
7	Proof (Verification)	• Students Together with the Teacher Discuss the Results of Observations Regarding the Structure and Linguistic Rules of Procedural Texts. • The Teacher Guides Students to be Able to Carry out Discussions Together.	Display of Student Activities from Activity 1 to Activity 5.
8	Draw Conclusions	• The Teacher Directs Students to Make Conclusions from Learning Regarding the Structure and Linguistic Characteristics of the Procedural Texts that have been Discussed.	-
9	Closing Activities: Reflection	• The Teacher Invites Students to Reflect on the Learning that has been Carried out. • The Teacher Invites Students to Play Games in the form of doing Exercises in the ASABI Application.	The "Pengetahuan" Exercise Display is in the form of Multiple-Choice Questions.
10	Closing Activities	• Students Conclude the Results of the Learning that has been Carried out. • Students and Teachers Pray Together.	-

Discussion

The research results show that the ASABI application can be used for learning Indonesian in class VII, especially in examining the structure and linguistic characteristics of procedural text competencies from various sources that are read and heard. Utilizing the ASABI application can accommodate procedural text learning which still lacks learning media and does not yet have interesting learning media. The results of the trial and distribution of questionnaires given to students and teachers indicated that as many as 89% of respondents agreed that the ASABI application was interesting and provided benefits in learning procedural texts in class VII of junior high school. The following are several benefits that students and teachers can gain from using the ASABI application in learning procedural texts.

A More Attractive Appearance

Seventh graders are students who are classified as early teens because they are still 11-13 years old (Wulandari, 2014). At this age, children tend to prefer learning media that has an appearance with attractive colors, and appropriate illustrations, and is not monotonous. This is realized in the ASABI application in the form of selecting appropriate colors, a simple and attractive appearance, and illustrations that are appropriate to the student's age. The aim is to increase student enthusiasm by choosing bright colors which are expected to raise learning motivation in students.

Easy to Use

Teachers and students agree that the ASABI application is easy to use. This is because the ASABI application is designed to make it easier for users. The ASABI application is equipped with a user manual which can be found on the home screen. Instructions for use are clearly stated. Apart from that, the use of navigation buttons is easy to use and does not confuse users. The navigation buttons used are quite large with clearly visible icons. The choice of letters in the ASABI application also does not make it difficult for users to read the written text.

The Material is Easier to Understand

The material contained in the ASABI application is designed according to the material sub-chapters in the Indonesian language book published by the Ministry of Education and Culture. Clearer examples are also added to these materials so that users can more easily understand the material. Apart from that, the language used in the material in the ASABI application is appropriate to the age of the user. This application is designed for use by class VII students so that the language used in the material is also adapted to the age of the students. Students can also understand the material in the ASABI application independently because it is detailed.

Media is More Practical to Use

ASABI application as a media mobile learning is more practical to use because it does not require a large space. This application can be operated on cellphones with the Android 4.0 to 11.0 operating system without having to use an internet network. This makes it easier for users because it can save more on internet usage and doesn't take up as much space as when using textbooks.

Be Equipped with Evaluation Questions

The ASABI application is equipped with evaluation questions in the form of multiple-choice and essays. Multiple-choice questions can be used creatively, such as material for playing games with students. Multiple choice questions are also equipped with the final score obtained by students so that students can immediately find out the score they obtained after answering the questions. Apart from that, multiple-choice questions also include audio as an illustration of when students answer the question correctly or incorrectly. This adds to the attractiveness of the multiple-choice evaluation question displayed in the ASABI application.

The five factors above can attract students to use the ASABI application in learning procedural texts. The strongest attraction lies in the attractive appearance of the ASABI application which is designed to have a display full of bright colors and illustrations in the form of supporting images and sounds. The choice of bright colors, supportive sound and visual illustrations, and easy-to-read writing is adapted to the psychological condition of students who are still in their early teens so they still enjoy attractive visuals and illustrations that arouse emotions (Mahmud, 2016). Seventh graders are students who have just graduated from elementary school so their emotions are still unstable. Students at this age prefer the use of bright colors, attractive illustrations, and letters and numbers that are easy to read (high readability according to the student's development phase) (Putri et al., 2020).

The ASABI application is also able to accommodate procedural text learning because it is more flexible and practical to use. Use of applications that only require a phone and do not require the use of an internet network when operating it, which is an added value for the ASABI application. This makes the ASABI application more practical to operate when learning inside and outside the classroom and can increase students' learning motivation. This is following the aim of developing digital learning media which should be able to help students learn anytime and anywhere and can optimize students' abilities and independence because it can be used repeatedly and encourages students to have meaningful learning experiences.

The ASABI application is a medium of learning that was developed using a software computer. This application is operated using an Android-based cellphone which is included in computer-based learning media or ICT. There are 14 characteristics of ICT-based learning media (Cahdriyana & Richardo, 2016). The ASABI application meets the characteristics of ICT-based learning media according to the following explanation.

There are Clear Learning Objectives

One of the menus displayed on the ASABI application is the learning objectives menu. In general, ASABI consists of 1) a material menu, 2) an evaluation menu, 3) a core competency menu, 4) a basic competency menu and competency achievement indicators, 5) a learning objectives menu, 6) a learning material concept map menu, and 7) application manual menu. The learning objectives menu describes the learning objectives to be achieved after carrying out learning using the ASABI application. This objective is adjusted to the core competencies and basic competencies contained in the ASABI application. This application was developed based on the current curriculum's competencies.

There are Learning Materials According to the Competencies you want to Achieve

The preparation of material in the ASABI application refers to the syllabus in the 2013 curriculum. The material adapts the structure and linguistic characteristics of procedural texts. The material contained in the ASABI application includes 1) procedure text structure consisting of objectives, materials and tools, steps, and conclusion; 2) a type of procedural text consisting of how to make something and how to do something; 3) linguistic aspects of procedural texts consisting of command sentences, suggestion sentences, prohibition sentences, criteria or limitations, passive forms, adverbs, conjunctions, references; and 4) provisions for writing procedural texts consisting of title, introduction or purpose, 3) materials and tools, 4) steps or stages, and 5) conclusion.

Contains Material Concepts that are Presented Correctly

The material presented follows the material contained in the syllabus because it is adapted from an Indonesian language book published by the Ministry of Education and Culture. Apart from that, the materials summarized in the ASABI application are also obtained from other supporting and appropriate sources.

Contains Explanations of Material According to Students' Thinking Abilities

The delivery of material in the ASABI application is stated in text form which is supplemented with supporting visual and audio illustrations. The delivery of material is designed to suit students' thinking abilities. This is shown in the order of material presented in the ASABI application. The material presented begins with presenting Elements and Competencies, and Learning Objectives first. The presentation of the material then begins by showing an example of a procedural text as a form of modeling that can be used to build a learning context. Before studying the structure of procedural texts, students are invited to first understand the types of procedural texts that will influence the different forms of procedural text structures. This material is presented first before the material on the structure and linguistic rules of procedural texts in the ASABI application.

There is a Clear Learning Flow

The systematic material used in the ASABI application refers to the current curriculum. The learning carried out also adapts to the 2013 Curriculum. The ASABI application is designed by taking into account the lesson plan that has been created by the teacher so that the systematic preparation of the material is also adjusted to the learning flow contained in the lesson plan and the module.

Equipped with Clear Instructions

The ASABI application is equipped with clear instructions for use. These instructions are found in the "Manual Aplikasi" menu which is located in the application's home view. This menu is available on the initial display after the ASABI application has been successfully opened. The application manual contains instructions for using each menu along with instructions for using each button in the application. This application's manual menu is also equipped with images that match the menu and buttons shown. The "Manual Aplikasi" also contains the application usage steps recommended by the developer. This makes it easier for teachers to create learning using the ASABI application.

There is Apperception

The ASABI application also contains an apperception section. This apperception section is shown in the procedure text entitled "Membuat Batik Tulis". This text can be used as modeling and to build a learning context.

There are Conclusions, Examples, and Exercises with Feedback

The ASABI application presents material equipped with explanatory sub-material. The material is equipped with examples that make it easier for students to understand the existing material. The ASABI application is also equipped with varied exercises in the form of plural choices and essays. In exercises in the form of multiple choices accompanied by feedback. Feedback is provided in visual and audio form. When a student answers a question incorrectly, a cross will appear accompanied by audio saying "Sorry you're wrong", "yeah that's not right", "oh oh", or "Yeah that's wrong" and there are no additional points shown at the bottom left. screen. When students succeed in answering a question correctly, a checklist will appear accompanied by audio that says "extraordinary", "solid", "cool", or "correct" and additional points shown at the bottom left of the screen. After the student has finished answering all the questions, the final score display will appear followed by audio that says "Congratulations, you are great!". The drawback of this application is that it does not provide conclusions from the material that has been explained.

Can Raise Students' Learning Motivation

The ASABI application can raise students' learning motivation. This is shown by students who are enthusiastic when learning using the ASABI application. Students are more active and show a more enthusiastic response than when they didn't use the ASABI application. For example, when playing a game and answering evaluation questions in the form of plural choices, students express their feelings by laughing, saying thanks, exclaiming with joy, and even wanting to repeat the game they have played again. The responses written by students in the comments column in the distributed questionnaire also show that the ASABI application can arouse students' learning motivation. The comments written were "The application is good and can broaden your learning horizons. And it can increase cooperation", "the application is good and can be used by everyone", "The application is good and easy to understand, suitable for all groups", "the application is good and makes you want to play again", "if you could make an application like this for all materials Indonesian language lessons" etc.

Contains Evaluation Questions Accompanied by a Discussion of Evaluation Questions and Results

The ASABI application provides two types of evaluation. The first evaluation is in the form of multiple-choice questions containing 10 questions. The second evaluation was in the form of essay/description questions contained in Student Activities, totaling five activities and one description question which included a video of making tempoyak chili sauce.

Selection of Images, Animation, Text, and Colors Presented Harmoniously, Harmoniously, And Proportionally

The ASABI application contains illustrative images adapted to the student's theme and condition. The colors used in the application graphics are a combination of bright colors to increase students' enthusiasm for learning. Apart from that, the images and videos displayed are visible. The selection of background audio and sound effects is adjusted to the characteristics of the students so that they can arouse learning motivation without breaking the students' concentration. The background music in the ASABI application can be adjusted whether you want to activate or deactivate it. Each screen display uses a harmonious combination of colors and letters, as well as not too many illustrations so as not to break concentration or cause discomfort.

Interactive

The presentation of material in the ASABI application is still in the form of text and is one-way. Students can't get direct feedback when asking questions or writing comments on the

application. The presentation of the material is also not in the form of videos or simulations so students cannot provide many comments or interact with the application. The form of interaction that students can get in the ASABI application is in the multiple-choice questions menu. Each question answered correctly will display a correct answer warning. Questions that are answered incorrectly will raise a warning that the answer is incorrect.

Easy Navigation

The ASABI application has 24 navigation buttons which make it easier for users. These navigation buttons are equipped with button name labels so that users can navigate more easily. For example, the buttons "Latihan, Belajar, Elemen, Kompetensi, Tujuan Pembelajaran, Peta Konsep Materi, Materi Pembelajaran, Aspek Kebahasaan, Jenis Teks Prosedur, Ketentuan Penulisan, Struktur Teks Prosedur, Teks Panduan Menari Bedana, Keterampilan, and Pengetahuan" that uses button name labels. The information button, sound button, exit button, home button, forward button, back button, pause button, son button, and menu button are buttons that do not use name labels but use symbols. The ASABI app icon button uses a photo of the ASABI app home screen as the icon.

The Language Used is Easy for Students to Understand

The ASABI application uses standard Indonesian so it does not cause misinterpretation. The language used is a formal variety of Indonesian which is usually used in learning activities so that it does not cause bias or double interpretation. This is also proven by the scores obtained from the questionnaires distributed. As many as 97% of respondents agreed that the ASABI application uses language that is easy to understand and 100% of respondents agreed that the language used in the ASABI application is free of bias or double interpretation.

CONCLUSION

ASABI application is an Android-based mobile-learning media that offers lots of profit for learning procedure text for seventh graders. ASABI offers several benefits that can considered by teachers and students as media in learning procedure text which can be used inside and outside the class or as a learning mobile. ASABI can become a choice which suitable for processing understanding and examining the structure and feature language of procedure text. This application can also be used to understand how to write procedural texts. ASABI was developed based on the needs of students. This indicates that the ASABI application can be used and beneficial for learning procedural texts both inside and outside the classroom.

The ASABI application provides meaningful experiences and learning for students because it has advantages, including 1) a more attractive, simple appearance and able to raise enthusiasm for learning, 2) easy to use because there are instructions for using the application and language that is easy to understand and free of bias, 3) the material easier to understand because appropriate and detailed examples are added, 4) more practical and economical because it only requires an Android cellphone, does not require additional devices such as an LCD or projector, does not require an internet network connection when operating and does not require a large amount of space/memory, 5) be equipped with evaluation questions accompanied by feedback, making it easier for teachers to carry out evaluations. Apart from that, using the ASABI application also makes it easier for students to re-study the material that has been taught without using textbooks. This helps students to get good learning results and reach the minimum completeness criteria that have been set. The forms of evaluation questions are varied which also makes it easier for teachers to choose which evaluation questions to give to students.

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Application of STEAM method in learning in madrasah to improve student understanding

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ABSTRACT

Islamic education in madrasah is important to form a generation of competent Muslims in the era of technology and science. The STEAM method integrates science, technology, engineering, art, and math in holistic learning. This study analyzes the application of the STEAM method in madrasah, focusing on Islamic education. The approach to this study uses qualitative descriptive analysis with data collection through observation, interviews, and document analysis. The madrasah teacher and 30 students who used the STEAM method were sampled. The results showed a positive impact on students' understanding of Islamic education. The integration of STEAM science enables the development of critical thinking, creativity, collaboration, and problem-solving skills. Students' interest and adaptability also increase. Madrasah teachers need to understand the STEAM method to integrate it into Islamic learning. The STEAM method prepares a holistic generation of Muslims for the future.

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INTRODUCTION

Islamic education Asyafah (2014) in madrasah is an integral part of building a generation of Muslims who are competitive and able to face the challenges of the times (Duderija, 2012). In the era of globalization and rapid technological advancement, madrasah need to adopt innovative and contextual learning methods to improve the quality of Islamic education (Asadullah & Chaudhury, 2016). One promising approach is the application of the STEAM method, Science, Technology, Engineering, Arts, and Mathematics) in the learning process (Padwick et al., 2023).

The STEAM method integrates various disciplines such as science, technology, engineering, art, and mathematics in a holistic learning context (Padwick et al., 2023). This approach encourages students to think critically, creatively, and actively in facing various real problems (Bedewy & Lavicza, 2023). The integration of Islamic education into the STEM context in the STEAM method not only creates a learning atmosphere relevant to religious values but also enriches the student experience with skills and knowledge in STEM fields placed in the context of Islamic values. Thus, students not only develop as competent individuals in the field of science and technology but also as a generation of Muslims who have a deep understanding of the teachings of their religion, preparing

them to face the challenges of the modern world holistically. By integrating Islamic education into the STEAM method, madrasah can create a learning atmosphere (Setiawan et al., 2021).

This research discusses the application of the STEAM method of learning in madrasahs with a focus on Islamic education. Researchers analyzed the positive impact generated by the application of this method on students' understanding of Islamic education, critical thinking skills, creativity, collaboration, and problem-solving (Kang, 2019). In addition, researchers will also discuss the challenges and implications of implementing the STEAM method in the context of madrasah and provide recommendations for the development of Islamic education based on the STEAM method in madrasah.

The application of the STEAM (Science, Technology, Engineering, Arts, and Mathematics) method in learning in madrasah is relevant because it provides a holistic approach that can increase students' understanding of Islamic education. This method not only explores the disciplines of science, technology, engineering, art, and mathematics but also creates links between these knowledge and skills with Islamic religious values and teachings. By integrating Islamic education into the STEAM method, students not only learn scientific concepts or technical skills but also permeate Islamic moral and ethical values in every aspect of learning. For example, when students undertake a scientific or artistic project, they may reflect on how the concept relates to the principles of justice, truth, or wisdom taught in Islam.

Analysis of the positive impact of applying the STEAM method in the context of madrasah can include increasing students' understanding of religious teachings because students can see the relationship between scientific knowledge and Islamic values. In addition, critical thinking, creativity, collaboration, and problem-solving skills become more meaningful when connected to the application of Islamic principles in everyday life.

However, challenges can arise in combining these two approaches, such as the availability of learning materials that are appropriate to the Islamic context, teachers' understanding of the STEAM method, and support from the madrasah environment. Therefore, recommendations for the development of Islamic education based on the STEAM method in madrasahs need to include teacher training, the development of teaching materials by Islamic values, and increased support from schools and parents. Thus, by combining the STEAM method with Islamic education, madrasah can create a learning approach that produces deeper understanding, diverse skills, and strong character in students in the context of Islam and the development of modern science.

Previous research was conducted to investigate the relationship between cognitive, affective, and psychomotor learning domains and learning intentions in STEAM education (Nafiati, 2021). This study proposes a learning cycle and research framework that integrates Bloom's taxonomy and a moderation model consisting of factors derived from the technology acceptance model (TAM) and the attention, relevance, confidence, and satisfaction (ARCS) model, and considering cognitive load (Lubis & Widiawati, 2020). Through empirical experiments involving college students and elementary school students, the results showed that perceptions of usefulness directly affect learning intentions and ARCS plays an important role in strengthening the relationship between learning attitudes and learning intentions (Sammeng & Marsaoly, 2022). This research provides useful theoretical and educational implications for future instructors in developing effective STEAM education (Wu et al., 2022).

There have been Several studies have been conducted related to the application of the STEAM method in Islamic educational institutions, for example, research conducted by Rohmawati & Prisdiana (2022) discussed the application of STEAM through the medium of animated stories for group B in RA Abdullah Bin Umar Gedangan Malang. This study showed that the application of STEAM through animation media can improve children's thinking power and enable them to adjust the process of growth and development in life (Rohmawati & Prisdiana, 2022).

Research on the implementation of STEAM as an effort to empower biology teachers in Madrasah Aliyah DKI Jakarta which was researched by Sartono et al. In this study, it was produced that there was a significant increase in teacher skills and knowledge related to the STEAM method which is expected to be carried out sustainably (Sartono et al., 2020). Then the research conducted by Ayuningsih et al., (2022), the result of this research is that the application of STEAM-based

learning can foster the creativity of grade XI students of Science 3 Madrasah Aliyah PPMI Assalam Sukoharjo.

Another study evaluated the effects of sequential integration of science and art in STEM education for bilingual and fluent English students. In this study, the STEAM approach first resulted in significant improvements in science learning, especially for bilingual students. Although students who are fluent in English also experience increased learning, the advantages of the STEAM approach first are greater for bilingual students (Sa'ida, 2021). This study concludes that the STEAM approach first followed by STEM provides important learning opportunities for bilingual students and increases equality of learning opportunities between bilingual students and students fluent in English in science (Akmal & Asikin, 2022).

The purpose of this study is to analyze the application of the STEAM method in learning in madrasahs with a focus on Islamic education. This study aims to understand the positive impact produced by the STEAM method on students' understanding of Islamic education, as well as to explore how the integration of science, technology, engineering, art, and mathematics in the context of Islamic education can improve students' critical thinking, creativity, collaboration, and problem-solving skills in madrasah (Hughes et al., 2022).

The research gap that can be identified based on the above research is the lack of research that specifically explores the application of the STEAM method in the context of madrasah and Islamic education. Although there have been studies discussing the application of the STEAM method in learning in public schools (Hasanah et al., 2021), there have been no studies that have specifically evaluated the positive impact produced by the application of this method on students' understanding of Islamic education, critical thinking skills, creativity, collaboration, and problem-solving in the context of madrasah.

In this study, it is known that the average result of an increase in students' understanding of Islamic education is as much as 6% after the application of the STEAM method in the learning process in Madrasah. The average student can understand more deeply about Islamic education after the teacher applies the STEAM method because, through the STEAM method, students will think more creatively in solving a problem, think critically, and have skills in solving problems by applying Islamic principles in everyday life. Integrating the STEAM method in the context of Islamic education in madrasah can be directed by a conceptual framework that combines elements of STEM (Science, Technology, Engineering, Arts, and Mathematics) with the values and principles of Islamic education. Here is the conceptual framework underlying efforts to link STEM with Islamic Education:

1. Theoretical Foundation
   a. STEM Education: The theoretical basis of STEM education, which emphasizes the integration of science, technology, engineering, arts, and mathematics for the development of critical skills and problem-solving.
   b. Islamic Education: The theoretical basis of Islamic education, which includes the teachings of Islamic religion, morality, and ethics.
2. Islamic Values in a STEM Context
   a. Justice and Ethics: Integration of Islamic values of justice and ethics in STEM projects to teach students about social and ethical impact in technology development.
   b. Environmental Considerations: Teaches students about environmental responsibility by considering the values of sustainability and nature conservation in STEM projects.
3. Students' Understanding of Islamic Education
   a. Integration of Curriculum Materials: Combining STEM materials with Islamic education concepts to increase students' understanding of religious teachings.
   b. Application of Islamic Values: Provide practical context for students to apply Islamic values in solutions to real-world problems faced.
4. Critical Thinking Skills and Creativity
   a. Multidisciplinary Projects: Design projects that involve STEM aspects and require critical thinking and creativity in problem-solving.
   b. Islamic Reflection: Encourage students to reflect on the impact and relevance of their solutions in the context of Islamic values.

5. Collaboration and Problem Solving
   a. Multicultural Work Teams: Establish work teams covering various backgrounds and expertise to stimulate collaboration.
   b. Application of Hikmah Islamiyah: Using hikmah Islamiyah (Islamic wisdom principles) in problem-solving and joint decision-making.

Implications and Further Development:

1. Teacher Training
   Competency Development: Training for teachers in integrating STEAM methods and Islamic values in learning.
2. Learning Materials
   Material Development: Creation of learning materials that include STEM elements and are relevant to the Islamic context.
3. Impact Evaluation
   Evaluation Metrics: Development of evaluation metrics that specifically measure the positive impact on students' understanding of Islamic education, critical thinking skills, creativity, collaboration, and problem-solving.
4. Involvement of Parents and Stakeholders
   Effective Communication: Involving parents and stakeholders in the learning process and ensuring effective communication related to the goals of integrating STEM and Islamic education.

In addition, the study has not explored the specific challenges and implications that may arise in implementing the STEAM method in madrasahs and provides relevant recommendations for the development of Islamic education based on the STEAM method in madrasahs. Therefore, further research is needed to understand the potential and challenges of applying the STEAM method in Islamic education in madrasah and to provide practical guidance for developing effective learning approaches in these contexts.

This research is expected to provide significant benefits for the development of Islamic education in madrasah. By applying the STEAM method in learning, madrasah can present an innovative and contextual approach, increase student interest in learning, and expand students' understanding of Islamic education (Fahrurrozi et al., 2022). In addition, this research can also provide practical recommendations for madrasah teachers in integrating the STEAM method into religious learning, as well as for educational institutions in designing educational policies that support the application of the STEAM method in madrasah.

This research has a significant practical and theoretical contribution to the development of Islamic education in madrasah. Here are some identifiable practical and theoretical contributions:

1. Practical Contribution
   a. Increased Religious Understanding: The integration of the STEAM method in Islamic religious learning can increase students' understanding of religious values through a more contextual and interactive approach.
   b. STEM-Based Skills Development: Madrasah can produce graduates who not only have a strong understanding of religion but also STEM (Science, Technology, Engineering, and Mathematics) based skills. This can help students prepare for the demands of work and the needs of the modern world.
   c. Islamic Character Building: The STEAM method can help shape students' Islamic character through a well-rounded learning experience, where Islamic religious values and ethics are integrated with practical knowledge and skills.
   d. Critical and Creative Thinking Skills: STEM integration can train students to think critically and creatively, linking religious principles with problem-solving and innovation.
   e. Preparation for Future Challenges: Students trained through the STEAM method in Madrasah will be better prepared to face future challenges, including technological advancement, globalization, and social change.

2. Theoretical Contributions
   a. Contribution to Islamic Education Literature: Adding new insights into Islamic education literature by introducing the STEAM approach as an innovative learning method oriented to the needs of modern society.
   b. Model of Merging STEM and Religion: Forms the basis for the development of a model of merging STEM and religious education that can be adopted by madrasahs and other Islamic educational institutions.
   c. Contextual Curriculum Development: Contribute ideas to the development of a curriculum that is more contextual and relevant to the needs of the madrasah and students.

This research, by embracing the STEAM approach in learning in madrasah, has a real and relevant impact on the development of Islamic education, bridging the gap between traditional needs and the demands of the modern world.

METHOD

This research uses a qualitative approach with a case study design (Kang, 2019). The case study design was chosen because this study aims to describe and analyze in depth the application of the STEAM method in learning in madrasah (Walsiyam, 2021). This case study focuses on several madrasahs that have applied the STEAM method in Islamic religious learning.

Sample selection was carried out by purposive sampling method (Guarte & Barrios, 2006), where madrasahs that have applied the STEAM method are selected based on certain criteria, such as commitment from schools to develop innovative learning, availability of supporting facilities, and willingness of teachers to participate in research (Yati et al., 2023). After the madrasah sample was selected, data collection was carried out through several techniques, including classroom observation, interviews with teachers, and document analysis (Ahmad et al., 2017). The following is a table of research instrument grids, this table includes several instruments that can be used to collect data related to the application of the STEAM method and student understanding:

Table 1. Research Instrument Grid

No.	Instruments	Measured Variables	Instrument Type	Data Collection Methods
1	Observation	Application of the STEAM Method	Checklist	Live Observation in Class
2	Interview with Teacher	Teacher Experience in STEAM Application	Semi-Structure	Individual Interviews
3	Student Portfolio	Student Creative Products	Rubric	Portfolio collection
4	Discussion Group Observation	Student Engagement in Discussions	Checklist	Live Observation in Class
5	Final Examination of Student Comprehension	Students' Final Understanding of the Material	Objective	Written Exam
6	Student Interviews	Student Experiences and Opinions on STEAM Learning	Semi-Structure	Individual Interviews

Table 1 demonstrates that the research includes a variety of data collection methods that are relevant and appropriate to the research objectives. The selected instruments can provide a deep understanding of the application of the STEAM method by teachers, teacher and student perceptions, and student understanding of learning materials.

