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Bekerja sama dengan
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Analysis of needs for the development of earthquake disaster mitigation animation videos for disabilities elementary school children

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ABSTRACT

Earthquakes are frequent disasters in Indonesia. This disaster often causes many fatalities, so reducing the risk of an earthquake is necessary. Disaster risk reduction can be carried out with government programs, namely disaster risk reduction education which aims to reduce the threat of victims due to disasters. However, in implementing this program, there are deficiencies in media accessibility and learning media for elementary school children with disabilities. The purpose of this study was to describe the results of the needs analysis for the development of earthquake disaster mitigation animation videos. This research is a type of qualitative research. The data from this study were obtained from filling out a needs analysis questionnaire by 161 students and 121 teachers from 13 special schools in Klaten Regency, data analysis using interactive analysis. Based on the results of filling out the questionnaire to analyze the needs of students and teachers, it is known that students and teachers of SLB throughout Klaten Regency need an animated video on earthquake disaster mitigation to become one of the learning media. Students agree as much as 97.70%, and teachers agree as much as 99.20% to develop an animated earthquake disaster mitigation video. The development of earthquake disaster mitigation animation videos must follow the needs of students and teachers regarding material, language, presentation, and graphics.

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INTRODUCTION

Earthquakes are natural disasters caused by the sudden release of energy beneath the surface, creating seismic waves. Klaten Regency is one of the districts located in Central Java which has complex physical and social geographic conditions, causing a high threat of disaster in the Klaten region (Kurniawan et al., 2017). The biggest earthquake disaster in Klaten Regency occurred in 2006; this disaster caused many fatalities, with 1,064 dead and 18,127 injured. The threat of an earthquake significantly impacts people's lives in Klaten Regency.

The high risk of disaster threats in the Klaten Regency area causes a danger to the safety of human life, especially for disaster-prone groups. High disaster risk in the community needs to be managed for vulnerable groups, namely groups of people at high risk because they are in situations and conditions that cannot prepare themselves to face disaster risks or disaster threats where one of

the disaster-prone groups is people with disabilities/disabilities (Hayati et al., 2021). Persons with disabilities have the same rights as other people in general. Therefore, every human being has another obligation to respect the rights of people with disabilities (Abriansyah et al., 2019). Students with disabilities have different characteristics, so something must be different too. Students with disabilities must be prepared to live in a world of inclusion, one of which can be started with inclusive education (Rizky, 2014).

Persons with disabilities have different levels of vulnerability from one another. An inadequate social environment can cause the vulnerability of persons with disabilities, problems in the economic sector, and physical limitations (Boon et al., 2014). Reducing the level of vulnerability for persons with disabilities can be done by implementing Disaster Risk Reduction (Siregar & Wibowo, 2019). Disaster adaptation and mitigation of disabilities in Klaten Regency has developed a disaster learning system with e-learning for the disabled (Sipakdedifa). Sipakdedifa is a disability information medium in Klaten Regency which is web-based and is currently being developed through migration from an Android application-based website.

The Sipakdedifa android application has some content contained in the application, one of which is a video about disaster mitigation for children with disabilities. Disaster mitigation for disabilities through Sipakdedifa will be more usable and acceptable for disabilities if learning content can be accessed easily through videos in an Android-based application so that disaster mitigation material can be studied anywhere and anytime easily. One component of video development in the Android application through Sipakdedifa is the development of earthquake disaster mitigation videos for elementary school disabilities in the Klaten Regency using audio and visually animated videos. Animated video media is one of the efforts to assist in understanding the adaptation and mitigation of earthquake disasters. Audio-visual media is a form of combined learning media between audio and visual media that can display pictures and. sound to stimulate students to pay attention to learning (Rosantiana, 2016).

The animated video was chosen for the innovation development because apart from combining audio, visuals, and text, videos can also be made in various forms. Audio and visual media with elements of movement and sound can be used as teaching aids in multiple fields of study because video media, besides providing information and entertainment, can also be used as a learning medium (Prahara et al., 2021). This development must involve good planning, appropriate approaches, learning methods, and effective learning media (Widiyasanti & Ayriza, 2018). Animated video learning media that is appropriate and effective can increase learning motivation. The development of earthquake disaster mitigation videos must be done, especially for persons with disabilities. Agree with the previous statement that persons with disabilities are vulnerable to natural disasters, especially when they lose their families, assistive devices and mobile devices, and obstacles to accessing information, facilities, and infrastructure (Indriani & Marlina, 2020).

Based on the results of the problems from previous studies, Klaten Regency is one area with a high level of disaster-proneness, so many disasters occur, including earthquakes. The existence of disasters can encourage educational efforts to reduce the risk of earthquake disasters through educational patterns and implementation of disaster education (Astara & Hafida, 2021). Disaster education can be carried out with learning media, one of which is an animated video on earthquake disaster mitigation. It is necessary to analyze the need to develop earthquake disaster mitigation videos. This study aims to present the needs analysis results for producing an animation video for earthquake disaster mitigation. Animated video analysis for elementary school children with disabilities requires a video animation design that contributes to designing friendly and applicable content in earthquake disaster mitigation. The novelty of this research is the deepening of video content developed in Sipakdedifa.

METHOD

This study used qualitative research methods. The research subjects included 161 students and 121 SLB teachers in Klaten District. SLB students need knowledge about earthquake disaster

mitigation and will understand it more easily if there are learning media such as animated videos. The data collection technique used is a needs analysis questionnaire. The data analysis technique simplifies the data obtained into a form that is easier to understand. The data analysis technique used is an interactive data analysis technique. A needs analysis questionnaire was prepared to determine the percentage of value to complete the needs analysis questionnaire. Questionnaires can be analyzed using interactive analysis by analyzing data in the form of scores obtained from the results of student questionnaires.

RESULTS AND DISCUSSION

Analysis of the needs of the earthquake disaster mitigation animation video is divided into two, namely the needs of students and teachers as respondents in this study. Data collection was carried out by distributing questionnaires directly to respondents who were carried out by researchers, distributing questionnaires throughout SLB in Klaten Regency, with the results of the analysis of the two respondents being explained in Figure 1.

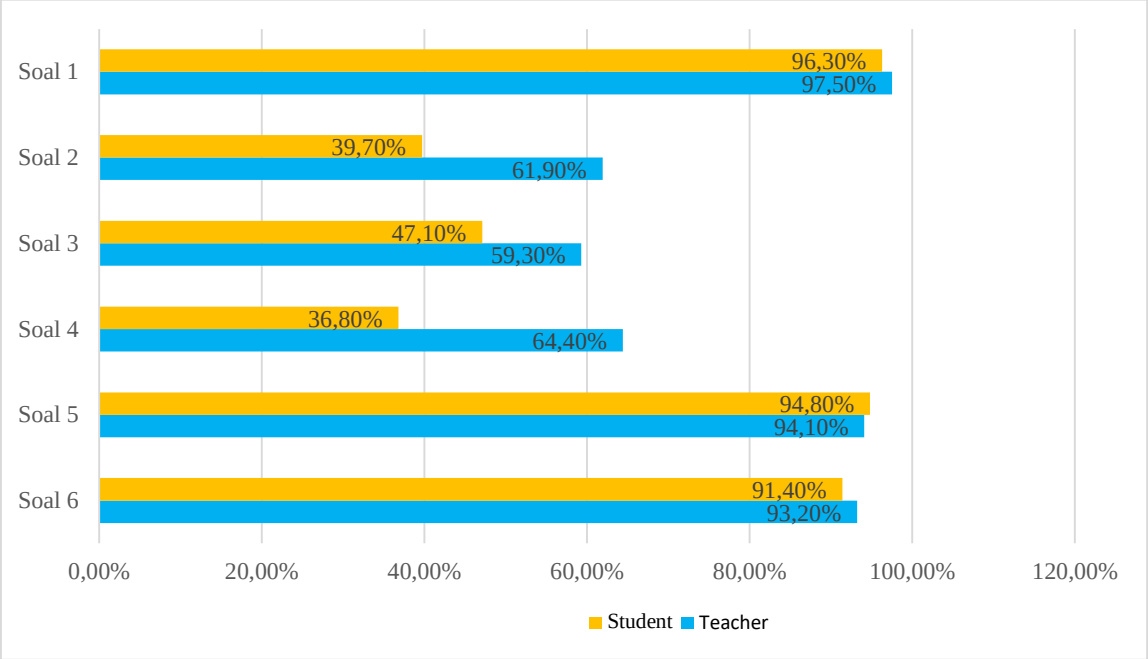

Figure 1. The results of the Student and Teacher Needs Questionnaire in the Material Aspect

The questionnaire results in Figure 1. show that as many as 161 students and 121 SLB teachers in all districts have filled out the needs analysis questionnaire sheet the researchers carried out directly. In Figure 1, 6 questions refer to the assessment of material aspects. Question number 1 stated that 171 student respondents chose to include learning objectives, with a percentage of 96.3%, while 115 teacher respondents chose to have learning objectives, with a percentage of 97.5%. Question number 2 discusses the availability of animated video learning media. Sixty-nine student respondents answered that it was not yet available, with a percentage of 39.7%, while 73 teachers responded that it was not yet available, with 61.9%. Question number 3 discusses the material that has been delivered using video animation. Eighty-two student respondents answered with a percentage of 47.1%, while 70 teacher respondents chose to answer 59.3%.

Furthermore, in question number 4, discussing the presentation of animated video learning media, 110 student respondents answered in detail and clarity with a percentage of 63.2%. In comparison, 76 teacher respondents answered in detail and clarity, with a percentage of 74.4%. In question number 5, discussing the introduction in the video, as many as 165 student respondents answered that it was necessary to be brief, with a percentage of 94.8%. In comparison, 111 teacher respondents answered that it was necessary to be brief, with a percentage of 94.1%. And in question 6, discussing the desired content of animated video media, as many as 159 student respondents

answered animated video material accompanied by examples, with a percentage of 91.4%, while 110 teacher respondents answered the same, namely animated video material accompanied by examples with a percentage of 93.2%.

Based on these results, the development of animated videos on earthquake disaster mitigation materials needs to be developed by researchers because, in all SLBs in Klaten Regency, there are no earthquake disaster mitigation animation video teaching materials as teaching materials for teachers. Even though it has not used animated videos as teaching materials in its application, teachers use other media, such as books, as teaching materials. It is in line with Izza's Statement (2019) stating that it is necessary to develop animated videos as teaching materials to make it easier for students to understand learning material and can increase student motivation and achievement. It is in line with the research conducted by Ponza, Jampel, and Sudarman (2018), that the learning animation videos developed are designed in such a way as to display text, colorful images, audio, and animation in one unit, it can provide a unique attraction for students to learn through the presentation of audio-visual material. It means that developing animated video teaching materials can help teachers convey teaching material with video to motivate students to learn it (Ananda, 2017). In addition, earthquake disaster mitigation material is packaged through an attractive animated video display. Teaching materials that can add insight and knowledge to students more efficiently by displaying images, text, and audio (Agustini & Ngarti, 2020).

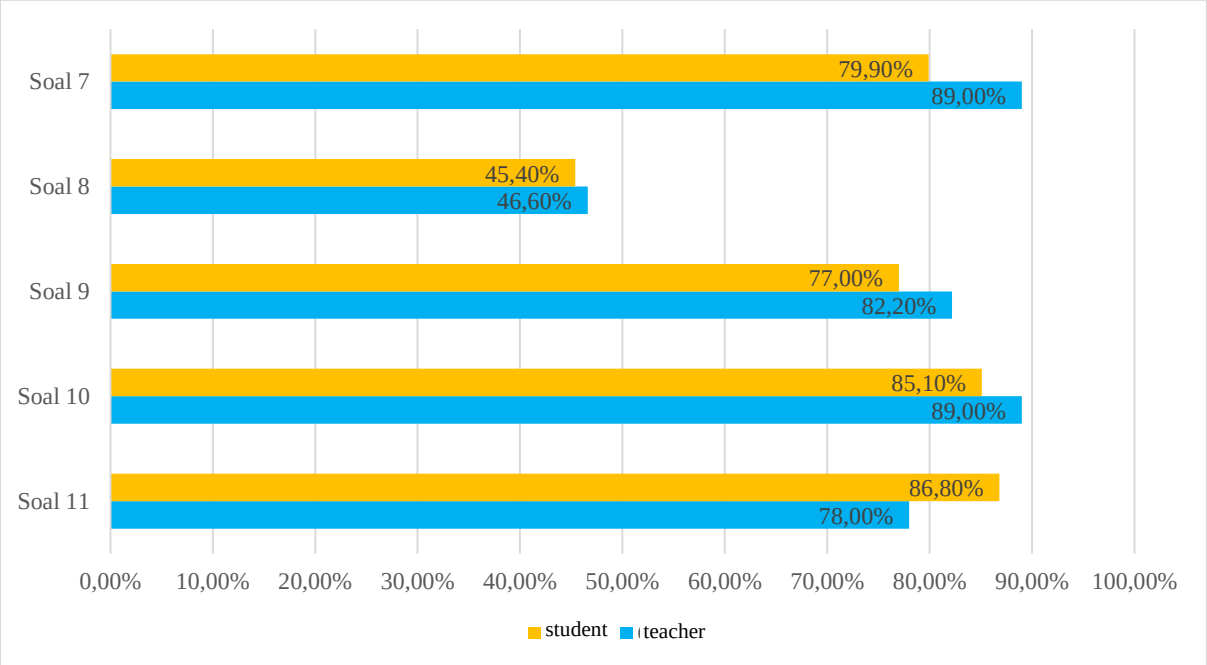

Figure 2. The results of the Questionnaire on Student and Teacher Needs in the Language Aspect

The results of the questionnaire are in Figure 2. The results of the questionnaire for the needs of students and teachers in the linguistic aspect show that 161 students and 121 SLB teachers from all districts filled out the needs analysis questionnaire sheet, which was carried out by the researchers directly. Question number 7 discusses the language used in the animated video. There are 161 student respondents, with a percentage of 79.90% choosing to use sign language, and 118 teacher respondents choosing to need to use sign language, with a percentage of 89%. Question number 8 discusses the criteria for using language style in the material, 161 student respondents chose to use communicative language with a percentage of 45.40%, and 118 teacher respondents chose to use communicative language with a percentage of 46.40%. Question number 9 discusses the use of language in animated video learning media. One hundred sixty-one student respondents choose to use language that is easy to understand, with a percentage of 77%, and 118 teacher respondents

choose to use language that is easy to understand, with a percentage of 82.20%. Question number 10 discusses the presentation of explanations of the contents of the material in the video, 161 student respondents chose audio-visual accompanied by text with a percentage of 85.1%, and 118 teacher respondents chose audio-visual accompanied by text, with a percentage of 89%. Question number 11 discusses the display of earthquake animation videos. 161 student respondents are choosing a balance between material and simulation with a percentage of 86.80%, and 118 teacher respondents choosing a balance between material and simulation with a percentage of 78%.

Based on these results, the development of earthquake disaster mitigation videos needs to be developed by researchers because animated videos can help the learning process of students and teachers through audio, visual, and text media to achieve learning success. The success of the learning process in teaching and learning activities is influenced by several factors, including teachers, students, curriculum, learning environment, and learning resources (Mutia et al., 2018). Students with disabilities need sign language in animated videos because it is more understandable for students with hearing impairments. It is in line with Mursita (2015) that deaf people in communicating find it challenging to convey and understand messages, so they need a language that suits their needs, namely by using sign language. The criteria for using language style in animated videos use communicative language so that students and teachers can understand quickly and clearly. It is in line with (Nisa & Sujarwo, 2020). Communication is essential when teaching, so communication skills are necessary for children and parents. Animated videos contain balanced teaching materials accompanied by simulations with examples. Each component is interconnected and influences each other in each teaching and learning process, which includes learning objectives, learning materials, teachers/teaching, students, methods, media/educational tools, learning environment situations, and learning evaluations (Farista & M, 2018).

Suitable teaching materials are teaching materials that contain all aspects of learning. Teaching materials are essential in learning (Prawindia et al., 2016). With teaching materials that have a function in learning, teachers can provide good material to students to improve learning outcomes.

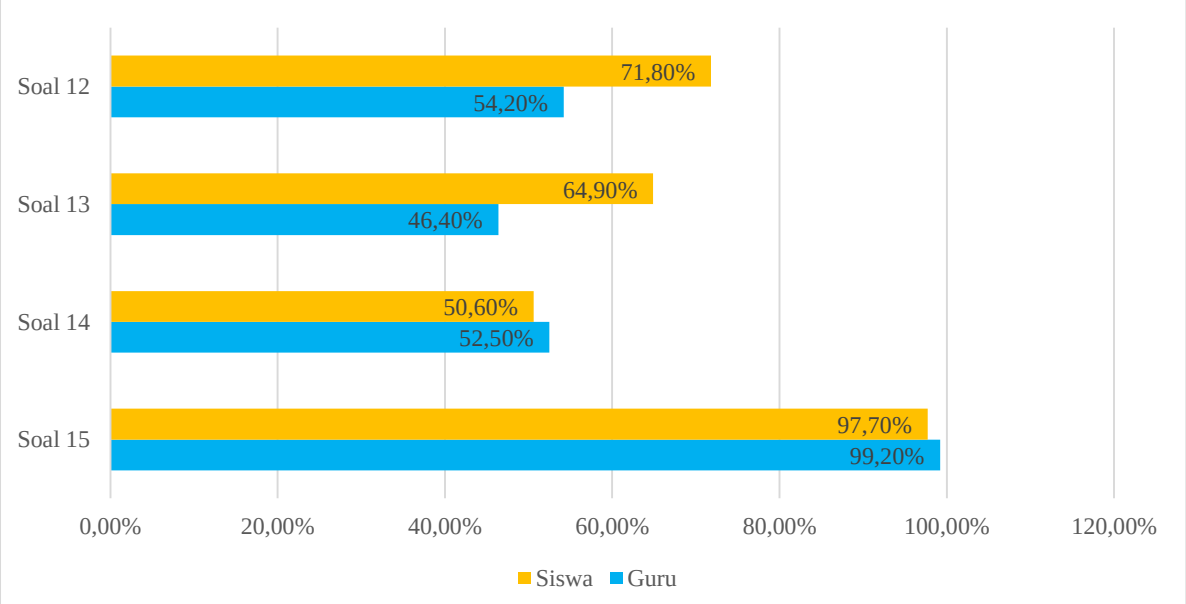

Figure 3. Results of Student and Teacher Needs Questionnaire in the Multimedia Aspect

The results of the questionnaire are in Figure 3. The results of the questionnaire on the needs of students and teachers in the multimedia aspect show that as many as 161 students and 121 SLB teachers from all districts filled out the needs analysis questionnaire sheet, which was carried out by the researchers directly. Question number 12 discusses the theme of music; 161 student respondents chose freely, with a percentage of 71.80, and 118 teacher respondents chose freely, with a percentage of 54.20%. Question number 13 discusses the color of the video display; 161 student respondents choose complimentary colors with a percentage of 64.90%, and 118 teacher respondents choose

complimentary colors with a percentage of 46.40%. Question number 14 discusses the duration of the video, 161 student respondents chose a duration of 10-15 minutes with a percentage of 50.60%, and 118 teacher respondents chose 10-15 minutes with a percentage of 52.50%. Question number 15 states whether the development of an earthquake natural disaster mitigation video needs to be developed. One hundred sixty-one student respondents stated it is necessary, with a percentage of 97.70%, and 118 teacher respondents stated it is necessary, with a percentage of 99.20%. Based on these results, the development of animated videos on earthquake disaster mitigation materials needs to be developed by researchers because, in all SLBs in Klaten Regency, there are no earthquake disaster mitigation animation video teaching materials as teaching materials for teachers. Even though its application has not used animated videos as teaching materials, teachers use other media, such as books, as teaching materials.

Based on these results, it is necessary to develop earthquake animation videos because, in practice, they have not used animated videos as teaching materials. Still, teachers use other media, such as books, as teaching materials. The audio for the music theme in the video must match what is visualized to make it more interesting. It is in line with that audio-visual learning can be more interactive and more likely to occur two-way traffic in the learning process. The video's duration and the colors chosen according to the needs of the video affect students' comprehension abilities. It is in line with (Assyifa et al., 2020) that introducing colors to children is vital to improving children's cognitive abilities.

CONCLUSION

Based on the study's results, it can be concluded that in learning earthquake disaster mitigation, teaching materials are needed in the form of an animated earthquake disaster mitigation video for elementary school disabilities. With exciting developments and following the needs of students in terms of material, language, presentation, and multimedia, the teacher's delivery of earthquake disaster mitigation material can be easily understood by students. This research serves as a reference for further research on developing earthquake disaster mitigation videos for elementary school disabilities.