First, class observations were conducted to gain a deep understanding of the learning process with the STEAM method (Dewi et al., 2021). Observations were made for several different learning sessions, focusing on interactions between teachers and students, the use of technology and tools, and student activities in completing STEAM-based tasks (Papilaya & Tuapattinaya, 2023). Secondly, interviews were conducted with teachers involved in the application of the STEAM method (Agusniatih & Muliana, 2022). This interview aims to gain their perspective on the benefits, challenges, and strategies used in integrating Islamic education with the STEAM method (Yunus, 2022). Interviews were also conducted with students to gain their views on learning with the STEAM

method and its impact on their understanding of Islamic education (Diana & Saputri, 2021). In addition, document analysis was also carried out to collect data on the curriculum used, learning materials, and documents related to the application of the STEAM method in madrasah (Sam & Rahayu, 2022). Data collected from classroom observations, interviews, and document analysis were analyzed qualitatively using a content analysis approach (Hamdi, 2020). The data are categorized, identified patterns, and analyzed to answer research questions and provide a comprehensive picture of the application of the STEAM method in learning in madrasah (Hapidin et al., 2023).

RESULTS AND DISCUSSION

Results

The following are the results of class observations, teacher and student interviews, and document analysis in the form of tables that have been described.

Table 2. Class Observations

No.	Madrasah	Teacher and Student Interaction	Use of Technology	Student Activities
1	Madrasah X	High	Intensive	Active
2	Madrasah Z	Keep	Moderate	Diverse
3	Madrasah Y	Low	Limited	Limited

Table 2 shows the results of class observations in three madrasah that apply the STEAM method. Madrasah X is seen to have a high level of interaction between teachers and students, where students actively participate in learning. The use of technology is also intensive with various tools used. Madrasah Y showed a moderate level of interaction and moderate use of technology. Meanwhile, Madrasah Z has a low level of interaction, limited use of technology, and limited student activities. The benefits of using the STEAM method in madrasah can affect the improvement of students' understanding of Islamic education, teach students to think critically, prepare students to work in their desired fields in the future, encourage students to learn independently, and increase students' desire to collaborate in problem-solving. The use of STEAM has a positive effect on students' understanding of Islamic education can be seen from the learning outcomes produced by students before and after the implementation of the STEAM method in the madrasah.

Table 3. Results of increased student understanding

No.	School	Average Score Before STEAM Implementation	Average Score After STEAM Implementation
1.	Madrasah X	79	85
2.	Madrasah Y	77	80
3.	Madrasah Z	75	79

Table 3 shows an increase in students' understanding of Islamic education after the application of the STEAM method in madrasah. The score is generated through a written test given to students before and after the application of the STEAM method in Madrasah. So it can be concluded that with the application of the STEAM method, students' understanding can increase regarding Islamic education.

Table 4. Results of Interviews with Teachers and Students

No.	Madrasah	Benefit	Challenge	Strategy
1	Madrasah X	Better Understanding of Islam	Limitations Resources	Collaboration with External Institutions
2	Madrasah Y	Critical Thinking Skills	Intensive Curriculum Preparation	Training and Professional Development
3	Madrasah Z	Creativity and Problem Solving	Limited Understanding of	Partnering with the STEM Community

Table 4 shows the results of interviews with teachers and students in three madrasahs that apply the STEAM method. Madrasah X emphasizes the benefits of a better understanding of Islam but faces the challenge of limited resources. They overcome these challenges by collaborating with external agencies. Madrasah Y reveals the benefits of critical thinking skills but faces the challenges of intensive curriculum preparation. Therefore, they emphasize training and professional development for teachers. Madrasah Z highlights the benefits of creativity and problem-solving but faces the challenge of limited understanding of STEM. To address this, they are partnering with the STEM community.

Table 5. Document Analysis

No.	Madrasah	Learning	Teaching Materials	Related Documents
1	Madrasah X	Synchronized	STEAM-based Learning Modules and Islamic Religion	STEAM Method Development Plan
2	Madrasah Y	Integrated	STEAM Guidebook for Islamic Learning	Class Notes
3	Madrasah Z	Structured	Summary of the Concept of STEAM and its Application in Islam	Teaching Materials on the STEAM Approach

Table 5 presents the results of document analysis from three madrasahs that apply the STEAM method. Madrasah X shows an integrated learning plan between STEAM and Islam. They use STEAM-based learning modules and Islam as guidelines in the learning process. Madrasah Y has an integrated learning plan using a special STEAM guidebook for Islamic religious learning. In addition, they recorded class notes containing the application of the STEAM method in practice. Madrasah Y adopts a structured learning plan that provides a summary of STEAM concepts and their applications in an Islamic context. Teaching materials on the STEAM approach are also structured to increase students' understanding of this method.

The following is a content analysis in tabular form to clarify the results of research on the application of the STEAM method in learning in madrasah.

Table 6. Content Analysis

No.	Aspects	Findings
1	Interaction	There is an Increase in Interaction Between Teachers and Students in the Learning Process.
2	Technology	The Use of Technology such as Computers, Laptops, and Interactive Devices is Becoming More Integrated.
3	Activity	Student Activities are More Active and Involve Experiments, Projects, And Presentations.
4	Understanding	There is an Increase in Students' Understanding of Islamic Religious Teachings Through the STEAM Approach.
5	Critical Thinking	Students are trained in Critical Thinking Skills and can Analyze Better.
6	Creativeness	Students are Developed in the Ability to Think Creatively and Implement Innovative Solutions.

Table 6 the content analysis shows that the application of the STEAM method in learning in madrasah has a significant effect in several aspects (Heryati, 2023). First, there is an increase in interaction between teachers and students, which illustrates a more active involvement in the learning process. Furthermore, the use of technology is becoming more integrated in learning (Oktavian & Aldya, 2020), reflecting the adoption of a STEAM approach involving elements of technology. Student activity has also increased, with experiments, projects, and presentations becoming integral parts of learning (Septiani & Kasih, 2021).

In addition, the application of the STEAM method also has a positive impact on students' understanding of Islamic religious teachings (Budiyono et al., 2020). STEAM concepts are combined with religious material so that students can see the interrelationship between science and religious practice in relevant contexts. In addition, the STEAM method trains students in critical thinking skills (Fitriyah & Ramadani, 2021), so they can better analyze information and develop deeper

understanding. Students' ability to think creatively is also enhanced, enabling them to come up with innovative solutions in the context of Islam.

Overall, the content analysis shows that the application of the STEAM method in learning in madrasah contributes positively to important aspects, such as interaction, use of technology, student activities, religious understanding, critical thinking, and creativity (Nurhikmayati, 2019). This confirms the importance of integrating the STEAM approach in curriculum development and learning strategies in Madrasah to improve the quality of Islamic education (Wahyuni et al., 2020).

Discussion

The application of the STEAM method contributes positively to increasing students' understanding of Islamic education. By integrating STEM concepts into the context of Islamic religion, students can see a stronger connection between science and religious practice. They can understand how religious teachings can be applied in everyday life and in solving complex problems (Purnamasari et al., 2020).

Table 7. Percentage Increase in Student Understanding

No.	School	Average Score Before STEAM Implementation	Average Score After STEAM Implementation	Increase (%)
1.	Madrasah X	79	85	8%
2.	Madrasah Y	77	80	4%
3.	Madrasah Z	75	79	5%
Average				**6%**

Table 7 shows the percentage increase in students' understanding of Islamic education after the implementation of the STEAM method in madrasah. Based on the table above, it can be understood that the application of the STEAM method has a positive impact on students' understanding of Islamic education.

In addition, the STEAM method also has an impact on the development of students' critical thinking skills. Through this approach, students are invited to analyze, explore, and face problems systematically and logically (Maarang et al., 2023). They are trained to question, investigate, and formulate solutions based on religious knowledge and STEM principles. These critical thinking skills are important in helping students face real-world challenges and sharpen their ability to analyze information and make informed decisions (Davidi et al., 2021). Furthermore, the application of the STEAM method also encourages the development of student creativity. In the context of religious learning, students are invited to think out of the box and find innovative solutions. They are allowed to explore various ideas and approaches to understanding and applying religious teachings (Sari & Rahma, 2019). This helps students to be more creative in solving problems and conveying their understanding uniquely and engagingly (Lumbantobing & Azzahra, 2020).

In addition, the STEAM method also promotes collaboration between students (Pabubung, 2021). Through group projects and activities, students are invited to work together in completing tasks involving aspects of STEM and religious understanding (Zulirfan et al., 2021). They learn to listen to each other, share ideas, and build solutions together (Zubaidah, 2018). This collaboration not only improves students' social skills but also helps them understand the importance of cooperation in achieving common goals (Zainuddin, 2017; Fairuza, 2017). Finally, the application of the STEAM method in learning in madrasah provides long-term benefits in the development of Islamic education (Muyassaroh & Suyadi, 2020). By integrating STEM into religious education, madrasah (Shofiyati, 2018), can produce students who have a solid understanding of the Islamic religion as well as skills and knowledge relevant to the needs of the modern world. This helps students to become better prepared for future challenges and engage actively in innovative and sustainable community building.

CONCLUSION

Based on research, the application of the STEAM method in madrasah has contributed positively to students' understanding of Islamic education, with an increase of 6%. The integration

of STEM and Islamic religion helps students link science with religious practice, relevant to everyday life. The STEAM method also influences the development of students' critical thinking skills and creativity and encourages collaboration that improves social skills. However, the study had limitations, such as a focus on one madrasah and a lack of comparisons. Therefore, it is recommended that future research involve more madrasah, broaden the scope of the subject, and investigate the long-term impact in more depth to provide a stronger basis for the implementation of the STEAM method in the context of Islamic education.

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HOTS checker: Quick reviewing cognitive levels of learning outcomes using large language models

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ABSTRACT

The development of tools for efficient and effective assessment of learning outcomes is crucial in education. However, identifying the appropriate cognitive levels for learning outcomes can be challenging for educators. This study proposes to develop a tool to address this challenge by combining the strengths of large language models (LLMs) and Bloom's taxonomy. The tool can benefit educators by providing them with a streamlined reviewing process and enhancing their ability to assess learning outcomes. This research referred to prototype development models by Pressman. The research stages included communication, quick plan, modeling and quick design, construction of prototype, delivery, and feedback. The validation process involved assessing the tool's accuracy, consistency, and potential to be implemented in real educational settings by educators. The overall score obtained from the validation process is 76.92%, with the highest results coming from the categories of the tool's potentiality. It demonstrates its potential as a valuable educational tool. The insights gained from the expert validation serve as a crucial guidepost for future iterations of the tool, aligning them more closely with the goals of enhancing learning outcomes in educational settings.

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INTRODUCTION

Learning design is a thoughtful and purposeful approach to organizing educational experiences to achieve specific learning outcomes (Koh, 2022). It involves thoughtfully considering different components, including content, assessment techniques, instructional strategies, and the integration of technology, to create an engaging and meaningful learning environment (Rosson, 2014). By employing effective learning design principles, educators can maximize students' learning activities so that they align with the desired goals and objectives of the course or program (Whitelock & Rienties, 2016). Furthermore, a well-designed learning experience can enhance students' understanding and retention of knowledge (Amien & Hidayatullah, 2023). By incorporating elements such as instructional objectives, course details, teaching plans, and learning outcomes, educators can create a clear and systematic structure for their courses.

One fundamental aspect of learning design is the establishment of clear and measurable learning outcomes (Wei et al., 2021). Learning outcomes articulate what students are expected to

know, understand, or be able to do by the end of a course or instructional module (Harden, 2002). These outcomes serve as a crucial foundation for designing the entire learning experience and providing learners with a clear understanding of the goals and expectations (Albatti, 2023; Mehany & Gebken, 2021). In addition to this foundational element in the learning design theory framework includes three variables: conditions, treatments, and results (Schunk, 2012).

Conditions refer to the specific factors, such as the learning environment, resources, and support, that affect the learning experience. By understanding the conditions in which students will be learning, educators can make informed decisions about the instructional strategies and resources to employ (Bowman, 2022). Treatments involve the deliberate design and implementation of various instructional activities and interventions to facilitate learning. This includes selecting appropriate teaching methods, technologies, and assessments that align with the desired learning outcomes. Educators must carefully consider the needs and preferences of their learners when designing treatments to ensure that they are engaging and effective (Abulhul, 2021). Results refer to the expected learning outcomes and the assessment of student achievement. By clearly defining the desired results, educators can develop appropriate and meaningful assessments to measure student learning. These assessments can take various forms, such as quizzes, projects, or presentations, and should align with the intended learning outcomes (Ramanathan, 2022).

When defining learning outcomes, it is essential to identify the cognitive levels at which these outcomes operate (Maxwell, 2021). Cognitive levels represent the depth of thinking and complexity required to achieve specific learning objectives. Bloom's Taxonomy provides a framework for categorizing cognitive levels, ranging from lower-order thinking skills (e.g., remembering and understanding) to higher-order thinking skills (e.g., analyzing and creating) (Krathwohl, 2002). Research has shown that students are more likely to be motivated, satisfied, and engaged when they are presented with learning outcomes designed at higher levels of cognitive demand (Crichton & Kinsel, 2003). This underscores the significance of creating challenging and intellectually stimulating objectives.

By implementing effective learning outcomes that align with these principles, educators can create meaningful experiences for learners. Designing a student-centered environment involves clarity in course expectations and outcomes while also developing a community where interaction is encouraged. Ensuring success in following this design-based approach to enhancing teaching practices requires careful consideration of various factors such as assessment models for evaluating student achievement along with systematic evaluation techniques aimed at measuring impacts on diversity.

However, identifying the appropriate cognitive levels for learning outcomes can be challenging for educators. It requires effective measurement methods and assessment tools, including those for high-level cognitive skills, the affective domain, and the psychomotor field (Goel et al., 2021). Furthermore, determining whether an outcome should require lower-level or higher-level cognitive skills depends on various factors, including the subject matter, the level of the course, and the student's prior knowledge and abilities (Krathwohl, 2002).

This process often involves repetitive activities, such as administering the same test to different groups of students or grading numerous similar assignments (Olsen et al., 2019). Additionally, instructors must strike a balance between setting challenging goals that promote deep learning and ensuring that the objectives are achievable and attainable (Troitschanskaia et al., 2019).

Large language models (LLMs) have demonstrated remarkable capabilities in natural language processing and understanding (Pallagani et al., 2023). Large language models are Al-powered systems that can process and generate human-like text. These models have been trained on massive amounts of data to understand and generate language, making them powerful tools in various domains, including education.

Large language models (LLMs) have shown excellent text generation capabilities, capable of generating fluent human-like responses for many downstream tasks (Xiao & Shan, 2023). LLMs can mimic the human translation process and improve translation quality by extracting translation-related knowledge such as keywords, topics, and relevant demonstrations (Chen et al., 2023). These models

have been trained on massive amounts of data to understand and generate language (Chang et al., 2021), making them powerful tools in various domains, including education.

In recent years, the emergence of large language models has presented new possibilities for enhancing learning design in education settings (Sarsa et al., 2022). One potential application of large language models in education is the creation of personalized learning experiences (Ma et al., 2021). With their ability to analyze and generate text, these models can adapt instruction context to meet the unique needs and preferences of individual learners (Muse et al., 2023).

By considering factors such as students' characteristics and subject matter, educators can integrate technology seamlessly into the learning process (Ramírez & Gerena, 2010). This integration serves not just as a tool for critical thinking development but also supports the practice of learning design, which involves creating, managing, and evaluating various learning activities with the aid of technology (Arcas, 2022). By leveraging large language models, educators can create tailored learning experiences that cater to the specific needs and interests of each student, maximizing their engagement and learning outcomes (Park et al., 2019).

Large language models (LLMs) work by using semantic information to process and understand text (Gilbert et al., 2023). LLMs have revolutionized various tasks such as information retrieval, question answering, summarization, and code generation (Zhang, 2021). They can effectively compress and reconstruct text while preserving the semantic essence of the original text.

However, while it operates based on semantic information, it can also be a limitation. The information or analysis results provided by LLMs may be broad and, at times, unpredictable (Tamkin et al., 2021). This unpredictability stems from the diverse sources of data the models have been trained on, including a wide array of internet text, which can encompass both accurate and inaccurate information. Consequently, when educators rely on LLMs to assist in the evaluation and categorization of cognitive levels in learning outcomes, there is the inherent risk of receiving overly generalized or even misleading guidance.

To address these limitations and enhance the precision of insights generated by LLMs, it is crucial to provide explicit context (Ratner et al., 2023). By specifying the context, it narrows down the scope of responses generated by LLMs, making them more applicable to educational environments. Contextual cues like subject matter, course level, or educational framework can help in this regard.

On the other hand, Bloom's taxonomy is widely used as a framework to classify educational objectives and assess learning outcomes (Alhazmi et al., 2015; Zorluoğlu & Güven, 2020). It provides a structured approach to understanding the complexity of cognitive processes involved in learning. Bloom's taxonomy consists of six levels, each representing a different cognitive skill: remembering, understanding, applying, analyzing, evaluating, and creating (Krathwohl, 2002).

Table 1. Six Levels of Cognitive Skills of Bloom's Taxonomy

No.	Cognitive Level	Definition	Action Verbs Representing Intellectual Activity in Learning Outcome
1	Knowledge	At the Foundational Level of Bloom's Taxonomy, "Knowledge" Refers to the Cognitive Skill of Recognizing and Recalling Fundamental Facts, Terms, Concepts, and Information Related to a Subject Matter. Learners at this Stage Exhibit a Capacity to Memorize and Articulate Essential Data and Terminology.	Define, Identify, Label, List, Name, Recall, Recite, State.
2	Comprehension	“Comprehension" Denotes a Cognitive Skill where Learners Demonstrate their Ability to Grasp the Meaning, Interpretation, and Significance of the Acquired Knowledge. It Involves Understanding the Content in a way that allows for Explanation, Illustration, or Summarization of the Material.	Describe, Explain, Illustrate, Infer, Paraphrase, Summarize.

No.	Cognitive Level	Definition	Action Verbs Representing Intellectual Activity in Learning Outcome
3	Application	The Cognitive Skill of "Application" Necessitates the Practical Utilization of Knowledge and Comprehension to Address Real-World Problems, Perform Tasks, or Employ Acquired Concepts in Novel Contexts. Learners are Expected to Apply their Understanding to Solve Issues or Complete Activities Effectively.	Apply, Demonstrate, Implement, Solve, Use, Execute.
4	Analysis	"Analysis" Entails a Higher Level of Cognitive Engagement in which Learners Break Down Complex Information Into its Constituent Parts, Uncovering Underlying Structures and Identifying Relationships and Patterns. This Level Requires Examining the Material Critically and Identifying Key Elements.	Analyze, Compare, Contrast, Deconstruct, Differentiate, Investigate.
5	Synthesis	At the "Synthesis" Level, Learners Exhibit The Cognitive Ability to Create Novel Insights or Ideas by Integrating and Recombining Various Elements and Concepts Into a Coherent and Original Whole. This Entails a Creative Approach to Problem-Solving and the Generation of Innovative Solutions.	Combine, Design, Develop, Formulate, Integrate, Propose.
6	Evaluation	"Evaluation" Represents the Highest Level Of Cognitive Skills in Bloom's Taxonomy, where learners make Informed Judgments or Assessments based on Predetermined Criteria and Standards. It Involves Weighing the Merits of Various Options, Often Necessitating the Justification of Choices.	Assess, Critique, Evaluate, Judge, Justify, Prioritize.

By using Bloom's taxonomy in Table 1, educators and learners can gain a deeper understanding of the depth and complexity of learning outcomes. It helps in designing effective learning experiences by aligning instructional strategies and assessment methods with specific cognitive levels (Charoensap & Saeheaw, 2022; Goštautaitė, 2019). For example, if the learning objective is to remember information, educators can design activities that focus on memorization and recall. On the other hand, if the objective is to analyze and evaluate information, educators can create tasks that require critical thinking and problem-solving. Bloom's taxonomy also serves as a guide for curriculum development and instructional planning (Hyder & Bhamani, 2016). It ensures that learning objectives progress from lower-order thinking skills to higher-order thinking skills, promoting intellectual growth and development (Sideeg, 2016). By incorporating Bloom's taxonomy into the assessment process, educators can assess not only the acquisition of knowledge but also the application, analysis, evaluation, and creation of new ideas.

Furthermore, Bloom's taxonomy encourages learners to engage in active learning (Sobral, 2021). A recent study shows that Bloom's taxonomy promotes deeper understanding by encouraging students to analyze, apply, evaluate, and create connections between course themes, texts, and concepts (Mulcare & Shwedel, 2017). It also encourages reflection by providing a framework for categorizing and assessing different levels of thinking skills (Zamir & Jan, 2023). The use of Bloom's taxonomy in textbooks and learning activities has been found to have a positive impact on critical thinking skills, creativity, and problem-solving abilities (Pujawan et al., 2022; Stevani & Tarigan, 2023).

By combining the strengths of LLMs and Bloom's taxonomy, we propose to develop a tool to answer the challenge of identifying cognitive levels of learning outcomes. This tool provides

educators with a streamlined reviewing process and enhances their ability to assess learning outcomes. By leveraging the power of LLMs, educators can generate concise and contextually appropriate content to support their instructional strategies. This not only saves time but also enables educators to personalize the review experience for each learner. Additionally, incorporating Bloom's taxonomy into the assessment process ensures a comprehensive evaluation of learning outcomes. It guides educators in designing effective learning experiences that align instructional strategies and assessment methods with specific cognitive levels. These tools are also designed to promote higher-order thinking skills, critical thinking, and problem-solving, empowering learners to achieve deeper understanding and intellectual growth.

However, while it holds potential possibilities, it is important to acknowledge that this tool is currently in the development and expert validation stage. To assess its practical utility and effectiveness, empirical testing is essential. Only by conducting thorough experiments and analyzing data can we accurately assess the effectiveness of these tools. This research contributes to increasing the cognitive level using large language models.

METHOD

This research relies on prototyping models that provide a structured framework for the iterative creation of a software or technological solution (Pressman & Maxim, 2020). In the context of this study, prototyping models have been systematically refined to address specific requirements garnered through interviews with educators depicted in Figure 1.

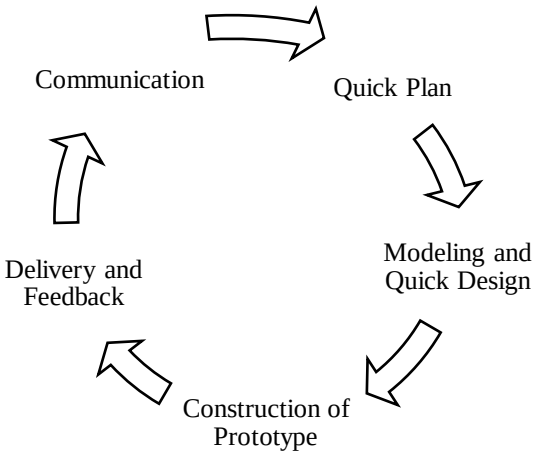

Figure 1. The Diagram of Prototype Models

1. Communication
   The first stage of the prototyping process involves customizing the features of the tool to meet educators' specific needs and preferences. Educators have emphasized the need for a tool that can effectively assess learning outcomes at an early stage in the learning plan. They also stress the importance of aligning this assessment with Bloom's Taxonomy, which categorizes cognitive levels for comprehensive evaluation. It is crucial for educators to seamlessly integrate this tool into their Learning Management Systems to ensure easy access and use. Additionally, they would like valuable feedback from the tool that addresses different cognitive levels of learning outcomes and provides suggestions to improve higher-order thinking skills. These insights will guide subsequent steps in developing an authentic student assessment system that meets all requirements.
2. Quick Plan
   A comprehensive understanding of educators' needs drives the creation of a well-defined project plan. This plan outlines specific timeframes for each development phase and incorporates key elements identified through teacher feedback. It ensures that the assessment tool aligns with

Bloom's Taxonomy, enabling educators to meet their teaching goals while fostering critical thinking and providing valuable feedback. Additionally, the plan emphasizes smooth integration within existing Learning Management Systems, simplifying access and usability for students. Resource allocation is carefully managed to ensure timely completion of the prototype while enhancing student engagement in applying knowledge and skills relevant to real-world scenarios.

3. Modeling and Quick Design
   Based on the information gathered, the design phase will be conducted to create a user-friendly and efficient interface. The wireframing process will take into account different levels of cognitive thinking according to Bloom's Taxonomy to align with educators' pedagogical goals. Additionally, careful planning will involve integrating LLMs APIs and prioritizing accurate feedback that is relevant to the context. The objective is to develop a user experience that supports educators in simplifying assessment processes while fostering advanced critical thinking skills.
4. Construction of Prototype
   During the development phase, the prototype is carefully constructed according to design and functional specifications. The coding process aims to incorporate LMS capabilities and align assessment features with learning outcomes based on Bloom's Taxonomy. This ensures a thorough analysis that supports curriculum development. Extensive testing is conducted to identify and address any technical issues, resulting in a resilient and user-friendly prototype. Collaboration with educators through feedback loops plays a crucial role in refining the tool, optimizing its effectiveness, and considering individual variations in learning styles while aligning it with their educational objectives.
5. Deployment, Delivery, and Feedback
   To ensure the effectiveness and usability of the prototype, it is deployed to a selected group of educators and stakeholders. Their valuable feedback on factors such as ease of use, efficiency, and impact on learning outcomes is carefully gathered. In addition, expert validation sessions involving educators are conducted to further refine the tool's assessment capabilities for cognitive levels and promote higher-order thinking skills. The received feedback and validation results serve as important inputs for continuous improvements, ensuring that the Quick Reviewing Learning Outcomes using the LLMs tool remains aligned with evolving needs and goals in education.

RESULTS AND DISCUSSION

Results

The need assessment is conducted by interviewing some teachers. Table 2 shows the results of the interview.

Table 2. Need Assessment Results

No.	Question	Answer
1	How do Educators Approach Learning Plan Development?	Educators Prioritize Addressing Learning Outcomes and Dedicate Considerable Time to Assessing Them at an Early Stage.
2	What Emphasis do Educators Place on Assessment Alignment?	Educators Stress the Importance of Aligning Assessments With Bloom's Taxonomy to Ensure Comprehensive Evaluation of Cognitive Levels.
3	How do Educators Aim to Integrate Assessment Tools Into their Systems?	Educators Find It Crucial to Seamlessly Integrate Assessment Tools Into their Learning Management Systems for Easy Access and Usability.
4	What Feedback Do Educators Seek from Assessment Tools?	Educators Seek Valuable Feedback That Addresses Different Cognitive Levels of Learning Outcomes and Provides Suggestions to Enhance Higher-Order Thinking Skills.

After conducting a need assessment with educators, we have decided to develop a web browser extension that can seamlessly integrate into an LMS. The primary function of this tool will be to analyze and assess the cognitive level of learning outcomes. Additionally, it will provide valuable feedback in the form of recommendations aimed at fostering high-order thinking skills.

To begin development, a quick plan has been outlined. In the initial stage, determine the flow diagram in Figure 2 to visualize a sequence of actions within the tools. Following that, the appropriate LLMs models to be used are determined and the necessary backend infrastructure will be developed in stage two. Stage three involves designing an intuitive user interface that can be easily integrated as a web browser extension. Finally, stage four will focus on integrating this tool directly into existing LMS platforms.

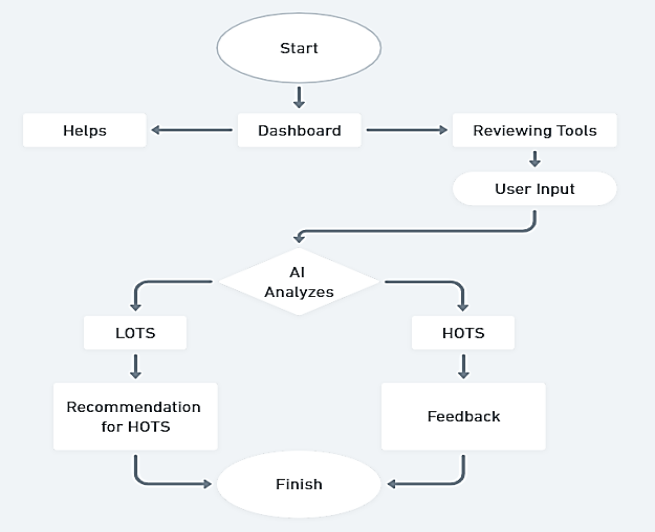

Figure 2. The Diagram of the HOTS Checker

To begin, users should access the installed tools. Then, they can navigate to the review menu or help section. Within the reviewing menu, users can input their learning outcomes and click on the send button. The system will then analyze the input and provide a response that includes the cognitive levels of the learning goals. Additionally, it will offer reasoning for its judgment. If the cognitive levels indicate lower-order thinking skills, recommendations will be generated to enhance higher-order thinking skills. A visual preview of these tools is displayed in Figure 3.

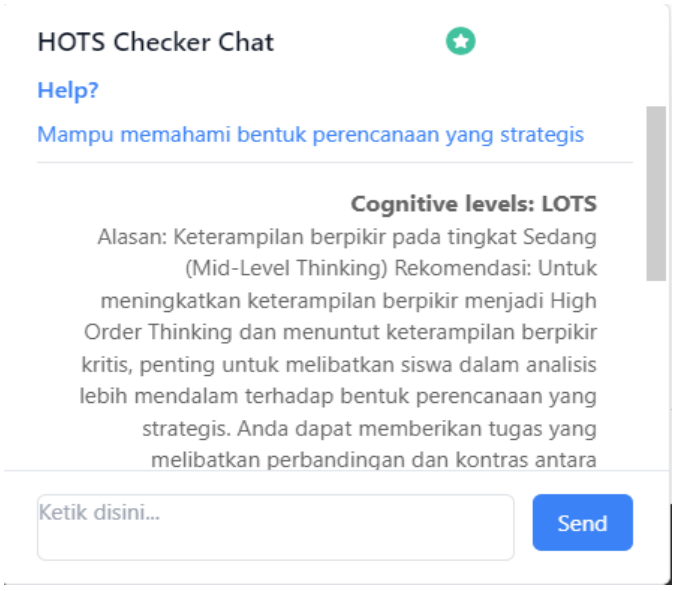

Figure 3. The Interface of HOTS Checker

After developing the tools, the next step in the process is expert validation. This serves as the final step in prototyping models. Expert validation plays a pivotal role in assessing the effectiveness and viability of the developed models. By involving the experts, we can gather valuable insights, identify potential flaws or improvements, and ensure that the prototype aligns with the desired objectives. We can refine and validate the model before moving forward with its implementation.

The validation of the tool was conducted by a learning assessment expert. The validation process involved assessing the tool's accuracy, consistency, and potential to be implemented in real educational settings by educators. The expert provided feedback using a questionnaire format, with each item rated on a scale of 1 to 4. The following results are presented in Table 3.

Table 3. Expert Validation Results

No.	Validation Category	Evaluation Aspect	Results
1	Tool's Accuracy	Accuracy of Learning Outcome Assessment	3
		Clarity of Explanations	3
		Clarity of Recommendations	4
		Alignment with Bloom's Taxonomy	3
2	Tool's Consistency	Consistency in Classification	2
		Consistency in Explanations	2
		Consistency in Recommendations	2
3	Tool's Potentiality	Usefulness for Identifying Areas of Improvement	4
		Enhancing Critical Thinking and Learning Skills	3
		Support for Better Lesson Planning	4
		Direct Application for Learning Improvement	2
		Information for Learning Improvement	4
		Adaptability to Various Learning Scenarios	4

Table 4 provides a quantitative summary of the expert validation results for each part and the overall assessment of the tool's effectiveness.

Table 4. Quantitative Summary of Expert Validation

No.	Part of Validation	Scores	Percentage (%)
1	Tool's Accuracy	13	81.25%
2	Tool's Consistency	6	50%
3	Tool's Potentiality	21	87.5%
Overall (All Parts)		**40**	**76.92%**

Discussion

The expert validation results indicate that the tool for Quick Reviewing Learning Outcomes using LLMs holds promise as a valuable educational resource. Its strengths lie in its accuracy in aligning assessments with actual skill levels and in its potential to offer valuable insights to educators for lesson planning and identifying areas of improvement in student learning skills (Caines et al., 2023). However, there are clear areas for improvement, particularly in terms of ensuring consistency in assessments, explanations, and recommendations (Raj et al., 2022). Additionally, efforts should be directed toward enhancing the tool's direct applicability for learning improvement, which received a lower rating from the expert.

Overall, these validation results provide a valuable foundation for the ongoing development and refinement of the tool. By addressing the identified areas of improvement, the tool can be further optimized to meet the needs of educators and contribute to more effective and data-informed educational practices (Sahu et al., 2022). The insights gained from expert validation serve as a crucial guidepost for future iterations of the tool, aligning it more closely with the goals of enhancing learning outcomes in educational settings.

The expert validation results offer valuable insights and lead to several key findings and recommendations. The incorporation of learning level matrices in assessments has great promise for educators (Elkins et al., 2023). They can benefit from the efficient review process and personalized

experiences provided by these tools. Additionally, the ability of the tool to align assessments with skill levels represents an encouraging advancement in educational technology that is aligned with Bloom's taxonomy principles, providing a comprehensive framework for assessing learning outcomes (Caines et al., 2023).

However, the validation results also underscore the need for improvement in terms of consistency. Achieving uniformity in assessments, explanations, and recommendations is pivotal to enhancing the tool's reliability and usability (Chen et al., 2023). Addressing this aspect should be a priority in further tool development. Furthermore, the lower rating for the tool's direct applicability for learning improvement highlights an area that requires attention. Enhancements should focus on making assessment results more actionable for educators, thereby facilitating immediate improvements in the learning process.

CONCLUSION

It is crucial to acknowledge that these tools are currently in the stage of development and expert validation. Their practical usefulness and effectiveness in actual educational settings can only be determined through empirical testing and ongoing improvements. The process of development and validation is ongoing, emphasizing the importance of addressing recognized limitations and improving overall functionality. Furthermore, it is important to note that while LLMs can be a valuable tool for quick reviewing, they struggle with long-term planning and finding optimal solutions. Therefore they should not replace educators for comprehensive studying and deep learning. They are best utilized as a supplementary resource to complement traditional learning methods.

In summary, the integration of LLMs and Bloom's taxonomy into assessing and reviewing learning outcomes presents a promising new approach to education. These tools have the potential to empower educators to personalize learning experiences, align instructional strategies with cognitive levels, and ultimately improve student learning outcomes. However, it is important to recognize that these tools are still developing and require ongoing refinement and validation to fulfill their transformative potential in education. By incorporating feedback from experts and actively working on areas that need improvement, we can develop more efficient educational approaches that are based on data and prioritize the needs of learners. This will be beneficial for both educators and students alike.

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Utilization of interactive e-flipbook media oriented toward contextual approaches to learning in elementary schools

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ABSTRACT

An educator is required to continue to make updates in the learning process carried out, especially in learning media innovations that can support face-to-face and online learning. This study aims to determine the results of the feasibility analysis of interactive e-flipbook media oriented toward contextual approaches to science learning in elementary schools. This research uses a research and development approach, especially the design of the ADDIE. The subjects of the study were grade V students of an Elementary School in Surakarta. Data collection techniques include questionnaires and interviews. Data analysis is done using descriptive analysis. The results showed that the results of media expert validation obtained an average score of 4.38 in the very good category, and material expert validation obtained an average score of 4.59 in the very good category. Then the results of student responses to interactive e-flipbook products at the time of the initial trial, which included a one-to-one trial, obtained an average score of 3.54 included in the very good criteria; a small group trial obtained an average score of 3.37 included in the good criteria; and a field trial obtained an average score of 3.21 included in the good criteria. In addition, the results of the t-test at the field trial stage show that the value of probability or sig. (2-tailed) which is 0.000 < 0.05 and the coefficient = 4.688 greater than the coefficient value t_{tab} = 2.018 then H_0 is rejected meaning that there is an average difference in students' critical thinking ability scores between the experimental class and the control class at the field trial stage. The average post-test score in the experimental class was 83.45 and the average post-test score in the control class was 75.68. The average difference is 7.773. Thus, interactive e-flipbook media oriented towards contextual approaches is said to be feasible and can be used in science learning in elementary schools.

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INTRODUCTION

Education at the primary level is a critical foundation in the formation of the intellectual and social development of students. Education is a conscious and planned effort to create an

environment and learning process in which students actively develop their potential to have religious and spiritual strength, self-control, personality, intelligence, noble character, and skills needed for individuals, society, nation, and state (Undang Undang Republik Indonesia Nomor 20 Tahun 2003 Tentang Sistem Pendidikan Nasional, 2003; Kemdikbud, 2013). In this digital era, integrating technology into teaching in elementary schools is becoming increasingly important to facilitate more interactive and contextual learning, including the need for technology integration in science learning in elementary schools (Khair et al., 2023; Sumardi et al., 2020). The use of technology in science learning will make it easier for educators to convey messages to learners so that learning objectives can be carried out according to plan.

Science subjects are one of the subjects in the primary school curriculum. Science as a product (factual, conceptual, procedural, and metacognitive knowledge) and science as a process (scientific work) are two interrelated components in the science curriculum (Aprilia, 2021; Wisudawati & Sulistyowati, 2022). The results of observations and interviews conducted with grade V teachers in the three elementary schools showed that students' thinking skills in science learning at Cemara Dua State Elementary School, Mangkubumen Kidul State Elementary School No. 16, and Mangkubumen Lor State Elementary School No. 15 were still low; only 2-4 students (10% of the number of students in each class) were able to express their opinions, ask, or conclude and solve a problem posed by the teacher. As for student learning outcomes, it shows that the average score of students' science tests in semester 1 has met the minimum completeness criteria, almost 85% above 75. This shows that students' learning outcomes in science subjects are good, but their critical thinking skills are still low. Several factors contribute to these students' critical thinking skills, and it is necessary to investigate those factors. Indicators of students' critical thinking skills can be influenced by several things, such as the use of learning models based on student centers, supporting infrastructure, and varied, innovative, and contextual-based digital learning media (concrete) (Aprilia, 2021; Latifah et al., 2023).

The presence of learning media is very important in the learning process because it can help learners understand unclear material. Learning media can be used to describe what teachers cannot say in certain words or sentences. With learning media, the abstractness of the material can even be concretized (Aprilia et al., 2023; Smaldino et al., 2012). As a result, students more easily understand the material than without the help of learning media. Therefore, it is an alternative medium that helps students think critically. One promising medium to achieve this goal is the interactive e-flipbook, a form of electronic book that offers a dynamic and engaging reading experience.

The advantages of e-flipbooks are that they can display text, images, animations, and videos equipped with tools and connections that allow students to interact, navigate, and communicate. Students not only see but also hear, observe, and perform interactively with various e-flipbook features (Aprilia et al., 2017; Azizah et al., 2022). Moreover, in this study, interactive e-flipbook media was integrated with a contextual approach that connects material concepts with concrete examples in the student environment. This makes learning more meaningful and fosters students' curiosity, thus impacting their critical thinking skills while learning science. In line with this research, Oktarina et al., (2021) stated that multimedia-based e-flipbooks make learning materials very easy for students to understand and can increase student interest, motivation, and learning activities.

The development of contextual-based interactive e-flipbook media plays an important role in innovation in learning media in elementary schools. The majority of the use of learning media today tends to be one-way between teachers and students. The absence of interactive-based digital learning media (two-way) between teachers and students or students with other students makes this product development research important to continue and know the level of feasibility when used by students or teachers in the learning process. Therefore, this study aims to determine the results of the feasibility analysis of interactive e-flipbook media oriented toward contextual approaches to science learning in elementary schools. This research contributes to improving the quality of elementary school science subjects through the use of e-flipbook media with a contextual approach.

METHOD

This research uses a research and development approach, especially the design of the ADDIE development model. This research procedure contains research stages that refer to the steps of the ADDIE development model, starting from analysis, design, development, implementation, and evaluation, as developed (Branch, 2009). In this study, the research procedure was simplified to the stage of developing interactive e-flipbook media, which was carried out through expert validation and media feasibility tests involving elementary school students. The subjects of the study were grade V students of elementary schools in Surakarta, namely Cemara Dua State Elementary School and Mangkubumen Kidul State Elementary School No. 16.

The selection of research subjects is done by considering the ease of access and experience of researchers related to the problems in this study. Media feasibility test subjects were carried out using purposive sampling techniques, namely sampling techniques by determining certain criteria (Sugiyono, 2014). The criteria are schools that already have adequate facilities for using this interactive e-flipbook product. In detail, the technique of taking research subjects in each trial according to Suparman (2012) can be seen in Table 1.

Table 1. Sampling Techniques

No.	Stages	Number of Students
1	One-To-One Trial	3
2	Small Group Trial	8-10
3	Field Trial	20-35

The subjects of the one-to-one trial as many as three students with different abilities (tall, medium, and less), were conducted at SDN Cemara Dua in the VB class to provide an assessment of the feasibility of the interactive e-flipbook media. Meanwhile, the subjects of the small group trial were 10 students of the VB class as an experimental class, and 10 students of the VC class as a control class, which was carried out at SDN Cemara Dua Surakarta. The experimental design used a post-test-only control group. The data obtained is a reference for revision to correct the shortcomings that exist in the interactive e-flipbook media so that it is feasible to be tested in the field trial. Then, the field trial involved 22 students of the VA class as an experimental class and 22 students of the VB class as a control class which was carried out at SDN Mangkubumen Kidul No. 16. At this stage, the media was applied in the learning process, namely the experimental class (using interactive e-flipbook media) and the control class (using science printed book media). After the field trial, revisions were made to reduce the level of weakness of the interactive e-flipbook media product to produce a final product that is worth using.

This interactive e-flipbook product validation is carried out by involving material experts and media experts. The data from the results of this study is a response from material experts and learning media experts to the quality of interactive e-flipbook media products developed in terms of aspects of communication, technical design, material, language, and display format. Data in general comments or suggestions as well as the results of researchers' observations during trials are analyzed in a qualitative descriptive manner and will be concluded for input in revising or improving the learning media products developed. Quantitative analysis with percentage and categorization techniques is used for data in the form of response scores from material experts and learning media experts. The validation instrument of media experts and material experts uses the Likert scale, which is 5 scales (very good, good, enough, less, very less).

The product feasibility test instrument for users of this interactive e-flipbook uses 4 scales, namely strongly agree, agree, disagree, and strongly disagree. The instruments used are interview guidesheets and questionnaires. Interview guidelines are used to find out how students respond and respond openly about the product being tested. The questionnaire instrument was prepared with the intention of evaluating the quality of interactive e-flipbook media developed from aspects of critical thinking skills, material content, and product design display.

Data analysis uses descriptive statistics, where criteria or categories of interactive multimedia product assessment results and LMS-integrated online quiz-based gamification, both in the validation of media experts, material experts, and product trials, are said to be feasible if they

have at least a good category. As for the guidelines for converting quantitative data, the resulting score into qualitative data, according to Rofiq et al., (2019), is described in the following Table 2.

Table 2. Guidelines for Converting Product Feasibility Value into Qualitative Data

No.	Qualitative Data (Category)	Quantitative Data (Scale 5)	Quantitative Data (Scale 4)
1	Very Good	X > 4.20	X > 3.94
2	Good	3.40 < X ≤ 4.20	2.98 < X ≤ 3.94
3	Good Enough	2.60 < X ≤ 3.40	2.02< X ≤ 2.98
4	Less	1.80 < X ≤ 2.60	1.01 < X ≤ 2.02
5	Very Less	X ≤ 1.80	X ≤ 1.01

Descriptive data analysis is used for expert due diligence and one-to-one trial stage. While the small group trial and field trial stages were carried out, a comparison analysis of post-test values between the experimental class and the control class was carried out to determine the level of difference through the calculation of hypothesis tests using independent sample t-tests with the help of the SPSS program. Hypothesis testing can be done after the data is known to be normally distributed and homogeneous, so it is necessary to calculate the normality test and homogeneity test first.

RESULTS AND DISCUSSION

Results

The process of designing interactive e-flipbook media is oriented towards a contextual approach; in this case, display design needs a design sketch to illustrate media making. The sketch is formed into a flow chart. A flow chart is a flowchart of an interactive e-flipbook medium to be developed. Flow charts start from the front cover, copyright page, flipbook usage instructions, preface, teaching program analysis, book usage instructions, table of contents, chapter 1 style, chapter 2 simple plane, science dictionary or glossary, answer key, notes, and up to the back cover.

This interactive e-flipbook media discusses two chapters of material, namely simple styles and planes. Each chapter contains text, images, videos, activities or exercises, and quizzes that are oriented towards a contextual approach and trigger students to express their opinions both orally and in writing. The sections contained in each chapter include chapter titles, decrees, basic competency, learning objectives, national character values, contextual-based perceptions, concept maps, keywords, material accompanied by concrete images, let's find out (practicum), let's see (video), let's argue (exercise), do you know? (important information), let's do (activities), national character (motivation), let's play while learning (quizzes), character info (figures who invented the material discussed in each chapter), summary, and evaluation practice questions. Here is the designed flow chart, which can be seen in Figure 1.

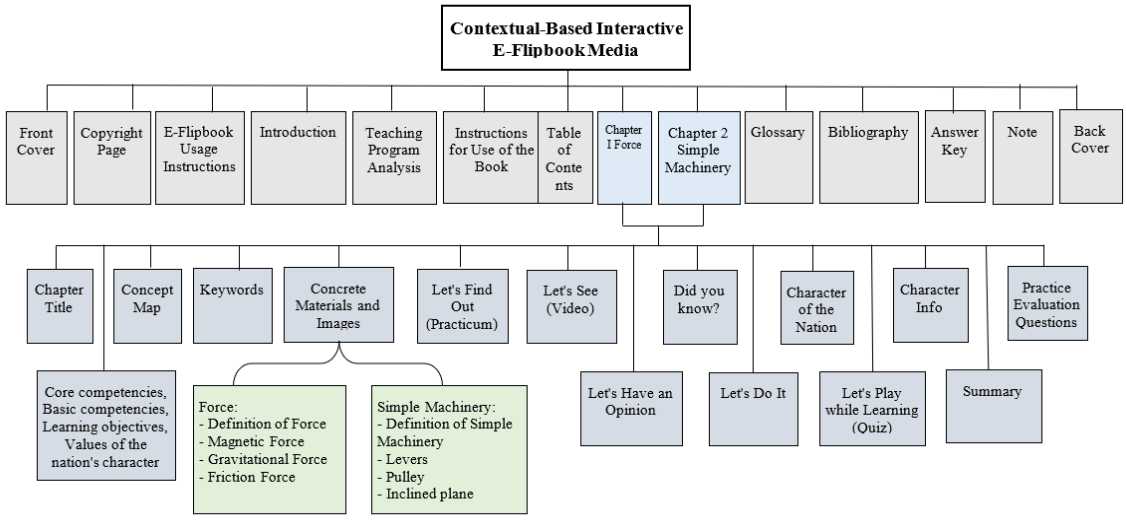

Figure 1. Interactive E-Flipbook Media Flow Chart

At the development stage, researchers carry out several steps, including the media production stage, the media and material expert validation stage, and the product trial stage.

a. Interactive E-Flipbook Media Production Stage

The media production stage is carried out based on the flow chart that has been made before. In making interactive e-flipbook media, researchers use Kvisoft Flipbook Maker Pro 4 software. The output produced by interactive e-flipbook media in format (.swf) that can be opened on all PCs or laptops starting from Windows XP OS, Windows 7 OS, Windows 8 OS, and Windows 10 OS has minimum specifications for Intel Pentium III and has been installed with Adobe Flash Player or GOM Player so that it can produce image display (visual) and sound (audio). In Kvisoft Flipbook Maker Pro 4 software, PDF format books that have been imported into the Kvisoft Flipbook Maker software must go through the editing stage, starting from template selection, background settings, background, navigation button selection, language, and inserting learning videos, images, or .swf into the flipbook. After completing the editing process and having been saved, the next step is that the flipbook product is published according to the desired format Figure 2.

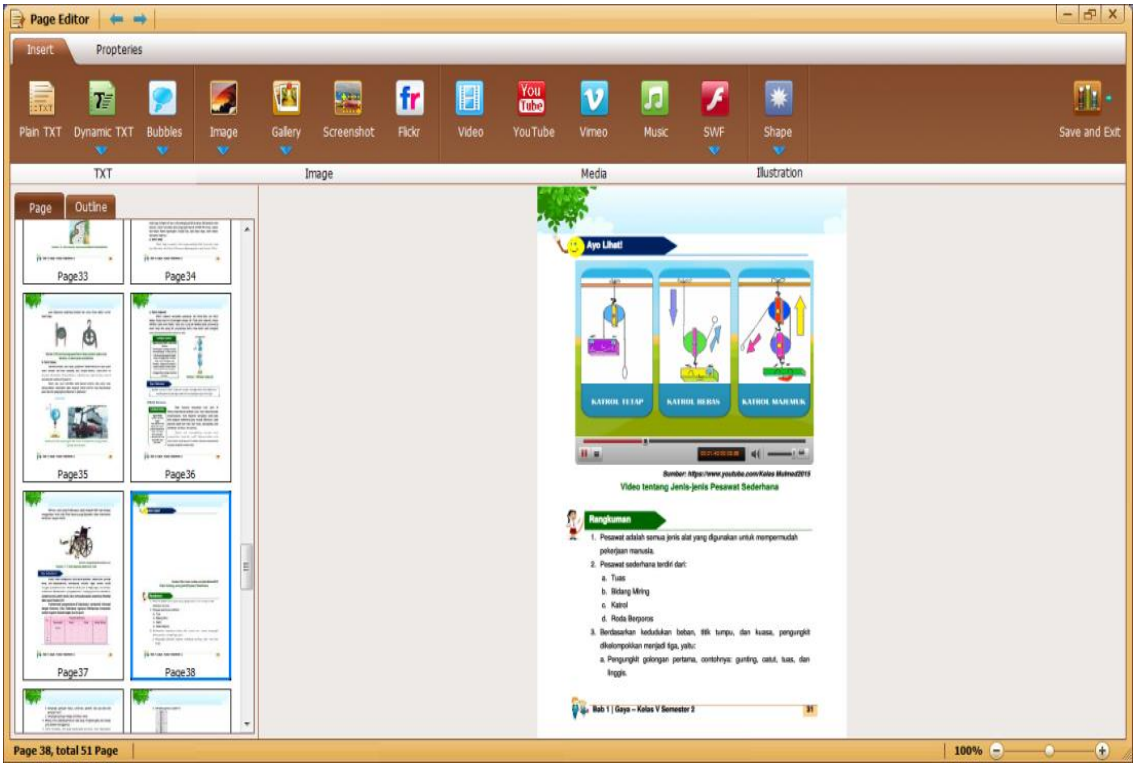

Figure 2. Display of E-flipbook Editing Process in Kvisoft Flipbook Maker Software

The interactive e-flipbook product display results from the production stage through the Kvisoft flipbook maker pro 4 software are a) front cover display: the front cover display contains the author's name, book title, science subjects, class and school level (V elementary school semester 2), the curriculum used Education Unit Level Curriculum and the author's institution; b) front page display and copyright: the front page display contains the title of the book and the material discussed, the author, and the author's institution, while the copyright page contains the author's name, cover design, editor, expert consultation 1 and 2, validator, and book identity such as year published, number of pages, print to- and size of the book; c) Display instructions for use of e-flipbooks and preface: The display instructions for use of e-flipbooks contains an explanation of each navigation button contained in the flipbook. The preface of the book is gratitude, thanks, and a brief description of the description of the book; d) Teaching program analysis display and book use instructions: The teaching program analysis display contains a description of the material outline along with the allocation of teaching time. The instructions for use of the book contain instructions for activities contained in each

chapter; e) Table of contents display: contains a list of parts of the book from the front page to the back page accompanied by the page number of the book; f) Display chapter 1 style: this display includes book titles, competency standards, basic competencies, learning objectives, character values, concept maps, keywords, materials (understanding and types of styles), concrete images, activities (let's find out, let's see (learning videos), let's argue, let's do it), character info, quizzes, summaries, and evaluation exercises; g) Display chapter 2 simple planes: this display contains book titles, competency standards, basic competencies, learning objectives, character values, concept maps, keywords, materials (understanding and types of simple planes), images, videos, activities (let's find out, let's see, let's argue, let's do it), character info, quizzes, summaries, and evaluation exercises; h) display of science dictionary: also referred to as a book glossary containing a list of terms in the material/chapter accompanied by their meanings; i) bibliography display: the bibliography contains a list of citation or reference sources used by the author in compiling the book; j) Note display: is a blank page provided by the author so that the reader can write important notes or a summary of material from the material that has been read. In writing or drawing, the reader can use the draw navigation button contained in the flipbook; k) Back cover display: the back cover contains a brief description of the contents of the book and the identity of the author's institution.

b. Product Validation Stage

The expert validation stage is carried out before product trials. In this study, validation of interactive e-flipbook media products was carried out with 3 media experts and 3 material experts. The purpose of product validation is to validate or assess whether the design of interactive e-flipbook media and the material presented in the flipbook is feasible to test or not.

1. Media Expert Validation and Revision

Media expert validation was carried out by 3 lecturers of Sebelas Maret University Surakarta who are experts in the field of learning media in the PTIK Study Program, Visual Communication Design Study Program, and Educational Technology Study Program. There are five aspects assessed by validators in testing the feasibility of interactive e-flipbook media; namely navigation aspects, convenience aspects, audio aspects, writing or text aspects, and display aspects. The assessment results used are on a scale of 5 to 1, where a score of 5 is for very good, a score of 4 is for good, a score of 3 is for sufficient, a score of 2 is for less, and a score of 1 is for very little. The results of the assessment of the three media experts can be seen in the following Table 3.