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The development of educational game-based learning media in natural science subject for elementary school students

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ABSTRACT

This research is based on the lack of innovative learning media that is easily accessible and suitable for the characteristics of students. This research aims to produce a learning media in the form of science learning educational games aimed at fifth-grade elementary school students. This educational game was developed using Construct2. This type of research is research and development (RnD) with the 4D development model (Define, Design, Develop and Disseminate). This educational game validation was obtained from media experts consisting of lecturers, practitioners, and teachers whose fields correspond to the media being developed. The questionnaire distributed to media experts obtained an average value of 0.97 which was categorized as valid. This educational game was also tested on users consisting of 21 fifth grade elementary school students, and obtained an average score of 94.15 in the very good category, this indicates that the science learning educational game for elementary school children is also very suitable for grade students. V elementary school which is evident from the assessment of grade V elementary school students who stated that this media was very good.

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INTRODUCTION

Education cannot be separated from the role of innovative learning media. The learning media used must be learning media following students' characteristics. Learning media that are by the characteristics of students will undoubtedly attract more students to take lessons. The use of appropriate media can lead to learning experiences not only limited to the sense of sight but also the sense of hearing so that it can increase students' understanding and will affect learning outcomes for the better (Fridayanti et al., 2022). Learning media is also very helpful for children's psychological development and can provide different learning experiences (Nurfadhillah, 2021).

Some of the reasons why learning media are beneficial in the psychological development of children are: (1) Attract children's attention: Learning media such as images, videos, and animations can make children more interested and more focused on the subject matter being studied. It can help children to understand the material and absorb information better and more efficiently (Hellyana et al., 2023); (2) Increase interest in learning: Engaging and interactive learning media can help increase

children's interest in learning. By actively involving children in learning, for example, by assigning challenging tasks or questions, children become more motivated to learn (Aditama et al., 2022); and (3) Increase Learning Motivation: Motivation is one of the most significant aspects of education in any field that learners desperately need to learn is motivation (Moradi & Noor, 2022). Engaging and interactive learning media can also increase students' confidence and motivation. Students who successfully understand complex concepts through learning media will feel more confident and motivated to continue learning.

Nowadays, there are many kinds of learning media available. Increasingly advanced information Technology certainly has a critical role in this development. Of the many types of learning media public, not all meet the needs of the teaching and learning process. The media is used only as a tool, and the students are only spectators of the media used by the teacher (Cahdriyana & Richardo, 2016).

One of the learning media that is developing today is educational games. Educational games are games that are combined with learning materials. Games have positive functions and benefits for children, including getting to know computer technology, lessons to follow directions and rules, problem-solving exercises and logic, training motor nerves and spatial skills, establishing child-parent communication when playing together, and providing entertainment. Educational games have several advantages that are suitable to be applied to elementary school students because games allow active participation from students, which can increase learning motivation (Sutarman et al., 2022). On the other hand, games certainly also harm children.

The negative impact of games is the onset of addiction to games. Addiction to games can result in children not being motivated to learn and lacking interaction with peers because they prefer gaming activities; activeness also helps parents because they like to play the internet, especially online games (Arianto & Bahfiarti, 2020). In addition to the negative impact, games certainly also have a positive effect. In addition to the negative consequences, of course, games also have a positive effect because children can still be controlled, with time they can still be divided for studying, eating, and other activities such as additional tutoring as well because the parents themselves also always supervise their children while playing (Sihaloho et al., 2020). Educational Games are as functional as other learning media. Educational games foster student learning motivation, make it easier for students to understand learning, and make teaching methods more varied so that students focus more on learning activities (Darmawati et al., 2021).

The world of education should take the positive side of the impact of games on this child. Learning media packaged in games will undoubtedly attract children's interest. The display of learning media in games will stimulate children's thinking power, increase concentration, and solve problems (Nuqisari & Sudarmilah, 2019). Playing games can develop brain abilities related to cognitive or logic-mathematical intelligence such as the ability to calculate, think logically, and solve problems. Games can help children learn if their play can be controlled or limited to ≤ 3 hours daily (Manggena et al., 2017).

Important educational games are developed for students aged 7 – 11 years. This educational game can be an alternative learning medium to attract students' interest. Presenting innovative learning media utilizing computer technology is one of the weaknesses of teachers in elementary schools. Educational background and lack of time hinder elementary school teachers from developing innovative learning media.

Developing learning media in the form of educational games can be built using Construct2. Construct2 is a game creator created by Scirra, one of the software game developers are interested in because Construct2 is easy to use and has many tutorials and templates available. Android is one of the Construct2 devices using HTML5 (Damayanti et al., 2020). Construct2 can be downloaded for free with limited scenes and features, making the game not accessible but different from those licensed to have more scenes and features.

This study contributes to producing a learning media for Natural Science Education Games. This educational game developed is expected to help teachers in delivering material and assist students in understanding science material. This game is built using Construct 2. The material used

in this media is sourced from the Integrated Tematik Terpadu Kurikulum 2013 Tema 4 untuk Kelas V SD/MI book.

METHOD

The type of research used in this study is the 4D Version of Research and Development (R&D). Thiagarajan developed the research stage of 4D model development. This 4D model consists of Define, Design, Develop, and Disseminate. According to Fadilla (2021), the activities carried out at each stage of the development of the 4D Version can be described in Figure 1. (Fadila et al., 2021).

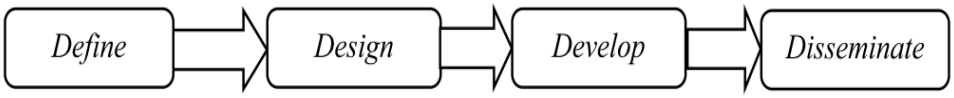

Figure 1. Research and Development Version 4D

The first stage of this 4D Model is the defining (define) stage. At the defining stage, the steps are problem determination, needs analysis, and material analysis. The second stage is the design stage, which compiles learning materials and designs the initial form of educational games. The third stage is development, an activity to make educational games and conduct validation tests. The fourth stage is the dissemination stage which is carried out to promote the development product to be accepted by users (Kurniawan & Dewi, 2017; Musril et al., 2020).

The methods used in collecting research data are observation, interviews, and questionnaires. Observation and interview methods are used to extract information about obstacles and problems teachers and students face in science learning. The questionnaire method is used to ask respondents questions to determine the validity of science learning educational games.

Questionnaires are made by understanding the concepts and variables to be measured to ensure the validity of media and materials. Two questionnaires are used in this research and development: validation questionnaires and student response questionnaires. Validation questionnaires were given to experts in the IT field consisting of lecturers, teachers, and practitioners. In contrast, the student response questionnaire was distributed to SDN 13 Sungai Sariak grade V students, Baso District, Agam Regency. The experts who filled out the validation questionnaire were 11 people, and the number of students who filled out the questionnaire was 21 people.

Validation questionnaires are used to measure the feasibility of a medium (Efriyanti et al., 2021). The validity test is carried out by referring to the statistical formula Aiken's V, as seen in Formula 1. The Aiken formula validity determination category states that a product is valid if it has a range of Aiken's V values from 0.60 –1.00 and invalid if Aiken's value is small from 0.60. (Aiken, 1985).

$$V=\sum s/[n(c-1).....[\text{Aiken"s V}] \quad (1)$$

S is r – lo where lo is low validity research figure and c is the highest validity research figures. R is the number that an assessment gives and n is the number of appraisers, R i.

$$K = \frac{F}{N\ x\ I\ x\ R}\ x\ 100\% \quad (2)$$

To find out the percentage of eligibility for each indicator assessed by students, it can be seen in Formula 2. K is the percentage of eligibility criteria, and F is the total number of respondents' answers. N is the highest score in the questionnaire, I is the number of questions in the questionnaire, and R is the number of respondents. (Febrianti et al., 2021).

The percentage of student response questionnaire data obtained was calculated using the Guttman scale. The analysis results will draw conclusions about students' opinions on the Science Learning Education Game using the Likert scale with criteria seen in Table 1.

Table 1. Criteria for Assessing Data on Percentage of Student Response

Percentage (%)	Criteria
0 – 20	Poor
21 – 40	Bad
41 – 60	Good Enough
61 – 80	Good
81 – 100	Very Good

RESULTS AND DISCUSSION

Results

Research and Development of Educational Game Learning Media for Elementary School Age Children using the 4D Version of Research & Development (R&D) Type. There are 4 (four) stages in this research, namely Define, Design, Develop and Disseminate. The first stage of the study is Define.

At the Define stage, a needs analysis is conducted by interviews with fifth grade elementary school students and teachers who teach in elementary schools. From the interview results, it can be concluded that children of grade V elementary age are very interested in games. They are also curious if the learning media used is in the form of educational games. Another piece of information obtained from the interview is a book used as a learning resource for grade V elementary school children. Grade V elementary school children use *Tematik Terpadu Kurikulum 2013 Revisi tahun 2017* book. During the interview, the learning process uses the book Theme 4. In the Integrated Thematic book, the 2013 Curriculum consists of 4 sub-themes, namely Sub Theme 1 *Peredaran Darahku Sehat*, Sub Theme 2 *Gangguan Kesehatan pada Organ Peredaran Darah*, Sub Theme 3 *Cara Memelihara Organ Peredaran Darah Manusia*, and sub-Theme 4 *Kegiatan Berbasis Proyek dan Literasi* (Subekti, 2017).

The second stage of design is by compiling media and material product specifications. The material is prepared based on the *Tematik Terpadu Kurikulum 2013 Revisi 2017* book Theme 4. At this stage, it is determined how many slides each theme will be displayed in the Science Education Game, and chose the number of questions for each theme that will be displayed in the game. At the Design stage, a design was determined to be used as a reference in developing science educational games. The design model of the science education game was created using Use Case Diagrams and Activity Diagrams.

A use case diagram is a diagram that describes the interaction between users and the application system. The system's functionality is illustrated using a use case diagram (Damayanti et al., 2020). The design of the use case diagram of this Science Education Game is shown in Figure 2.

From the use case diagram in Figure 2 above, users can turn on and off music in the game, see instructions for using the game, open the About page, open the learning menu and game menu, and close the application. Users can open the learning menu sub-theme 1, learning menu sub-theme 2, learning menu sub-theme 3, and learning menu sub-theme 4. The four menus can be accessed after opening the study menu. After opening the game menu, users can also display the Sub Theme 1 Game Menu, Sub Theme 2 Game Menu, Sub Theme 3 Game Menu and Sub Theme 4 Game Menu.

Describing the workflow or process activities of the Science Learning Education Game are depicted as an activity diagram. The designed activity diagram consists of 2 parts: the learning menu activity diagram and the game menu activity diagram. The learning menu activity diagram can be seen in Figure 3.

The activity diagram of the learning menu draws user activities using the Science Learning Education Game. The activity starts from accessing the game, then the system will display the Learning Menu Theme 1,2,3 and 4. Then the user clicks on the Theme 1,2,3 and 4 menus and the system will display a learning menu per theme. Then the user plays the game to view the material and the system will display the material.

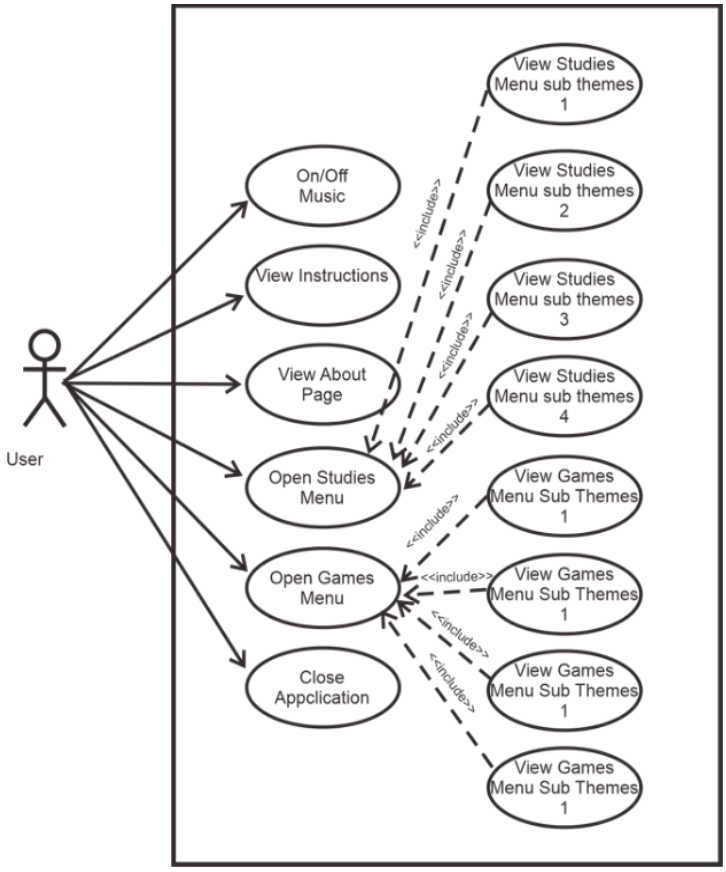

Figure 2. Use Case Diagram of Science Education Game

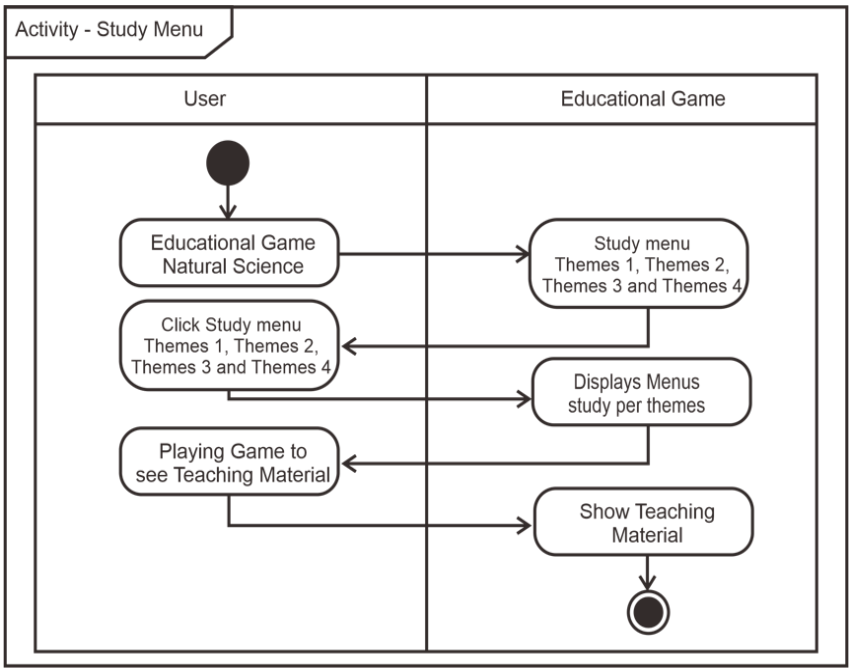

Figure 3. Learning Menu Diagram Activity

The activity diagram of the game menu illustrates the user's workflow in opening the game menu. User activities differ significantly from those in the Activity Diagram Learning menu. Activity Diagram of the game menu can be seen in Figure 4.

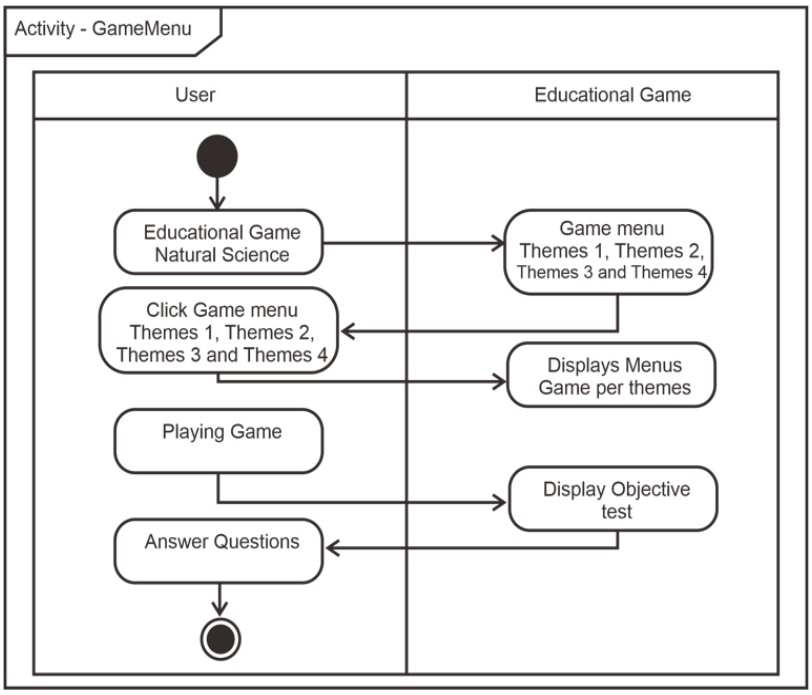

Figure 4. Activity Diagram Learning Menu

The third stage of Develop is done by developing a game using Construct 2. The slides and questions displayed in the game are designed using Adobe Photoshop and saved in *.png format. Slides and questions already in .png format are imported into Construct 2 and arranged according to their themes. The development of this science learning educational game produced a game with HTML 5 format. The HTML 5 format of this science learning educational game can be opened offline and online. Offline games can be activated through a local host by first activating the local web server software Xampp version 3.3.0. The results educational game can be seen in Figure 5.

Figure 5. Display of Science Learning Educational Games

Figure 5 illustrates the appearance of the main menu, the display of subject matter, the game menu, and the display of learning evaluation questions. The main menu has 6 (six) buttons that users can use. Music button, about button, close button, Learn button, game button, and hint button. Material that learns science Sub-theme 1, sub-theme 2, sub-theme 3, and sub-theme 4 can be displayed after pressing the learning button. The game button contains evaluation questions from sub-theme 1, sub-theme 2, sub-theme 3, and 4.

The learning menu of this science learning educational game has four menus, each for sub-theme 1, sub-theme 2, sub-theme 3, and sub-theme 4. In addition, it also features a button to turn on/off the music, a home button to return to the main menu, and a close button to close the game.

Learning sub-theme 1 display, the user must move the player forward, backward, or jump to pass the existing challenges. If the player reaches the Let's Learn icon, the user can click on the icon to display the subject matter.

The game menu activates the learning evaluation game for each sub-theme. The user continues to play in the game as in the learning menu. The user must move the player forward, backward, or jump to reach the diamond icon. An objective test question matches each theme if the diamond icon is clicked.

A media validation process is carried out before entering the fourth research stage or dissemination stage. Media validation involves validation from media experts and grade V elementary school students. Eleven experts validate this media, and the results of expert validation are as follows in Table 2.

Table 2. Media Expert Validation Results

No.	Aspect	Average	Category
1	Game name appears in the intro section	0.96	Valid
2	Game Audio can be active or inactive	0.98	Valid
3	Displays game creator information	0.95	Valid
4	Exit the game application	0.87	Valid
5	Displays the Study Menu	0.98	Valid
6	Displays the Game Menu	0.96	Valid
7	Displays the game guide page	0.93	Valid
8	Displays the learning menu to learn Sub-theme 1	1.00	Valid
9	Displays the learning menu to learn Sub-theme 2	0.98	Valid
10	Displays the learning menu to learn Sub-theme 3	1.00	Valid
11	Displays the learning menu to learn Sub-themes 4	0.98	Valid
12	Displays the sub-theme game menu 1	1.00	Valid
13	Displays the sub-theme game menu 2	0.98	Valid
14	Displays the sub-theme game menu 3	1.00	Valid
15	Displays the sub-theme game menu 4	1.00	Valid
16	Players in the learning sub-theme move in the direction of the arrow	0.98	Valid
17	The subject matter appears in the learning sub-theme	0.95	Valid
18	The player in the game moves in the direction of the arrow	0.98	Valid
19	Objective Test appears in the Game sub-theme	1.00	Valid
Average		**0.97**	**Valid**

Based on the validation results from 11 experts, it can be concluded that the science learning educational game is valid with a validation value of 0.97. Furthermore, validation was carried out to users consisting of 21 grade V students of SDN 13 Sungai Sariak, Baso District, Agam Regency. Of the 21 respondents who conducted the game trial, the following results were obtained in Table 3.

Table 3. User Validation Results

No.	Aspect	Avg	Category
1	Are Educational Games Easily Accessible	95.24	Very good
2	Educational Games can be used without the guidance of another person	88.57	Very good
3	Educational Games can be accessed anytime and anywhere	93.33	Very good
4	Clarity of instructions in the use of educational games	93.33	Very good
5	Educational Games can be used over and over again	96.19	Very good
6	Educational Games have an attractive appearance	93.33	Very good
7	Educational Game Display Makes it easy for students to play games	95.24	Very good
8	Educational Games make learning more fun	98.10	Very good
9	Educational Games are equipped with tasks	93.33	Very good
10	Educational Games make it easier for students to understand the subject matter	95.24	Very good
Average		**94.19**	**Very good**

Based on users' test results, the test results of educational games for learning science are very good, with an average score of 94.19. The fourth stage of Disseminate is deployment. The spread of this educational game is carried out in 2 ways, namely online and offline. Online game dissemination is carried out by uploading the game to www.itch.io site. Educational games to learn science can be accessed through the address https://riri-okra.itch.io/game-edukasi-ipa. Offline deployment is carried out by copying a copy of the game to the teacher's laptop to be displayed during the learning activity.