Table 3. Media Expert Assessment Results

No.	Media Expert	Aspects	Average Score	Criterion	Average Aspect
1	Media Expert 1	Navigation	4.33	Very Good	Navigation
		Ease	4.20	Good	4.22
		Audio	4.00	Good	(Very Good)
		Writing/Text	4.50	Very Good	Ease
		Display	3.56	Good	4.60
2	Media Expert 2	Navigation	4.00	Good	(Very Good)
		Ease	4.60	Very Good	Audio
		Audio	4.50	Very Good	4.17
		Writing/Text	4.50	Very Good	(Good)
		Display	4.44	Very Good	Writing/Text
3	Media Expert 3	Navigation	4.33	Very Good	4.61
		Ease	5.00	Very Good	(Very Good)
		Audio	4.00	Good	Display
		Writing/Text	4.83	Very Good	4.30
		Display	4.89	Very Good	(Very Good)
Average Media Expert Rating			**4.38**	**Very Good**	

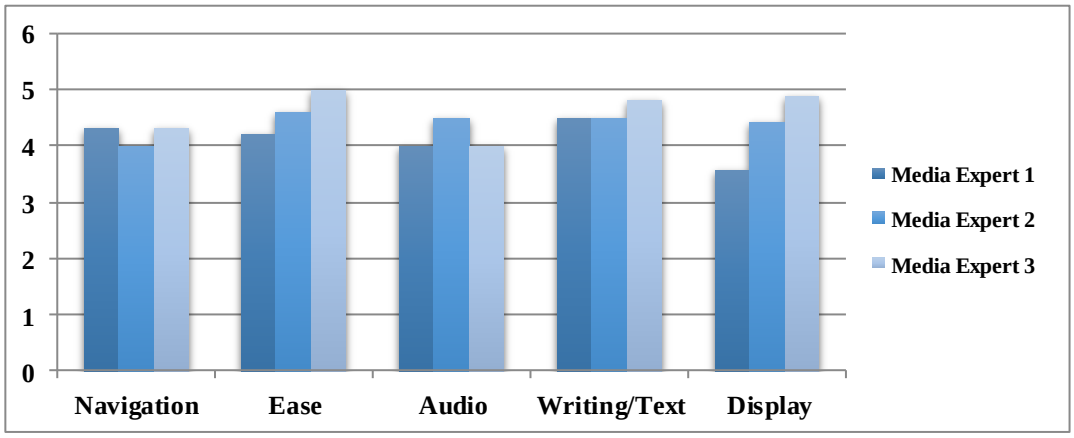

Figure 3. Media Expert Validation Assessment Results Diagram

Based on Table 3 and Figure 3, which show that the results of the media expert validation assessment on the navigation aspect obtained an average score of 4.22 with very good criteria, the ease aspect averaged a score of 4.60 with very good criteria, the average score for the audio aspect was 4.17 with good criteria, the writing or text aspect obtained an average score of 4.61 with very good criteria, and the average viewing aspect score of 4.30 with excellent criteria. Thus, it can be concluded that the interactive e-flipbook media oriented towards a contextual approach in science learning in Class V elementary school can be said to be very good with an average score of 4.38 that the interactive e-flipbook media oriented to a contextual approach is declared suitable for use in the science learning process. The inputs and revisions given by the three media experts are as follows: a) Media expert 1: the navigation buttons need to be given explanatory information to make it easier for students to operate; the display on the flipbook is attempted to be more fullscreen; b) Media expert 2: the background used as an e-flipbook template needs to be revised according to the material to be delivered; c) Media expert 3: the volume of the e-flipbook background should be reduced; the display on the e-flipbook is attempted to be more fullscreen, in the notes section it is necessary to add a description of the use of draw navigation buttons. This is in agreement with Sumarmi & Mutia (2021) research, which explains that the use of background must be made fully screened to be clearer and by the characteristics of elementary school students. Furthermore, researchers revised the interactive e-flipbook media according to input from the three media experts. The interactive e-flipbook media display after revision is as follows.

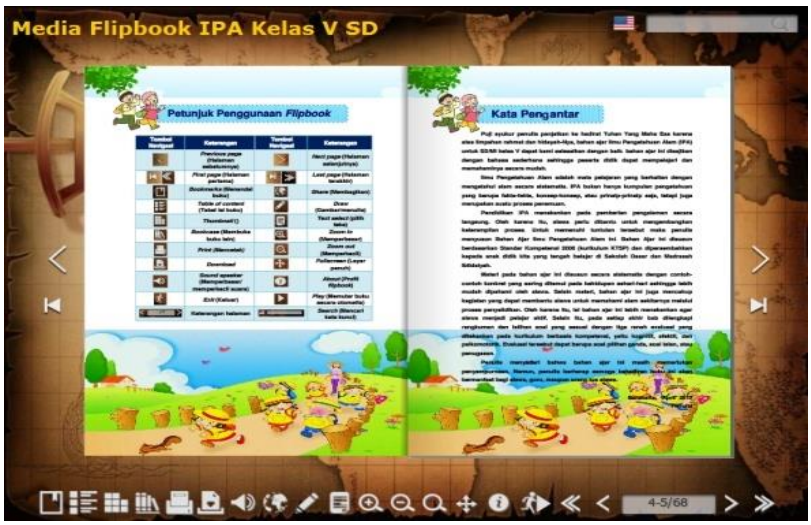

Figure 4. Post Revision View (Navigation Button Caption)

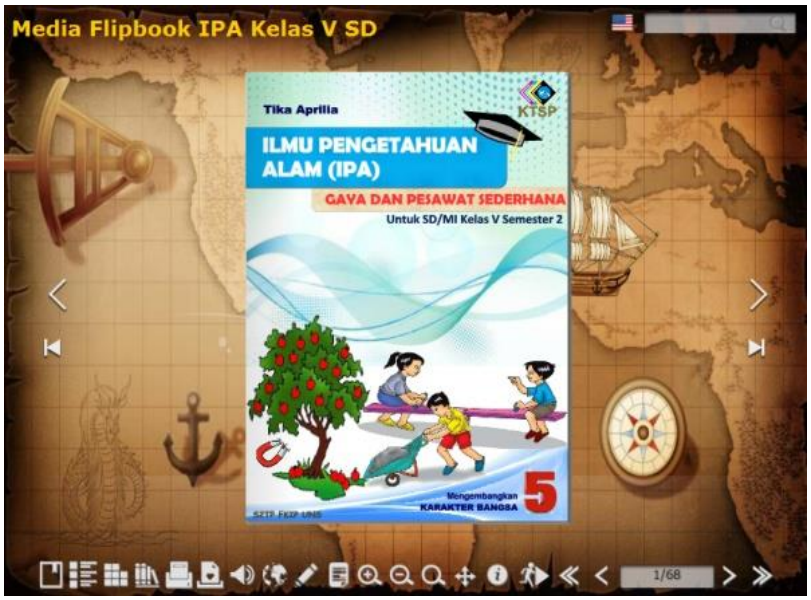

Figure 5. Background Display

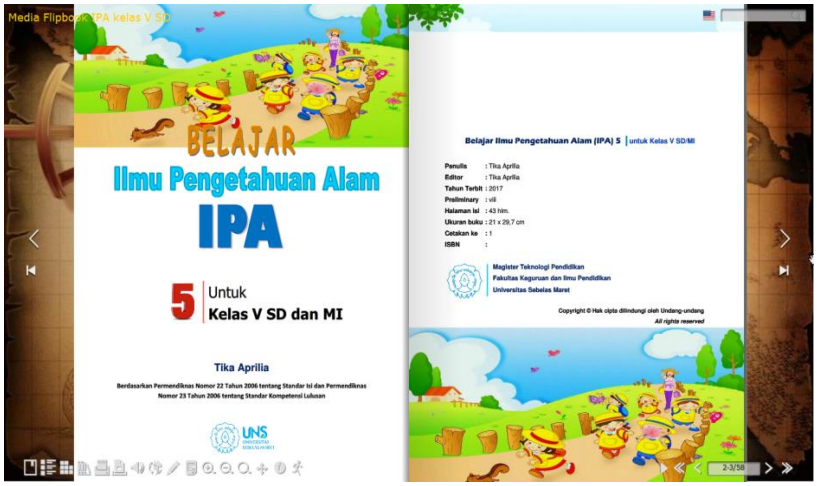

Figure 6. Display (Full Screen)

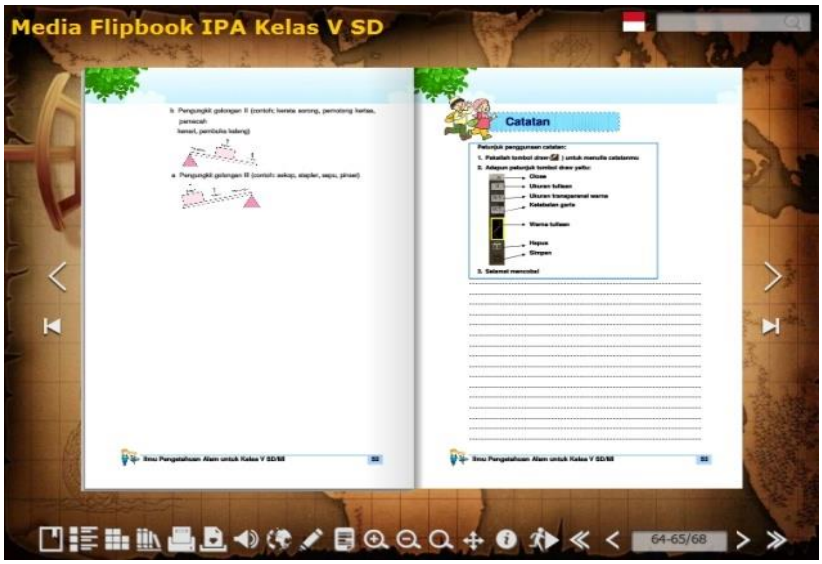

Figure 7. Display of the Book Notes Section

2. Material Expert Validation and Revision

Material expert validation was carried out by 1 lecturer of the Primary Teacher Education Study Program, Sebelas Maret University, Surakarta, who is an expert in the field of elementary science, and 2 practitioners, namely class V teachers of SDN Mangkubumen Lor No. 15. There are 2 aspects assessed by validators to test the feasibility of the material presented on the interactive e-flipbook media, namely the learning aspect and the material aspect. The rating scale used is a scale of 5 to 1, where a score of 5 is for very good, a score of 4 is for good, a score of 3 is for sufficient, a score of 2 is for less, and a score of 1 is for very little. The results of the assessment by the three material experts can be described in Table 4.

Table 4. Material Expert Assessment Results

No.	Material Expert	Aspects	Average Score	Criterion	Average Aspect
1	Material Expert 1	Learning	4.25	Very Good	Learning 4.54 (Very Good)
		Material	4.54	Very Good	
2	Material Expert 2	Learning	4.75	Very Good	
		Material	4.69	Very Good	Material 4.64 (Very Good)
3	Material Expert 3	Learning	4.63	Very Good	
		Material	4.69	Very Good	
Average Material Expert Assessment			**4.59**	**Very Good**	

Based on Table 4, which shows the data obtained from the results of material expert assessment of the material presented on the interactive e-flipbook media, In the acquisition of these data included in the learning aspect, the average score obtained was 4.54 with very good criteria, while in the material aspect, the average score was 4.64 with very good criteria. Thus, it can be concluded that the material presented on the interactive e-flipbook media oriented towards a contextual approach to learning science in grade V elementary school is very good, with an average score of 4.59, so that the interactive e-flipbook media oriented towards a contextual approach is declared suitable for use in the science learning process of grade V elementary school. The inputs and revisions given by the three material experts are as follows: a) material expert 1: in the "let's find out" activity in each chapter, it is necessary to add parametric measurements so that students' critical thinking skills are more visible; b) material expert 2: on the front cover, it is necessary to add the specifications of the material discussed, "force and simple machinery"; c) material expert 3: no input and suitable for use in science learning in grade V elementary school. The following is a display of interactive e-flipbook media results that have been revised by researchers based on input from material experts.

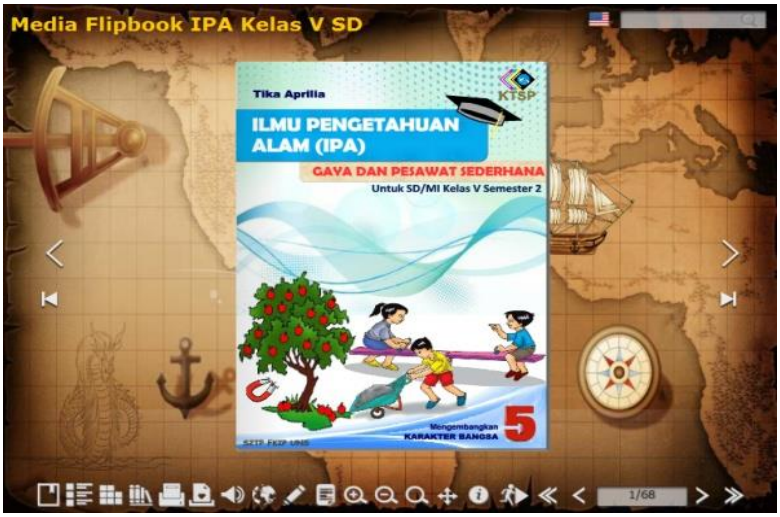

Figure 8. Front Cover Display

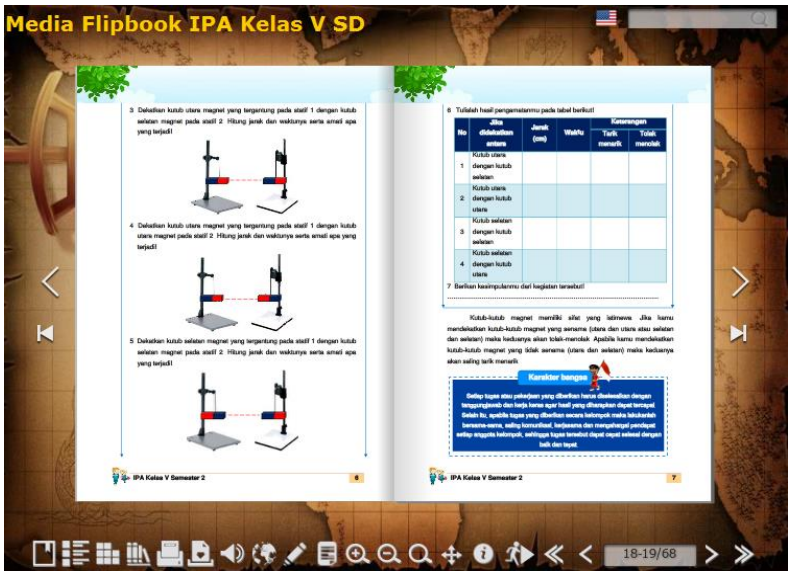

Figure 9. Display of "Let's Find Out" Activities

c. Validation by Students through Product Trials

The interactive e-flipbook media is ready to be tested in the science learning process of grade V elementary school after a revision of the interactive e-flipbook media product based on input from media expert validators and material experts. The product trial phase carried out in this study consisted of three trials, namely one-to-one trials, small group trials, and field trials (Branch, 2009).

1. One-to-One Trial

In one-to-one trial was conducted with three students individually. The three students come from students who have different levels of ability (Suparman, 2012). Each student faces one computer on which interactive e-flipbook media oriented to contextual approaches has been installed. Students begin to read and observe interactive e-flipbook media oriented to contextual approaches that are displayed on each computer. Upon completion, students are given a questionnaire with responses to the developed interactive e-flipbook media product. The results of the trial, in the form of a media feasibility questionnaire, were then analyzed to determine student assessment scores on aspects of motivation, attractiveness, ease, and usefulness of interactive e-flipbook media before being tested for the next stage. The results of the student assessment questionnaire on the feasibility of interactive e-flipbook media oriented to the contextual approach of the one-to-one trial stage can be seen in Table 5.

Table 5. Results of Student Assessment of Interactive E-flipbook Media in One-to-One Trial Stage

No.	Ability Level	Motivational Aspects	Attractiveness Aspect	Convenience Aspect	Expediency Aspect
1	Low	2.86	3.50	3.67	3.67
2	Middle	2.57	3.83	3.67	3.33
3	High	3.43	4.00	4.00	4.00
Average		**2.95**	**3.78**	**3.78**	**3.67**
Criterion		**Good**	**Very Good**	**Very Good**	**Very Good**
Average Total		**3.54**		**Very Good**	

Based on Table 5, shows that students' assessment of interactive e-flipbook media oriented to a contextual approach on the motivation aspect averaged a score of 2.95 with good criteria, the media attractiveness aspect obtained an average score of 3.78 with very good criteria, then the ease aspect averaged a score of 3.78 with very good criteria and the last for the expediency aspect of media obtained an average score of 3.67 with very good

criteria. The average total score of student assessment of interactive e-flipbook media at the one-to-one trial stage is 3.54 with very good criteria. This shows that the interactive e-flipbook media developed is very good and feasible to use.

The results of the student assessment of the feasibility of interactive e-flipbook media, researchers also conducted open interviews with three students who were research samples at the one-to-one trial stage. The average student said that the interactive e-flipbook media product developed for science learning in grade V elementary school was good and interesting; it's just that there was one student who gave advice not to use music background sounds because sometimes when playing videos, students become less concentrated on the content of the material in the learning video. Therefore, based on student input, researchers finally eliminated the music background in the interactive e-flipbook media so that students were easier to understand and not disturbed when viewing and observing learning videos displayed in the interactive e-flipbook media (Putra et al., 2023; Setiyani et al., 2022). Based on the results of the assessment and student input on the feasibility of interactive e-flipbook media products, it can be concluded that interactive e-flipbook media oriented towards a contextual approach to science learning in grade V elementary school is suitable for use in the next stage of trials.

2. Small Group Trial

In the small group trial stage, the number of samples used was 10 VB class students as an experimental class and 10 VC class students of SDN Cemara Dua Surakarta. This trial was carried out with an experimental class using interactive e-flipbook media oriented towards a contextual approach to science learning, while the control class only used science package book media (printed books). The experimental design used was a posttest-only control group design.

In the experimental class, before using interactive e-flipbook media, researchers must first install the GOM Player application on each computer used by 10 students so that interactive e-flipbook media can be operated. This is because the average computer in the school does not have an Adobe Flash Player application or a GOM Player application. After completing the learning process, both experimental and control classes were given post-test question items to determine students' critical thinking skills (Gall et al., 2003; Gall et al., 2014). The number of post-test questions tested was 15 multiple-choice questions and 5 description questions for basic competencies 5.1 (force) and 15 multiple-choice questions and 5 description questions for basic competencies 5.2 (simple machinery).

Learning was carried out in as many as two meetings for each basic competency. The results of post-test scores are the average results of students' scores on both basic competencies tested. Then compare the post-test values between the experimental class and the control class to determine the level of difference through the calculation of the hypothesis test using an independent sample t-test with the help of the SPSS program (Santoso, 2014). Hypothesis testing can be done after the data is known to be normally distributed and homogeneous, so it is necessary to calculate the normality test and homogeneity test first. The results of the calculation of the normality test and homogeneity test using the SPSS program can be seen in Tables 6 and 7.

Table 6. Normality Test Results at the Small Group Trial Stage

No.	Group		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
			Statistic	df	Sig.	Statistic	df	Sig.
1	Value	Eksperiment	.223	10	.172	.951	10	.681
		Control	.224	10	.168	.904	10	.242

a. Lilliefors Significance Correction

Based on Table 6 of the Normality Test Calculation Data, which states that the sig value of 0.681 > 0.05 for the experimental class value data and the sig value of 0.242 > 0.05 for the control class value data, it can be said that the experimental class and control class value data are normally distributed data.

Table 7. Homogeneity Test Results at the Small Group Trial Stage

No.	Levene Statistic	df1	df2	Sig.
1	.740	1	18	.401

Based on Table 7 of the homogeneity test calculation data above, a sig value of 0.401 > 0.05 is obtained so that the data value of the experimental class and the control class of the small group trial stage can be said to be homogeneous. Based on the state of the data that is said to be normally distributed and homogeneous, the post-test value data of the experimental class and the control class at the small group trial stage can be carried out for the next calculation, namely the hypothesis test or t-test. The results of the t-test using the Independent Sample T-Test can be seen in Table 8.

Table 8. Results of Hypothesis Test in Small Group Trial Stage

No.	Value	Levene's Test for Equality of Variances		t-test for Equality of Means					95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
1	Equal Variances Assumed	.740	.401	2.831	18	.011	5.900	2.084	1.522	10.278
	Equal Variances not Assumed			2.831	17.442	.011	5.900	2.084	1.511	10.289

Based on Table 8 shows that the value of probability or sig. (2-tailed) which is 0.011 < 0.05 which means that H_0 is rejected (there is a difference in the average score of students' critical thinking skills between the experimental class and the control class). The average post-test score in the experimental class was 81.50 and the average post-test score in the control class was 75.10. The average difference is 5.90. In addition, judging from the assessment criterion coefficient which is greater than the value of coefficient t_{tab} then H_0 is rejected. The results obtained are t_{hit} = 2.831 consulted at t_{tab} = 2.101 (significance level 5% and df = 18) so it can be said that $t_{hit} > t_{tab}$ or 2.831 > 2.101 which means there is a difference in the average value of students' critical thinking skills between the experimental class and the control class at the small group trial stage. In the small group trial stage of the experimental class, students were given an assessment questionnaire on the feasibility of the interactive e-flipbook media product developed. The media feasibility questionnaire was then analyzed to determine the average score of student responses on aspects of motivation, attractiveness, ease, and usefulness of interactive e-flipbook media before being tested to the last stage.

The results of students' assessments of interactive e-flipbook media oriented towards contextual approaches at the small group trial stage showed that the motivation aspect of the average score obtained was 3.13 with good criteria, the media attractiveness aspect of the average score obtained was 3.43 with very good criteria, then the ease aspect of the average score was 3.50 with very good criteria, and the last aspect of media expediency obtained an average score of 3.42 with very good criteria. The average total score of student assessments of the feasibility of interactive e-flipbook media at the small group trial stage is 3.37 with good criteria. This shows that the interactive e-flipbook media developed is suitable for use in the science learning process.

Researchers also conducted open interviews with 3 students who were randomly selected from the number of students who were the research sample at the small group trial stage. The average student said that the interactive e-flipbook media product developed for science learning in grade V elementary school was very good, there were learning videos, it became easier to understand the material, and it was very interesting (Aprilia et al., 2017). However, there is one student who gives input to add quizzes or games to each

chapter of flipbook material. Therefore, based on student input, researchers finally added quizzes to each chapter, namely the "Let's play while learning" activity, into the interactive e-flipbook media, so that students are more enthusiastic, interested, and not bored to read and understand the material presented in the interactive e-flipbook media oriented to the contextual approach developed (Amin et al., 2020; Haryanto et al., 2020). Based on the results of the hypothesis test of differences in students' critical thinking ability scores, as well as the results of students' assessments and input on the feasibility of media products, it can be concluded that interactive e-flipbook media oriented towards contextual approaches for science learning in grade V elementary school is feasible to be used in the next stage of trials.

3. Field Trial

The field trial was conducted with a sample of 22 students of the VA class as an experimental class (using interactive e-flipbook media oriented towards a contextual approach in science learning) and 22 students of the VB class of SDN Mangkubumen Kidul No. 16 Surakarta as a control class (using science package book media (printed books). After the learning process, students were given post-test question items to determine students' critical thinking skills after using the interactive e-flipbook media both in experimental and control classes (Gall et al., 2003). The number of post-test questions tested was 15 multiple-choice questions and 5 description questions for basic competencies 5.1 (force) and 15 multiple-choice questions and 5 description questions for basic competencies 5.2 (simple machinery).

Learning was carried out in as many as two meetings for each basic competency. The results of post-test scores are the average results of students' scores on both basic competencies tested. Then a comparison of post-test values between the experimental class and the control class was carried out to determine the level of difference through the calculation of the hypothesis test using an independent sample t-test with the help of the SPSS program (Pituch & Stevens, 2015). Hypothesis testing can be done after the data is known to be normally distributed and homogeneous, so it is necessary to calculate the normality test and homogeneity test first. The results of the calculation of the normality test and homogeneity test using the SPSS program can be seen in Table 9 and 10.

Table 9. Normality Test Results at the Field Trial Stage

No.	Group		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
			Statistic	df	Sig.	Statistic	df	Sig.
1	Value	Eksperiment	.169	22	.102	.916	22	.064
		Control	.219	22	.007	.914	22	.057

a. Lilliefors Significance Correction

Based on Table 9 of normality test calculation data states that the sig value of 0.064 > 0.05 for experimental class value data and a sig value of 0.057 > 0.05 for control class value data, it can be said that the experimental class value data and the control class of the trial stage are normally distributed data.

Table 10. Homogeneity Test Results at the Field Trial Stage

No.	Levene Statistic	df1	df2	Sig.
1	.152	1	42	.698

Based on Table 10 of the homogeneity test calculation data above, a sig value of 0.698 > 0.05 is obtained so that the data values of the experimental and control classes of the field trial stage can be homogeneous. Based on the state of the data that is said to be normally distributed and homogeneous, the post-test value data of the experimental class and control class at the field trial stage can be used for the next calculation, namely the hypothesis test or t-test. T-test results using the Independent Sample T-Test are shown in Table 11.

Table 11. Results of Hypothesis Test at Field Trial Stage

No.	Value	Levene's Test for Equality of Variances		t-test for Equality of Means					95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
1	Equal Variances Assumed	.152	.698	4.688	42	.000	7.773	1.658	4.426	11.119
	Equal Variances not Assumed			4.688	41.402	.000	7.773	1.658	4.425	11.120

Table 11 shows that the value of probability or sig. (2-tailed) which is 0.000 < 0.05 which means H_0 is rejected (there is a difference in the average score of students' critical thinking skills between the experimental class and the control class at the field trial stage). The average post-test score in the experimental class was 83.45 and the average post-test score in the control class was 75.68. The average difference is 7.773. In addition, judging from the assessment criterion coefficient which is greater than the value of the coefficient table, then H_0 is rejected. The results obtained are t_{hit} = 2.831 consulted at t_{tab} = 2.018 (significance level 5% and df = 42), so it can be said that $t_{hit} > t_{tab}$ or 4.688 > 2.018, which means that there is a difference in the average value of students' critical thinking skills between the experimental class and the control class at the field trial stage.

In the experimental class of the field trial stage, in addition to being given post-test questions, students were also given an assessment questionnaire on the feasibility of the interactive e-flipbook media product developed. The media feasibility questionnaire was then analyzed to determine the average student assessment score on aspects of motivation, attractiveness, ease, and usefulness of interactive e-flipbook media (Sugianto et al., 2013). The results of the student assessment questionnaire on the feasibility of interactive e-flipbook media oriented toward contextual approaches at the field trial stage can be seen in Table 12.

Table 12. Results of the Student Assessment of Media Feasibility E-flipbook in Field Trial Stage

No.	Aspect	Average	Criterion
1	Motivational Aspects	3.09	Good
2	Attractiveness Aspect	3.24	Good
3	Convenience Aspect	3.26	Good
4	Expediency Aspect	3.24	Good
Average Total		**3.21**	**Good**

Based on Table 12, shows that the results of student assessment of interactive e-flipbook media oriented to a contextual approach on the motivational aspect of the average score obtained 3.09 with good criteria, the media attractiveness aspect of the average score obtained was 3.24 with good criteria, then the ease aspect of the average score was 3.26 with good criteria, and the last for the expediency aspect of media obtained an average score of 3.24 with very good criteria. The average score of the total student assessment of the feasibility of interactive e-flipbook media at the field trial stage was 3.21 with good criteria. This shows that the interactive e-flipbook media developed is good and feasible to be used in the science learning process in grade V elementary school.

The results of the student assessment of the feasibility of interactive e-flipbook media were randomly selected by three students from the number of students who became research samples at the field trial stage. The average student said that the interactive e-flipbook media product developed was good and colorful; many activities trained students to express their opinions and work together; there were quizzes and learning videos so that learning became clearer in understanding the material; and it was very interesting and not

boring (Mutiara & Emilia, 2022; Prasetyono & Sigitta, 2020). Thus, the interactive e-flipbook media oriented to the contextual approach developed is good and feasible to use in elementary science learning.

Based on the data on the feasibility results of interactive e-flipbook media products oriented towards contextual approaches, it can be concluded that interactive e-flipbook media oriented towards a contextual approach is feasible to be used for the science learning process in grade V elementary school with very good criteria. The average result data for the feasibility assessment score of interactive e-flipbook media products oriented towards a contextual approach can be seen in Table 13.

Table 13. Product Feasibility Results in Interactive E-Flipbook Media-Oriented Contextual Approach

No.	Respondents	Score	Criterion	Conclusion
1	Media Expert	4.38	Very Good	
2	Material Expert	4.59	Very Good	
3	Student:			
	One-To-One Trial	3.54	Very Good	FEASIBLE
	Small Group Trial	3.37	Good	
	Field Trial	3.21	Good	
Average		**3.82**	**Very good**	

The feasibility results of continually based interactive e-flipbook media products in science subjects show that the results of media expert assessments can be declared feasible with very good criteria, while material expert assessments can also be said to be feasible to use with very good criteria. Then the results of student assessments in one-to-one trials also show that they are feasible and very good to be used in learning, as well as that small group trials obtain good and feasible criteria for use, and the results of the last assessment in the field trial also show that the media is good and suitable for use. Thus, the results of media feasibility assessments ranging from media experts and material experts to assessments by students at each stage of the trial, show that interactive e-flipbook media oriented towards a contextual approach is feasible to be used for class V elementary science subjects on force and simple machinery.

Discussion

The use of interactive e-flipbook media oriented to contextual approaches in elementary school learning, especially on style materials and simple planes, shows significant results in improving science learning in grade V. This is proven from the development stage to the test of the effectiveness of interactive e-flipbook media, showing that it is feasible and can be used in supporting the science learning process in elementary schools. The initial stage starts with the validation of material and media experts and then continues with feasibility tests and media effectiveness tests in learning. Based on the validation of media experts, the navigation aspect obtained an average score of 4.22 with very good criteria, the ease aspect averaged a score of 4.60 with very good criteria, the average score for the audio aspect was 4.17 with good criteria, the writing or text aspect obtained an average score of 4.61 with very good criteria, and the display aspect averaged a score of 4.30 with very good criteria, so overall in the aspect of media elements, it met the eligibility criteria with an average score of 4.38. There are several inputs from media experts in the development of interactive e-flipbook media, namely that the background and background aspects used must be by student characteristics. In addition, there is a need for explanatory information on every navigation button used. This is by research that states that the development of learning media needs to be adjusted to the learning styles of students. However, the influence of student behavior on digital-based learning is not only influenced by internal factors of students; but also there is the influence of teachers and parents in facilitating the learning process (Smaldino et al., 2018; Hirata & Ozawa, 2023). In addition to media validation, in this initial stage, validation is also carried out related to materials, namely style materials and simple planes in science learning in elementary schools. The results in the learning aspect averaged a score of 4.54

with very good criteria, while in the material aspect, the average score was 4.64 with very good criteria. Thus, it can be concluded that the material presented on the interactive e-flipbook media oriented towards a contextual approach to learning science in Class V elementary school is very good, with an average score of 4.59. The presentation of science material that tends to be disliked by students must be presented as interesting and practical as possible so that the learning process fosters student interest in science. This is in agreement with research conducted by Yoon-Sung Choi (2023), namely that students with a higher level of interest in science tend to participate more in science activities, become more independent, and re-engage in science activities.

In the early stages, interactive e-flipbook media oriented to contextual approaches have been feasible to use in the later stages. Furthermore, the stage in the development of this media is the trial stage in classroom learning, which is carried out in three stages: a one-to-one trial, a small group trial, and a field trial (Branch, 2009). The results in the one-to-one trial stage obtained a score of 3.54 with very good criteria. There are several inputs in this stage, namely that the influence of using music background in media must be given an on and off button, so as not to interfere with students' concentration and enthusiasm when playing videos in this interactive e-flipbook media. In addition, student learning style factors are also a consideration for the on-off background button. In the opinion of Korber & Shepherd (2019), the interest and enthusiasm of students who participate in activities on e-flipbooks can provide positive feedback on learning and certainly have an impact on student cognitive outcomes. This is because the e-flipbook contains text, video, audio, and animation, which are combined according to the learning needs of students (Andini et al., 2018; Ningsih et al., 2022; Putra et al., 2023). Digital interactive e-flipbook media has several advantages, one of which is that it can present learning materials in the form of words, sentences, and images that can be equipped with colors so that they attract more students' attention (Amin et al., 2020; Mutiara & Emilia, 2022; Sudiarti et al., 2023). In addition, e-flipbooks will make students engage in searching for information and assessing reference sources that are advantageous as material for solving problems.

The development of interactive e-flipbooks in this study used the Kvisoft Flipbook Maker application. This is because the Kvisoft flipbook maker application makes it easy to create assessment and evaluation features, resulting in interactive digital textbooks equipped with multimedia elements such as video, images, sound, and text (Divayana et al., 2019; Erna et al., 2021; Haryanto et al., 2019; Sumarmi et al., 2021). This application can also be used on Windows 10 PCs or laptops and above so that when applied in the classroom, learning can be done in groups or individually. The next stage of the trial is the small group trial. At this stage, the average motivation aspect score obtained was 3.13 with good criteria; the media attractiveness aspect obtained an average score of 3.43 with very good criteria; then the ease aspect averaged 3.50 with very good criteria; and the media expediency aspect obtained an average score of 3.42 with very good criteria so that the average total score of student assessment of the feasibility of interactive e-flipbook media at the small group trial stage was 3.37 with good criteria. There is some input from students at this stage, namely adding quizzes or games to each chapter. Therefore, this study is not just about developing media but also testing student learning outcomes through evaluations and assessments in the e-flipbook in the form of questions or quizzes per chapter. The results of this evaluation were carried out in the third trial stage, namely the field trial stage.

The field trial stage was divided into two groups, namely the experimental group (learning using interactive e-flipbook media) and the control group (learning using printed books) with a quasi-experimental design. The average post-test score in the experimental class was 83.45, and the average post-test score in the control class was 75.68. The average difference was 7.77. In addition, judging from the assessment criteria of that = 2.831 coefficient greater than that = 2.018 coefficient value (significance level 5% and df = 42), H0 is rejected, so it can be said that this> tab or 4.688 > 2.018, which means that there is a difference in the average value of students' critical thinking skills between the experimental class and the control class at the field trial stage. These results agree with research conducted by Prasetyono & Sigitta (2020) and Erna et al., (2021) that e-flipbook media can guide learning activities, save time, optimize teaching aids, help students be actively involved in learning, improve students' ability to solve problems and improve critical thinking skills. The

influence of contextual-based material is also an effect of increasing students' critical thinking skills. With this contextual approach, students can directly imagine real examples in everyday life so that learning becomes more meaningful (Gastama et al., 2023; Koch & Bock, 2023; Lestari et al., 2023). The average score of the total student assessment of the feasibility of interactive e-flipbook media at the field trial stage was 3.21 with good criteria. The interactive e-flipbook media product developed must be interesting, and colorful; many activities train students to express their opinions and cooperate and are not boring (Firdaus et al., 2023; Prasetyono & Sigitta, 2020; Samarraie et al., 2020). But it would be even better if this media could also be integrated into digital learning platforms that can be accessed online and offline easily for elementary school students, such as Moodle, Google Classroom, or Edmodo (Ahmed & Indurkhya, 2020; Alim et al., 2019; Tinmaz & Lee, 2020). Therefore, this e-flipbook product has a novelty in its use that can be integrated into the LMS as above. In addition, this e-flipbook can be used offline without being connected to the internet network, so students can use it anytime. Content in e-flipbooks is presented in several variations to accommodate various student learning styles, such as video, voice, text, and quiz features.

Thus, it can be concluded that contextually based e-flipbook media can be declared worthy of use, with a total average of 3.82 in the excellent category. This is reinforced by the results of research conducted by Chen et al., (2021) and Saraswati & Linda (2019) who found that teaching using electronic book media such as e-flipbooks that emphasize interactive features is better than conventional teaching. Therefore, the use of e-flipbooks needs the support of adequate facilities and infrastructure for their operation in learning. This interactive e-flipbook can also be used by teachers both online and offline, according to the needs of each class. It is hoped that all parties, including the education office, schools, teachers, and students, will be able to work together in implementing interactive e-flipbook media oriented towards this contextual approach that is feasible to use.

The contribution of this research to the learning process in elementary schools can be described theoretically, practically, and methodologically. Theoretically, product development in this study, can facilitate student needs and be the main learning resource for students who can train and improve students' interaction and critical thinking skills to achieve planned learning goals. In practical terms, this research has succeeded in proving feasible to be used in supporting the implementation of the science learning process on the subject of simple styles and planes. Then, methodologically, this research was carried out using a development research design by paying attention to the feasibility testing procedures of media products that exist by existing their studies so that they can be a reference as well as a source of learning for future researchers.

CONCLUSION

The interactive e-flipbook media development procedure oriented towards a contextual approach is carried out using the ADDIE development model design. The steps taken by researchers start with analysis, product design, product development, implementation, and evaluation of the final product. However, this feasibility analysis is focused on the analysis, design, and product development stages only. At the analysis stage, there are several activities carried out, including curriculum analysis, literature analysis, and analysis of student and teacher needs. Furthermore, carrying out the product design stage starts with setting competency standards and basic competencies, selecting and collecting e-flipbook materials or content, and finally making flowcharts. The product development stage is carried out at this stage the interactive e-flipbook media production stage, media and material expert validation, and student validation through product trials (one-to-one trial, small group trial, and field trial). The results of the media expert validation assessment averaged a score of 4.38 with very good criteria, material expert validation obtained an average score of 4.59 with very good criteria, student validation ranging from one to one trial obtained an average of 3.54 included in the very good criteria, small group trial obtained an average score of 3.37 included in the good criteria, and the field trial stage obtained an average score of 3.21 included in the good category. Thus, it can be concluded that the interactive e-flipbook media oriented towards a contextual approach has met the requirements with very good

criteria and is worthy of being used as a science learning media for grade V elementary school. Through the use of interactive e-flipbook media, teachers can collaborate with various innovative learning models according to the characteristics of students and the learning objectives to be achieved. Suggestions for further research are expected in the development of digital media, especially in the form of e-books or e-flipbooks, that can be improved so that they can be used on any device, including PCs, laptops, and mobile phones based on Android or iOS.

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Adoption of mobile learning among university students during and after the covid-19 pandemic in Bangladesh

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ABSTRACT

Limited research has been done about the adoption of mobile learning among Bangladeshi university students, including those from public, private, and national universities. This study aims to unravel the nuances in students' attitudes influenced by personal and institutional factors, investigating the diverse higher education landscape post-return to traditional classrooms. The survey, encompassing demographic data and mobile technology utilization pre-, during, and post-COVID-19 from 453 Bangladeshi university students, is analyzed to measure their perceptions and attitudes regarding the efficacy of mobile learning. The result varies between public, private, and national university students. While many students have complimented and appreciated mobile learning for its ability to assist with financial struggles, the learning process, and grades, many of them have also reported a decline in the quality of their education during M-learning. Several students have expressed difficulty communicating and concentrating during online sessions. The study suggests that incorporating mobile learning technologies into traditional classroom settings could improve teaching and learning. Further research is needed to understand the impact of institutions on online education acceptance and student perceptions.

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INTRODUCTION

The growing prevalence of urbanization and economic integration at a worldwide level has enabled enhanced global connectedness. The result of that connectivity has a significant impact on distance learning as well as using mobile technology in the education sector. Though COVID-19 makes this adoption of electronic learning a lot faster than planned.

The COVID-19 pandemic has had a significant detrimental effect on the education industry, resulting in the disruption of face-to-face instruction for around 1.6 billion students worldwide. Consequently, these students have been compelled to transition to an online learning environment. According to several studies, the closure of schools and educational institutions in 150 nations has impacted more than 80% of the global student population (Bozkurt et al., 2020; Sahu, 2020). In response to the COVID-19 pandemic, the Government of Bangladesh (GoB) implemented a "statewide lockdown" on March 23, 2020, to protect the general population (Sorder, 2020). Additionally, all educational institutions were ordered to close starting from March 17, 2020.

According to the UNICEF Survey on Children's Education in Bangladesh 2021, the period of closure persisted for 18 months, with the subsequent reopening of schools occurring on September 12, 2021 (BBS & UNICEF, 2022).

The COVID-19 pandemic has had a significant impact on the educational sector in Bangladesh, affecting around 36 million students and 100.000 instructors across elementary, secondary, and tertiary levels (Uddin, 2020). As a result of adhering to the social distancing measures advised by the World Health Organisation (WHO) to mitigate the spread of the virus, both students and instructors have been confined to their homes. On April 30, 2020, the government issued a request for public and private universities to maintain their educational programs through online instruction and initiate their academic operations in an online format (Barua, 2020).

Distance education has a rich history spanning over a century, encompassing a wealth of experience and established practices (Georgiev et al., 2004). Distance learning has been available in Bangladesh for around 30 years with Bangladesh Open University. The University Grants Commission of Bangladesh (UGC), the governing body responsible for overseeing higher education in the country, has imposed restrictions on the provision of distant or online courses in Bangladesh, limiting this privilege only to Bangladesh Open University (Chowdhury & Behak, 2022). These restrictions were in place before the onset of the pandemic.

As a result of the COVID-19 pandemic, educational institutions swiftly transitioned to online methods to maintain uninterrupted classroom instruction and prevent disruptions to the teaching-learning process. This involved the adoption of an e-learning environment, the establishment of standards and procedures, and the exploration of effective methods (Khan et al., 2022). Various platforms, such as Microsoft Office, Google Hangouts, Skype, Zoom, WhatsApp, and others, were introduced to both instructors and students (Rouf et al., 2022).

The acceptance or adoption of mobile learning has been uncovered by numerous pieces of evidence (Viberg et al., 2020). However, the impact of extensive use of m-learning in an online learning environment as the sole option during the pandemic time to complete the educational process as well as the transition from m-learning to traditional learning, has yet to be researched. The study aims to better understand how students perceive the variables that affect m-learning in higher education after getting back to a physical classroom. In Bangladesh, the delivery of tertiary education is characterized by distinct modules and study structures. Furthermore, the resources that are accessible to students are contingent upon a wide range of factors, including the educational institution that they attend, the circumstances of their family and finances, the location that they were in during the epidemic, and so on.

The Bangladesh government's decision to allow continuing education online, numerous higher education institutions in Bangladesh were compelled to initiate online operations, without a well-defined strategy in place. Due to this rash action, all parties had to deal with a wide range of issues. Despite possessing the technical competence to operate electronic devices, several students faced financial constraints preventing them from acquiring high-speed internet or these gadgets. This hindered their ability to adapt to the rapid transition of educational institutions to online systems (Hosen et al., 2022).

Despite the existence of numerous research gaps, the impact of mobile learning remains a significant area of study in the Bangladesh context. There is limited evidence available regarding the effects of implementing portable device-based learning as opposed to traditional face-to-face instruction on students in underdeveloped countries. One notable research gap pertains to the limited scope of inclusive investigations concerning students enrolled in diverse sorts of tertiary institutions (public university, private university, national university) that operate under distinct operational frameworks. Hence, this study aims to address this discrepancy and ascertain students' perceptions regarding the use of mobile learning.

The objective of this study is to enhance our comprehension of the heterogeneous student population in higher education institutions and investigate their perspectives regarding the elements that impact mobile learning once they transition back to traditional classroom environments. An analysis of the factors that affect the acceptance and use of mobile technologies in education is crucial, given the growing number of mobile internet users and

the potential benefits offered by mobile technologies (Khan et al., 2022). This research contributes to the improvement of learning through mobile devices, especially in State, Private, and National Universities.

LITERATURE REVIEW

Given the global trend of distance education during the COVID-19 era, it is important to note that distance education has a long history and traditions. Its main characteristic is the distance and time separation between instructor and students. By nature, mobile learning (m-learning) is a form of existing digital learning (d-learning) and electronic learning (e-learning) (Basak et al., 2018).

Digital education is a sort of education where students use their home computers laptops or smartphones through the internet, staying away from their academic institutions (Anastasiades et al., 2010). M-learning is viewed as an extension of e-learning; however, its effectiveness might be dependent on the unique advantages and limits of mobile devices (Basak et al., 2018). However, the literature has several definitions of mobile learning. Some of them only think it can be internet- or wireless-based (Georgiev et al., 2004). Behera (2013) stated that modern technology, namely, the internet is no longer limited to the four walls of classrooms and it includes all sorts of electronically supported learning as well as teaching (Behera, 2013). According to Kacetl and Klímová "Mobile Learning occurs whenever learners have access to knowledge and resources everywhere and at any time utilizing portable apps to complete relevant tasks in an educational context (Kacetl & Klímová, 2019).

M-learning must be defined as the capacity to learn anywhere, at any time, without a constant physical connection to cable networks. The general development of new technology, which was not designed for academic objectives, may limit the wider application of its adoption in teaching due to potential technological constraints (Khan et al., 2022). Multiple studies indicate that mobile studies in higher education primarily employ instructional methodologies and lack transformative elements (Criollo et al., 2018). Recent research revealed that to properly utilize the instructional advantages provided by the use of mobile devices, more widespread and effective instructional enhancements are needed (Qashou, 2021).

With the appearance of new educational and technological advancements, m-learning would inevitably transform. By applying creative teaching methods, different aspects of educational resources can be easily understood (Kacetl & Klímová, 2019). Learning outcomes and educational strategies have been interdependent and mutually influential (Adejo et al., 2018). The full benefits of online learning are unavailable to students who cannot afford high-speed internet or technological gadgets (Murphy, 2020). A review suggested that as students' understanding differs between traditional classroom and online systems, the current curriculum of study and syllabus should be updated (Toquero, 2020).

Income inequality significantly affects the online learning environment (Beaunoyer et al., 2020). Students from middle-class families have experienced significant effects from the pandemic. (Rundle et al., 2020). The lockdown prevented tertiary students from earning through part-time jobs or other activities (Owusu et al., 2020). Due to the high price of laptops and desktop computers, mobile phones become the best tools for students to use for learning (Insorio, 2021). The most prevalent survey results were fatigue, stress, overwhelm, depression, and anxiety from more than 1300 students from high school, undergraduate, and postgraduate, apart from a poor e-learning system (Zuñiga et al., 2021). Tertiary students in Bangladesh, a lower middle-income Asian country, also had similar consequences.

Even though Bangladeshi universities and colleges produce a large number of graduates, there are few articles from Bangladesh about the impact of mobile learning on tertiary education including all groups including public, private, and college-based national universities. Most articles focused on single group perspective review rather than comprehensive scenarios.

The UGC annual report for 2021 reveals that Bangladesh has a total of 158 universities, consisting of 50 public universities and 108 private universities. At the tertiary level, there are a total of 4.44 million students enrolled in various programs at public universities and little more than

300 thousand students in private universities (UGC, 2021). The National University of Bangladesh (NUB), established in 1992, is an independent public university that operates as an umbrella institution. It oversees the academic operations of over 2,257 affiliated colleges and professional institutes. Based on the UGC Annual Report 2021, out of a total of 4,131,610 students enrolled in public universities, 2,934,712 are enrolled in different colleges and professional institutes affiliated with national universities, representing 71.04% of the total public university student population (UGC, 2021). This extensive network makes NUB one of the largest universities globally by student enrolment A large portion of National University students are from rural areas and lower and middle-income households with subpar academic achievement (Mukherjee et al., 2014). This extensive collection of samples is excluded from any investigation of the adoption of mobile learning at the tertiary level of education.

The issues considered about the adoption of mobile learning among university-level students are very confusing. In the context of Bangladesh, according to a survey conducted by Hosen et al., (2022) with 2,038 samples from Bangladeshi private and public universities, 55% of the students were unable to enroll in online classes due to inadequate internet connections, and 44.7% were unable to do so due to a lack of available equipment. Additionally, 87% of students say that online assessments are less helpful than assessments conducted in person, and 82% think that online classrooms are less effective than in-person ones (Hosen et al., 2022). Due to the obstacles, students encounter when taking online courses, including their lack of enthusiasm, conception of the subject, contact between the students and their lecturers, and a sense of isolation brought on by taking online courses, students continue to prefer face-to-face classroom instruction (Wallace, 2003).

Conversely, the above outcome contradicts other research findings. According to empirical research, smartphones are widely accepted by undergraduate students, particularly those studying business, as a tool for learning (Yağcı, 2018). A different study found that just 11.90% of students took online courses on a PC, the remainder of them use various mobile devices, 92.7% of which are Android-based (Chanda et al., 2022). According to the 2018 GSMA Mobile Economy Report, approximately half (51%) of the population in Bangladesh possesses a mobile phone. 38% of mobile phone consumers in Bangladesh owned a smart device before the pandemic. In May 2022, the ratio increased to 48% (Hasan, 2022). Approximately 82.02 million of the 87.79 million total internet consumers access the internet using mobile devices (Azad, 2022). In 2020, at the onset of the COVID-19 pandemic, internet connectivity was limited to just under 25% of the population in Bangladesh (Kameke, 2024).

One of the key considerations in mobile learning is the accessibility of internet connection. In January 2022, according to DataReportal, there were 52.58 million internet users in Bangladesh, which was 31.5 % of the whole population. According to a Kepios investigation, between 2021 and 2022, the number of internet users in Bangladesh rose by 5.5 million. These user statistics show that 114.5 million Bangladeshis, accounting for 68.5 % of the country's population, did not have access to the internet at the beginning of 2022 (Kemp, 2022). Another important apparatus required for online classes is internet speed. Bangladesh consistently ranks at the bottom of the Ookla Mobile Internet Speed Index. In July 2021 Bangladesh was at number 135 among 137 countries, though ranked 130th in the world for mobile speeds and 101st for fixed Broadband speeds in July 2022.

An effective and efficient online class depends on several criteria, but it is unclear which is most important (König et al., 2022). However, poor Internet connections, the cost of Internet connections and other technology gadgets, and students' lack of preparation are a few among many obstacles that have been faced by students (Rouf et al., 2022). Mobile learning is a helpful tool in this pandemic era, allowing students to learn outside of the classroom or engage in class from any location, strengthen their contact with their teachers, and bridge the long-term study gap. There is a lack of study on the viewpoints of diverse students, particularly those attending national universities, about mobile learning and its impact in Bangladesh since educational institutions have reopened and students have returned to traditional classrooms. This article will therefore aim to provide some insight on that particular topic.

METHOD

Research Design

This study utilizes a quantitative research approach to examine the views and attitudes of university students in Bangladesh regarding the effectiveness of mobile learning. Data on demographic information and mobile technology utilization were collected using a structured survey. The survey covered two different periods: pre-COVID-19 and during COVID-19 & post-COVID-19. Irrespective of gender, the survey was accessible to all university students for participation.

Participants

The sample comprised 453 university students, from many institutions in Bangladesh, out of a total of over 500 individuals. The research included students from several universities in Bangladesh, encompassing both public and private institutions, as well as affiliated colleges and institutes associated with the National University of Bangladesh. The participants were chosen by a stratified random selection technique to guarantee a diverse representation across many demographic factors, such as age, gender, field of study, and year of study.

Data Collection

The study was carried out using primary data. The acquisition of main data was accomplished via the use of a closed-ended structured data-collecting approach. The investigation makes use of a variety of methodological approaches, including survey methods and quantitative descriptive methodology. The survey questions utilized in this study were derived from a previous research study (Biswas et al., 2020; Hosen et al., 2022; Khan et al., 2022). Following the modification of the questionnaire components, it was distributed to experts on the appropriateness of its implementation for mobile phone adoption. The questionnaire underwent minor revisions before its finalization, as per the recommendations of the experts.

The questionnaire was sent to undergraduate and graduate university students using both physical means and online platforms (such as email, and social networking platforms), using a random sampling method. A considerable proportion of pupils participated in the online survey. The data is acquired after students return to a conventional classroom setting, without direct use of mobile learning technologies. The questionnaire was designed in both English as well as in the native language and included clear instructions to facilitate accurate and honest responses.

Survey Instrument

The survey questionnaire contained three distinct sections:

Demographic Data

This section accumulates demographic data regarding students' age, gender, academic discipline, year of study, educational history, financial circumstances, and socio-economic background.

Mobile Technology Utilization

The subsequent section examines the utilization of mobile technology by individuals both before the pandemic and during and after the COVID-19 outbreak. This investigation encompasses the adaptability of mobile and technological devices for educational purposes, the frequency of online usage, the daily time allocation for mobile device usage, and the extent to which mobile devices are employed for educational activities.

Perceptions and Attitudes

This third section of the questionnaire measures students' opinions and attitudes regarding the utility of mobile learning technologies during the COVID-19 pandemic. The final segment of the survey assesses the perspectives and attitudes of students regarding the efficacy of mobile learning tools amidst the COVID-19 pandemic. The participants' responses to the third portion

were measured using a five-point Likert scale, with options ranging from 'Strongly Disagree' (1) to 'Strongly Agree' (5).

Data Analysis

The gathered data was subjected to quantitative analysis using the SPSS software. Before conducting data analysis, the responses provided by the participants were subjected to coding and subsequent analysis to ensure reliability. The following steps were undertaken:

1. Descriptive statistics, used to summarize the demographic data and general trends in mobile technology utilization.
2. Comparative and inferential analysis, Compared the frequency and nature of mobile learning practices across the two phases (pre-, during, and post-COVID-19) of different groups as well as their financial conditions and summarize the learner's major area of perceptions on mobile learning. This comparative analysis is the major focus of this study included. Inferential statistics shows the ANOVA result.