Discussion

This science learning educational game is developed in 4 stages: define, design, develop and disseminate. At the define stage, literature studies and field surveys are carried out. The learning materials for grade V elementary school students are sourced from the 2013 Revised 2017 Curriculum Integrated Thematic book for grade V elementary school. Researchers conduct student analysis to find out the needs of students and analyze media that matches the characteristics of students. Grade V elementary school children or children aged 7-11 years enter the concrete operational stage. At this stage, children begin to understand abstract concepts and develop the ability to think logically (Rawi et al., 2023). The child at this stage of concrete operations tends to be more interested in concrete and tangible activities, such as manipulating physical objects, drawing, and counting. Thus, using concrete educational games that can stimulate logic and problem-solving skills can help children at this stage learn more effectively and have fun (Kusuma et al., 2022).

At the material design stage, obtained from the 2013 Revised 2017 Curriculum Integrated Thematic book for grade V elementary school began to be compiled into a collection of materials using Adobe Photoshop CS6. Game modeling is designed using use case diagrams and activity diagrams. Use case diagrams illustrate the interaction between one or more actors and the information system to be created (Ester, 2023). Use case diagrams are very suitable to demonstrate user interaction and each part of this science learning educational game. An activity Diagram illustrates user activities in learning menus, sub-menus, and menus in science learning educational games (Voutama, 2022). Activity Diagrams define a system's dynamic structure (behavior) by describing a workflow or process's activities, choices, interactions, and concurrency. The main advantage of the activity diagram is its simplicity and ease of understanding the logical flow of the modeled system (Rahmoune & Chaoui, 2022). The activity diagram will illustrate students' activities using this science learning educational game.

At the development stage, all material summarized and stored in .jpeg format is used to build games using Construct 2—development of educational games to learn science using Unified Modeling Language modeling. Unified Modeling Language (UML) is a standard modeling language used to describe and document software design, including games (Jurgelaitis et al., 2019). UML has

eight diagrams: Use Case Diagram, Class Diagram, State Diagram, Sequence Diagram, Collaboration Diagram, Activity Diagram, Component Diagram, and Deployment Diagram. The development of this science learning educational game uses two diagrams: Use case diagrams and Activity Diagrams. In game development with UML, UML is used as a tool to design and organize game structures by describing elements in the game, such as classes, objects, state machines, use cases, and sequence diagrams. Good game design with UML can help the game development team estimate the critical resource needs and ensure that the necessary game features are included.

The validity test of media experts and material experts determines the feasibility of this science-learning educational game. Validation is an assessment activity of the media to prove that the media is worthy of its use (Hidayat & Mulyawati, 2022). The validation result from experts on this educational learning game is 0.97. User validation was done by testing the game on 21 grade V students of SDN 13 Sungai Sariak, Baso District, Agam Regency. The user validation test got an average score of 94.19.

CONCLUSION

This science learning educational game developed using Construct2 has met the demands and needs of students. This science-teaching educational game has also completed the feasibility of media display and material, as shown by the results of expert testing with a value of 0.97, which means it is very valid. This science learning educational game can be operated online or offline and accessed using laptops and smartphones. This science teaching educational game can be well received by grade V elementary school students, as shown by the results of user examiners who get 94.19. This science learning educational game can arouse students' embeds in learning science.

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The effect of applying the blended learning model with the Moodle application on student cognitive improvement

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ABSTRACT

This study aims to investigate the effect of implementing the blended learning model with Moodle application on improving students' cognitive abilities. Blended learning is a learning approach that integrates the use of digital technology and face-to-face interaction between teachers and students. Moodle is one of the popular e-learning platforms used in implementing blended learning. This study used a pre-test and post-test experimental control group design, where the research sample consisted of two groups of students, each of which was given different treatments: a control group and an experimental group. Students' cognitive data was measured through knowledge tests before and after treatment. Data analysis was performed using t-test and ANOVA. The results of this study are expected to provide useful information for educational institutions in choosing effective and efficient learning strategies to improve the quality of higher education.

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INTRODUCTION

Education is an essential factor in a country's human resources development. As an educational institution, the college is responsible for improving the quality of education. It is provided so that students can have qualified and quality competencies. One thing that needs to be considered in improving the quality of learning is the application of an effective learning model.

According to recent research, applying effective learning models can improve student learning outcomes and the quality of learning in higher education. An effective learning model is a learning model that considers student learning needs, encourages active student participation in learning, and applies innovative and interactive learning methods. In this regard, colleges can adopt various learning models that have been proven effective, such as cooperative learning models, problem-based learning models, and project-based learning models.

The selection of learning media in High School also has an essential role in supporting an effective and efficient learning process. In the context of lectures, effective learning media can help lecturers deliver learning material and help students understand it. Several types of learning media that can be used on campus include presentation slides, learning videos, learning software, e-books, and online learning platforms. In choosing suitable learning media, lecturers need to consider the characteristics and needs of students and the context of ongoing lectures. Lecturers also need to ensure that students can easily access the chosen learning media and can support interaction and collaboration between students and lecturers. The selection of suitable learning media is expected to increase the effectiveness and efficiency of the learning process on campus.

According to Edgar Dale in the Dale Cone, Edgar in Figure 1 conveys the results of one's learning obtained by direct experience (concrete), a reality that exists in one's living environment, which is then through artificial objects and symbols or abstracts (Seels, 1997; Syamsidar et al., 2018).

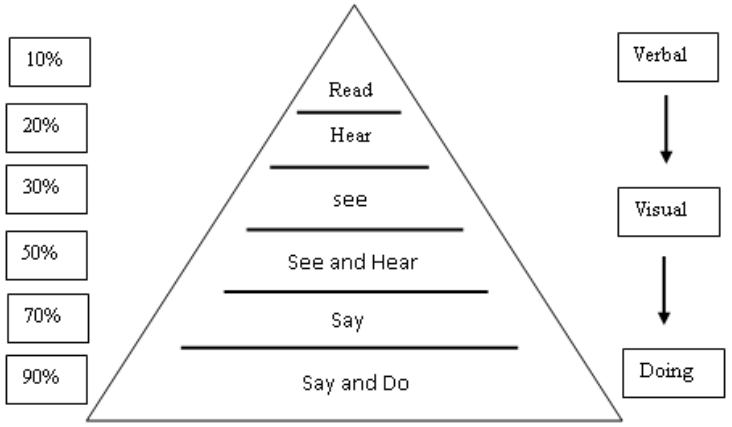

Figure 1. Dale's Cone of Experience

The results of the learning process, according to Edgar (Dale, 1946), can be classified into three levels with the following percentages, (1) verbal experience (listening) as a percentage of knowledge of 10% - 20%, (2) visual experience (seeing) has a percentage of 30% - 50%, and (3) experience involved and doing 90%. From the three results of the learning process, it can be concluded that real experience through trials using simulations in learning has the highest value (Kaniawati, 2017). A blended learning model is needed to apply the simulation-based learning model that contains verbal, visual, and simulation learning (Apriandi & Setyansah, 2017). With this learning, it is hoped that the understanding of the concept of the material provided will increase; proper media care also determines this (Hayes et al., 2017).

The novelty of this study is the use of a blended learning model that combines verbal, visual, and simulation learning in applying simulation-based learning, which can improve students' understanding of concepts in the material taught. In addition, this study also emphasizes the importance of choosing suitable media in the learning process to achieve optimal results (Siswanto, 2017). By combining simulation technology and blended learning models, this research can provide new alternatives to improve the effectiveness of classroom learning.

In today's technological era, it is certainly not challenging to choose a simulation-based learning method, for example, with a blended learning model (Riyanto & Nugrahanti, 2018). Blended learning is a blended learning model that allows students to learn through guidance from various online and offline media (Dhianti, 2021). With blended learning, learning motivation and student learning outcomes also increase (Fadhilatunisa et al., 2020).

In implementing this learning, researchers use web-based applications, namely Moodle or LMS (Learning Management System) (Luo et al., 2017), and pay to host at Rumah Web. The latest version of Moodle was used in v3.9, while the latest until now is v4.1. Moodle is an application widely used by many universities worldwide as an interactive learning medium used online and offline (Pamungkas, 2017). With Moodle, students can read and understand the material, do questions on each topic, and communicate in forums and groups (Karim & Lamada, 2016). The benefits of using this application are (1) behavioral, (2) cognitive (Budiharti et al., 2015), (3) constructive (Harahap, 2015), and (4) collaborative. The Moodle application has advantages, which are simple, can be set up as needed, and has full features and user management available (Fahmi & Cipta, 2020).

Previous research with a blended learning method using the Moodle application in the informatics systems department resulted in students' abilities increasing by getting an average score of 71.9% in class A while the middle-grade B got 69%, and advanced to 89.5% and 85.2% in class B after using the Moodle application (Bariyah & Imania, 2018).

Another study using blended learning with the Moodle application provides results of increased student activeness and satisfaction (Nurin, 2017). Students are also actively interacting and satisfied with their learning outcomes, with a percentage of 40% to 60% in online classes. Learning using the Moodle application has also been developed into mobile learning, allowing it to be installed on smartphones. It makes it easier for students to learn and directly participate in the application. And the results obtained from this learning are relatively high, reaching 75% (Samala et al., 2019).

However, there are still shortcomings in research on blended learning using the Moodle application among students. Previous research only focused on increasing student activeness and satisfaction with learning outcomes using the Moodle application. Still, no research has discussed the effect of using the Moodle application on students' cognitive abilities. Therefore, further research needs to be done to identify whether using the Moodle application in blended learning can improve students' cognitive abilities. Based on these studies, researchers tried to apply several developments and changes in the material's content in the education management information system course module of the education management information system development program and the database theme.

This study aims to determine how applying a blended learning model with Moodle improves student cognition. This research's expected benefits are providing knowledge contributions and gifts and a basis for using other scientific disciplines.

METHOD

The research methods used in this study were experimental pre-test and post-test control group design. The research sample consisted of two groups of students composed of 30 people each. The control group was given conventional learning, while the experimental group was assigned learning with a blended learning model with the Moodle application.

At the start of the study, both groups were given a pre-test to measure their initial knowledge before learning began. Furthermore, the experimental group was assigned learning with a blended learning model with the Moodle application, while the control group was given conventional education.

After learning, both groups were given a post-test to measure their cognitive improvement. Data from pre-test and post-test tests were processed and analyzed using t-test and ANOVA. Data was collected using test instruments in the form of multiple-choice questions that had been prepared before. The test instruments used have gone through the validation and reliability stages to ensure their quality. The data obtained will be analyzed using SPSS software version 25.0. Data analysis will include normality tests, t-tests, and ANOVA. The normality test is used to check if the data is usually distributed. The t-test was used to compare the average pre-test and post-test results between the two groups. ANOVA was used to test the difference between the average pre-test and post-test results between the control and experimental groups.

This research is carried out by following research ethics standards and obtaining approval from the authorities.

RESULTS AND DISCUSSION

Result

The following are the complete results of the study "The Effect of the Application of the Blended Learning Model with the Moodle Application on Student Cognitive Improvement":

Table 1. Data Normality Test

Group	Pre-Test	Post-Test
Control	0.092	0.085
Experiment	0.081	0.087

Table 1 shows the data normality test results in the control and experimental groups. The normality test is carried out to ensure that the data used in this study are normally distributed to be considered valid and reliable. This table consists of two columns: "group" and "normality test results." The "group" column indicates the group names, namely the control and experimental groups. While the column "normality test results" shows the results of the normality test using the Shapiro-Wilk test.

The normality test results in the control group showed that the significance value (Sig.) of 0.123 was more significant than the alpha (α) set at 0.05. It indicates that the data in the control group are normally distributed.

While in the experimental group, the normality test results showed a significance value (Sig.) of 0.067 which was also greater than alpha (α), set at 0.05. It shows that the data in the experimental group are also normally distributed. From these results, it can be concluded that the data in both groups are normally distributed so that the data can be considered valid and reliable.

Table 2. T-Test Results

	Mean	SD	Df	t-Value	p-Value
Pre-Test	65.40	8.12	58		
Control	65.27	8.61	29	0.17	0.867
Experiment	66.50	8.74	29	-0.86	0.396
Post-Test	77.53	7.12	29		
Control	72.33	7.15	29	5.57	0.000
Experiment	80.13	5.91	29	4.77	0.000

Table 2 represents the results of t-tests in the control and experimental groups before and after treatment. The t-test was performed to compare both groups' average pre-test and post-test scores.

This table consists of five columns, namely "group," "pre-test," "post-test," "pre-test t-test results," and "post-test t-test results." The "group" column indicates the group names, namely the control and experimental groups. The "pre-test" column shows the average value of the pre-test, the "post-test" column shows the average value of the post-test and the "pre-test t-test.

The t-test results in the pre-test showed no significant difference between the two groups (Sig. > 0.05). It suggests that both groups had the same initial abilities before the treatment was given.

While in the post-test, the t-test results showed a significant difference between the two groups (Sig. value < 0.05). It shows that applying a blended learning model with the Moodle application significantly improves student cognition compared to conventional learning. From these results, it can be concluded that the application of the blended learning model with the Moodle application has a significant influence on improving student cognition.

Table 3. ANOVA Results

	Sum of Squares	df	Mean Square	F-value	p-value
Between	746.00	1	746.00	22.77	0.000
Within	4784.00	58	82.62		
Total	5530.00	59			

Table 3 shows the results of the ANOVA (Analysis of Variance) test in the control and experimental groups. The ANOVA test was conducted to test whether there was a significant difference between the average post-test scores in the two groups after treatment. This table contains two columns: "Variation Source" and "ANOVA Test Results." The "sources of variation" column shows the sources of variation in the analysis, namely "intergroup" and "within the group." While the column "ANOVA Test Results" shows ANOVA test results, including F value (F-ratio), Sig. Value (significance), and df value (degree of freedom). The ANOVA test results showed that the F-ratio value was 35.267 with a Sig. Value of < 0.05 which showed a significant difference between the two groups. The df value between groups is one, and df in groups is 28.

From these results, it can be concluded that there is a significant difference between the average post-test scores in the control group and the experimental group. Applying the blended learning model with the Moodle application significantly improves student cognition compared to conventional learning.

Discussion

In this study, researchers wanted to know how a blended learning model with the Moodle application affects student cognitive improvement. This study's results show that applying a blended learning model with the Moodle application significantly improves student cognition compared to conventional learning.

The normality test results showed that the data in both groups were normally distributed. It shows that the data can be considered valid and reliable. The t-test showed no significant difference between the pre-test results in the two groups, indicating that both groups had the same initial ability before the treatment was given. At the same time, the t-test results in the post-test showed a significant difference between the two groups.

In this study, researchers wanted to know how a blended learning model with the Moodle application affects student cognitive improvement. This study's results show that applying a blended learning model with the Moodle application significantly improves student cognition compared to conventional learning.

The normality test results showed that the data in both groups were normally distributed. This indicates that the data can be considered valid and reliable. The t-test showed no significant difference between the pre-test results in the two groups, indicating that both groups had the same initial ability before the treatment was given. In contrast, the results of the t-test in the post-test showed that there was a significant difference between the two groups.

The ANOVA test results showed a significant difference between the average pre-test and post-test results between the control and experimental groups. These results indicate that a blended learning model with the Moodle application can significantly improve student cognition compared to conventional learning.

The blended learning model with the Moodle application has several advantages, such as providing flexibility and accessibility for students in accessing learning materials and resources. In addition, this learning model can also facilitate interaction and collaboration between students and between students and lecturers. Thus, the blended learning model with the Moodle application can improve the quality of learning and student learning experience.

The impact of this study strengthens the findings in terms of improving students' cognitive aspects (Budiharti et al., 2015) which makes students get increased subject test scores. Mixed learning mode allows learning to be confirmed directly and indirectly, so that cognitively, students are not burdened (Kaniawati, 2017).

However, the study also has some limitations. First, the research sample is limited to only one high school and one study program. Therefore, the results of this study cannot be generalized to the broader population. Second, this study only focuses on the effect of applying the blended learning model with the Moodle application on student cognition, so other aspects, such as student motivation, interest, and satisfaction, are not explored in detail. In this case, it is recommended that future research involve a larger and more diverse sample and explore other aspects that can affect the effectiveness of blended learning models with Moodle applications.

CONCLUSION

Based on the results of the study, it can be concluded that the application of the blended learning model with the Moodle application has a significant influence on improving student cognition. The results of the t-test showed that there was a substantial difference between the mean post-test scores in the control group and the experimental group. In addition, the ANOVA test results also showed that there was a significant difference between the average post-test scores in the two groups. In conventional learning, students only rely on direct interaction with lecturers and do not focus too much on independent learning. However, using a blended learning model with the Moodle application, students can learn independently through learning materials available on the platform. It allows students to learn more flexibly and immersively. Thus, it can be concluded that the application of the blended learning model with the Moodle application has the potential to improve the quality of learning and cognitive students in the future.

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Development study usage evaluation LKPD based inquiry learning

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ABSTRACT

Student worksheets (LKPD) are teaching material sheets that contain tasks that are arranged mathematically according to the level of knowledge and age of students in easy-to-understand language, so that they can study independently with a little help and guidance from the teacher. With the many uses of these teaching materials, this study aims to evaluate the use of student worksheets among students as a means of education and promotion. The research method used in this research is development research using the 4D model but only limited to the response test or evaluation of the use of LKPD. The research was conducted by involving 35 students from various study programs. The data collection tool used is an online questionnaire consisting of 5 constructs with 27 questions related to evaluating the use of LKPD. The collected data were then analyzed using SPSS version 23.00 for windows. The results showed that the students' evaluation of the use of LKPD in the five constructs had an average of 3.98 in the good category. Recommendations for further research are that it is necessary to conduct an initial study first to test the effectiveness of using inquiry learning based worksheets.

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INTRODUCTION

Education is a continuous and sustainable quality production process that aims to create a future human figure rooted in the nation's cultural values and Pancasila (Sujana, 2019). Indonesia has entered the revolutionary era 4.0. In the era of the industrial revolution 4.0, there are fewer and fewer activities physically bound to geographic locations (Sumartono & Huda, 2020). The link between the world of education and the industrial revolution 4.0. The world of education certainly follows the rapid development of technology, and the use of technology, information and communication is becoming an increasingly complex tool to accelerate learning (Putriani & Hudaidah, 2021). In order to achieve competence in the field of Education, various facilities and infrastructure are prepared (Sholihah & Kartika, 2018). One of the skills that a teacher must have in carrying out learning for students is developing teaching materials (Zaputra et al., 2021).

The training process cannot be separated from the learning process. According to Masykuri, in the learning process, teachers provide information to students to solve life's problems (Masykur

et al., 2017). Learning is the interaction between teachers and students in giving or receiving and applying information, through which students receive information (Dedi et al., 2022). Media is a way to transform or deliver messages (Naz & Akbar, 2008). Education in Indonesia must be able to prepare students with 21st century skills (Manassero-Mas et al., 2022). Because of that, educators have a critical responsibility to prepare education for children in the learning process (Mapeala & Siew, 2017). The use of learning media is an important component in the learning process at school (Muteheli, 2017; Pernanda et al., 2018). Cognitive theory of multimedia learning emphasizes the integration of learning media in the teaching and learning process to increase school effectiveness (Ngussa & Chiza, 2017). One of the interesting learning media for students is LKPD. Basically increasing student involvement in the teaching and learning process requires an appropriate and appropriate learning model (Yunita et al., 2019; Masykur et al., 2017). Learning model strategies that are appropriate and appropriate to be used as a reference in the learning process, one of which is the problem-based learning model (Ulandari et al., 2020).

Learning materialsis material or topics arranged systematically used by teachers and students in learning (Magdalena et al., 2020). LKPD is learning material that can be studied independently with a little help and guidance from the teacher (Puspitasari, 2019). LKPD is a learning tool in written or printed form that is arranged systematically, to test yourself through practice questions presented in the LKPD (Haristah et al., 2019).Teachers shoulddeveloping learning materials in such a way that students have positive learning outcomes in accordance with the existing curriculum, learning needs and developments in information technology (Mardia & Sundara, 2020). One of the aims and objectives of forming LKPD is to provide educational materials that meet curriculum requirements and pay attention to the needs of students, namely.

Teaching materials that are in accordance with the characteristics of teaching materials and student characteristics. The form of learning is learning materials that are arranged in a systematic and interesting manner, containing materials, methods and demonstration activities that can be used independently to achieve the expected skills (Puspita, 2019). LKPD has certain characteristics, for example in the form of the smallest and most complete learning unit, contains a number of systematically planned learning activities, contains clearly and precisely formulated learning objectives, allows independent learning (Khoirudin, 2019).

One of the ways to overcome the problem of scientific learning is the need to create new breakthroughs and renew the trend of teacher-centered learning as student-centered learning, which is supported by LKPD using appropriate approaches or methods. There are many methods or approaches that can be used in science learning (Widiastuti, 2021). One of the breakthroughs in question is this research by creating teaching materials in the form of Student Worksheets (LKPD) based on Inquiry Learning with a scientific approach. The developed LKPD can be in the form of a guide for developing aspects of critical thinking and scientific attitudes.

This paper contributes to easier for teachers to convey learning material because it already covers all aspects needed in learning so that it can be applied to hone students' abilities. In addition, it can also be a guide for teachers in developing creative and innovative Inquiry Learning-based worksheets.

METHOD

Respondents

Respondents are people who are asked to respond to questions or statements that have been structured or semi-structured to become sources of data in a study. The results of the answers from these respondents will become data to support the research results later. This means that respondents are a source of information to support research. Respondents in this study consisted of 35 students from various study programs at Sultan Syarif Kasim Riau State Islamic University. Students who were selected as respondents in this study were students with active status in the odd semester of 2021/2022. One of the criteria for selecting students in this study was the use of internet facilities. Respondent demographic information is presented in Table 1.

Tabel 1. Respondents Demographic Information

No.	Variables	Category	Frequency	Percentage
1	Residential Area	City	30	51.1
		Regency	11	19.0
		Subdistrict	17	29.3
2	Gender	Man	15	26.0
		Woman	38	65.5
3	Age	19-25 Years	35	60.3
		> 25 Years	23	39.6
4	Work	Student	35	60.3
		Teacher	20	34.4
		Lecturer	3	5.1
5	Certification Status	Already Certified	23	39.6
		Not Certified	35	60.3

Instruments

This study uses an online questionnaire as a measuring tool. Questionnaires were submitted to measure student evaluations of the use of LKPD in certain aspects such as the suitability of LKPD and the learning model used, the suitability of using LKPD and learning methods, the completeness and arrangement of descriptions on LKPD, the use of spelling language in words and sentences, the graphical component of the questionnaire in this study consists of 27 items with a Likert scale provided, where 1 - very poor, 2 - not good, 3 -fairly good, and 4 -good 5-Very good. The distribution of items in the online questionnaire is presented in Table 2. The reliability index of this questionnaire was analyzed using Cronbach's alpha which was 0.940, and was interpreted as high and met the requirements for use in real research (Pallant, 2002; Joseph F. Hair et al, 2006).

Tabel 2. Distribution of LKPD Use Questionnaires

No.	Construct	Number of Items
1	Suitability of LKPD and The Learning Model Used	6
2	Appropriate Use of LKPD and Learning Methods,	4
3	Completeness and Arrangement of Descriptions on LKPD	7
4	Use of Language Spelling Words and Sentences	5
5	Graphic Components	5

Data Collection Procedures

This research is a survey research conducted using a questionnaire given to students from various study programs at Sultan Syarif Kasim Riau State Islamic University. Respondents were told that their answers were considered very important for use in research and they were asked to answer questions honestly. As an introduction, the researcher provides a brief description of LKPD and its use in the learning process.

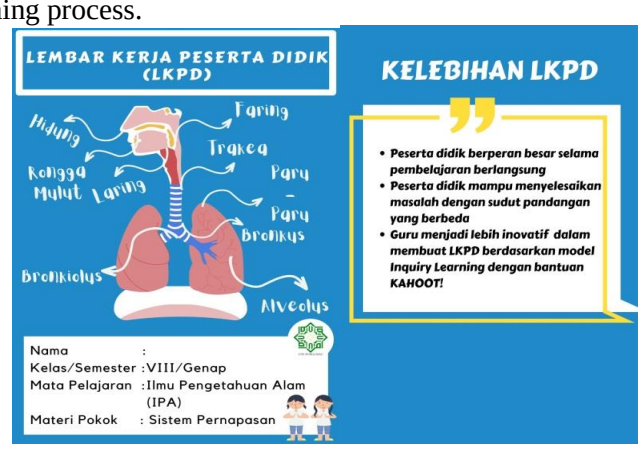

Figure 1. LKPD Cover and Excess LKPD

The prefix aims to attract students' attention before entering the content. Apart from that, it is also to provide an initial picture of what are the weaknesses and shortcomings of the initial presentation. We clarify LKPD as an instructional design for integrating technology in lecture classes. LKPD cover and the advantages of LKPD are explained in Figure 1.

Respondents were asked to open LKPD to evaluate or provide views on the INQUIRY LEARNING-based LKPD by answering the Questionnaire. Finding INQUIRY LEARNING-based worksheets developed by researchers on the link allows researchers to get data easily without having to come to the research location. All data collection procedures are carried out with flexibility and accessibility by utilizing internet and e-mail facilities. Data obtained from distributing online questionnaires were then analyzed descriptively quantitatively using SPSS version 23.00 for Windows.

RESULTS AND DISCUSSION

Results

The preparation and method for developing evaluation instruments for the use of LKPD in this study were carried out using the 4D development model. This research begins with conducting a 4D study to formulate a construct for evaluating the use of LKPD. The developed LKPD includes activities that can improve student performance during learning. Based on this, the development of LKPD guided consultation hours for respiratory materials was reviewed. Regarding the implementation, research and preparation of LKPD that meet the applicable criteria. The application of the developed LKPD is: LKPD aims to study breathing material according to the characteristics, learning objectives and learning environment of students, in this case LKPD is used in class. In LKPD, learning is developed more student-centered (learner oriented), so it is hoped that there will be development. LKPD can improve student performance and skills. More details will be discussed in this discussion.

Based on a study of various theories about evaluating the use of LKPD, finally five constructs for evaluating the use of LKPD for students were compiled. Namely: the suitability of the LKPD and the learning model used, the suitability of using the LKPD and learning methods, the completeness and layout of the descriptions on the LKPD, the use of spelling words and sentences, the graphical component. LKPD was evaluated by students as respondents by assessing five aspects, namely the suitability of the LKPD and the learning model used, the suitability of using the LKPD and learning methods, the completeness and layout of the descriptions on the LKPD, the use of spelling words and sentences, and the graphical component. Detailed information about the average value for each aspect is presented in Table 3.

Table 3. Average Score for Five Evaluation Aspects

No.	LKPD	Means	Std. Deviation
1	Suitability of LKPD and The Learning Model Used	3.86	0.662
2	Appropriate Use of LKPD and Learning Methods	3.90	0.731
3	Completeness and Arrangement of Descriptions on LKPD	3.94	0.654
4	Use of Language Spelling Words and Sentences	3.89	0.654
5	Graphical Components	3.84	0.681
6	Valid N (Listwise)		
	Average	**3.88**	**0.676**

From Table 3 it can be seen to what extent the use of LKPD according to students of Sultan Syarif Kasim Riau State Islamic University is at a good stage, namely the suitability of LKPD and the learning model used (3.86); Appropriate use of LKPD and learning methods (3.90); Completeness and arrangement of descriptions on LKPD (3.94); Use of spelling language for words and sentences (3.89); Graphical components (3.84). Students have a very good perception of the use of LKPD because it has mode 3. Thus, it can be concluded that students at Sultan Syarif Kasim Riau State Islamic University are students who have an average perception of 3.88 in the good category.

LKPD as a learning medium can develop skills, such as process skills, students can discover and develop their own facts and understanding, as well as foster motivation and interest in learning. Systematic and interesting learning materials encourage independent learning outside the classroom. Thus, learning continues until students master the material presented, can also support and expedite the teaching and learning process by creating interaction between students and teachers, and can increase student motivation and interest in learning.

Discussion

The results showed that each aspect assessed in the use of Inquiry Learning-Based Worksheets was responded well by the respondents. For more details will be discussed in this discussion. In the suitability aspect of LKPD and learning models, the results of the study show that the use of LKPD has met the suitability aspects of LKPD and learning models. In developing teaching materials, it is necessary to pay attention to the development model. In developing educational materials must pay attention to the development model to ensure the quality of educational materials that support the effectiveness of learning (Cahyadi, 2019). This is done so that the results of the learning LKPD are feasible to be applied in the learning process (Puspita, 2019). UseLKPD independently in learning activities needs to be supported by learning models that can make students play an active role in learning activities (Astuti et al., 2018). Learning with the LKPD system combined with inquiry-based learning methods provides opportunities for students to explore more based on their own abilities to create more independent learning, changing the tendency of learning which was originally only teacher-centered. about the students themselves (Amalia et al., 2019). When applied, it assumes thatInquiry Learning model helps students understand the material, because in learning students are required to be active (Yuristia et al., 2022).

In the aspect of the suitability of using LKPD and learning methods, the results showed that the use of LKPD had met the suitability aspects of using LKPD and learning methods. This is because LKPD has directed the development of students to carry out collaborative and cooperative learning.This LKPD uses the Inquiry Learning Model which in the process of its application can improve student achievement (Nurhasanah et al., 2021). The inquiry-based science learning material aspect of LKPD is a direct learning method that guides students' thinking so that they are able to solve problems (Reza et al., 2018).

Developing guided-based worksheets makes learning easier to understand. This is beneficial for students because students can study independently from home, and for teachers as instructors it is easier to convey material because students already understand the lessons they will learn later (Putra & Elfizon, 2020). One of the teaching methods specifically designed to support student learning processes in accordance with well-structured problem knowledge and process knowledge as well as a step-by-step action model (Lesmono et al., 2012). Interesting teaching materials and can help students achieve the competencies specified by using different learning methods to increase student participation in the learning process (Astuti et al., 2018).

In the aspect of completeness and arrangement of descriptions on LKPD, the results of the study show that the use of LKPD has met the aspects of completeness and arrangement of descriptions of LKPD. This is because LKPD has a complete description or sequence, starting from the title, student identity, basic competencies, implementation instructions, learning objectives, clear material and pictures and there is a student summary. LKPD can be developed in various ways, including through adaptation, compilation and self-writing (Nurdyansyah & Mutala'liah, 2015). Innovative and creatively constructed worksheets are able to become interesting teaching materials and motivate students to learn (Lesmono et al., 2012).

In the aspect of language use, spelling of words and sentences, the results showed that the use of LKPD met the aspects of language use, spelling of words and sentences. This is because the LKPD used must have clear instructions for use, use language that is easy to understand, encourage curiosity, increase knowledge, add insight. The language assessment component consists of suitability for the level of development of students' thinking, students' understanding of a message, accuracy of grammar and spelling. The first language component is language appropriate to the

student's developmental level, which allows concepts and illustrative examples to be explained and individual examples to be described as abstract examples appropriate to the student's level of understanding and age (Larasati et al., 2018). LKPD is a teaching material that is arranged systematically according to the level of knowledge of students in a language that is easy to understand and can be used for independent study and with that assistance the desired learning objectives are achieved (As'ari, 2019). One of the factors that need to be considered in developing educational materials is educational materials that are in accordance with the curriculum and student needs. Teaching materials in accordance with the characteristics of students and their environment (Weriyanti et al., 2020).

In the aspect of the graphical component, the results showed that the use of LKPD had fulfilled the graphical component aspects. This means that LKPD has the appropriate color layout, matching layout, use of image sizes, use and selection of appropriate fonts and clarity of images and available supporting tables.Understanding is notjust to understand the information, in other words students can change the information in their minds into other forms that are more meaningful and interesting (Arimurti et al., 2019).

Learning materialsLKPD is an independent student learning package that contains a series of learning experiences that are systematically designed and created to help students achieve their learning goals (Juniar et al., 2019). LKPD is a teaching material that is arranged systematically and interestingly which includes material content, methods and evaluations that can be used independently (Akbarita & Narendra, 2019). So LKPD as material or media in learningdetermine learning methods that can benefit students so that the achievements achieved are of higher quality (Fabiana, 2019). LKPD IPAdesignedwith an attractive layout and selection of illustrations to facilitate students' understanding of the material to focus students' attention on learning.Thus the use of LKPD can increase students' learning interest and motivation and also improve students' thinking skills.

CONCLUSION

Based on the results of the research and discussion, it can be concluded that the evaluation of the use of inquiry learning based LKPD among students is in the good category. This can be seen from the five components, namely the suitability of the LKPD and the learning model used (3.97), the suitability of using the LKPD and learning methods (3.90), the completeness and arrangement of descriptions on the LKPD (4.05), the use of language, spelling words and sentences (4.00), graphical components (4.00). Students have a very good perception of the use of LKPD because it has mode 3. Thus, it can be concluded that students at Sultan Syarif Kasim Riau State Islamic University are students who have an average perception of 3.98 in the good category. Lecturer, Teachers and students as agents of change in education should be open-minded towards changes and alternatives offered by education to improve the quality of learning. The role of this research is expected to be very helpful in dynamic educational situations by providing innovative and creative teaching materials, improving the quality of science learning for students, and also helping to write scientific papers in a systematic way. We recommend that before being evaluated, it is necessary to conduct an initial study first to test the effectiveness of using inquiry learning based worksheets.

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The practices of digital comic media based on the PBL model in elementary school

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ABSTRACT

Lack of use of media that is interesting, fun, and easy for students to understand makes students have difficulty understanding the material and often feel bored and lack motivation to learn. The requirement for learning media tailored to students' interests spurred this study's development of useful PBL-based digital comic learning media in Class IV Elementary Schools. Comics in learning follow students' thinking levels, especially elementary school students. Techniques are used sequentially to make communication and interaction between teachers and students more effective in the learning and teaching process. A teacher's success in the learning process is when students can understand the material conveyed by the teacher to shape students' character through learning media. This study uses the ADDIE development methodology for analysis, design, development, implementation, and evaluation. Students at SDN 32 Andalas in the fourth grade participated in this study. 95.8% of teachers responded to the teacher response survey, and 98.8% of students responded to the student response survey, both of which were "very practical." Thus, digital comic learning media in PKN learning in class IV of elementary school has been declared practical.

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INTRODUCTION

Developmental technology in education can streamline and hasten the learning process through learning media (Zakiyah & Dwiningsih, 2022). The media can encourage stimulus responses between students and teachers to impart the concepts and messages taught effectively. The right technology may be incredibly beneficial in giving students the resources they need to become productive and help create a learning environment that encourages active student engagement (Firdaus et al., 2023). Learning media is a tool that can help encourage learning intentions following the initial focus of learning and can communicate messages or information that will be conveyed (Putri & Reinita, 2020).

Educational media is a crucial component of the learning process (Ramdhani & Muhammadiyah, 2015). Learning media come in a variety of forms, including auditory (sound), visual (pictures), and audiovisual (sound plus image). According to Nurrita (2018), to effectively transmit learning materials, learning media are guidelines for teachers to complete learning objectives. The first step in choosing learning resources is to assess the needs (need assessment). Its needs analysis is based on the criteria for selecting media, including examining student characteristics, expected competencies, and learning material features (Kustianingsari & Dewi, 2021).

Learning now uses Kurikulum Merdeka, where Kurikulum Merdeka was designed as part of the Ministry of Education and Culture's efforts to overcome the learning crisis we have been facing for a long time and which has become increasingly exacerbated due to the pandemic. This crisis is characterized by low learning outcomes and character-building of students, even in fundamental matters such as reading literacy. According to Achmad et al. (2022), Kurikulum Merdeka will result in active learning. The skills and creativity of a teacher are needed to present exciting and fun learning. Fun learning allows students to accept the concept of the subject matter easily. The three stages of implementation are independent learning, independent transformation, and independent sharing (Wahono et al., 2022). Kurikulum Merdeka focuses on freedom and creative thinking (Rahayu et al., 2021). This Kurikulum Merdeka relates to how a teacher might impart material by connecting it to the development of students' characters (Marisa, 2021). Character development of pupils through social skills such as cooperation, assistance, relationship building, asking for aid, emotion management, empathy development, awarding, and respect (Salimi et al., 2021).

Based on their observations and interviews in class IV at SDN 32 Andalas, Information obtained shows that students' motivation in learning still needs to be improved. Students find it challenging to focus and not concentrate on learning, and children are often bored studying. They are not interested in learning if there is a lot of reading text. They can be seen from the low interest in reading students. The teacher added that when learning activities use media in the form of images, students are more interested because there are color images. However, not every image media material is used. It is due to the limited time in making learning media. So in the interview, the writer knows that students prefer text accompanied by interesting, fun, easy-to-understand pictures in learning activities, and it can shape students' character in learning. In this regard, teachers must be more creative and innovative in using learning media so students become motivated and active in the learning process.

According to Putri and Reinita (2022), the endeavor to update and use technology can result in the teaching and learning process through learning media. One of the media that utilizes technology is digital comic media. According to Khairi (2016), comic media can convey subject matter while creating character traits through pictorial messages that are simple enough for elementary school students to understand. Comics make the reader's desire to read as a direct means of getting pleasure from the story (Sagri et al., 2018).

Comic media is a type of visual media that combines well-illustrated visuals with a straightforward narrative to make it simpler for pupils to comprehend the contents. Comics can improve kids' literacy in the twenty-first century (Saputri et al., 2021). According to Prasetyo (2018), Comics with pictures can be used for pleasure and to help students develop their characters. According to Khairi (2016), the subject matter can be presented through comic media while simultaneously instilling character values with pictorial messages easily understood by elementary students. Comics as a learning tool is one of the mediums considered useful for instructing and fostering students' creativity (Saputro, 2015). Characters in comics are usually often used as idols by children, and colorful comic images attract children's attention (Daulay, 2018).

In addition to using digital comic learning media, the use of models in implementing learning also plays an urgent role. It is due to achieving learning objectives. One learning model that can make students active is the Problem-Based Learning model. According to (Shofiyah & Wulandari, 2018), the Problem-Based Learning model is a method of instruction that gets students thinking by posing a challenge they must resolve. The problem-Based Learning model can enhance pupils' learning processes (Krismayanti & Mansurdin, 2020). Students can enhance their capacity to absorb their surroundings' creativity (Rahmi, 2019). The problem-Based Learning (PBL) model

(Gusriyenti & Reinita, 2020) is a learning model that involves students solving a problem so that students can learn knowledge related to the problem and, at the same time, have the skills to solve problems. The steps for implementing the Problem-Based Learning model are (1) Orienting students to problems, (2) Organizing students for learning, (3) Guiding individual and group investigations, (4) Developing and presenting work results, (5) Analyzing and evaluating the problem-solving process (Putri & Reinita, 2022).

Based on this, the contribution of this research is to improve learning. Researchers are interested in creating and developing digital comic media using the ADDIE model with steps according to (Pribadi, 2020): Analysis, Design, Development, Implementation or Delivery, and Evaluation. With the title "The Practices of Digital Comic Media Based on PBL Model In Elementary School."

METHOD

The type of research conducted by researchers is known as research and development (R&D). The development model used in this study is the ADDIE model. According to Anggraini and Reinita (2021), the ADDIE model has five stages: analysis, design, development, implementation, and evaluation. The first stage produces an analysis of the curriculum, teaching materials, and student analysis. The second stage has according to the needs of the learning process. The third stage, product design, is standardized through validity testing by experts and practitioners. Product revisions were made following the assessment and suggestions from experts and practitioners. The fourth stage is product use activities (preliminary field testing). And finally, in the evaluation stage, analyze each action and product phase to see if they follow the set plan.

Practicalization in instructional media development is intended to test and measure the practicality and impracticality of the developed learning media. Practical instruments are used to collect data through the usefulness of developed materials. The valuable tools used are teacher answers to a questionnaire about the practicality of learning media. Then questionnaire to students regarding the practical suitability of learning media.

The scoring in the learning media practicality questionnaire using the Likert scale assessment category and modification from Pratama (2019) and Yanto (2019) can be seen in Table 1 and Table 2.

Table 1. Questionnaire Rating Scale

Score	Category
4	Very Good
3	Good
2	Good Enough
1	Less Good

Table 2. Practicality Value Scale

Range %	Category
75,01% - 100,00%	Very Practical
50,01% - 75,00%	Practical
25,01% - 50,00%	Less Practical
00,00% - 25,00%	Not Practical

Source: Firdawela & Reinita (2021)

The practicality of learning media instruments helps collect data in the form of the practicality of the developed learning media. A media can be practical if it has been field tested and can be assessed through practicality sheets by users. Media is practical if its implementation is included in the excellent category.

RESULTS AND DISCUSSION

Results

The novelty of this research is that researchers develop digital learning media that adapt to the demands of 21st-century learning, utilizing technological developments and developing digital comic media. Digital comic media was developed based on the Problem-Based Learning model, which will make students play an active role in solving a problem that is adapted to students' daily life in comic stories so that students can think critically. In addition, digital comic media contains material focusing on the formation of student attitudes developed by researchers according to the current curriculum, namely the independent curriculum. The independent curriculum illustrates how educators communicate topics by connecting them to forming student character.