The Cronbach Alpha reliability score of the questionnaire was determined to be 0.789, indicating a level of dependability that is considered acceptable.

RESULTS AND DISCUSSION

Results

This section includes demographic information about students and their background, technological know-how during & after the pandemic, and their impression of mobile learning. Table 1 represents the students' information regarding gender, educational institutions, and station during a pandemic, and Figures 1 and 2 illustrate the daily time allocation of university students to mobile phone usage before and after the pandemic, as well as the distinction between educational and non-educational objectives.

Table 1. Background Information

No.	Classification	Category	Percentage
1	Gender	Female	46.1%
		Male	53.9%
		Total	100%
2	Institutions type	Public University	25.4%
		Private University	53.9%
		National University	20.8%
		Total	100%
3	Residence during pandemic	Inside Dhaka (Capital City)	62.0%
		Out of Dhaka City	38.0%
		Total	100%

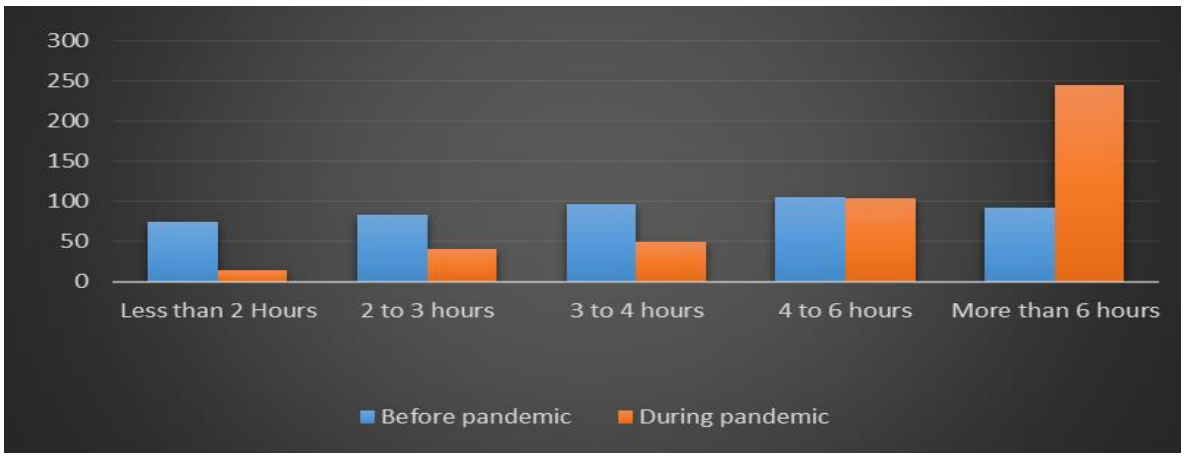

Figure 1. Everyday Mobil Device Uses

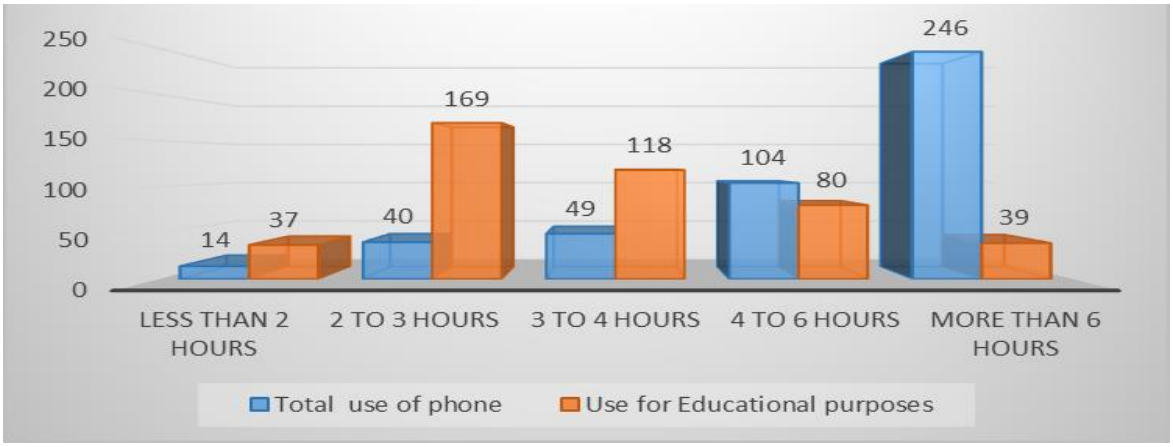

Figure 2. Purpose of Using Device During Pandemic

Amidst the pandemic, there was a surge in the utilization of mobile phones. Over 250 students reported using their phones for more than 6 hours each day, compared to less than 100 students before the epidemic. Additionally, the majority of students used their phones for less than 2 hours before the pandemic. Despite the COVID-19 pandemic, a mere 29.5% of students utilize their phones for educational purposes for a duration of 3-4 hours, while 37.5% of students use their phones for educational purposes for 2-3 hours. These findings closely align with the outcomes of several prior research (Biswas et al., 2020; Rouf et al., 2022).

Based on the technological data, it was evident that during the pandemic, only 165 students (36.42%) utilized more than one device, which was an increase from the pre-pandemic figure of 125 students (27.59%). During the epidemic, it was discovered that 38.7% of students purchased a new device specifically for educational purposes. Additionally, over 35% of students were required to share their educational equipment with another individual, which indicates the negative impact of quality education. This study provides further evidence for prior research on the influence of COVID-19 on Bangladeshi pupils (Hosen et al., 2022).

Among the entire student population, 287 individuals, or 63.4%, reported experiencing a substantial decrease in income as a result of the pandemic. Within this group of students. In the dataset categorized by institutional type, 60.9% of the students are from public universities, 63.1% are from private universities, and 67.0% are from national universities. Out of all the participants, 44.5% of students are currently facing challenges in restoring their income to pre-pandemic levels. Table 2 displays the percentage of students experiencing financial hardships, both overall and categorized by institution kinds.

Table 2. Financial Hardship During Covid-19

No.	Institutions Type	Category Percentage	Did you Suffer Financial Difficulties due to the COVID-19 Pandemic?		Total
			Yes	No	
1	Public University	% within the Institution's Sample	60.9%	39.1%	100.0%
		% within Total Population	24.4%	27.1%	25.4%
2	Private University	% within the Institution's Sample	63.1%	36.9%	100.0%
		% within Total Population	53.7%	54.2%	53.9%
3	National University	% within the Institution's Sample	67.0%	33.0%	100.0%
		% within Total Population	22.0%	18.7%	20.8%
Total		**Count**	**287**	**166**	**453**
		% of Total	**63.4%**	**36.6%**	**100.0%**

Smartphones enhance the learning process. Out of the students surveyed, 35% agreed and 28.4% expressed strong agreement with the ease of adopting mobile learning. This combined to a total of almost 60% of all students. That is also supported by the mean values of 1.46 and standard deviation of 1.56. However, just 20% of the participants agreed, and a mere 12.8% expressed a strong desire to pursue their education further through mobile learning platforms. These findings contradict some prior studies conducted in Bangladesh (Hosen et al., 2022; Rouf et al., 2022), nevertheless align with certain other national and international research (Biswas et al., 2020; Khan et al., 2022).

Approximately 57% (255 students) reported that mobile education had a positive impact on their financial situation during the Covid-19 pandemic. The mean value (M= 3.53) and standard deviation (SD 1.168) have likewise been similar. Over 64.4% of students expressed a preference for studying without any constraints on location or time. The student's response is characterized by a higher level of ambiguity regarding the dynamics of contact with professors and classmates. Nevertheless, 58.50% and 52.25% of students expressed that the lack of face-to-face connection and the absence of practical or lab lessons, respectively, diminish the effectiveness of their education. The present findings exhibit both congruities (Khan et al., 2021), and disparities with prior research on students' perceptions of mobile learning (Sarkar et al., 2021).

The learners exhibited various reactions to the challenges they encountered during mobile learning. The majority of students (65.56%) reported experiencing difficulties with network connectivity, while 58.30% encountered audio-visual issues during online lectures. These findings are also corroborated by research on the influence of the digital gap on e-education among Bangladeshi students (Alam et al., 2023; Badiuzzaman et al., 2021). A significant proportion of students (43.97%) acknowledged experiencing stress and anxiety when engaging in mobile learning. These conclusions have likewise been observed by the majority of earlier surveys (Emon et al., 2020; Hosen et al., 2022; Khan et al., 2021).

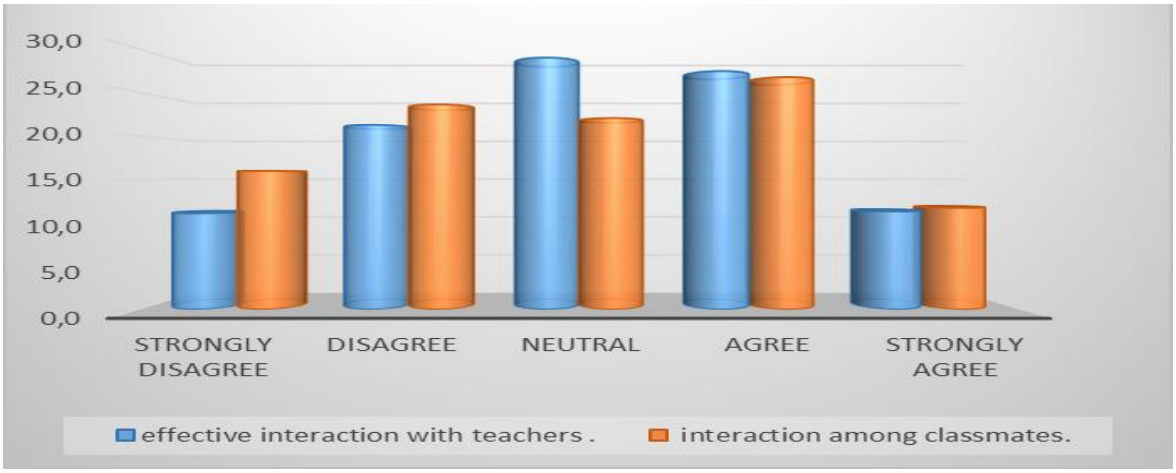

Figure 3. Effective Interaction During Online Learning

Figure 3 presents a feedback overview. The feedback regarding certain possibilities is impenetrable. Deriving a definitive conclusion from this study is remarkably challenging. 44.4% of students reported that m-learning facilitated their teamwork, while 43.8% of students expressed disagreement with the statement on the challenges of submitting reports or assignments. Conversely, 70% of students concur with the assertion that mobile learning enhances their technological proficiency, while 74% of students affirm that recorded classes were beneficial to them. 43.4% of the students reported that taking exams using mobile learning was easier for them, while 43.6% of the students agreed to varying degrees that mobile learning helps enhance their grades. Conversely, 12.8% of students hold an extremely negative opinion of the ease of mobile learning, while 14.4% strongly disagree with the notion that it improves their performance. Although a majority of 61.1% of students found the adoption of mobile learning to be easy. Conversely, 19.2% of individuals expressed disagreement with the remark to varying degrees, while 19.7% of students remained neutral on the matter. Nevertheless, transitioning from mobile

learning to traditional learning proved challenging for over 27.6% of students, as opposed to the 43.7% of students who found it straightforward. Only 11.9% of students express a strong desire to pursue their education using mobile learning. 45.00% of students exhibit a preference for the traditional mode of learning as opposed to mobile learning.

While many students have complimented and appreciated mobile learning for its ability to assist them improve their grades, a significant number of them have also reported a decline in the quality of their education during m-learning. Several students have expressed difficulty concentrating during online sessions, as they find themselves preoccupied with other tasks, consistent with prior research (Chanda et al., 2022). The following is the percentage of student perceptions regarding m-learning in learning which is presented in Table 3.

Table 3. Descriptive Statistics of the Learners' Perceptions of Mobile Learning

No.	Category	SD	D	N	A	SA	Mean	Std. Deviation
		%	%	%	%	%		
1	Mobile Learning Provided Great Financial Assistance for Education During COVID-19.	8.0	9.8	25.2	35.3	21.7	3.53	1.168
2	Learning Through Mobile was Easy to Adopt	7.5	11.7	19.7	35.8	25.2	3.60	1.198
3	M-learning Support to Study without Obligation at any Place or Time.	4.4	7.1	24.1	38.3	26.1	3.75	1.059
4	Interaction with Teachers is More Effective Through M-learning.	11.1	21.2	29.0	27.4	11.3	3.07	1.174
5	M-Learning Increased the Interaction Among Classmates.	16.0	23.6	22.0	26.7	11.7	2.95	1.269
6	Exams on M-learning were Easier than the Traditional Exam.	12.8	18.8	25.0	24.1	19.2	3.18	1.297
7	M-learning Helped to Improve Grades in Exams.	14.4	16.4	25.7	27.2	16.4	3.15	1.284
8	M-Learning Simplified Accomplishing Teamwork/Group Project.	10.3	23.3	22.4	31.8	12.3	3.13	1.201
9	Absence of Face-to-Face Interaction Declined Usefulness of Learning.	5.7	7.7	28.0	37.5	21.0	3.59	1.083
10	Recorded Classes/Labs were Helpful for Study/Learning.	4.3	5.8	15.9	26.7	47.3	4.07	1.117
11	The absence of Practical Classes/ Lab Classes/Hands-on Experience Deteriorated the Quality of Learning.	6.3	11.3	30.2	32.9	19.4	3.48	1.115
12	I could not Concentrate on Online Classes.	9.5	18.4	30.8	24.6	16.8	3.18	1.205
13	Screen Size Hamper my Learning Efficiency.	10.5	19.5	25.8	31.2	13.0	3.17	1.193
14	I Faced Audio- Visual Problems During Class Time.	6.3	14.1	21.3	37.4	20.9	3.52	1.153
15	Slow Network Strength Hampers the Effectiveness of Study	4.6	13.0	16.8	38.9	26.7	3.70	1.135
16	Suffered from Mental Stress and Anxiety During M-learning Education.	12.7	23.4	19.9	28.8	15.2	3.10	1.277
17	It was Very Difficult to Submit and present a Report/Project/ Assignment Through the M-learning Process.	19.0	24.6	22.8	21.5	12.2	2.82	1.294

No.	Category	SD	D	N	A	SA	Mean	Std. Deviation
		%	%	%	%	%		
18	It was Very Easy for me to Shift from M-learning to Traditional Classroom Learning.	10.2	17.4	28.7	30.0	13.7	3.19	1.182
19	I would prefer to continue my Studies through Mobile rather than in the Traditional Way.	22.3	22.7	25.6	17.4	11.9	2.77	1.301

Table 4. The ANOVA Test.

No.	(I) Institutions Type	(J) Institutions Type	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
1	Public University	Private University	.159	.147	.523	-.19	.50
		National University	.587*	.180	.003	.16	1.01
2	Private University	Public University	-.159	.147	.523	-.50	.19
		National University	.427*	.158	.019	.06	.80
3	National University	Public University	-.587*	.180	.003	-1.01	-.16
		Private University	-.427*	.158	.019	-.80	-.06

*. The Mean Difference is Significant at the 0.05 Level.

A one-way between-groups analysis of variance (ANOVA) was employed in Table 4 to examine the preference for mobile learning compared to traditional classroom learning, taking into account the educational institutes (public, private, and national universities) of a total of 453 students. Mean test scores and standard deviations were from public universities (M = 2.97, SD = 1.223), private universities (M = 2.81, SD = 1.334), and national universities (M = 2.39, SD = 1.243).

There was a statistically significant difference at the $p < .05$ level in students' preference for the three groups F (2.441) = 5.679, p=.004. Despite reaching statistical significance, the actual difference in the mean score between the groups was quite small. The effect size, calculated using the eta square was 0.02, indicating lower impact. Post-hoc comparisons using the Tukey HSD test indicated that the mean score and standard deviation of National universities were significantly lower than public universities and private universities. There was no significant difference observed between private universities and public universities.

Discussion

The survey results demonstrate that students possessed a robust comprehension of mobile learning, notwithstanding the likelihood of variations in their perspectives. Consequently, students were able to persist in their academic pursuits without any disruption, even throughout the period when the university was subjected to a lockdown. Just as previous analyses posed significant challenges in reaching a conclusive determination, this survey analysis similarly presents considerable difficulty in drawing clear conclusions. The objective of this study was to examine the degree to which students enrolled in diverse higher education institutions utilize different mobile phones for educational purposes.

The findings suggest that mobile learning is a highly effective technique for reducing the extended period between study sessions, despite the various challenges students encounter about their physical and mental well-being. Furthermore, mobile learning can enhance students' academic performance. This study also indicates that the vast majority of students have a preference for mixed learning over mobile learning and traditional learning. The result

from the survey posits that mobile learning, also referred to as M-learning, may prove advantageous in situations such as the COVID-19 pandemic. Similar to how earlier analyses presented substantial obstacles in the way of arriving at a definite conclusion, this survey analysis also poses a great amount of difficulty in terms of arriving at a conclusion that can be considered final.

The disparity between the findings of this research and prior studies can be largely attributed to the time of its implementation. Amid the height of the COVID-19 pandemic, a significant amount of research was carried out, marked by a sudden and widespread shift to online learning. The primary concerns expressed by participants revolved around the immediate challenges and disruptions they faced during this period, such as technological issues, limited engagement, and adapting to unfamiliar learning settings. These underlying concerns, which emphasized the adverse features of online learning due to its sudden and unstructured nature, probably influenced their comments.

Nevertheless, the latest study was carried out after the students' shift from virtual learning to conventional classroom environments. This scheduling will allow participants to make a fairer comparison between online and in-person learning. By employing both approaches, students may assess their experiences more discerningly, taking into account the benefits and drawbacks of each. The epidemic has brought about greater stability and reduced vulnerability in the educational environment, allowing for a more thorough and impartial assessment of online education.

Additionally, the ability to contrast the two situations following the pandemic offers distinct perspectives on the enduring consequences of online education. Students may now evaluate the effectiveness, level of involvement, and general satisfaction with online courses in comparison to traditional ones, without the added pressure and worry caused by the epidemic. This comparative method is expected to lead to a more thorough understanding of the educational experience by taking into account the changes and improvements in online teaching strategies that have been made over time. Hence, the discrepancies in survey answers highlight the importance of contextual elements on students' views and the relevance of timing in educational research.

CONCLUSION

Amidst the COVID-19 pandemic, the primary objective of the research is to ascertain the viewpoints of university students in Bangladesh on the use of mobile phones exclusively for educational purposes. In the realm of education, digital networks offer the opportunity to improve the teaching and learning process. Therefore, lawmakers and educational establishments should consider the potential of incorporating mobile learning technologies into traditional classroom settings. This uncertainty may be attributed to many constraints. To address limitations in time and finances, the study sample comprises 456 persons, predominantly consisting of students from the institution situated in the metropolitan area of Dhaka. To gain a precise understanding of the situation, further investigation is required on students from various regions of Bangladesh, including diverse educational systems (public, private, and national universities as well as specialized education), their financial background, and other pertinent details. The use of mobile learning will have positive effects on the educational system for a specific duration, as evidenced by the study's findings and the currently available evidence. This study deepens our knowledge of the influence of institutions on the acceptance of online education in tertiary education in Bangladesh, while also guiding subsequent studies in this field. This comprehensive investigation also presents a compelling argument regarding the overall perception of university students toward mobile learning upon their return to the classroom. Academics and researchers will surely benefit from this study if they persist in conducting comparable research. The education sector should make a concerted effort to create a system that effectively bridges the gap between online and offline learning.

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The role of mobile learning in improving 21st-century teacher competencies: A systematic literature review

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ABSTRACT

The current learning process has entered the 21st-century era, requiring teachers to possess digital learning technology competencies in the teaching and learning process. The 21st-century teacher competencies are known as TPaCK or Technological, Pedagogical, Content Knowledge, which involves integrating technology in designing teaching materials, delivering content, and teaching students. One of the current hot trends in learning, especially in Indonesia, is mobile-based learning or Mobile Learning. The TPaCK framework and mobile-based learning share the similarity of requiring technological learning competencies. Therefore, this research aims to examine efforts to enhance 21st-century teacher competencies using Mobile Learning. The main contribution of this research is to provide empirical evidence on the effectiveness of Mobile Learning in improving teachers' technological competencies. This research serves as an important reference for educators and policymakers in designing strategies for improving teacher competencies based on digital technology. The method used in this research is a Systematic Review with the PRISMA framework. The research results indicate that the implementation of Mobile Learning can create various mobile-based learning media, enabling teachers to enhance their competencies. Moreover, the findings highlight the significant role of Educational Technologists in facilitating learning and improving performance.

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INTRODUCTION

At present, education has entered the 21st-century learning era. Learning continues to improve in terms of learning models, learning strategies, and technology learning. The latest trend that is currently happening is the actualization of technology in learning, specifically Rahmadayanti & Hartoyo (2022) the teaching and learning process in the Merdeka Curriculum where which is also known as Merdeka Belajar to improve the 2013 curriculum by the need to achieve the objectives of national education (Inayati, 2022). However, something is interesting about the development of education in the 21st century, where the curriculum is developed regularly by adjusting knowledge, information, and technology according to the current criteria (Julaeha et al., 2021).

To implement the 21st-century curriculum, teachers must have adequate skills and competencies. A teacher is expected to be able to innovate in teaching, teach competencies by current

trends, and design learning that can bring attraction, happiness, and meaning. The difference between 21st-century learning and conventional, traditional, or classical learning as in the previous era (Inayati, 2022). The educational curriculum is dynamic, experiencing development by adjusting the needs of student' characteristics with their time. In today's 21st-century learning, a teacher must be able to design learning innovations so that the learning process is more meaningful and happy (Cholilah et al., 2023).

Teacher competence in general has been regulated and mandated in Law No. 14 of 2005, namely teaching competence (pedagogic), personality, social, and professional competencies are the competency requirements that a teacher must have. These competencies need to be contextualized and "adjusted" so that teachers are competent in preparing and predicting matters related to the learning needs of learners according to the 21st century (Hamsia et al., 2022). These requirements, along with the development of science, require teachers to have specific 21st-century competencies. As explained by Kemendikbudristek (2021), teachers actively participate in the design of an independent curriculum, which focuses on the material that matters and the development of students' competencies at a particular stage. This allows students to have more in-depth, meaningful, and enjoyable learning without being rushed (Rahmadayanti & Hartoyo, 2022).

Some literacy sources in efforts to upgrade teacher competencies in the 21st-century era, Technological, Pedagogical, Content, Knowledge, or TPaCK competencies are the right framework for 21st-century teacher competencies. Integrating technology in teaching (pedagogy) and delivering material (content) by teachers is a complete framework and can be a unified option that teachers can master in the 21st century. Koehler & Mishra (2009) in this circumstance, teachers are expected to improve their professional skills and create new learning activities. The challenges teachers face when using complex technology to teach (Mardhiati, 2023). Ineffective teaching with technology, there are three main elements: content, pedagogy, and technology, and how these three components interact with each other. The way these three components interact differently in various contexts can lead to different levels and qualities of technology integration in education (Koehler & Mishra, 2009).

Koehler & Mishra (2009) in their research also said that teaching with technology is increasingly complicated given the new technological challenges that teachers face. Practically speaking, most of the technologies considered in the current literature are newer and digital and have some inherent properties that make their direct application difficult. But thanks to the proliferation of scientific publications and knowledge, TPaCK is becoming more intensively promoted to improve teachers' competencies in the 21st century.

Gozali et al., (2023) opined that the national teacher certification program in Indonesia, which is nationally called the Teacher Professional Program, includes TPACK mastery as one of the criteria in the rubric of in-service teachers' micro-teaching evaluation. In addition to its utilization as an assessment instrument, the TPACK survey has been widely reviewed by scholars in studies related to teachers' self-perceptions of their TPACK skills (Castéra et al., 2020; Efwinda & Mannan, 2021; Novita et al., 2022; Roussinos & Jimoyiannis, 2019). The implementation of the TPaCK has a significant positive impact on teachers' skills. By mastering the TPaCK, teachers not only become more competent in using technology but also more innovative in their teaching strategies, ultimately improving student engagement and learning outcomes. The effective integration of technology, pedagogy, and content in the TPaCK makes this framework a very important tool in 21st-century education.

On the sidelines, current educational trends are also experiencing innovation with mobile learning commonly known as "Mobile Learning". The concept of mobile learning is learning that can be done anywhere through mobile devices, meaning that it does not have to be face-to-face in one place directly. Many benefits can be achieved by using this Mobile Learning system. Such as delivering material for learning, finding study sources, and so on. Mobile Learning also has the characteristics of adaptability, namely using mobile devices, laptops, and information technology that is widely used in the teaching and learning process, subject matter can be tailored to the needs and level of progress of each student (Sari & Priatna, 2020).

Mobile Learning as a substitute means students are given the flexibility to choose their preferred learning model. Whether they want to learn using a learning model by (1) using a

conventional learning model, (2) combining a conventional model with technology, or (3) completely using a learning model that integrates technology (Musahrain et al., 2017). How can teachers utilize technology in teaching with these issues in mind? There is no "one best way" to incorporate technology into the curriculum. Instead, integration efforts must be creatively designed for specific subject matter relevant to specific classroom environments. An understanding approach to successful technology integration requires educators to develop new ways of understanding and accommodating this complexity (Koehler & Mishra, 2009). In the 21st-century learning era, digital technology is key to educational success. Teachers' competence in using technology, known as TPaCK (Technological Pedagogical Content Knowledge), is critical to creating effective and relevant learning. This research highlights the urgent need to improve teachers' TPaCK competency through the implementation of Mobile Learning.

Mobile Learning provides flexibility and accessibility, allowing teachers and students to access learning materials anytime and anywhere. It increases the interactivity and adaptability of learning, according to students' individual needs. With the Systematic Literature Review (SLR) method and PRISMA framework, this research collects and analyzes data from various studies to provide practical guidance in the development of teacher competencies. The main contribution of this research is to provide empirical evidence on the effectiveness of Mobile Learning in improving teachers' technological competencies. This research serves as an important reference for educators and policymakers in designing digital technology-based teacher competency improvement strategies. Overall, this research offers practical solutions to the challenges of implementing technology-based learning in the era of Industrial Revolution 4.0, strengthening teachers' ability to integrate technology into teaching.

The three key factors that influence the application of TPACK are instructional factors (teaching and learning issues), curriculum factors (the use of ICT in the school environment), and organizational factors (the logistics of ICT integration in the curriculum) (Majid & Ismail, 2019). Educational technologists play an important role in integrating technology into the learning process. They assist teachers in performing their function as facilitators of learning and performance improvement, ensuring effective and efficient use of technology in the classroom (Bueno et al., 2023; Rossi & Trevisan, 2018).