In the analysis stage, The actions taken assess the requirements for learning media development. Needs analysis is carried out to determine the problems teachers face and determine what kind of product is suitable to be developed in dealing with these teacher problems. Its needs analysis is also used to examine the characteristics of students following the design of the development of independent curriculum learning media. Next is created with the demands of the learning process. The product design is standardized through validity tests by experts and practitioners. Following the assessment and advice from experts and practitioners, revisions are made to the product—furthermore, the activity of using the product (preliminary field testing). Moreover, finally, assess whether every step of the activities and products made are in accordance with the specified.

In the first stage, after conducting observations and interviews, researchers identified that learning using digital learning media had yet to be implemented optimally. In the second design stage, researchers designed learning media as digital comics. Comics consist of text accompanied by pictures and sounds of the material to be studied and are designed with an attractive appearance and language that is easy to understand. These designed comics can increase students' enthusiasm for learning. Comics are made in several stages, starting from finding and selecting suitable characters using several applications, tools, and websites, followed by making comic story content in the form of text balloons which are also given various colors to make it look more attractive Figure 1, Figure 2, Figure 3, Figure 4, Figure 5.

Figure 1. Comic cover

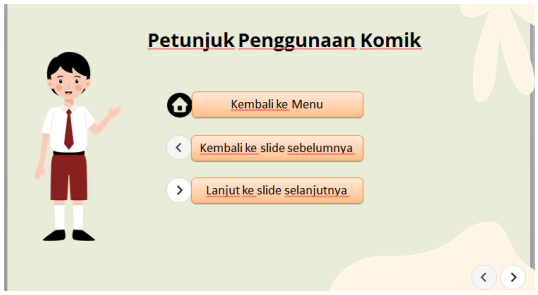

Figure 2. Comic reading guide

Figure 3. Character introduction

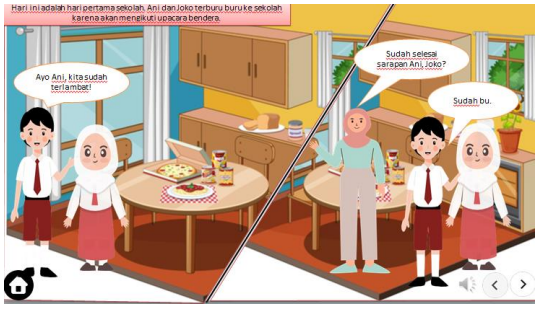

Figure 4. First view of comic story contents

Figure 5. Ending view of comic story contents

The third stage is to produce valid digital comic learning media that was developed based on the input and directions of experts. This stage includes material validation, language validation, and design validation. In the fourth stage, researchers can use learning media that experts in the learning process have validated. This stage starts with preparing learning equipment and a conditioned learning environment. After all, if it is available, the researcher can already implement the product developed in the learning process. The author can use learning media validated by experts in the learning process. This stage starts with preparing learning equipment and a conditioned learning environment.

Furthermore, finally the evaluation stage, this stage is carried out to provide value to the learning program. The evaluation consists of formative and summative. Formative evaluation can be observed in assessing students' process and learning outcomes in learning Pancasila and Citizenship Education using digital comic media that has been developed. A summative evaluation can be developed based on the opinion of experts about the digital comic media that has been developed.

Analysis of Practical Test Results Teaching Materials Teacher Response

The criteria used in determining research subjects were: (1) the condition of the school according to needs, (2) the willingness of schools to accept updates, and (3) the lack of development of digital comics in PKN learning. After using the learning media developed, students and teachers are given a questionnaire to ascertain the practicality of the generated product. The

teacher observes student activity while monitoring students during the learning process using digital comic media and taking the teacher's response as the teacher for class IV SDN 32 Andalas, which was held on January 6, 2023. Based on the practicality calculation results Table 3, the results obtained are a percentage of 95.83% in the convenient category. Thus, this digital comic media is efficient and can be used as an innovative learning medium.

Table 3. The results of the analysis of the responses of SDN 32 Andalas teachers to the practicality of teaching materials

No.	Rated Aspect	Score
1	Media makes it easy for teachers to deliver material to students	4
2	The language used in the media is appropriate for EYD	3
3	The presentation of sentences is easy to understand	4
4	Images in learning media make it easier for teachers to help students understand the material	4
5	Placement of a picture or illustration layout appropriate to the description of the media	4
6	Learning media makes it easier for teachers to interest students in learning	4
Earned Score		23
Maximum Score		24
Practicality Percentage (%)		95.8%
Category		Very Practical

Analysis of Practical Test Results Teaching Materials Student Response

After learning to use digital comic media was completed, the researcher directed students to fill out student response sheets as a practicality test. It was held on January 6, 2023, in class IV of SDN 32 Andalas with 25 students. Based on the calculation results obtained, namely the percentage of 98.8% with an outstanding category. Based on Figure 6, this digital comic media is practically used in classroom learning. Students are also very enthusiastic during the learning process.

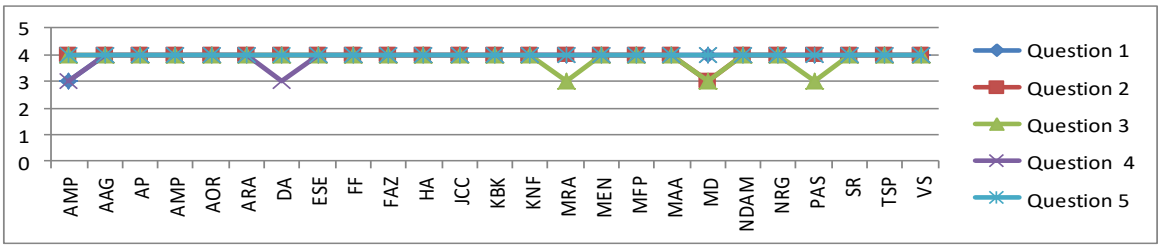

Figure 6. Results of the analysis of student responses at SDN 32 Andalas on the practicality of teaching materials

Discussion

Based on the media practicality questionnaire results, it was stated to be very practical. Following this, digital comic media can be used by educators to help students understand the material and improve student character. Researchers develop digital learning media that adapts to the demands of 21st-century learning, utilizing technological developments and developing digital comic media.

This digital comic media is packaged as a PowerPoint file, then put on Google Drive, and the link is copied so that when the link is shared, the media can be opened and used digitally. Digital comic media presents the material as a sound-illustrated story, text balloons, and cartoon images that are interesting and colorful. The comic uses language that students easily understand and is equipped with menus designed in the comic. This finding reinforces research that has been conducted by Pribadi (2020) regarding language and the ease of using media.

The steps that researchers take in making comics from ideas to character designs are as follows: determine ideas, create scripts, especially scripts that are ready to be staged, create various characters and their roles, precisely determine the symbols or characters that will play in comics

such as; good characters, flawed characters, and neutral characters or companion roles, as well as creating character images according to the scripts that have been made, editing in the form of interactive PowerPoint using the hyperlink feature, adding comic story sounds and after that adding videos containing pictures and sound so that more exciting and varied. Because comic media is so attractive in students' lives and some students recognize and remember the characters from the comics they watch, the use of comics plays an essential role as a learning tool that is considered valuable and helpful for teaching and developing student creativity.

This media practicality test can be used in a problem-based learning model, so it supports pupils' learning processes (Krismayanti & Mansurdin, 2020), enhance their capacity to absorb their surroundings' creativity (Rahmi, 2019), and foster skills to solve problems (Gusriyenti & Reinita, 2020).

There are limitations in this development research; the digital comics produced only reach the practicality stage. However, material, language, and media are very feasible to use in the learning process. This research is expected to help make it easier for teachers to convey learning material, and students can be assisted in understanding learning material and the formation of positive character/attitude.

CONCLUSION

Digital comics are digitally packaged tools for communicating educational content through graphic story text provided by comic characters. The results of the practicality test of learning media in the form of digital comics were stated to be very practical for fourth-grade elementary school students. The results of this practicality test were obtained through teacher and student responses. The results of the teacher's response show a 95.83% convenient category, and the results of the students' responses get a percentage of 98.8% convenient category. The digital comic learning media developed is not only used during face-to-face learning but can be used anywhere without the need for an internet network so that students can access learning media but must still pay attention to the characteristics and needs of students.

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Assessing students' metacognitive strategies in e-learning and their role in academic performance

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ABSTRACT

The presence of e-learning as a new way of learning in the education system has attracted the interest of researchers worldwide. Higher education still uses the system as part of the method. The critical issue in e-learning is how to promote academic performance. Metacognition theory argues that students' skills determine academic performance. Through metacognitive, students set their own goals, learning, monitoring, and evaluating in e-learning. However, less is known about how students use strategies in e-learning in the Indonesian context. Also, there is a scarcity of empirical evidence about the role of on academic performance. This study aims to assess students' metacognitive strategies and their impact on academic performance (i.e., engagement and achievement) in the e-learning context. One hundred and fifty students participated in the present study. Descriptive statistics and structural equation modeling were performed for data analysis. This study revealed that students have high skills in metacognitive strategies in e-learning. Our study suggested that metacognitive strategies for self-regulated learning were significantly associated with achievement and engagement in e-learning. In comparison, metacognitive for time and environment was only significantly associated with students' attention but not achievements. The contribution of this study to academic practice was explored.

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INTRODUCTION

The integration of digital technology and the presence of e-learning for several decades has led to massive growth in the number of e-learning courses globally. One of the most significant current discussions regarding e-learning as a new system in education is how to promote students' academic performance, including their active participation, particularly in e-learning. Students' engagement has been perceived as a primary challenge the teacher faces in e-learning (Sharif Nia et al., 2022). Metacognition knowledge theory (Veenman et al., 2006) argues that students' academic performance (e.g., engagement and achievements) was closely associated with their skill in

regulating and evaluating their strategies knowledge. Therefore, to promote academic performance, students should use metacognition strategies.

Metacognition refers to a set of regulatory meta-abilities and meta-skills that are intentionally employed to smooth the cognitive and psychophysiological system (Drigas et al., 2022). Metacognition refers to the knowledge about and regulation of one's mental activities in learning (Veenman et al., 2006). Therefore, the terminology of metacognition constitutes knowledge and strategy of cognition. Taxonomically, metacognition can be divided into metacognitive declarative and metacognitive procedural. Metacognitive declarative refers to one's beliefs about their ability or general knowledge. At the same time, metacognitive procedural refers to the control and regulation process (Csíkos, 2022). Metacognitive strategies in our study guide to the metacognitive procedural, where the investigation of this metacognition relates to how students regulate, control, and evaluate their learning. Metacognition promotes academic performance (Anthonysamy, 2021; Csíkos, 2022; Dignath & Veenman, 2021).

Academic performance refers to the students' output, such as engagements, grades, taking exams, giving presentations, etc. (Credé & Kuncel, 2008). In the present study, we emphasized the academic performance on students' engagement and grades. Student engagement is a student's psychological investment in an effort directed toward learning, understanding, or mastering knowledge, skills, or craft that academic work is intended to promote (Kong et al., 2003). Engagement refers to the student's involvement in educationally effective practices and commitment to educational goals and learning (Chiu, 2022). There are several forms of engagement in academic performance: cognitive, emotional, and behavioral. Our investigation will focus on behavioral and cognitive engagement in the present study. Behavioral engagement refers to the extent involved students are in learning activities in terms of attention, participation, effort, intensity, and persistence (Chiu, 2022).

Numeral studies have tried to address the link between metacognitive strategies and academic performance. Student's academic performance in an e-learning context, such as student engagement and achievement, has resulted from metacognitive strategies (Y. Zhang et al., 2022). For example, Csíkos and Steklács (2010) pointed out that metacognitive strategies in the intervention class have been found to run more excellent students' performance in academic reading and mathematics skills. Burin et al. (2020) suggested that students with high metacognitive skills tend to perform better in answering comprehensive questions. Valencia-Vallejo et al. (2019) indicated that students who used the metacognitive strategy presented better achievement than their classmates who did not involve metacognitive skills. Not only has metacognition influenced academic achievement, but also it has been found to play a significant role in promoting academic engagement (Coelho et al., 2019). Sun and Rueda (2012) reported that how students regulate their learning strategies was found to be significantly correlated with three types of academic engagements (cognitive, emotional, and behavior). Overall, from the previous studies, the role of metacognitive strategies in academic performance is crucial.

Although the role of metacognitive strategies in academic performance has been extensively researched in previous studies (Burin et al., 2020; Csíkos, 2022; Csíkos & Steklács, 2010), the extent to which students use metacognitive strategies in the Indonesian context has been rarely investigated, particularly for metacognitive in E-learning. E-Learning and offline learning are different. In offline learning, teachers and students can interact actively with each other. In the e-learning context, students are more independent. Therefore, the role of metacognitive strategies is crucial. Several metacognitive strategies are relevant to promote students' academic performance, such as metacognitive strategies for self-regulated learning and metacognitive for time and environment (Pintrich, 2015). Metacognitive strategies for self-regulated learning refer to the awareness, knowledge, and control of cognition. Metacognitive for time and climate refers to the students' strategy to manage and schedule their education (Pintrich, 2015).

In Indonesia, most of the higher education has already used the e-learning system as the new way of learning. During the pandemic, learning has been transformed into an online system. After the pandemic, learning has come back to offline learning. At the same time, e-learning still has been used in higher education. However, the extent to which students involve in metacognitive

strategies has hardly been studied. Also, few studies have addressed the effect of these skills on academic performance in the e-learning context. Therefore, to contribute to the existing gap in the previous study, this research aim is to assess students' metacognitive skills and their relations to academic performance in the Indonesian context. Gender differences were also examined in the present study. Because gender become an essential issue in several countries regarding academic performance (Shafiq, 2013). For instance, Ciascai and Lavinia (2011) pointed out significant differences between boys and girls students in their metacognitive skills. L. Zhang (2018) suggested that males use higher metacognitive skills than female students. Accordingly, the research questions below will guide our investigations.

1. What is the level of Indonesian students' metacognitive strategies in the e-learning context?
2. Do gender differences exist in terms of metacognitive strategies for e-learning in the Indonesian context?
3. Do the students' metacognitive strategies in e-learning affect their academic performance?

METHOD

Our study's purpose is to explore the effect of students' metacognitive strategies in e-learning and to explore the role of these metacognitive in shaping perceived autonomy and academic performance. This cross-sectional study was conducted in Indonesia. Using snowball random sampling methods, 157 students from two higher education participated in the study. All of the samples in the present research fully participated in e-learning systems. 76% were female students, and 24 % were male students. 38% were second semester, 26% were fourth semester, 16 % were sixth semester, and 20 % were eighth semester.

Concerning the measurement tools, several instruments were adapted to measure students' metacognitive strategies and students' academic performance. The adaptation of the instruments has been through the translation of the instruments from English to the Indonesian language. We measure metacognitive strategies with metacognitive self-regulated learning and metacognitive time and study environment questionnaire. All the questionnaires were rated with a 5-point Likert scale (1= = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, 5= = strongly agree).

We adapted nine metacognitive strategies self-regulated learning items from the motivated strategies for learning questionnaire (MSLQ]; Pintrich et al., 1991) to measure students' *metacognitive strategies*. We modified the items of this questionnaire for the e-learning context. For instance, "I ask myself questions to make sure I understand the material in e-learning" and "When I join e-learning, I set my goal to direct my activities." Four items were also adapted from the same questionnaire to measure students' metacognitive time and study environments. For example, "I study in a place where I can focus on my e-learning" and "I make good use of my study in e-learning." We measure academic performance with students' engagement and achievements. Six items were adapted from need support satisfaction (Standage et al., 2005) to measure students' engagement. For example, "I often discuss with my friend what I learn in e-learning" and "I regularly participated in class discussions." We asked students' grade point averages to measure their achievements. All the instruments were distributed through Google Forms. Students were invited to complete this questionnaire using WhatsApp.

The data analysis has been conducted with several steps. First, we examined the validity of our instruments with exploratory factor analysis (EFA) and confirmatory factor analysis (CFA). Several criteria were used to investigate the fit model of this instrument. These are the comparative fit index (CFI), Tucker Lewis Index (TLI), RMSEA, and SRMR. The cutoff value for CFI and TLI should be > .90, RMSEA < .08, and SRMR < .05, indicating the model fit (Hair et al., 2019; Hu & Bentler, 1999). Second, students' metacognitive strategies were explored using descriptive statistics. The students' metacognitive strategies level was also examined based on their gender differences by performing a t-test. Multiple regression analysis examined the association between students' metacognitive strategies and academic performance.

RESULT AND DISCUSSION

Result

Confirming the validity and reliability

We confirmed the validity and reliability of our instrument by performing confirmatory factor analysis (CFA) using Mplus 8 software. CFA result showed the fit model of our instruments, Chi-square = 181.29, df = 63, CFI = .92, TLI = .91, RMSEA = .07, SRMR = .06. According to Hair et al. (2019) and Hu and Bentler (1999) the cut off criteria CFI, TLI should close to .95 and RMSEA should < .08. The loading factors range from 0.52 to 0.78 which indicated that the items were valid to measure the latent variables. We deleted two items (a4 and a6) of academic engagement and 1 item of metacognitive self-regulated learning (Ms5). Cronbach alpha was used to confirm the internal consistency of our instruments. The coefficients of Cronbach alpha for our instruments indicated that metacognitive strategy for self-regulated learning, metacognitive for time and study environments, and engagement instruments were reliable. .87, .83, and .82, respectively.

Concerning the convergent validity, we evaluated it based on the values of average variance extracted (AVE). Although the AVE for metacognitive self-regulated learning and metacognitive time and environment was lower than 0.5, the composite reliability (CR) for these scales was higher than 0.7. Therefore these instruments were acceptable (Hair et al., 2019). The convergent validity was evaluated based on the root of AVE. The data showed that all the roots of AVE were higher than the correlation between factors. Therefore, our instruments fulfilled the discriminant validity criterion (Hair et al., 2019).

Descriptive statistics and correlations

Table 1. describes the descriptive and the correlations among variables in the present study. The data showed that students have high skills in metacognitive self-regulated learning and metacognitive time and environment according to the mean result of a 5-point Likert scale. Students also viewed they were engaging in e-learning. The correlations data showed that metacognitive self-regulated learning and metacognitive time were strongly correlated with metacognitive time and environments. Both metacognitive strategies were also strongly correlated with students' engagement in e-learning.

Table 1. Descriptive statistics and correlations

No.	Variables	Mean	SD	1	2	3	4	5
1.	Metacognitive self-regulated learning	3.56	.62	**.71**				
2.	Metacognitive time and environment	4.07	.76	.56**	**.64**			
3.	Engagement	3.77	.66	.68**	.63**	**.77**		
4.	Gender	-	-	.15	.03	.08		
5.	GPA	-	-	.41**	.30**	.34**	.02	
6.	AVE	-	-	.50	.41	.60	-	-
7.	CR	-	-	.87	.73	.70	-	-
8.	Skewness	-	-	-.32	-1.49	-.46	-	-
9.	Kurtosis	-	-	1.59	3.70	1.32	-	-

Note. ** significant in the level.001 (p <.001), * significant in the level .05 (p <.05). AVE = Average variance extracted; diagonal values are the root square of average variance extracted. CR = Composite reliability.

RQ1: What is the level of Indonesian students' metacognitive strategies in e-learning?

Table 2 describes the students' metacognitive skills in e-learning. Overall, the data indicated that students used metacognitive skills. In the e-learning, most students expressed that they noted every critical information. It means that students not only used the information provided in the tools, but also, they recorded each piece of information. Students also expressed that they have changed their strategy if they were difficult to understand the course in e-learning.

Table 2. Descriptive statistic of students' metacognitive strategies in e-learning

No.	Variables	Mean	SD
1.	Metacognitive Strategies for self-regulated learning		
2.	During e-learning, I noted the importance of information	3.77	0.90
3.	When I read the course in e-learning, I make up questions to help my focus	3.21	0.83
4.	When I become confused about something I'm reading in e-learning, I try to figure it out.	3.72	0.95
5.	If course materials are challenging to understand, I change the way I read the material	3.45	0.95
6.	I ask myself whether I understand the topic or not in e-learning	3.55	0.82
7.	I try to change the way I study to fit the course requirements	3.65	0.83
8.	In e-learning, I try to determine which concepts I don't understand well.	3.59	0.80
9.	In e-learning, I set goals to direct my activities in each study period.	3.68	0.95
10.	Metacognitive strategies for time and environment		
11.	I join e-learning regularly	4.39	0.88
12.	I make good use of my study time in e-learning	3.85	0.93
13.	I have a regular place set aside for study	4.12	0.93
14.	I study in a place where I can concentrate on my coursework	3.92	0.99

Concerning the skill of managing time and environment, the data showed that most students expressed that they were good at managing their time and environment. They said that they were regularly joining e-learning. They were strategic in setting their time and environment to reach their desired goals. Students showed that they were strategic in finding a comfortable place in e-learning. They could see a comfortable place when joining e-learning.