This literature systematic review (SLR), wants to explore how the competencies of 21st-century teachers, namely TPaCK, can be improved through mobile-based learning or Mobile Learning to suit the needs of 21st-century learning which is currently running with the provisions of the independent learning curriculum. Where the similarity between the two is to actualize technology into learning. So it is hoped that this literature review will create many new ideas and innovative methods in the world of education with the Mobile Learning learning model in improving teacher competence in the 21st century. This research contributes as a reference for every teacher that mobile learning media is a reference for increasing teacher competence in the learning process.

METHOD

This research is a Systematic Literature Review (SLR). A systematic review is an evaluation of a formulated question that uses systematic and explicit methods to identify, select, and critically evaluate relevant research, as well as collect and analyze data from studies covered by the review. The results of the included studies may or may not be analyzed using statistical methods known as meta-analysis (Moher et al., 2010).

This research focused on TPaCK skills as a teacher skill in the 21st-century era that can be improved through mobile learning. To improve TPaCK competence through mobile learning, this study chose this approach for several reasons. One of them is to find out how well teachers can utilize technology in learning that integrates with the Pedagogical Content Knowledge Technology (TPaCK) framework and what things can be utilized from the Mobile Learning learning design. Before conducting the review, the author must prepare research questions to evaluate, namely: Research Question1. How is the TPaCK competency framework a 21st-century teacher competency? Research Question2. How is the learning process based on Mobile Learning in formal schools?

Research Question3. What is the role of mobile-based learning in improving the technological competencies of 21st-century teachers?

This research was analyzed using the Systematic Literature Review (SLR) method. The literature review stage began with a search strategy, where most of the articles to be reviewed were collected from Google Scholar and Research Rabbit. The initial research process began with searching for literature related to the research subject to gather important information. Next, the selection criteria were determined by focusing on keywords such as TPaCK Competency, 21st Century Learning, and Mobile Learning. Articles and journals selected for review should be relevant to the research topic and published by credible sources such as Open Journal Systems (OJS). The authors read the titles and abstracts of the literature to ensure their quality and relevance.

The data extraction process was carried out by selecting eleven published journals related to the selected topics, namely the TPaCK framework in 21st-century learning and Mobile Learning to improve technological competence. These journals were collected over the past five years, from 2019 to 2023, with a focus on Indonesian-language journals. This process ensures that the data obtained is relevant and up-to-date to support the analysis in this study.

RESULTS AND DISCUSSION

Results

As a result of the discussion of scientific articles, eleven journals discuss TPaCK competencies as 21st-century teacher skills and the role of mobile learning in improving 21st-century technology competencies. This study examines eleven journals that discuss TPaCK competencies as 21st-century teacher skills and the role of mobile learning in improving technological competencies. In the planning stage, articles were collected from Google Scholar and Research Rabbit using the keywords “Competency in TPaCK”, “21st Century Learning”, and “Mobile Learning”, and focused on articles published in the last five years to ensure the data was relevant and up-to-date.

In the implementation phase, quality assessment was conducted on journals published on Open Journal Systems (OJS) by reading titles and abstracts to ensure relevance and quality. Eleven journals were selected based on the topics of the TPaCK framework in 21st-century learning and Mobile Learning to improve technological competence. The results showed that the application of TPaCK and Mobile Learning can improve teachers' competence in integrating technology into teaching. Emphasized the importance of mastering TPaCK and using the Merdeka Teaching Platform to adapt to technological developments (Cholilah et al., 2023; Hamsia et al., 2022). Sari & Priatna (2020) found that Mobile Learning increased learning flexibility and interactivity, while Hakiki et al., (2022) reported that Mobile Learning training improved teachers' ability to develop technology-based learning media. Hasjiandito et al., (2023) and Akbar & Djakaria (2023) showed that training and using Android-based applications can improve teachers' technological competence and confidence. This research shows that Mobile Learning is effective in improving teachers' TPaCK competencies, helping them integrate technology into teaching, and adjusting to 21st-century learning needs. This supports the conclusion that technology and pedagogy must be continuously developed to improve the quality of education.

Table 1. Research Study of Previous Literature

No.	Author/Year	Title	Journal	Purpose	Method
1	Veronica et al., (2023)	Penguasaan TPACK & Kemampuan Abad 21 Bagi Guru Sekolah Dasar dalam Perspektif Kurikulum Merdeka	Prosiding Seminar Nasional Pagelaran Pendidikan Dasar Nasional (PPDN)	The Importance of Professional Elementary School Teachers having Mastery of TPACK and Modern Skills from an Independent Curriculum Perspective	Metode Systematic Literature Review

No.	Author/Year	Title	Journal	Purpose	Method
2	Tambak et al., (2023)	Penguatan Kompetensi Technological,Pedagogical Content Knowledge Guru Madrasah Tsanawiyah Melalui Pelatihan Pembelajaran. Berbasis Etnopedagogi	SAJAK	To DEVELOP the Competence of Technological Pedagogical Content Knowledge of Private Madrasah Tsanawiyah Teachers in Dumai City.	Metode Participation Action Research.
3	Akbar & Djakaria (2023)	Pemanfaatan Media Pembelajaran Berbasis Android: Menggunakan Pendekatan inkuiri untuk Menguatkan, Technological, Pedagogical and Content Knowledge (TPACK) Calon Guru	Oxygenius: Journal Of Chemistry Education	To Get an Illustration of the Utilization of Android-based Learning Media, an Inquiry Approach is Used to Improve Prospective Teachers' Educational Technology and Content Knowledge (TPACK).	Metode Library Research
4	Cholilah et al., (2023)	Pengembangan Kurikulum Merdeka, dalam Satuan Pendidikan Serta Implementasi Kurikulum Merdeka Pada Pembelajaran Abad 21	Sanskara Pendidikan dan Pengajaran	To Determine how Similar and Suitable these Two Stages of Development are to the Principles of Educational Technology and the Application of Merdeka Curriculum in 21st Century Education.	Descriptive Qualitative Method
5	Sari & Priatna (2020)	Model Model Pembelajaran di Era Revolusi Industri 4.0 (E-learning, M-learning, AR-Learning dan VR-learning)	Biormatika : Jurnal ilmiah fakultas keguruan dan ilmu pendidikan	Outline learning Models that can be Used to Deal with the Industrial Revolution 4.0 in Indonesian Education.	Metode Systematic Literature Review
6	Rahmi et al., (2020)	Pelatihan E-learning untuk Mengintegrasikan TIK dalam Pembelajaran bagi Guru-guru SMA	Jurnal Panrita Abdi	Provide Training to SMA N 4 Pariaman Teachers on how to Create E-learning and how to Use ICT in the Learning Process.	Method of Implementation
7	Hasjiandito et al., (2023)	Pengembangan Aplikasi Berbasis Android Sebagai Upaya Peningkatan	Jurnal Penelitian dan Pengabdian Kepada Masyarakat UNSIQ	Improving PAUD Teachers' Cognitive and TPACK Skills through Android Application	Method of Implementation

No.	Author/Year	Title	Journal	Purpose	Method
		Kompetensi TPACK Guru PAUD		Development Training Activities.	
8	Hakiki et al., (2022)	Pelatihan Media Pembelajaran Berbasis Mobile Learning Menggunakan Aplikasi, Goole Sites di SMK Negeri 4 Bungo	Jurnal Pengabdian Pendidikan Masyarakat (JPPM)	To Help Teachers Optimize and Utilize 'Mobile Learning' based Learning Media during the Learning Process.	Implementation methods with lectures, demonstrations, practice/training, and design
9	Hikmah et al., (2023)	Pelatihan Pembuatan Perangkat Pembelajaran Berbasis TPACK bagi Guru-Guru Madrasah Al-Aziziyah Gunungsari	Rengganis Jurnal Pengabdian Masyarakat	To Improve the Professionalism of Educators, Especially in Terms of Technology-based Learning Media Design.	Implementation method through lectures, discussions, and questions and answers
10	Rosmaladewi et al., (2023)	Mastering Of Technological Content Knowledge (TPACK Of Prospective Teaching Students In Supporting Digital Learning	KOLOKIUM: Jurnal Pendidikan Luar Sekolah	To Explain how Important TPACK Mastery is for Students who will Become Teachers for their Readiness in Digital Learning	Metode Systematic Literature Review
11	Perdani & Andayani (2021)	Pengaruh Kemampuan: Technological Pedagogical Content Knowledge (TPACK) Terhadap Kesiapan Menjadi Guru	Jurnal Pendidikan Akuntansi Indonesia	To Explore how Technological Pedagogical Content Knowledge (TPACK) Affects Students' Readiness to Become Teachers	Explanatory Quantitative Method

RQ1: Framework of TPaCK Competencies as 21st-Century Teacher Competencies

Technological, Pedagogical, Content Knowledge (TPaCK) competency is the right framework as a 21st-century teacher competency. Integrating technology in teaching (pedagogy) and delivering material (content) by teachers becomes a complete framework and becomes a unified option that teachers can master in the 21st century (Koehler & Mishra, 2009). TPACK (Technological Pedagogical and Content Knowledge) is the knowledge a teacher has about technology, pedagogy, and learning content and how they work together. This concept divides TPACK into seven components, namely technological knowledge (TK), pedagogical knowledge (PK), content knowledge (CK), content technological knowledge (TCK), pedagogical technological knowledge (TPK), and content pedagogical technological knowledge (TPACK) (Hasjiandito et al., 2023).

In research by Veronica et al., (2023) it is revealed that mastery of competencies in the perspective of 21st-century learning, namely education today is not only sourced from books, but can be obtained from various sources both from digital platforms, the environment, and other sources. This phenomenon is in line with the Merdeka Curriculum used in Indonesia. Therefore, the role of teachers who are technologically literate and have adequate soft skills is indispensable.

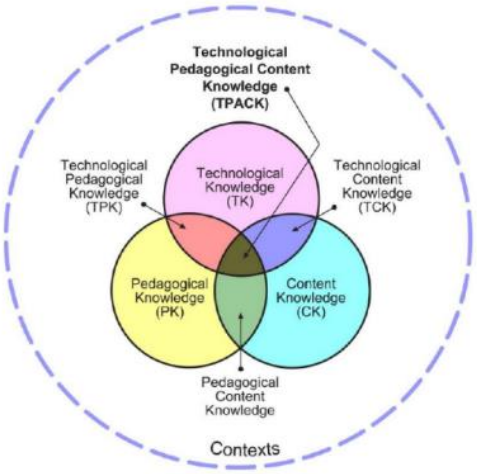

Figure 1. Framework TPACK (Koehler & Mishra, 2009)

This responds to the question of TPaCK competency as a 21st-century teacher competency. Teachers must be able to master 21st-century skills (mastery of 4C; creative thinking, critical thinking and problem-solving, communication, and collaboration), through the HOTS approach, and TPACK so that they can be implemented in learning. This mastery is expected to create creativity and innovation in education that can meet and accommodate the needs and characteristics of students (Veronica et al., 2023).

Research by Cholilah et al., (2023) revealed that to accelerate the development of an independent curriculum in educational institutions, there are several things that need to be considered. One of them is optimizing the Independent Teaching Platform (PMM). In addition, this will impact achieving learning objectives effectively and efficiently. The people involved, including teachers, school staff, learners, and parents, always need socialization, both online and offline. This is given the need for educators to adjust to the times.

Cholilah et al., (2023) also mentioned that there is a role of Educational Technology in designing learning in the 21st century, which if summarized from several previous researchers can be known according to: (1) Michael Molenda - Instructional Technology or Instructional Technology, which includes the design, development, use, and evaluation of technology in the learning process. (2). Seels & Richey - Educational Technology, which includes the utilization of resources, processes, and technological principles to improve the effectiveness of the learning process. (3). Januszewski & Molenda - Learning Technologies, which includes using technology to support, enhance, and facilitate the learning process of learners. (4). David H. Jonassen - Cognitive Tools, which covers the development and use of technology to help learners construct knowledge and effectively solve problems.

So the authors know that in terms of improving the competence of 21st-century teachers with mobile-based learning, the role of Educational Technologists through their area is also needed. Educators who have high TPACK competence will be more confident in the design of lesson plans, methods, strategies, and the use of digital learning media. They must also be able to adapt TPACK to the rapid development of the times and use technology in various areas of TPACK dominance in learning, from content preparation to assessment analysis preparation (Rosmaladewi et al., 2023).

RQ2: Mobile Learning Process in Formal Schools

Research by Sari & Priatna (2020) explains that mobile-based learning or Mobile Learning in the 21st century has been frequently used. M-learning, also known as mobile learning, refers to the use of information technology devices such as cell phones, mobile phones, laptops, and laptops. In this context, we concentrate on mobile phone devices. One of the goals of Mobile Learning development is long-life learning.

Mobile Learning is a learning concept that uses information and communication technology. According to this learning idea, Mobile Learning has advantages such as teaching materials that can

be accessed at any time and attractive visualizations for the material (Sari & Priatna, 2020). The ASSURE model is a framework used to effectively plan and implement technology-based learning, which is particularly relevant in the context of the Industrial Revolution 4.0. The first step is to analyze the characteristics and needs of learners, who are now digital natives accustomed to technology. Next, learning objectives are set with specific and measurable, including improving digital literacy and the ability to use technology (Dikmen & Demirer, 2022). In selecting methods, media, and materials, the ASSURE model encourages the use of E-Learning, M-Learning, AR-Learning, and VR-Learning, which are proven to increase learner interest and engagement. Educators should prepare and use these media and materials effectively during the learning process. The ASSURE model also calls for active learner participation through online discussions, collaborative assignments, and interactive learning applications, and provides constructive feedback. Continuous evaluation and revision is done to improve the quality of learning. The implementation of the ASSURE model utilizes technology to enhance interaction between learners and educators, provide unlimited learning resources, and improve learning effectiveness, ensuring that technology is used optimally to support the teaching and learning process and achieve expected learning outcomes. So it can be known that mobile-based learning can take place by integrating technological competencies into it so that the material can be provided with a delivery strategy for teaching (pedagogy). And this is included in the concept of TPaCK thinking.

RQ3: The Role of Mobile Learning in Improving Teachers' 21st-Century Technological Competencies

Table 2. Experimental Results of M-Learning on TPaCK

No.	Indicator	Before (%)	After (%)
1	Technological Knowledge	83.61	89.30
2	Pedagogical Knowledge	83.71	89.64
3	Content Knowledge	88.42	89.94
4	Technological Content Knowledge	83.49	89.22
5	Pedagogical Content Knowledge	86.14	89.64
6	Technological Pedagogical Knowledge	82.95	88.73
7	Technological Pedagogical Content Knowledge	83.66	89.16
Mean		**84.57**	**89.16**

From several utilizations of mobile as a tool for the learning process, the author found several studies related to the actualization of Mobile Learning. Hasjiandito et al., (2023) research said the Development of Android-based applications as an Effort to Improve Tpack Competencies for Paud Teachers: The results showed that the teacher's understanding of TPACK before the service activity was 84.57%, and after processing the training material the teacher's understanding became 89.16%. Android application development is carried out using smart application developer software, which is a computer application used to create various kinds of learning media or something similar to that. Then the research from Hakiki et al., (2022) is the increasing ability of SMK Negeri 4 Bungo teachers to develop online learning media, as shown by the results of making cellphone-based learning media using the Google Sites application, where each PKM participant has relevant subjects. In addition, the increased confidence of SMK Negeri 4 Bungo teachers in incorporating technology into digital learning services.

The implementation of Mobile Learning allows teachers to develop various mobile-based learning media, which improves their ability to use technology for teaching. Teachers become more skilled in designing teaching materials and delivering materials using mobile devices (Bueno et al., 2023). In line with this Rossi & Trevisan (2018) mentioned in their findings that the implementation of Mobile Learning allows teachers to develop a variety of mobile-based learning media, which improves their ability to use technology to teach.

The same thing was also found in Akbar & Djakaria (2023) to strengthen previous research using android, namely by using an inquiry approach to improve pedagogical and content technology knowledge (TPACK) of prospective teachers, it has been found that the results of using Android-based learning media with an inquiry approach can improve pedagogical and content technology knowledge (TPACK) of prospective teachers. This is because this approach can train prospective

teachers, build confidence, and give them the confidence to integrate technological knowledge with content knowledge (Koehler et al., 2013; Mishra & Koehler, 2006).

Rahmi et al., (2020) research where E-Learning Training to Integrate ICT in High School Teachers' Learning produced results that teachers have successfully created a complete e-learning material package for one meeting, which covers all subjects in class X SMA. This material package consists of various types of e-learning content, including text, images, and videos, which can be accessed by students through their respective accounts. With this training, teachers become ready to import ICT into their learning. Research by Bahroni et al., (2019) which resulted in research that almost all teachers on average can operate well without many obstacles Using the saktibuider.com android application which means that teachers can integrate technology in designing subject matter (TCK) through mobile-assisted applications.

Then the research of Tambak et al., (2023) through Strengthening Competence: Technological Pedagogical Content Knowledge of Teachers in Madrasah Tsanawiyah with Learning Training with Ethnopedagogy found the results of android-assisted learning with a local cultural approach, madrasah tsanawiyah teachers can design and create video learning media by adjusting to the elements of video media. At this stage there are five stages designed and developed by madrasah teachers in making video learning media, so the results of this study concluded that the competence of technological pedagogy content knowledge (TPaCK) of teachers in madrasah tsanawiyah can develop through training designed with Ethno pedagogy-based learning materials.

From several studies above, it can be understood that many strategies and methods can be applied and developed by teachers using the Mobile Learning model, where mobile-based learning is very broad and has many technologies. So that the author can conclude that 21st-century learning requires teachers who have TPaCK (Technological Pedagogical Content Knowlege) competencies as 21st-century teacher competencies that must continue to be developed through various applications of methods so that teachers are ready to integrate ICT technology into digital learning to adapt the needs of students according to the demands of the times, which in this time the independent learning curriculum.

Discussion

The results of this study show that the application of TPaCK and Mobile Learning can significantly improve 21st-century teachers' competencies in integrating technology into teaching. This finding is consistent with the TPaCK theory that emphasizes the importance of simultaneous technological, pedagogical, and content knowledge. For example, Veronica et al., (2023) argued that mastery of TPaCK is essential for creating effective and meaningful learning, while Sari & Priatna (2020) also found that Mobile Learning enhances learning flexibility and interactivity. This research is consistent with the results of previous studies. Hasjiandito et al., (2023) showed that Mobile Learning training improved teachers' understanding of TPaCK, and Hakiki et al., (2022) found that the training improved teachers' ability to develop technology-based learning media. Akbar & Djakaria (2023) also reported that the use of Android-based applications and an inquiry approach improved prospective teachers' confidence and technological competence.

The main difference between this study and previous studies is the focus on the application of Mobile Learning as the main approach to improving teachers' TPaCK competencies in Indonesia. This study uses the Systematic Literature Review (SLR) method with the PRISMA framework, which allows for a more comprehensive and systematic analysis compared to other studies using different methods. However, this study has several limitations. First, it only reviewed eleven journals published in the last five years, so it may not cover all relevant literature. Secondly, the focus of this study is limited to the Indonesian education context, so the results may not be fully applicable in other contexts. The implication of these limitations is the need for further research covering more literature and a wider context to strengthen these findings. In addition, more in-depth field research is needed to test the effectiveness of mobile learning in various educational settings.

The findings are important for policymakers in designing digital technology-based teacher competency improvement strategies, providing empirical evidence supporting the adoption of Mobile Learning as an effective method. This research made an important contribution to educational

practice by showing that Mobile Learning can be an effective tool to improve teachers' TPaCK competencies. Educators and policymakers can use these findings to design training programs that are more effective and relevant to 21st-century needs. For future research, there are opportunities to further explore how different types of mobile technologies can be used to support learning in various educational contexts. Research could also focus on developing learning models that combine TPaCK with new and evolving technologies, as well as examining the long-term impact of implementing mobile learning on the quality of education.

CONCLUSION

From the discussion, it can be concluded: 1). The competencies of 21st-century teachers are TPaCK competencies. Where TPaCK competence is by the competencies of teachers in teaching and mastering material and integrating and actualizing technology into the teaching and learning process. 2). TPaCK competency is a framework of combining Technological Pedagogical Content Knowledge. The framework can be described as TK (Technological Knowledge), PK (Pedagogical Knowledge), CK (Content Knowledge), TCK (Technological Content Knowledge), PCK (Pedagogical Content Knowledge), TPK (Technological Pedagogical Knowledge), and TPaCK (Technological Pedagogical Content Knowledge). 3). Mobile-based learning, also known as Mobile Learning, can be used as a learning model that can improve teachers' TPaCK ability to adapt to 21st-century learning in the era of independent learning curriculum. By developing, implementing, and using mobile devices, teachers can improve their ICT skills in the design and use of synchronous and asynchronous learning. 4). The role of Educational Technologists through the areas of design, development, utilization, management, and assessment/evaluation is also needed as a 'friend' of teachers in improving performance and facilitating learning so that teachers do not feel difficult alone in developing 21st-century competencies because educational technologists are present with their role.

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Zoom slide presentation on basic electrical & electronics subjects Class X Electrical Engineering Department SMK Darussalam Makassar

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ABSTRACT

The research aims to: (1) Identify the need for interactive multimedia presentations using Microsoft Office PowerPoint version 2019 (2) Design interactive multimedia presentations using Microsoft Office PowerPoint version 2019 (3) Produce interactive multimedia presentation media using Microsoft Office PowerPoint version 2019 which are valid and practical. The method used is research and development with the Alessi and Trollip models. The results of the needs analysis show inferior qualifications. The validation results of media and design experts show excellent qualifications and are at a very valid category level. At the same time, the design aspect is in good qualification and is at the valid category level. The results of the content expert validation show excellent qualifications and are at the very valid category level. Product development was then handed over to 3 students who were selected based on learning achievement by the subject teacher. The results of the individual test questionnaire show that the percentage of student 1 is in very satisfactory qualifications, the percentage of student 2 is in satisfactory qualifications, the percentage of student 3 is in very satisfactory qualifications and is at the practical category level so that the 2019 interactive multimedia PowerPoint presentation media does not need to be revised. The product development was then handed over to 9 selected students to be divided into 3 groups consisting of 3 students. The 2019 interactive multimedia PowerPoint presentation media is in good qualifications and at the practical category level. Assessment results. The teacher of the basics of electricity shows a percentage of 100% achievement level, has very good qualifications, and is at the level of a very practical category to use.

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INTRODUCTION

Educational Technology is an integral part of the education sector. Various kinds of reforms have been carried out to improve the quality of education. To improve the quality of education, various breakthroughs are needed both in the quality of teachers/instructors, curriculum development, and learning innovations as well as the completeness of facilities and infrastructure. To improve the learning process, teachers are required to make learning more innovative and creative which encourages students to learn optimally both in independent learning and in

classroom learning, and are required to master the devices that become modern technologies that support the needs of using appropriate media with the demands of scientific development so that they go hand in hand in achieving educational goals. Various kinds of reforms are carried out by educational technologists to improve the quality of education. According to Miarso (2011) argues that: Human resources from the field of Educational Technology are one of the human resources who have competence especially for developing learning and can help to improve the quality of learning. Improving the quality of learning itself can be done through the process of design, development, utilization, management, and evaluation of all components in a learning system (Ridwan et al., 2022).

Media have a very big influence on the learning process carried out both in the classroom and outside the classroom. This shows that the media has a role in presenting objects directly so that they can foster students' learning interest and motivation, concretize objects that are considered abstract by students, minimize misconceptions because students get the same information (knowledge), streamline learning time, and provide presentations. Information consistently so that the learning objectives that have been set can be achieved (Syaepudin & Juhji, 2020).

Based on initial observations and needs analysis at Darussalam Vocational School, data were obtained including (1) Productive Electricity Subject Teachers need PowerPoint Presentation Media that are multimedia in nature because they still use the lecture method and are still the main media center in delivering practice-based discussion material or presenting real thing. Ideally, material that contains a series of practices or presents modeling requires media that supports students in understanding lessons so that learning objectives can be achieved. (2) Class X students of the Department of Electrical/Electrical Engineering need PowerPoint Presentation Media that is multimedia in nature as an alternative. (3) Teachers at SMK Darussalam Makassar have skills in using electronic devices. Thus the use of multimedia-based presentation media allows for further development in supporting the learning process. (4) Darussalam Vocational High School has adequate facilities and infrastructure such as digital light projectors, electronic devices, and other equipment that allow for the use of multimedia-based presentation media. This is also supported by the competence of teachers/educators in general in the use of electronic equipment which allows learning to take place using digital presentations. (5) In the Productive Electricity Subject, apart from including theory, there is also a demonstration process in the learning process. In addition, the needs related to the use of Multimedia are seen from the different characteristics and ways of learning of students so that they require multimedia components in this case text, sound, video, animation, graphics, and alternative links to make it easier for students to learn.

Referring to the needs analysis above and the results of initial observations made by researchers. So the development of interactive multimedia-based presentation media is very important to research class X students of SMK Darussalam Makassar can be a solution in improving quality and supporting learning success. Multimedia comes from 2 words multi and media. The meaning of multi and media in the quote is everything that is used by the teacher to convey messages (subject matter) to students with various types of media so that they can activate all the senses.

So linguistically the term multimedia is a combination of types of media which include text, images, sound, and video which are used to convey messages or information. Interactive multimedia is media that combine two or more elements consisting of text, graphics, images, photos, and audio, video, and animation in an integrated manner and creates two-way communication/interaction between users (humans/as users/product users) and computers (e software /applications/products in certain file formats) (Fikri & Madona, 2018). Multimedia can be described as an electronic device in which information is stored and transmitted in the form of digital media, therefore, is a carrier and mediator of various types of digitally encoded information, such as text, images, sound, video, animation or a combination of these elements this (Degner et al., 2022).

Djamaluddin & Wardana (2019) state that the learning process is essentially a process of communication, students with educators, and learning resources in a learning environment. Learning is also the assistance provided by educators so that the process of acquiring knowledge

and knowledge can occur, mastering skills and character, as well as forming attitudes and beliefs in students. Meanwhile, the term learning or teaching (a more widely known expression before), is an attempt to teach learners. Learning means trying to make someone learn. Learning is a system in which there is a series of communication interaction processes between learning resources, teachers, and students. The interaction is carried out face-to-face or indirectly through digital media, where the learning model has previously been determined. Learning is a system that consists of several components, and the components are interconnected with each other to achieve the goals that have been set (Hasan, 2021). Learning will be interactive by using multimedia. The interactive features of multimedia help students learn and remember better (Bustanil et al., 2019). Interactive means there is action in it (Kusumawati et al., 2021).

In the context of interactive multimedia-based learning, we can find significant differences because we have been able to provide various characteristics and principles so that learning can be said to use multimedia if there are certain characteristics in multimedia learning. The characteristics of multimedia can be identified in its use for educational purposes. Multimedia has advantages compared to other media. As stated by Warsita (2013) interactive multimedia programs have several advantages, including: (1) flexible, meaning that multimedia utilization can be carried out in class, individually, or in small groups. In addition, the flexibility of multimedia in the use of time is also a prominent feature so that it can be suitable for everyone (2) Serves individual learning speed (self-pacing), meaning that the speed of its utilization can be adjusted to the abilities and readiness of each student who uses it (3) It is content-rich, meaning that this program provides quite a lot of information content, even contains subject matter that is enrichment and deepening, and also provides further details of the content of the material or elaboration of the contents of the material specially prepared, or wants to learn more. (4) Interactive (interactive), which is two-way communication, meaning that this program provides opportunities for students to respond and carry out various activities which in the end can also be responded to by multimedia programs with feedback. This level of interactivity is one of the benchmarks in assessing the quality of interactive learning multimedia programs (Fikri & Madona, 2018).

Mercado (2022) suggests that multimedia or digital learning resources help students adapt to mental representations by using different media elements, which support information that can be processed. Information, which consists of content and sometimes learning activities, is presented using a combination of text, images, video, and audio with digital learning resources. One of the multimedia devices commonly used in learning is presentation media. Educators, in this case teachers, use digital media such as Microsoft Office PowerPoint. Digital media offer the opportunity to present information in various ways, for example, visual and auditory or by combining virtual and real environments. In addition, adaptive and interactive functions can refer to the learner's level of knowledge and provide a means for active learning (Degner et al., 2022). Digital-based computer presentations allow students to focus on important points from the information presented and create effective visuals in the form of illustrations, and diagrams. Presentation types affect memory at once: visual, auditory, emotional, and in some cases motor (Najmiddinova, 2021). Dale (1969) revealed that the effectiveness of understanding learning material is only 10%. It's different if a learning media is made with good design, involving graphics, audio, video, and interactivity will increase the effectiveness of material absorption up to 80 - 90% (Wibawanto, 2017). Powerpoint presentations are a great way to convey information, usually in online form to a large audience. Generally, PowerPoint presentations appeal to users because they are easy to create and edit and are generally small enough to fit on a CD or USB Jump drive (Patil & Jadhav, 2021).

PowerPoint is widely used by educators in schools or colleges in the teaching and learning process for several reasons. Powerpoint is a common application included with the Microsoft Office suite making it accessible to most computer users. It is widely used because of its ease of use with a concise interface, simple and easy-to-understand menus, and a multi-language system in addition to the usual Roman system (Osman et al., 2022).

Various versions have been released to meet the demands of users using presentation media so that the presentations displayed are better. Powerpoint version 2019 is a product released to make presentations more creative and interesting. By adding features to this application, you can

improve the quality of the presentations produced. Utilizing various new features from Microsoft PowerPoint will certainly produce interactive media in the form of multimedia-based PowerPoint slide shows that are different and more interesting and look like video media if previously they only contained a collection of material full of writing, slide designs, or transitions which are now normal with Utilizing the morph and zoom transition features will make the display different from the multimedia used before and of course also more interactive, creative and interesting (Istianah et al., 2020). Batubara (2021) explains that as a very popular program, Microsoft Office always develops its programs with the latest features. Additional features that get a lot of attention are the slide zoom and morph features. This feature makes the PowerPoint display even more attractive. The presentation was said to be successful in attracting and maintaining student interest. If it fits into the lesson structure and is not used mechanically, the results are positive. However, if learning follows the presentation that has been prepared, then the presentation becomes the main focus and is not aligned with the reality of learning (Ivanova, 2021). This research contributes as a reference in developing interactive multimedia based on PowerPoint 2019.

METHOD

The type of research used is Research and Development (R&D), namely research and development. This type of research refers to the process, research does not produce objects, while development produces objects that can be seen and touched. Development is a process or steps to develop an existing product that can be accounted for. According to Sugiyono (2015), the research and development method is a research method used to produce certain products and test the effectiveness of these products. This development model is based on the model developed by Alessi & Trollip. This model is the research carried out by the researcher (Alessi & Trollip, 2001). This development model is used for multimedia development with a simpler procedure than other development models (Rusadi et al., 2019). The suitability of the stages in this study includes the planning stage, the design stage, and the development stage. The advantage of this model is that its stages are more concise, consisting of several different parts explained in detail.

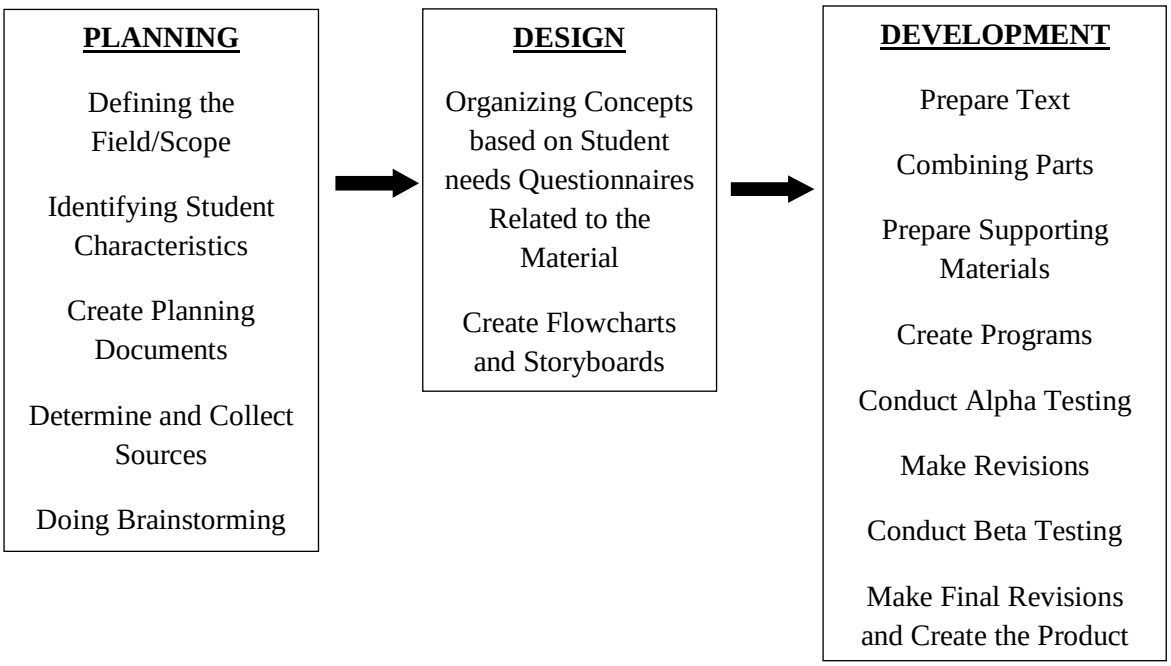

Figure 1. Multimedia Development Process by Alessi & Trollip

The procedural stages of the Multimedia Development Process by Alessi & Trollip are as follows; The planning stage consists of 4 parts, including defining the field/scope, namely taking from the syllabus and learning program design for productive electricity subject teachers, identifying student characteristics from pre-survey results, making planning documents, regarding

materials, things needed in making products, etc., collecting and determining sources for the Productive Electricity subject, for example: from books, PowerPoint presentations, the internet, etc., conducting brainstorming, namely holding discussions with the Productive Electricity Subject teacher. The design stage consists of 2 parts, namely structuring the concept based on a questionnaire regarding student needs related to the productive field of electricity. Create a storyboard (steps to operate Microsoft Office PowerPoint software based on Interactive Multimedia). The development stage consists of 4 parts, including; Creating instant programs, namely collecting data or material for Productive Electrical courses in the form of editing multimedia-based presentations, carrying out alpha tests, namely carrying out product validation by media experts and material experts (formative evaluation), making the first revision of product material that has been created, conducting beta tests, namely testing participants/students as users and subject teachers' responses to find out responses to the 2019 multimedia PowerPoint-based presentation media product (formative evaluation), and carry out the revised final assignment, namely creating a final instant digital presentation media product via Microsoft Office Powerpoint 2019 based on interactive multimedia. Productive Electricity lessons in the form of interactive learning CDs.

Research subjects are people, objects, or things that are attached to the research variables. The research subjects studied at here are 12 Class X students of the Department of Electrical Engineering. Before being tested on students, the research media was given to media experts, design, and content experts for validation to determine whether or not the media was suitable for testing. According to Mawarni & Muhtadi (2017), this process aims to determine the feasibility of the product, both from material and media aspects. So that all research data can be collected properly, an evaluation instrument is needed that can package all aspects that need to be assessed (Dosi & Budiningsih, 2019).

The instruments used to collect data in this development research were questionnaires and interview guides. The questionnaire used by the researcher is a closed interview questionnaire, which is a questionnaire presented in such a way that the respondent only needs to mark the appropriate column. The questionnaire used was a design and learning media expert questionnaire, a content/learning media expert questionnaire, a student characteristics questionnaire, a student needs questionnaire, an individual trial questionnaire, a small group trial questionnaire, and a teacher assessment/response questionnaire. From the questionnaire, the results will be obtained in the form of qualitative data which will then be processed into quantitative data using existing data analysis to determine the percentage of achievement of successful development research conducted by researchers. Respondents in this case were design/media experts and content/material experts to measure the level of validity, and teachers and students to measure the level of practicality. The Formula 1 used to calculate the percentage of each subject is:

$$Percentage = \frac{\sum(The\ Answer \times Weight\ of\ Each\ Choice)}{N \times Highest\ Weight} \times 100\% \quad (1)$$

The note ∑ is the amount and N is the number of all questionnaire items Furthermore, to calculate the percentage of all subjects use the formula F: N (F is the total percentage of all subjects and N is many subjects). To be able to give meaning and decision-making to the characteristic questionnaire, the conversion Table 1 is used as follows.

Table 1. Conversion of Student Needs Analysis Achievement Levels

No.	Achievement Level	Qualification	Information
1	90% - 100%	Very Good	Alternative Media
2	75% - 89%	Good	Alternative Media
3	65% - 74%	Enough	Need Multimedia
4	55% - 64%	Not Enough	Need Multimedia
5	0% - 54%	Very Less	Need Multimedia

(Arikunto, 2006)

Table 2. Conversion of Media Validation Achievement Levels

No.	Achievement Level	Qualification	Information
1	90% - 100%	Very Good	Very Valid
2	75% - 89%	Good	Valid
3	65% - 74%	Enough	Revised
4	55% - 64%	Not Enough	Revised
5	0% - 54%	Very Less	Revised

(Arikunto, 2006)

Table 3. Conversion of Media Practicality Achievement Levels for Teachers

No.	Achievement Level	Qualification	Information
1	90% - 100%	Very Good	Very Practical
2	75% - 89%	Good	Practical
3	65% - 74%	Enough	Pretty Practical
4	55% - 64%	Not Enough	Less Practical
5	0% - 54%	Very Less	Impractical

(Arikunto, 2006)

Table 4. Conversion of Media Practicality Achievement Levels for Students

No.	Achievement Level	Qualification	Information
1	90% - 100%	Very Satisfactory	Very Practical
2	79% - 89%	Satisfying	Practical
3	69% - 70%	Enough	Revised
4	55% - 60%	Not Enough	Revised
5	0% - 50%	Very Less	Revised

(Arikunto, 2006)

RESULTS AND DISCUSSION

Results

Results of Identification of Student Needs

Identification of student needs was carried out on February 8 2023 after initial observations and free interviews were carried out with the head of the Electrical Engineering department and the Electrical Basics subject teacher. Based on the learning objectives contained in the Basic Electricity & Electronics Textbook, researchers identified students' initial knowledge of the topics contained in the sub-chapters of the textbook. Identification of needs was carried out through a needs analysis questionnaire for all class X students of the Department of Electrical Engineering, SMK Darussalam Makassar. According to Morrison, in analyzing needs, it is necessary to pay attention to four steps, namely; (a) Planning, by classifying who will be involved in the activity and how it will be collected. (b) Data collection, considering the size of the sample in its distribution (distribution). (c) Data analysis, after the data is collected then the data is analyzed with consideration of economic factors, ranking, frequency, and needs. (d) Make a final report, with four items, starting from Junaidin (2022) presentation of data through a questionnaire which is divided based on learning objectives as follows in Table 5 and Table 6.

Table 5. Table of Descriptions of Students' Abilities and Needs for Material Basic Electrical and Electronics Subjects

No.	Description of Student Abilities and Needs
1.	Know the History and Basic Concepts of Electricity
2.	Know the Materials of Electrical Components
3.	Know the Electric Current Circuit
4.	Know the Properties of Passive Elements in Direct Current Circuits
5.	Know the Properties of Electrical Elements
6.	Know the Definition of Electrical Energy
7.	Know the Instruments for Measuring Electrical Quantities and their Functions

Table 6. Table Description of Results of Students' Abilities and Needs for Basic Electrical and Electronics Subject Material

No.	Respondents	Description of student abilities and needs							Amount	Average Percentage
		1	2	3	4	5	6	7		
1	R1	3	3	2	2	2	3	3	18	51%
2	R2	3	4	3	2	3	1	3	19	54%
3	R3	2	3	2	2	1	2	3	15	43%
4	R4	3	3	3	2	2	2	3	18	51%
5	R5	2	3	4	3	2	3	3	20	57%
6	R6	3	3	4	4	5	3	5	27	77%
7	R7	4	4	5	3	3	3	5	27	77%
8	R8	3	3	3	2	2	2	4	19	54%
9	R9	3	3	3	3	2	2	4	20	57%
10	R10	3	3	4	4	3	3	3	23	66%
11	R11	3	3	3	4	3	4	5	25	71%
12	R12	3	1	4	2	4	2	3	19	54%
13	R13	3	4	4	4	2	3	2	22	63%
14	R14	3	3	3	4	3	4	4	24	69%
15	R15	2	3	2	2	1	2	3	15	43%
N Amount										**59%**

The results of the needs analysis questionnaire showed that students' understanding of the subject matter of discussion of programming was in inferior qualifications with an achievement level of 59%, and based on the interview data on the needs analysis, data was obtained that one of the things that caused the low ability of students was that teachers were not optimal in using learning media digital-based so that it has not been able to optimally increase student learning motivation. Therefore, learning media is needed, namely interactive multimedia PowerPoint presentation media.

Design and Media Expert Validation Test Results

Validation of multimedia learning media from validators was carried out to assess the design of multimedia learning media in simulation and digital communication subjects. Validators assess the media prototypes developed through questionnaires (Hutabri, 2022). Validation of the development product was declared valid by media experts and content experts. Based on the validation results from media experts, after converting into a table conversion, a percentage achievement level of 90%, is in the excellent qualifications and is at the very valid category level. Based on the results of design expert validation, after being converted into the conversion table the achievement level percentage is 88%, which is in good qualifications and is at the valid category level. Based on the validation results of content experts, after being converted into a conversion table the percentage achievement rate is 91%, is in very good qualification, and is at a very valid category level.

Media Practicality Test

In terms of practicality in learning media, several aspects need to be considered that support the media. The first is that the media is seen from the formats available, the time used and the costs incurred. The second is the suitability of students, namely the suitability of media content with the development and experience of students, and the third is the suitability of educators, namely the suitability of the media with the learning carried out by educators and being able to facilitate students to understand the material through the media developed (Milala et al., 2022). The level of practicality in this study was seen through the application of interactive multimedia in the learning process which was obtained from the results of teacher, observer, and student questionnaires (Kumalasani, 2018). As a development product that has been revised based on a design expert test and learning media with a content/learning material expert test, it is then handed over to 3 students who are selected based on learning achievement by the subject teacher. Based on the results of the

assessment through a questionnaire, it can be seen the percentage of individual trials of interactive multimedia presentation media PowerPoint 2019, as follows:

$$Percentage\ of\ Student\ 1 = \frac{48}{10 \times 5} \times 100\% = 96\%$$

$$Percentage\ of\ Student\ 2 = \frac{43}{10 \times 5} \times 100\% = 86\%$$

$$Percentage\ of\ Student\ 3 = \frac{32}{7 \times 5} \times 100\% = 90\%$$

The PowerPoint presentation media shows that the percentage of student 1 is 96%, with very satisfactory qualifications, the percentage of student 2 is 86%, with satisfactory qualifications, the percentage of student 3 is 90%, with very satisfactory qualifications, and is at the practical category level so the media interactive multimedia PowerPoint presentation 2019 doesn't need to be revised. The next development product was handed over to 9 students who were selected to be divided into 3 groups consisting of 3 students. Based on the results of the assessment via questionnaire, it is known that the percentage of group trials on the 2013 version of multimedia-based PowerPoint presentation media is as follows:

$$Group\ Percentage\ 1 = \frac{44 + 47 + 45}{(10 \times 5)\ 3} \times 100\% = 91$$

$$Group\ Percentage\ 2 = \frac{44 + 34 + 40}{(10 \times 5)\ 3} \times 100\% = 79$$

$$Group\ Percentage\ 3 = \frac{38 + 38 + 43}{(10 \times 5)\ 3} \times 100\% = 79$$

$$Percentage\ of\ Entire\ Group = \frac{91 + 79 + 79}{3 \times 100} \times 100\% = 83\%$$

The average 2019 interactive multimedia PowerPoint presentation media was 83% in good qualifications and at the practical category level so there was no need for revision. The learning media is then assessed by teachers in the basics of electricity subject. Based on the results of the assessment via questionnaire, the average percentage of interactive multimedia Powerpoint 2019 presentation media can be seen, as follows:

$$Percentage = \frac{55}{11 \times 5} \times 100\% = 100\%$$

After being converted into a conversion table, the achievement level percentage is 100%, is in the very good qualifications, and is at the category level which is very practical to use. The basic electricity subject teacher at Darussalam Vocational School, Makassar, was greatly helped by interactive multimedia presentations. With the use of developed presentation media, awareness and interest in the importance of developing and developing skills in creating and using presentation media, especially Microsoft Office PowerPoint, has become higher.

Application of presentation media interactive multimedia PowerPoint 2019 version requires a strategic environment. The right environment at SMK Darussalam Makassar is a learning environment that is supported by adequate facilities and infrastructure in the form of conducive classrooms, the provision of a computer lab supported by LCD projector facilities, and an internet connection.

Discussion

Needs Analysis for Interactive Presentation Multimedia

The results of the needs analysis show that students' understanding of the subject matter of programming discussion is at very low qualification. Therefore, learning media is needed, namely

interactive multimedia PowerPoint presentation media. Multimedia provides an alternative to providing information on electrical tools and materials through components presenting various forms of various media. Batubara (2021) says that "multimedia is software that uses more than one type of media in presenting information. Multimedia gives the impression of direct experience to students because it does not only provide visualization but combines all types of learning media, namely writing images, audio, video, and digital animation. This is in line with Edgar Dale's theory which states that the more directly something is learned, the more real the knowledge gained and vice versa (Purba et al., 2020).

Development Design

PowerPoint 2019 presentations on the Productive Subject of Electrical Engineering with material discussing the basics of electricity and electronics. This product combines all multimedia components and is packaged interactively according to the design contained in the storyboard. This product combines the distinctive style of three presentation applications known as slide Zoom with a variety of interesting transitions and animations. Zoom slide or Slide Zoom is the newest style of Microsoft Office PowerPoint today. By combining morph transition animations, the media display of PowerPoint presentations becomes more lively and attractive, supported by the level of interactivity. The level of interactivity of the 2019 Microsoft Office PowerPoint version can be adjusted in such a way by users by maximizing multimedia functions and the latest updated features. Multimedia products and interactive presentations containing learning material content for the basics of electricity and electronics including four chapters of discussion for 1 semester, converted in the form of writing, images, video, audio, and digital animation.

Validity of Interactive Presentation Multimedia

The development product is declared valid by media experts and content experts. Based on design aspects which include the quality of the theme display, color, suitability of the font to the media, quality of the media layout design, suitability of the media theme to the subject, and quality of the slide show display, it shows that the media developed is worthy of being tested. Use of slide zoom and morph transition features Microsoft Office PowerPoint version 2019 allows users to combine animated transitions and objects according to their abilities and creativity. Stated that: The use of consistent design, interesting types of writing, the use of animation, and also pictures can attract children's attention. But remember, don't display a lot of text, insert an image that provides dozens of information (Sufiatmi et al., 2020). Meanwhile, based on media aspects which include presentation quality, hyperlink/action menu features, media features, the attractiveness of slide show visualization along the suitability of the media and learning materials, it is stated that the media developed is worthy of being tested. States that "Powerpoint media is a form of software that is created and designed to be usable and able to display multimedia that is attractive and easy to make and easy to use (Herlina & Saputra, 2022).

Presentation media were developed based on the clarity of textbook content, the suitability of content with learning objectives, the suitability of media with learning objectives, the suitability of media with learning objectives, the presentation of concrete/simple material, using standard language and the suitability of material content with student needs was declared worthy of being tested. The use of media for abstract teaching materials can be concreted and create conditions for learning to become more interesting (Sufiatmi et al., 2020). Presentation media is media that contains content in the form of writing, images, video, audio, and digital animation. Wijayanti & Relmasira (2019) explain that learning using PowerPoint media is designed for interactive learning and increases students' interest in learning because in learning PowerPoint is designed in such a way starting from selected material, animations, and hyperlinks (Herlina & Saputra, 2022).

Practicality of Interactive Presentation Multimedia

Teacher assessment and response to the basics of electricity and electronics are in very good qualifications and are at the level of the very practical category to use. Based on this, interactive multimedia PowerPoint 2019 presentation media can be an alternative solution and solve one of the problems in the learning process, namely in the learning process of students. In particular, the

advantages of interactive multimedia PowerPoint 2019 presentation media developed by researchers are combining all the view slide show concepts from 3 types of applications for presentations, namely PowerPoint, Prezi Desktop, and Focussky. With this combination, the media being developed becomes more interesting in its broadcast. The interactive multimedia PowerPoint 2019 presentation media developed can convey information according to student learning methods because it provides complete multimedia features to make it easier for teachers in the teaching and learning process in the classroom.

Advantages and Disadvantages

The advantages of multimedia-based presentation media compared to other learning media are being able to combine all types of learning media so that they can be used for all characteristics and ways of learning of students. In particular, the advantages of interactive multimedia PowerPoint 2019 presentation media developed by researchers are combining all the view slide show concepts from 3 types of applications for presentations, namely PowerPoint, Prezi Desktop, and Focussky. With this combination, the media being developed becomes more interesting in its broadcast. The interactive multimedia PowerPoint 2019 presentation media developed can convey information according to student learning methods because it provides complete multimedia features to make it easier for teachers in the teaching and learning process in the classroom. According to Newby et al., (2000) the advantages possessed by interactive learning multimedia as learning media), among others, are providing learning with good information storage, learning designs aimed at students with different learning characteristics, directly aimed at certain effective learning domains, presenting realistic learning, can increase student motivation, requires students to be more interactive, learning activities are more individual, have consistency in the material provided and students have control over each individual's learning speed (Nopriyanti & Sudira, 2015). In general, it can be interpreted that interactive media is a delivery media system that presents recorded video material with computer control to viewers (students) who not only hear and see video and sound but also provide an active response and that response determines the speed and sequence of presentation (Nurseto, 2011).

According to Batubara (2021) the characteristics of interactive multimedia lie in its interactivity features. The effectiveness of multimedia can be seen in several advantages of multimedia, including a) the use of several media in presenting information. b) Ability to access up-to-date information and provide deeper and more information. c) It is multi-sensory because it stimulates many of the senses, so it can lead to good attention and retention levels. d) Attract attention and interest, because it is a combination of sight, sound, and movement. Moreover, humans have limited memory. e) Alternative media in conveying messages reinforced with text, sound, images, video, and animation. f) Improving the quality of information delivery. g) It is interactive and creates. The two-way relationship between multimedia users. Interactivity that allows developers and users to create, manipulate, and access information (Munir, 2013).

Teachers of the basics of electricity at SMK Darussalam Makassar are greatly helped by interactive multimedia presentation media. With the use of developed presentation media, awareness and interest in the importance of developing and developing skills in creating and using presentation media, especially Microsoft Office PowerPoint, has become higher. The implementation of the interactive multimedia version 2019 of PowerPoint presentation media requires a strategic environment. The right environment at Darussalam Vocational School, Makassar, is a learning environment that is supported by adequate facilities and infrastructure in the form of classrooms that are conducive enough, providing a computer lab that is supported by LCD projector facilities and an internet connection.

Interactive multimedia requires skills and knowledge to operate. Teachers are required to increase knowledge and develop abilities in creating interactive media as stated by Prastowo (2015) interactive learning is a communication method where interactive requires adequate supporting knowledge and skills from the media used in the learning process, especially in operating the equipment used to support students' ability to understand the knowledge being taught (Trimansyah, 2021). Teachers must be able to choose the right media in the learning process, including the media

used must pay attention to several provisions, with the consideration that the use of media must be truly effective and effective in improving and clarifying students' understanding. Learning media helps reduce the abstractness of a concept of the material being taught, leading students to a meaningful learning experience, activating and enjoyable (Fonna et al., 2022).

PowerPoint presentation media based on multimedia includes the use of media tied to certain types of PC or laptop qualifications so that its use must be adjusted accordingly. The solution to the problems in using PowerPoint presentation media version 2013 is to create 2 different types of files, namely the editing and final. Files editing is a file in the form of a project that is used to re-edit if there is an error or the user wants to change the contents of the presentation made, while the final file is a permanent presentation media that displays presentations instantly in the form of a PowerPoint slide show format. In addition, a PC or laptop that has a low capacity can open the 2019 version of Office PowerPoint files using the previous versions, namely Office PowerPoint 2013 and 2016 so that many users can still use them.

PowerPoint's weaknesses include (1) Not all material can be presented using PowerPoint (2) Requires special skills to convey good messages or ideas in the design of the Microsoft PowerPoint computer program so that it is easily digested by the recipient of the message (3) Requires careful preparation when using complex presentation (animation) techniques (Kamil, 2018).

CONCLUSION

Based on research and discussion, it was concluded that the results of the analysis of needs for multimedia-based presentation media stated that interactive multimedia presentation media using Microsoft Office PowerPoint version 2019 was needed. The media design results are multimedia presentation media using Microsoft Office PowerPoint version 2019 which contains three styles of digital presentation media applications combined with the latest Microsoft Office PowerPoint features, namely zoom slides, and morph transitions to create an attractive slideshow. Interactive multimedia presentation media using Microsoft Office PowerPoint version 2019 contains lesson material on the basics of electricity and electronics for 1 semester in class electrical symbols. The evaluation results of learning media experts and learning media content/material experts show that the 2019 version of the multimedia-based PowerPoint presentation media produced is declared valid.

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