RQ2: Do gender differences exist regarding metacognitive strategies for e-learning in the Indonesian context?

An Independent sample t-test was used to examine whether male and female students were equal regarding their metacognitive strategic skills. The t-test result showed that gender inequality did not exist in this study. Both male and female students have the same level of metacognitive strategy for self-regulated learning (M (SD) = 3.41 (0.69) vs. M (SD) = 3.62 (0.59), respectively, F = 0.19, p = 0.7). Both of them were also equal in metacognitive strategy for time and environment skills (M (SD) = 4.03 (0.82) for male vs. M(SD) = 4.09 (0.74) for female, F = .00, p = .72)

RQ3: Do the students' metacognitive strategies in e-learning affect their academic performance?

Covariance Based- Structural equation modeling (CB-SEM) was performed to examine whether students' metacognitive skills positively impact academic performance. There are two exogen variables and two variables' endogens. Metacognitive skills, self-regulated learning, and metacognitive time and environment were exogen variables in the present study. Students' engagement and achievement were endogen variables in this study.

Figure 1 the standardized association between metacognitive strategy skills and academic performance. MSR = metacognitive for self-regulated learning, MTE = metacognitive skills for time and environment, AEG = Engagements, GPA = Grade point academic, ms1 – ms9 = the item 1 of metacognitive for self-regulated learning, tm1-tm4 = the items of metacognitive for time and environment, a1-a6 = the items of academic engagement.

The normality data was evaluated based on skewness and kurtosis. We accept the |3| criterion for skewness and |8| for kurtosis (Kline, 2005). We found the fit model of the relations between metacognitive strategy skills and academic performance, Chi-square = 192.08, df = 113, p < .001, CFI = .94, TLI = .93, RMSEA = .06, SRMR = .06. Metacognitive strategy for self-regulated learning were positively associated with GPA (β = .38, p < .001) and academic engagements (β = .59, p < .001). At the same time, the metacognitive skills for time and environment were positively associated with academic engagements (β = .41, p < .001). The association between metacognitive skills for time and setting and students' achievement was insignificant (β = .09, p = .45).

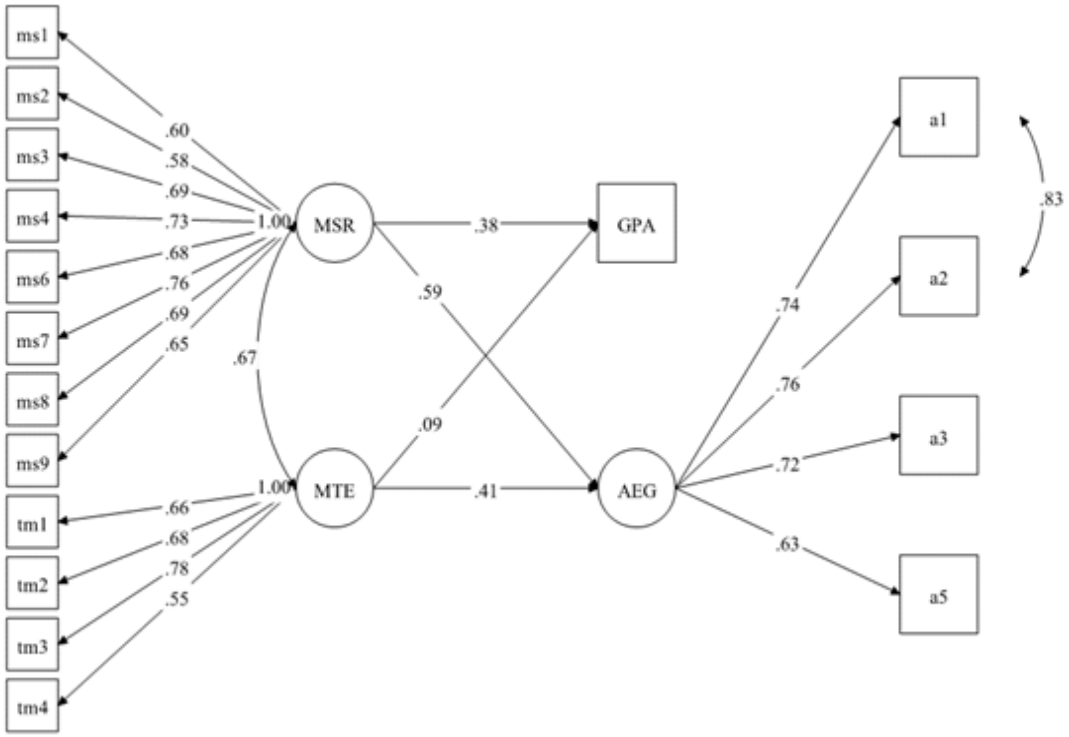

Figure 1. Standardized Association

Discussion

Our main study is to explore students' metacognitive strategy skills in e-learning and their effect on academic performance. The finding of this study contributed to providing data on the level of students' metacognitive skills and how to improve students' academic performance in e-learning. The first finding of this study told us that students have good metacognitive strategy skills in e-learning. Students expressed that they were strategic in regulating their ways to reach the goal, such as, "If course materials are difficult to understand, I change the way I read the material." In the context of e-learning, Barnard et al. (2009) argued that the strategy may fluctuate in the learning environment context.

Most importantly, students also have attempted to reflect on whether or not they understand the e-learning courses. In other words, students in e-learning tend to practice metacognitive strategy skills. The experience in using e-learning before and after the pandemic may contribute to students' metacognitive skills in Indonesia. However, further investigation is whether Indonesian students still use these skills for an extended period of the e-learning system. Because, in some cases, students can drop out of e-learning. For instance, in the MOOC context, students tend to drop out of online learning (Vilkova, 2022).

The second finding of this study told us that male and female students were equal in terms of metacognitive strategies. This finding contradicts Ciascai and Lavinia (2011) and L. Zhang (2018), who found significant differences in metacognitive skills between male and female students. This study aligned with Hidayatullah et al. (2023), who suggested that male and female students were equal in their metacognition beliefs in the Indonesian context. Our interpretation in this stage is that students have the same chance in online learning contexts. Therefore, gender was not a big issue regarding metacognitive strategies in e-learning. The third finding of this study revealed that metacognitive strategies for self-regulated learning influenced their engagement and their academic performance. In other words, when students regulate their own learning, they gained better achievement in academic performance. The more strategic students were in learning, they became

more active. This finding is in line with the study by Coelho et al. (2019), which suggested that the more strategic students in regulating their learning, the they were more engaged in academic performance. Sun and Rueda (2012) argued that in distance education, their environment determined personal factors, such as the metacognitive for self-regulated learning skills. E-learning may provide a situation that pushes students to be more autonomous and organize their learning. Also, this study found that metacognitive strategies for self-regulated learning were positively associated with their grade point academics (GPA). This finding revealed the same result as the previous studies (Ajisuksmo & Saputri, 2017; Jain & Dowson, 2009; Wang et al., 2013) that suggested the role of these skills in academic performance. It means that the level of students' metacognitive strategies for self-regulated learning determined their performance. The decreasing of their skill in metacognitive strategies for self-regulated learning has been found to be a serious problem for their achievements. Surprisingly, metacognitive time and environment was only significantly associated with students' engagement but not with academic performance. Our interpretation of this stage is that by the time students set their schedule and the environment, they become more comfortable discussing and interacting with their peers.

To summarize this finding, our study told us that metacognitive strategies were very important to promote academic performance, such as grade point academic and academic engagements. Metacognitive strategies for self-regulated learning were not only associated with their academic grade but also associated with their engagements. Although metacognitive for time and environment was insignificant to grade point academics, it was significantly associated with their engagements.

CONCLUSSION

The finding of this study contributes to the teaching and learning practice. Our study showed that metacognitive strategies play a significant role in academic performance. Therefore, for the teacher, demonstrating how to use metacognitive strategies to their students would help students in increasing their engagement and academic achievement. For example, encourage students to reflect on whether they are understood or not the courses in e-learning—training students to find some questions and focus on e-learning. Training students in setting their goals, schedule, and environment would also increase their academic performance and active participation in e-learning. Although our study provided important data for academic discourse and practice for teaching, several limitations should be reminded for the next study. This study is cross-sectional based. Therefore, each association between variables cannot be claimed as a causal relationship relation. For the next study, it is important to consider the longitudinal design study approach. This study only measured students' responses to e-learning. It is necessary for further investigation to involve students' metacognitive strategies in offline learning contexts. Our sample in this study was quite small, which affected the generalizability issue. For future research, expanding the sample is necessary.

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Using the second-generation Web 2.0 tools in developing university EFL students' English language skills

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ABSTRACT

In 2020, conducting education at a distance was obligatory while the world fought the coronavirus disruption. Technology utilization in distance education has demonstrated its significance in teaching English to instructors and learners. This quantitative study examines university EFL learners' perceptions regarding using second-generation Web 2.0 tools (Quizizz, Socrative, Edmodo, and Quizlet) to develop their English skills. This study was conducted with 150 students of the general English language requirement course at the University College of Applied Sciences in Gaza. The results of this study indicate that the participants appeared to have positive attitudes towards using Web 2.0 tools in general. The study results further indicate that both intermediate and low-level students reported more positive opinions about implementing the digital tools individually or all together when compared to other advanced-level students. The participants differed significantly in their perceptions of the awareness and actual usage of the Web 2.0 tools. The implications of this study indicate that these repeatedly used Web 2.0 tools as curricular tasks could be substituted or replaced with other digital tools to alleviate the oversaturation and reluctance to use digital tools by EFL learners.

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INTRODUCTION

Since February 2020, the world has been "caught by surprise with the unexpected arrival of a virus that has now claimed several innocent lives in different parts of the globe" (Muftahu, 2020). As preventive measures to control the rapid spread of the outbreak and to save people's life, governments worldwide assigned different strict roles ranging from imposing lockdowns and wearing masks to ensuring strict social distancing protocols (Nixon et al., 2020). Accordingly, the lockdown for countries becomes a problematic choice, hence its effects will be reflected in their economic, social, and educational life.

The education system is one of these sectors severely affected by the emergence of Covid-19. As stated in UNESCO, approximately 264 million students were not in their schools hence this

pandemic has worsened things (Getty & Pixelfusion, 2020; Holt, 2020). The spread of the pandemic has continually stipulated converting and transforming educational landscapes. There has been an increasing shift towards online virtual teaching because educational institutions are suspended indefinitely as the only option (Getty & Pixelfusion, 2020; UNESCO, 2020). Conducting education at a distance was obligatory since the education process must continue while the entire world was still fighting COVID-19 disruption. Throughout this period, technology utilization in distance education has demonstrated its significant role in teaching English to instructors and learners.

The advancements in computer and Internet technologies have formulated revolutionary trends entitled both language teaching and learning. These technologies range from concepts such as Computer-Assisted Language Learning (CALL), Technology-Enhanced Learning (TEL), and Web-Enhanced Language Learning (WELL) to Information and Communication Technologies (ICT) (Levy & Stockwell, 2007; Nami et al., 2016; Paulsen, 2002). Technology integration in language teaching indicates that it is not a recent concern. This technology utilization is to nourish prospects for language learning through the integration of technology into language teaching. Technology integration is essential to foreign language (FL) teaching. Implementing technology to serve the needs of learners' language acquisition would emerge as a major concern for language teachers. The new generation of technology learners is defined as "digital natives" (Thorpe, 2001), "Net generation" Jones et al., (2010), and "millennials" Oblinger & Oblinger (2005) and hence technology becomes a generation feature. Respectively, implementing Web 2.0 technologies into teaching practice and learning settings is of utmost importance for teachers who would not want to lag behind their students who see technology as a part of their daily life activities. Respectively, important elements should be considered as the attitudes and opinions of technology users (Ateş Çobanoğlu et al., 2017). These high-tech tools have positive reactions on behalf of both students and teachers, where they are highly motivated by means of technology. The integration of Web 2.0. tools in learning and teaching environments should be studied for effectiveness and efficiency by measuring and highlighting the students' perception, especially in the EFL learning context.

Theoretical Framework

Using educational technology can improve and reform students' learning. There are many types of educational technology worldwide and with various branches. For example, E-learning, Web-based Learning, Digital Learning, etc., are all classified as Distance learning. Classroom technology has become a necessary condition for conducting daily learning activities. Furthermore, technological advances have made it possible to integrate high-tech tools into classroom activities, such as supporting group learning and reviewing the material. As an emerging model, Multidimensional education is a particular type of learning model where students can learn in both settings; the classroom and at home (Clipa, 2014). Accordingly, in class, time is spent on practice or one-on-one learning, and when students are back home, they can use other online tools, such as Quizlet, Quizizz, or Google Forms, as a Self-Diagnostic and studying tools (Mohamad, 2020; Rahayu & Purnawarman, 2019; Thuận, 2018).

Second Generation Web 2.0 Tools and SAMR Model

The Shift from Web 1.0 to Web 2.0 started in August 1995 when Web 1.0 was born due to the Internet shifting from being invisible to being visible everywhere and to everyone (Getting, 2007; Thompson, 2007). Eight years later, Dale Dougherty introduced the popular buzzword 'Web 2.0' in 2004 (Thompson, 2007). Appointed by West and West (2008), the history of the World Wide Web witnessed a dramatic change from 'the read-only Web' or 'Web 1.0' to 'the read-write Web' or 'Web 2.0'. McLeod and Vasinda (2008) and Wang and Vasquez, (2012) described Web 1.0 as "one-way communication" or "a monologue" (p. 260) hence people were only able to browse, read and retrieve information. Respectively, Web 1.0 created more passive users with limited human-computer interaction (West & West, 2008). In this aspect, Web 2.0 can be described as a "dialogue" McLeod and Vasinda (2008), while Kapp and O'Driscoll (2010) used the term "web-volution" to describe the shift from Web 1.0 to Web 2.0 because of Web 2.0 technologies benefits. Considerably, Web 2.0 takes a participatory form engaging participants in social media,

blogs, and podcasts, shifting from read-only Web to read-write Web. It is worth noting that technology can make student-based learning highly interactive. Technology can enhance and reinforce the learning experience. It can be seen as a major support for education pedagogy. Integrating technology within classroom practices has become evident that students can go through formative steps to become proficient in the blended learning experience.

Web 2.0 tools facilitate authentic interactions with content and other learners, allowing them to respond to assignments innovatively. They also offer learners real-world problems, thus allowing them to practice problem-solving skills, considered among the 21st-century skills (Iwuanyanwu, 2020). Furthermore, the study by More and Nicole (2015) revealed that American students had positive perceptions regarding learning efficiency and using YouTube in online, hybrid courses. It was found that integrating YouTube into courses was especially effective in developing fully online learners' educational experiences. Parallel findings were reported in English for Specific Purposes (ESP) context. Balula et al., (2014) investigated the educational benefits of a concept-mapping tool called IHMC Camp. It was used to teach reading and speaking in a Business English course. According to the study results, in addition to the vocabulary acquisition of Business English, the linguistic competence of the Portuguese learners was enhanced. Additionally, their collaboration and communication skills were also developed.

Questions in research on the effects of this interactive technology and how 2.0 tools can be used to support the teaching-learning process can be answered in the light of online education theories and models. One of these models, representing a framework for evaluating online learning, is The SAMR (Substitution, Augmentation, Modification, Redefinition) Model. By exploring the possibilities and reviewing the literature, it becomes clear that many factors influence the implementation of 2.0 technology within the educational context in general and EFL language learning. Discussions of 2.0 technology in education often focus on selecting an appropriate tool for learning activities. However, it is more important for educators and instructional designers to focus on how these tools can improve learning.

Understanding the SAMR Model allows educators to reflect on their progress while investigating ways to use educational technology in a valuable and productive way. The SAMR Model allows all educators to view the steps they are taking down along the road of technology enhancement toward true transformation (Hamilton et al., 2016; Romrell et al., 2014). All educators must realize that the final goal of any classroom is redefinition (Marlatt, 2019; Zhai et al., 2020). Sometimes, even the most proficient educators with technology conduct a task at the substitution level. It comes down to the tool fitting the task and learning target. Through the work of Ruben Puentedura, the SAMR Model (Substitution, Augmentation, Modification, Redefinition) provides a wonderful lens to look at this progression. It must be understood that the goal is to create lessons that allow for the ability to facilitate lessons that practice redefinition. At the same time, it must be remembered that all the stages allow for technology interaction and increased student engagement. Sometimes, simple substitution is all that is needed and is most appropriate by giving the learning target. Educators becoming familiar with the SAMR Model allows them to reflect and evaluate their technology integration practice while striving for powerful learning experiences. While learning activities can get blurred between the steps of SAMR, it must be remembered that educators are working on a progression (Alivi, 2019; Budiman et al., 2016; Tseng, 2019). The first two steps involve technology as an enhancement tool, and the last two involve technology as a transformation tool. The steps between enhancement and transformation can often take some time as educators practice, reflect, and learn.

Examples of Web 2.0 Tools in Teaching EFL

Edmodo

Founded in 2008, Edmodo, also known as "Facebook for school," is a free social media and learning platform for teachers and students alike. The platform is supported by applications that enable educators, students, and parents to access Edmodo when needed. It is considered an educational website that takes the ideas of a social network and refines them and makes them appropriate for a classroom. As a collaborative platform (Rahman & Kodriyah, 2015), Edmodo

provides useful advantages for learners in developing their writing skills (Al-Naibi et al., 2018; Alsmari, 2019). Also, Edmodo can be helpful with sentence structure, spelling, and vocabulary for EFL students (Al-Naibi et al., 2018). In addition, Edmodo could provide scaffolding for students' motivation to learn English. Edmodo students also have positive opinions and attitudes regarding its usage in their language learning process (Al-Naibi et al., 2018; Alsaidi & Al-Ruheili, 2015). In a safe environment, students and teachers can reach out to one another and connect by sharing ideas, problems, and helpful tips. A teacher can assign and grade work on Edmodo, while students can get help from the entire class. With Edmodo, teachers can truly bring the classroom online. With the ability to give students assignments, quizzes, and polls, Edmodo users can manage their classes and consolidate all their activities in one place. Edmodo can be used in a classroom through various applications that allow students to connect with their teachers. Teachers can set up classes for each school or set up a large class and have all their students in one group, making it simple to track student progress. Grades can also be stored and easily accessible through Edmodo. It also allows teachers to gather student feedback on class discussions and assessments and offer suggestions to confused students. It is the teachers' all-in-one line of communication, grade book, and assessment tracker.

Quizlet

Quizlet is an American online study application that allows students to study various topics via learning tools and games. It was founded by Andrew Sutherland in October 2005 and released to the public in January 2007. Quizlet trains students via flashcards and various games and tests. As of February 2019, Quizlet has over 300 million user-generated flashcard sets and over 50 million active users as it ranks among the top 50 websites in the U.S. In 2016, Quizlet was recognized by Similar Web as the fastest-growing US Education site in 2015. As a Web 2.0 tool, Quizlet can be considered a promising tool for learners and teachers, considering the opportunities for vocabulary learning and teaching (Sanosi, 2018). The way learners perceive Quizlet's use and usefulness is another significant issue to be considered, and positive reactions are the most recurrent emergence (Anjaniputra & Salsabila, 2018).

Quizizz

Quizizz was founded by Antik Gupta and Deepak Joy Cheenath in 2015, and it started to be used in a school in Bengaluru, India. Quizizz is a Web 2.0 tool that has built a learning stage for pedagogies, learners, and parents. It helps teachers and parents to check children's homework and exams and bring those tasks into a self-paced game (Chaiyo & Nokham, 2017; Orhan Göksün & Gürsoy, 2019). Quizziz is considered an online student-paced formative assessment tool that allows teachers and students to create and use one another's quizzes. After providing students with a unique access code, a quiz can be presented live as a timed competition or used for homework with a specific deadline. After the quizzes have been completed, students can review their answers.

Furthermore, the resulting data is compiled into a spreadsheet to give the instructor a clear visual of the student's performance and analyze trends in which areas might need the most focus. Teachers can use this immediate feedback to revise future learning activities and alter the focus of material by putting a more significant emphasis on concepts that students are struggling with. Quizizz has a very straightforward layout, and the site does a great job of helping teachers through the step-by-step quiz-making process.

Socrative

Socrative is a cloud-based student response system developed in 2010 by Boston-based graduate school teachers and students. Socrative is an interactive and engaging assessment. It provides immediate paperless feedback via formative assessments. It saves time when grading assignments. It allows teachers to create simple quizzes that students can take quickly on laptops or, more often, via classroom tablet computers or smartphones (Guarascio et al., 2017; Lim, 2017). In Socrative, quizzes can be true or false, multiple choice, graded short answers, or allow open-ended short responses. Activities can either be teacher-paced during a classroom discussion or student-paced for use as a more traditional class-end "exit ticket" or quiz. There is also a gaming

element: the "Space Race" feature can set up a quiz so that teams of students can compete against one another to launch rockets into space. Results can be displayed live in the classroom to facilitate discussion with student identity kept anonymous, a "nifty way of using formative assessment to further students' learning." At the same time, teachers can access detailed classroom and student data on their own devices. Socrative is a smart student response system that empowers teachers to collect student data via smartphones, laptops, and tablets. Socrative is the most helpful SMS application because students can use it on any platform with internet service rather than phones with text messaging services.

Web 2.0 in The EFL Setting

Integrating Web 2.0 in education offers several features that could serve as educational value (Ferdig, 2007). Consequently, as indicated by the literature, a vast amount of research has explored using Web 2.0 tools in language classrooms. To illustrate, according to the classification made by (McLoughlin & Lee, 2010), among the Web 2.0 tools that are used mostly in the field of education are blogs, wikis, social networking tools such as Facebook and Myspace; multimedia archives such as podcasts, YouTube, e-portfolios; synchronous communication tools such as Skype, and 3D worlds such as Second Life. Furthermore, Wang and Vasquez (2012) investigated the literature on the current research trends that focused specifically on Web 2.0 and the second language (L2). They found that Web 2.0 technologies help create a learning atmosphere that is comfortable, relaxed, collaborative-oriented, and community-based. Another finding from their study indicates that Web 2.0 tools help to foster a favorable language learning environment for learners. Concerning these tools, for instance, Alsmari (2019) investigated the effects of using Edmodo on learners' development of paragraph writing skills. In his experimental research, eighty female Saudi ELT students of pre-intermediate level were exposed to Edmodo through writing tasks. Furthermore, (Al-Naibi et al., 2018) investigated the use of Edmodo for processing writing skills and the perceptions and attitudes of students regarding the use of Edmodo. In their action research, 25 pre-intermediate Arab EFL learners at the tertiary level volunteered. The pre-test and post-test showed that the learners' writing skills statistically significantly improved after the intervention using Edmodo regarding paragraph organization, topic sentence accuracy, and sentence structure. Also, the survey results demonstrated that students had positive opinions concerning using Edmodo for learning English. Almost all (90%) showed a positive attitude towards using Edmodo. The survey results also revealed that Edmodo helped passive students become more active. With the help of Edmodo, the learners learned from their peers. Moreover, they felt more secure and comfortable with Edmodo. They also thought that Edmodo helped with writing, grammar, spelling, and vocabulary.

Drawbacks and Limitations of Web 2.0 Tools.

Despite the benefits of Web 2.0 tools in motivating students and increasing their interest in learning and interacting with their instructor and the language, there are still some drawbacks. Students will feel ' oversaturated ' if the teacher overuses a Web 2.0 tool. Oblinger and Oblinger (2005) warns that "not all students have computers, not all are skilled users, and not all want to use technology" (p. 18). Therefore, it should be borne in mind that teachers who want to use Web 2.0 technologies in teaching and want their students to benefit from them must be prepared to provide scaffolding to the learners. Web 2.0 tools cannot be considered open and safe all the time hence most of these tools have a drawback side. For example, by using Quizizz, students can become more individualistic and unwilling to help other students who are in trouble. The drawback addressed in this part is that Quizizz may distract students when using Quizizz during class; the second one is that this kind of e-learning-based technique is not designing the knowledge individually. Pedagogies can use e-learning techniques to decrease their working pressure, but students are at different levels of learning. It is hard to follow teachers' progress and make themselves feel more stressed when they get low results than others. Therefore, using Quizizz to set up the same complex tasks for students is challenging. Quizizz does not deliver knowledge and assessments individually. At this point, it lacks consideration of personal needs and motivation.

Purpose Statement

While quite a vast amount of literature has been searched on Web 2.0 utilization into EFL language teaching and learners' attitudes, there is an urgent need to shed light on the learners' perception of the efficiency of this technology advancement on their EFL skills improvement. Different high-tech platforms are established to support the quest of learning and teaching; among these tools are Quizizz, Socrative, Edmodo, and Quizlet, which act as promising potentials in connecting students with their teachers. These platforms create interactive and enjoyable environments where students can improve language efficiency despite teaching virtually. Therefore, there is a need for studies that focus on less investigated Web 2.0 tools such as content creation tools, online study platforms, and learning management systems.

This study explores the students' perceptions of utilizing second-generation Web 2.0 tools represented by the platforms in developing English language skills. To the best of the researchers' knowledge, few studies on English preparatory school students' perceptions and attitudes. Regarding Web 2.0 have been conducted at the English EFL university students' level. In this respect, this study will make use of four Web 2.0 tools that are Edmodo, Quizlet, Quizziz, and Socrative, to investigate tertiary-level EFL learners' perceptions of perceived usefulness, ease of use, awareness, and actual system usage of these specific tools in their language learning quest. This study examines whether there are any statistically significant differences among different levels of EFL learners' perceptions and attitudes regarding the use of Web 2.0 tools. For these purposes, the study addresses the following research questions:

(1) What is the learners' perception of the usefulness of the Web 2.0 tools (Edmodo, Quizlet, Quizizz, and Socrative)?
(2) Is there a statistically significant mean difference among EFL learners regarding their perceptions of the usefulness of the Web 2.0 tools (Edmodo, Quizlet, Quizizz, and Socrative)?
(3) What are the EFL learners' attitudes towards using the Web 2.0 tools (Edmodo, Quizlet, Quizizz, and Socrative)?

METHOD

This descriptive-analytic study investigates the perceptions of tertiary-level English EFL learners regarding usefulness, perceived ease of use, awareness, and actual system usage and their attitudes toward Web 2.0 tools (Edmodo, Quizlet, Quizizz, and Socrative). This study examines whether there are any statistically significant differences among different levels of EFL learners' perceptions and attitudes regarding the use of Web 2.0 tools.

This quantitative and descriptive study uses a non-experimental, cross-sectional survey design. This study presents EFL learners' perceptions of using Web 2.0 tools for language learning. This study aims to describe EFL learners' perceptions as they are without applying any intervention. Next, this research study is non-experimental since the researchers do not attempt to control the variables as Ary et al., (2006) highlights: "The researcher identifies variables and looks for relationships among them but does not manipulate the variables" (p.29). Third, this study can be considered a survey design study because an adapted online survey was employed to obtain data. This study is also cross-sectional because the data were obtained at one point in time but from learners with different levels of English competency, and the sample was drawn from a predetermined population (Fraenkel et al., 2012).

This study was conducted at the University College of Applied Sciences in the Gaza Strip. The participants were first-level English requirements students at the University College of Applied Sciences in the first semester of 2020-2021. An online questionnaire was sent to 250 male and female students, and 150 questionnaires were retrieved, yielding a response rate of (60%). The questionnaire consisted of two main sections. The demographic information of the participants has been presented in Table 1.

Table 1. Demographic Information of Participants

No.	Variables	Category	N	Percentage
1	Gender	Male	98	65.3%
		Female	52	34.6%
2	Years of study	First Grade	33	22%
		Second Grade	27	18%
		Third Semester	47	31.3%
		Fourth Semester	43	28.6%

It can be seen in Table 1 that there were 52 female and 98 male students in the study group. In addition to this, 33 of the participants were their first semester, 27 of them were in their second semester, 47 of them were in their third semester, and 43 of them were fourth-semester students.

The first section of the survey focused on the participants' perceived usefulness, perceived ease of use, awareness, actual system usage, and attitudes toward using Web 2.0 tools. The results of the structural validity of the questionnaire indicate that all correlation coefficients in all areas of the first questionnaire are statistically significant considering ($p \leq 0.05$). The Cronbach's Alpha coefficient value for all the items was (0.942). It means that the coefficient stability is high and statistically significant. After cleaning the missing data from the survey, the Cronbach Alpha Coefficients and Corrected Total- Item Correlation levels for the four constructs in the survey were analyzed for the actual survey. Following the reliability analysis of the items, composite scores were formed for each construct to continue with inferential statistics. Nonetheless, descriptive statistics were run as well with the aim of a better understanding of the data.

RESULTS AND DISCUSSION

Results

Based on quantitative data from an online survey, tertiary-level EFL learners' perceptions and attitudes towards using the Web 2.0 tools (Edmodo, Quizlet, Quizizz, and Socrative) were gathered and analyzed using SPSS. With the following results and discussion regarding the overall descriptive and inferential statistics, it may be possible to make assumptions about tertiary-level EFL learners' perceptions and attitudes toward Web 2.0 tools.

The learners' perception of the usefulness of the Web 2.0 tools (Edmodo, Quizlet, Quizizz, and Socrative)

EFL learners' perceptions of the usefulness of the Web 2.0 tools (Edmodo, Quizlet, Quizizz, and Socrative) were examined. Before seeking the answer for whether there was a statistically significant difference among EFL students in terms of their perceptions on the usefulness of the Web 2.0 tools through one-way ANOVA, Levene's Test of Equality of Error Variances (homogeneity of variances) criteria were met ($p = .733$). It proceeded with Tests of Between Subjects Effects. As the results from Table 2 indicate, there was not a statistically significant mean difference between the students ($F_{(2, 83)} = 11.652$, $p = .321$) pertaining to the participant's perceptions of the usefulness of the Web 2.0 tools (i.e., Edmodo, Quizlet, Canva). Then, to find out which levels of learners differed from each other, multiple comparisons were conducted.

Table 2. One-Way ANOVA Results for EFL Learners' Perceptions of the Perceived Usefulness of the Web 2.0 Tools

No.	Perceived Usefulness of	N	Sum of Squares	Mean Square	df1, df2	F	P	R^2	Adjusted R^2	Observed Power
1	Web 2.0 Tools	146	1.248	.574	2.85	1.652	.231	.035	.013	.323
2	Quizlet	148	5.155	3.57	2,85	4.41	.006	.123	.092	.881
3	Edmodo	148	.112	.056	2,85	.012	.010	.002	-.002	.066
4	Quizizz	148	1.59	.970	2,85	.950	.210	.021	-.021	.207
5	Socrative	148	1.59	.805	2,85	.915	.232	.021	-.021	.251

Although it was found that there was not a significant mean difference among EFL learners in terms of their perceptions of the usefulness of the Web 2.0 tools, the results from a total of 150 participants showed that the mean scores of the participants from intermediate and low-level were very close and possibly indicated that they were mostly satisfied and share positive perception about the usefulness of the Web 2.0 tools altogether. However, as suggested by the mean results, there was not a strong inclination for the EFL learners to hold onto positive opinions regarding the usefulness of these Web 2.0 technologies. One possible reason could lie in the learning style and preferences of the learners in that "not all students want to use technology" in their learning journey, as asserted by (Oblinger & Oblinger, 2005).

Is there a statistically significant mean difference among EFL learners regarding their perceptions of the usefulness of the Web 2.0 tools?

In terms of their perceptions of the usefulness of Edmodo. The results demonstrated having the lowest mean score, the participants from the advanced level statistically differed from the other two levels. Whereas intermediate and low-level EFL learners possessed moderately positive opinions on the usefulness of Edmodo for their language learning, advanced-level EFL learners were hesitant to provide a clearer-cut opinion and therefore appeared to have neutral opinions. The reason might be that the advanced-level students used Edmodo only once as a curricular activity. Although there was not a statistically significant mean difference among the three levels, the descriptive statistics show that EFL learners from all three levels appeared to share moderately positive opinions about the perceived usefulness of Quizlet and Socrative. This result moderately aligns with other relevant literature studies (Phi et al., 2016). In terms of their perceptions of the usefulness of Edmodo, even though there was not a significant mean difference among the levels, the descriptive statistics suggest that EFL learners from all three levels have tended to possess neutral opinions. To a certain extent, this result diverged from what previous studies found. For instance, EFL learners' perceptions of the usefulness of Edmodo were generally positive (Manowong, 2017; Yundayani, 2019).

The EFL learners' attitudes towards the use of the Web 2.0 tools (Edmodo, Quizlet, Quizizz, and Socrative)

Before seeking the answer for whether there was a statistically significant mean difference among A, B, and C level EFL learners in terms of their attitudes towards the use of the Web 2.0 tools (through one-way ANOVA, Levene's Test of Equality of Error Variances (homogeneity of variances) criteria were met (p=.855). After that, it was continued with Tests of between-Subjects Effects. The results from Table 3 suggest that there was no statistically significant mean difference between A, B, and C levels (F(2, 84)= 1.194, p = .308) regarding the participants' attitudes towards using the Web 2 tools. Based on the information obtained from multiple comparisons through Bonferroni results, the participants in none of the three levels (MA = 3.97, SD = 0.718), (MB = 4.21, SD = 0.626) and (MC = 4.27, SD = 0.855) statistically significantly differed.

Table 3. One-Way ANOVA Results for EFL Learners' Attitude towards the Web 2.0 Tools

No.	Perceived Usefulness of	N	Sum of Squares	Mean Square	df1, df2	F	P	R^2	Adjusted R^2	Observed Power
1	Web 2.0 Tools	147	1.248	.574	2.84	1.194	.308	.035	.013	.323
2	Quizlet	148	5.155	3.57	2,85	4.41	.006	.123	.092	.881
3	Edmodo	148	.112	.056	2,85	.012	.010	.002	-.002	.066
4	Quizizz	148	1.59	.970	2,85	.950	.210	.021	-.021	.207
5	Socrative	148	1.59	.805	2,85	.915	.232	.021	-.021	.251

Even though it was found that there was not a significant mean difference among EFL learners in terms of their attitudes towards the use of Web 2.0 tools, it was seen from the results of a total of 150 participants that the participants from all three levels had quite positive attitudes towards the use of the Web 2.0 tools and found these Web 2.0 technologies helpful to interact with their teachers and peers. They also agreed on the collaboration opportunities offered by these Web technologies. Furthermore, the participants agreed that Web 2.0 tools make learning more

entertaining, diverse, comfortable, and less stressful than traditional classroom learning. They also agreed that Web 2.0 technologies enabled them to be more creative and innovative. Furthermore, the participants thought that the advantages of using Web 2.0 tools for their language learning endeavors were more than the drawbacks, thus, believing in the importance of using Web 2.0 technologies for their learning. In addition, through Web 2.0 tools, the participants agreed that they became more active than passive learners.

Discussion

The Internet has replaced other forms of communication in today's age of lightning-fast technology breakthroughs, both in our everyday lives and in the classroom. The second generation of online tools, or Web 2.0 technologies, have allowed students to participate more actively in their learning. This study investigated how university-level EFL students perceived utilizing second-generation Web 2.0 technologies (Quizizz, Socrative, Edmodo, and Quizlet) to improve their English. The findings of this study suggest that participants generally had a favorable impression regarding adopting Web 2.0 technologies. Parallel to this finding, Girgin and Cabaroğlu (2021) and Aşıksoy (2018) have stressed that Web 2.0 tools utilized inside or outside the classroom positively impacted the English learning skills of English students. The students agreed that Web 2.0 technologies had an impact on improving their understanding of English. The influence of Web 2.0 technologies, including various materials, on students' knowledge and linguistic communication abilities was highlighted, suggesting that utilizing Web 2.0 tools to learn is more enjoyable and efficient for students than doing it the old-fashioned way. Web 2.0 technologies allow students to develop dynamic, creative, and flexible learning environments. Creating a rich, dynamic, creative, and flexible learning environment from visual and audial elements may impact this result.

The study's findings also show that intermediate and low-level students had more favorable thoughts about using digital tools singly or collectively compared to other advanced-level students. There were notable differences among their opinions of the participants' knowledge and usage of Web 2.0 technologies. The results of this study suggest that other digital tools might be utilized in place of these frequently used Web 2.0 technologies in curriculum activities to reduce the oversaturation and resistance to using digital tools among EFL students. These findings are consistent with previous investigations in the pertinent literature (Phỉ et al., 2016). Even though there was no statistically significant mean difference across the levels, the descriptive statistics indicate that EFL students from all three levels tended to have neutral attitudes toward Edmodo. This conclusion was quite different from what had been discovered in other investigations. For instance, EFL students' opinions of Edmodo's perceived value were largely favorable (Manowong, 2017; Yundayani, 2019).

The influence of Web 2.0 technologies on language learning is crucial since they are user-friendly, affordable, and accessible. Teachers-in-training should be guided by educators on how to use these tools, which positively impact motivational, pedagogical, and emotional elements and may significantly advance learning. Important pedagogical and practical implications can be emphasized based on the results. First is the need to integrate high-tech tools that help create a student-centered environment to maximize and reinforce the target language's use. Second, the repetitive and continuous usage of specific Web 2.0 tools at all the learners' levels can yield oversaturation and reluctance. Considerably, it would be beneficial and more effective for language instructors to select other Web 2.0 technologies as a substitution or reinforcement for the already used Web 2.0 tools. Third, there is an urgent need to involve all the students in selecting the taught topics, contents, and the selected Web 2.0 tools. In this way, the learners would feel that their opinions and preferences were considered when integrating and implementing Web 2.0 technologies for their language learning. As a result, their perceptions of the awareness and the actual usage of Web 2.0 tools could become more positive.

Limitations and Future Research

There were limitations in this study as well. The first limitation was that the study was composed of EFL students involved in studying the English requirements. In future studies, EFL students studying specialized English courses may be interested in the study. The second limitation was that the gender factor was not considered in the study. The female and male students' attitudes toward the Web 2.0 tools can be compared in future studies. Another limitation was that the study used only questionnaires as data collection tools. Data can also be obtained through semi-structured interviews with students.

CONCLUSION

Second-generation Web 2.0 tools offer various opportunities for creating a student-centered environment that maximizes and reinforces the use of the target language. Integrating Web 2.0 resources into EFL language classrooms can create an engaging learning environment for instructors and learners. EFL learners can produce better language output as they interact and interpret content demonstrating their understanding and language abilities. This quantitative study highlighted the perceptions and attitudes of tertiary-level EFL learners about using second-generation Web 2.0 tools (Edmodo, Quizlet, Quizizz, and Socrative).

In this study, results from a total of 150 participants showed that the mean scores of the participants from intermediate and low-level were very close and possibly indicated that they were mostly satisfied and shared positive perceptions about the usefulness of the Web 2.0 tools altogether. Furthermore, the participants from the advanced level have statistically differed from the other two levels. Whereas intermediate and low-level EFL learners possessed moderately positive opinions on the usefulness of Edmodo for their language learning, advanced-level EFL learners were hesitant to provide a clearer-cut opinion and therefore appeared to have neutral opinions. In addition, the participants from all three levels had quite positive attitudes towards the use of the Web 2.0 tools and found these Web 2.0 technologies helpful to interact with their teachers and peers. They also agreed on the collaboration opportunities offered by these Web technologies. Furthermore, the participants agreed that Web 2.0 tools made learning more entertaining, diverse, comfortable, and less stressful than traditional classroom learning. They also agreed that Web 2.0 technologies enabled them to be more creative and innovative.

The study's results demonstrated that the intermediate and low-level participants generally reported more positive perceptions and attitudes regarding using the Web 2.0 tools individually or altogether. In contrast, advanced-level participants tended to have negative or neutral opinions. Edmodo was found the least useful for learning English, while Quizlet and Quizizz were the most useful, according to the participants' opinions. Furthermore, all the participants from the three levels (low-intermediate-advanced) appeared to have positive attitudes toward using Web 2.0 tools. They tended to have moderately positive opinions on the ease of using Web 2.0 tools. The results of this research evoke initiatives to conduct future research on the challenges teachers and students face in using Web 2.0 tools. Furthermore, more new tools can be explored.

In conclusion, the influence of easy-to-use, accessible, and low-cost Web 2.0 technologies on language acquisition is critical. Educators should educate preservice teachers in using these technologies, which have a favorable impact on motivational, pedagogical, and emotional elements and may result in major contributions to the advancement of learning.

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E-learning assisted AIR learning model to improve student's critical thinking skills

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ABSTRACT

A learning innovation that combines innovative learning with online learning needs to be done to bridge pandemic conditions such as Covid-19. One of them is the e-learning-assisted AIR learning model (e-AIR). The integration of e-learning into the AIR learning model is carried out to provide learning facilities for students so they can repeat learning material anytime and anywhere. One of the competencies expected to develop in physics courses is CBC. Developing critical thinking is crucial because it is a skill most students need when facing a problem. This study aimed to determine the increase in student CBC by applying the e-learning-assisted AIR learning model for the Physics Education Study Program students at Almuslim University. This quasi-experimental study with a one-group pretest and posttest design was conducted on all Physics Education students at Almuslim University with a sample of 9 students. The research instrument used was in the form of questions adapted to the KBK indicators. Data analysis using the n-gain test. The results of this study show that the e-learning-assisted AIR learning model can improve student CBC, as seen from the percentage obtained, namely as many as five students obtained a percentage of 56%, as many as three students obtained a percentage of 33% in the medium category. As many as one student received 11%, with a low category.

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INTRODUCTION

The rapid development of technology requires the implementation of the 4.0 education program so that it can evolve with the times. Therefore learning must be swiftly addressed by applying digital-based learning methods. The learning process is one of the spearheads in the education system. In the 21st century, learning is not just an activity designed for students to understand or know some knowledge. Still, one must develop thinking skills, literacy, and apply technology in life (Zaini, 2021). Learning aims to improve students' abilities and skills (Safarati & Zuhra, 2021). However, learning in the 21st century focuses more on the goal of developing students' thinking skills (Safarati & Zuhra, 2021), learning in the 21st century focuses more on the purpose of developing students' thinking skills (Nugraheny et al., 2019: Susilawati et al., 2020).

Based on the analyzed educational system according to current development, some transformations are called the 21st-century educational system.

In the 21st century, education has changed with a pattern of transformation in several forms, such as learning activities where students are required to participate actively during the learning process (Chuntala, 2019; Frache et al., 2019; Cruz & Dominguez, 2020; Minan et al., 2021). Critical Thinking Skills (CTS) is one of the thinking skills that can be developed. Learning activities should emphasize the development of CTS so that students can practice and transfer information (Azizah et al., 2018). Critical thinking skills are among the most important life skills for humans in the 21st century (Fajari, 2020). CTS is important in education because critical thinking (CT) is solving a problem, making decisions, and conducting analysis in various studies (Zuhra et al., 2021). All aspects of CT are skills needed in life because CT is a logical and reflective way of thinking that focuses on student decision-making. It deepens students' thinking skills when interpreting information, making the information they receive more meaningful.

In the 4.0 revolution era, various efforts have been made to develop students' CTS. One is implementing digital-based learning so students are more open to technological developments. E-learning is digital-based learning where the learning system combines electronic media in an application to support learning activities with Internet media (Marlina et al., 2021).

Each learning model applied has its advantages and disadvantages, as well as the use of e-learning. One of the disadvantages of e-learning is that students find it challenging to understand the information lecturers convey (Pulungan et al., 2021). This deficiency can be complemented by collaborative learning models that require students to be more proficient in lecture activities so that students can understand information more quickly and the learning process can run more pleasantly. Luthfiana & Wahyuni (2019) state that the AIR (Auditory, Intellectual, Repetition) learning model is an adequate model, and it can be applied to encourage active and creative students to take part in lectures because this AIR model assumes that learning will be more effective if it prioritizes hearing, thinking skills and repetition (Hutagalung & Harahap, 2018; Mustika & Kinanti, 2018; Sugiarni & Ifanda, 2020)

Auditory means hearing. It uses the sense of hearing (ears) to listen and pay attention to information, convey information, and argue. Intellectually implies the ability to think and practice through reasoning, creating and solving problems, and processing and applying data. Repetition means repeating. It is for the information obtained by students can be comprehended more in-depth and must be trained by working on questions, giving assignments and tests (Alan & Afiansyah, 2017; Martini et al., 2018; Risdianti et al., 2019). The studies that are relevant to this AIR research by Siswanto et al. (2018), Siregar et al. (2020), and Rahayuningsih (2017) learning the AIR learning model that can improve students' problem-solving abilities (PSA). The problem-solving abilities (PSA) are one of the indicators of CTS. The result of the study (Nurhayati & Zuhra, 2020) is that students are delighted with using e-learning in the learning process.

A learning innovation that combines innovative learning with online learning needs to be done to bridge pandemic conditions such as Covid-19. One of them is e-learning-assisted AIR learning (e-AIR). The integration of online learning in the AIR learning model will be carried out by offering flexible learning opportunities to students, which will allow students to access materials and assignments online. It helps students to repeat learning material anytime and anywhere due to this material can be accessed through online learning.

One of the skills developed in physics courses is CTS. Developing CTS is crucial because it is a skill most students need when facing a problem. There have been many attempts to develop critical thinking. Susilawati et al. (2020) state that one of the most effective ways to develop CTS is to relate the subject matter to students' real-life experiences. Based on these considerations, there should be further research on the e-learning-assisted AIR learning model for students' CTS.

Based on the description above, this study aimed to determine the increase in student CTS by applying the e-learning-assisted AIR learning model to the Physics Education Study Program students at Almuslim University. Auditory, Intellectually, and Repetition Models, integrated with e-learning and critical thinking skills, contribute to a variety of meaningful learning, not just remembering but approaching contextual information.

METHOD

The AIR learning model supported by e-learning is applied to work and energy materials. The AIR model is learned through auditory, intellectual, and repetition phases. In the auditory and intellectual phases, the task/exercise is carried out directly, while in the repetition phase, each task/exercise is given through online learning. Therefore, in each session, students will complete assignments/activities using e-learning. In addition, work and energy material is presented in e-learning so students can repeat learning material anytime and anywhere. This quasi-experimental study with a one-group pretest and posttest design was conducted on all students of the Physics Education Study Program, Universitas Almuslim, with a sample of 9 students. The research instrument used in this study was a test sheet based on the CTS indicator.

Susilawati et al. (2020) stated that indicators measured in the science process skills developed by Ennis are: (1) identifying questions; (2) advancing a hypothesis, (3) determining an action, (4) considering the use, (5) carrying out appropriate procedures, (6) recording observations, (7) interpreting questions, (8) identifying and managing the irrelevance, and (9) providing a definition. These nine indicators can be measured using the CTS test. The indicators used in this study were (1) identifying questions; (2) advancing the hypothesis; (3) determining an action; (4) interpreting the questions, and (5) providing definitions. Students' CTS test results were analyzed using the n-gain test with conversions in Table 1. The percentage of CTS achievement (Zahra et al., 2021) is interpreted descriptively based on Table 2.

Table 1. N-Gain Values

N-Gain Values	Category
$g < 0.3$	Low
$0.3 \leq g \leq 0.7$	Medium
$g > 0.7$	High

Table 2. Interpretation of Students' CTS

No.	Scores	Criteria
1.	80-100	Very Good
2.	66-79	Good
3.	56-65	Fair
4.	40-55	Low
5.	30-39	Very Low

RESULTS AND DISCUSSION

Results

Students' CTS was obtained through test sheets in the form of essay questions totaling ten questions on the pretest and posttest questions. Students were categorized as complete if the score or passing grade was≥ 75 for basic physics courses on work and energy material. The completeness of student learning using the e-learning-assisted AIR learning model can be seen in Figure 1.

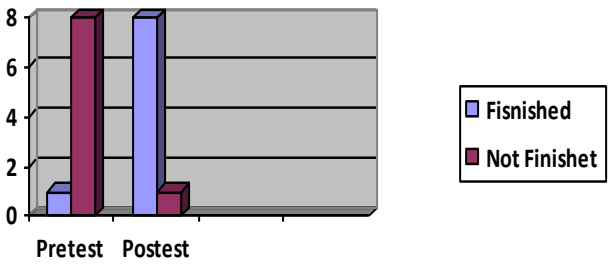

Figure 1. Comparison of Student Learning Completion

Based on Figure 1 it can be seen the comparison between the pretest and posttest results. The pretest scores obtained from 9 students showed that eight students were categorized as incomplete, and only one was categorized as complete. While for The posttest scores were acquired from 9 students, which led to 8 students being categorized as complete and only one as incomplete. The acquisition of pretest and posttest scores showed increased students' CTS on work and energy materials. The increase in value acquisition can be seen in Table 3.

Table 3. N-Gain Analysis Result

Category	Number of Students	Percentage (%)
High	5	56
Medium	3	33
Low	1	11
Total	9	100

Based on Table 3, it was found that there was an increase in the CTS of students using the e-learning assisted AIR learning model, with a high category of 5 students obtaining a percentage of 56%, with a medium category of 3 students obtaining a percentage of 33%, and with low category of 1 student obtaining a percentage of 11%. It could be seen based on data analysis carried out by field research.

Analysis of Students' CTS

Critical Thinking Skill (CTS) is a skill measured in this study. There were five indicators distributed through the questions given. These details can be seen in Table 4.

Table 4. The Details of CTS' Questions

No.	Sub Concept	Questions' Number
1	Identifying questions	1 and 5
2	Advancing hypothesis	4 and 6
3	Determining an action	7 and 8
4	Interpreting questions	2 and 3
5	Providing definition	8 and 5

Table 4 shows that the number of questions for the CTS test totaled ten questions, with each indicator consisting of 2 questions according to the results of the validity and reliability test items. Achievement of CTS was obtained by calculating the average percentage of students who answered the questions correctly for each indicator. Table 5 shows that in the five indicators used, the students' CTS achievement was in a good category, with an average score of 74.52.

Table 5. Average of Achievement Level of Student's CTS

No.	Sub Concept	Percentage of Achievement	Category
1	Identifying questions	71.42	Good
2	Advancing hypothesis	60	Very Good
3	Determining an action	78.57	Good
4	Interpreting questions	75	Good
5	Providing definition	76.92	Good
	Average	74.52	Good

Discussion

Based on the research results that researchers have carried out, the e-learning-assisted AIR learning model is applied to work and energy materials. Learning is carried out using the AIR learning model consisting of the Auditory, Intellectual, and Repetition stages. The task/exercise is performed directly at the auditory and intellectual stages. Through these two stages, students have explained the material and presentation of the material. Then students were trained in critical

thinking methods through reasoning, creating and solving problems, and constructing and applying based on the given material. Subsequently, students were given assignments/exercises at the Repetition stage, but each task/exercise was provided by using e-learning. So students complete assignments/exercises using e-learning at every meeting.

Based on the results of the analysis of research data obtained during the research, it can be said that there was a significant increase in the student's CTS by using the e-learning-assisted AIR learning model. Based on the analysis results, It can be seen that 56% of students were in the high category, 33% were in the medium category, and 11% were in the low category. The analysis of the number of questions for the critical thinking skills test was ten questions, with each indicator consisting of two questions following the test results of the validity and reliability of the items. Critical thinking skills were achieved by calculating the average percentage of students who answered questions correctly on each CTS indicator. From the five indicators used in this study, the achievement of students' critical thinking skills was in a good category, with an average value of 74.52.

This research was compatible with research that has been conducted by previous researchers, namely research conducted by Pujiastutik (2016). The research results indicate that applying the AIR (Auditory, Intellectual, Repetition) model can improve student learning outcomes. In addition, the results of classical learning by 80% and > 75% of students gave positive responses. The research conducted by Astuti et al. (2018) shows that the AIR learning model influences mathematical thinking skills, as evidenced by the final test scores of students using the AIR learning model, which were higher than conventional learning.

It is compatible with this research by Dwi and Putra (2015), learning activity with e-learning systems improves students' CTS. Fauji and Winarti's (2015) research results state that applying the AIR model has increased learning outcomes by 19.95% from cycle I to cycle II. Furthermore, research conducted by Astuti et al. (2018), after being analyzed using the t-test, obtained $t_{count}>t_{table}$ (0.05), namely 4.4603>2.011. It shows that AIR learning strategies can affect learning outcomes.

Based on the results and discussion above, it can be seen that the e-learning-assisted AIR learning model can improve students' CTS. It is also compatible with several studies conducted by several previous researchers. Through the AIR learning model, students are more challenged with the responsibilities given, thereby provoking students' CTS towards the assumptions given and taught. Following Fisher's opinion (Safarati & Zuhra, 2021) states that skills or ability in thinking of ideas must also exist in critical thinking, providing relevant questions, drawing short descriptions, thinking, and debating information continuously.

CONCLUSION

This study showed that the e-learning-assisted AIR (Auditory Intellectually Repetition) learning model can improve students' CTS (Critical Thinking Skills). The increase in student CBC by applying the e-learning-assisted AIR learning model for the Physics Education Study Program students at Almuslim University. This quasi-experimental study with a one-group pretest and posttest design was conducted on all Physics Education students at Almuslim University with a sample of 9 students could be seen from the percentage obtained. Five students received a percentage of 56% in the high category, three obtained a percentage of 33% in the medium category, and one obtained a percentage of 11% in the low category.

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Research trends in meaningful learning in distance education environments: A review of articles published in Q1 to Q3 indexed journal from 2012 to 2022

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ABSTRACT

This study aims to investigate the idea that there is a functional and efficient mechanism for meaningful learning. This study is a literature review with various references to data sources. This study's essential focus is on the difficulties and possibilities of meaningful distant learning. An amount of 21 publications had released between 2012 and 2022. Use the SEforRA.com search engine to find information for research. Thematic Analysis to examine the results and show the findings. The research findings shed light on several topics related to meaningful learning, including perceptions, challenges for teachers and students on distance meaningful education, and learning practices. The findings also explain how meaningful learning is in distance learning. The Results show that meaningful learning activities incorporated into distance learning activities enable teachers and students will gain authentic and meaningful experiences that will benefit their education, such as adding teachers' insights for their future teaching practices. The outcomes of this exploratory study have several consequences for anyone involved in remote education, including administrators, teachers, instructional designers, and policymakers, who want to ensure that students have meaningful educational experiences.

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INTRODUCTION

The challenges of the times are not just present obstacles but also opportunities to innovate. The SARS-Cov2 spread has accelerated moving forward in education transformation, and traditional learning models have shifted to online and distance learning.

The governments should make decisions regarding councils regarding education. Researchers Al-Taweel et al. (2020) and Al-Hosan et al. (2020) found that educational institution stakeholders, including teachers and students, are among the most severely impacted groups. In light of this, “educational institutions are said to be conducting disruption challenges to their learning and behavioral patterns (Al-Hosan et al., 2020; Al-Taweel et al., 2020; Blankenberger & Williams, 2020; Brammer & Clark, 2020; Driessen et al., 2020; Mladenova et al., 2020; Pavlik &

Dennis, 2020; Raaper & Brown, 2020; Torda, 2020). Additional challenges include those related to technology, academics, and social support from previous students (Barton, 2020; Brammer & Clark, 2020; Driessen et al., 2020). As this learning model has spread worldwide, educational institutions have become less dependent on the traditional model, where content is passively conveyed to students present in class. On the contrary, learning delivery methods are adopted to involve students through various active learning formats, leaving behind a 'passive' learning model (Sandrone et al., 2019; Stockwell et al., 2015).

There is also a significant challenge for the curriculum in Indonesia, where ensuring everyone has equitable access to high-quality education and opportunity for lifelong learning is one of the UN's 17 global goals (Assembly, 2015). The distance learning process had several problems. One of them is the issue that some instructors feel is the disorganized graduation assessment procedure and the inefficiency of the approach adopted. A strong combination of enduring abilities, theoretical knowledge, and procedural skills are among graduates' benefits of quality education (Greiff et al., 2014). In the fourth industrial revolution era, lifelong learning is crucial for enhancing the workforce's abilities (Gleason, 2018). The Covid-19 pandemic and the implemented social segregation regulations highlight the urgent need to improve the caliber of distance education by converting instruction to immersive online learning (Schultz & DeMers, 2020). With distance learning, students need time to adapt, which also impacts student assimilation of learning (Purwanto et al., 2020, p. 5). Likewise, only a few schools made this transition smoothly. However, for some people, especially those from developing countries with insufficient infrastructure, it was challenging. (Pham & Nguyen, 2020; Simbulan, 2020).

According to the description above, the Covid-19 pandemic is a situation when a health issue, specifically the spread of the Covid-19 virus, very quickly displays a very high increase in deployment and is becoming more and more commonplace across the nation. According to the Republic of the Indonesia Ministry of Education and Culture circular letter No. 4 of 2020, the government of the Republic of Indonesia, acting through the Minister of Education and Culture, directed all academic departments to conduct online learning at their residences.

During the COVID-19 outbreak, moving the learning process from the classroom to the home will at least provide parents to return to controlling their children's education in a significantly more meaningful educational activity (Masrul et al., 2020). The previous cognitive structure's concepts will connect to new experiences as they are acquired. Parents' roles as role models in setting an example for their children to follow, allowing them to emulate the positive deeds of their parents, will help students achieve their educational objectives.

Meaningful learning, according to Ausubel (1961), formal education must incorporate this, and it is done so through engaging in ongoing critical conversation. When teaching strategies like inquiry and problem-solving are used, students gain meaningful learning constructs that enable them to recognize underlying patterns, analyze them, and connect them to new ideas (Jonassen, 2004; Mystakidis et al., 2019). Teachers are urged to consider and incorporate the following characteristics in their design for teaching and learning if they wish to give their students meaningful educational experiences: active, beneficial, deliberate, genuine, collaborative, or related (Howland et al., 2012; Mystakidis, 2019). The fundamental component of effective lesson plans for meaningful learning is integrating theory and practice through moving instances where both teachers and students are allowed to express their feelings, whether positive or negative (Kostiainen et al., 2018).

The learning process occurs when students can assimilate their knowledge with new knowledge. The learning process occurs with the stages of paying attention to the stimulus given and the concept of the meaning of the stimulus, storing and using the information they understand.

According to Ausubel (1978), students will learn well if the content of the lesson is defined and then presented properly and appropriately to students (advance organizer), thereby influencing the regulation of students' learning abilities. Advance organizer provides three benefits, namely: providing a conceptual framework for the material being studied, functioning as a bridge that connects what is being studied and what will be studied, and can help students to understand learning material more easily. Besides that, this theory also acknowledges that assimilation and accommodation processes between people and their environment result in ongoing interactions that

lead to learning. So the process of learning is given more importance in the human mind (Ausubel, 1978).

According to the summary above, it is clear that connecting new knowledge to pertinent concepts already present in students' cognitive structures during the teaching and learning process is meaningful education. Meaningful learning can occur when it is relevant to the needs of students and accompanied by a curriculum that is not stiff in terms of meaningful learning driven by students' curiosity in certain fields. In this connection, Rogers (Rogers & Freiberg, 1994) suggests that classroom climates learn independently. Learners try to find themselves without direct guidance from the teacher. In general, this learning mode is the development of receptive learning and learning with guided discovery. Based on the explanation of the definition above, it is clear that meaningful learning in question is the process of connecting new knowledge with related ideas that already exist in students' cognitive structures during the teaching and learning process.

Meaningful learning can occur when it is relevant to the needs of students and accompanied by discoveries learning takes place, namely:

1. Accept students as they are
2. Recognize and foster students through their discovery of themselves
3. Seek learning resources that students may be able to obtain to choose from and use them.
4. Use the inquiry discovery approach.
5. The importance of self-approach and letting students take responsibility for themselves to meet their learning goals.

METHOD

A Scoping Review for Mapping the Field

Search processes and research questions

The works of Jesson (2011) were referenced several times in this investigation. The search process is a search stage to find sources that match the research questions. All literature review measures used the seforra.com bibliometric management tool (Sidiq et al., 2020). During the Covid-19 epidemic, meaningful learning arose as a learning strategy in response to the need to encourage and support pupils so that they had the desire to learn. So, it is necessary to analyze whether research that proposes a meaningful learning approach can help and motivate students in distance learning. The initial research questions in this study arose from the researcher's curiosity about students' learning strategies in distance learning. These questions greatly assist this research in extracting various student strategies related to meaningful learning. These questions are:

RQ1: Can students' motivation for learning activities rise when they participate in meaningful learning through distance education? The inquiry aims to determine whether the chosen publications are consistent with the notion that a meaningful learning strategy in an online learning setting might boost student motivation.

RQ2: What are the primary objectives of developing a meaningful learning model in a distance learning environment? In particular, this research topic seeks to determine whether the study intends to motivate and aid students in their academic endeavors.

RQ3: What strategies are widely used for successful, meaningful learning in distance learning environments? This inquiry seeks to learn more about the methods and materials contributing to successful, meaningful learning. The method can involve web-based learning, e-learning, or mobile learning.

Search Strategy

According to Kitchenham (2004), choosing and adhering to a search strategy is essential while doing a systematic literature review. Defining keywords and the various combinations of those keywords is the first step. The following keywords are used: “meaningful learning,” “distance learning,” “e-learning,” and “m learning.”

Comprehensive Search

The inclusion and exclusion criteria

This stage is the stage in determining the criteria of the data found, and whether the data can be used as a data source for research. The research moves on to the following stage when the researcher reviews the introduction and takes into account the conclusion to assess the paper's applicability if they do not have enough evidence to eliminate it. See Table 1.

Table 1 Criteria for Selection

No.	Type	Description
1	Inclusion	Primary research
2	Inclusion	A study that recommends a deliberate learning approach for a distance learning environment
3	Inclusion	Research papers released between 2012 and 2022 (10 years)
4	Exclusion	Secondary research
5	Exclusion	Duplicate research
6	Exclusion	Grey literature

Quality Evaluation

The information discovered is assessed at this stage using the criteria listed below: (1) QA1: Did the journal article appear between 2012 and 2022? (2) QA2: Does the journal article describe the effective remote learning approach used? (3) QA3: Does the journal article address the rationale for implementing meaningful teaching in an online learning environment?

Depending on the questions mentioned above, each paper will receive a score. (1) Yes: for journal articles that correspond to the quality assessment's queries. (2) No: for journal articles that don't align with the quality assessment's questions.

Extraction of Data

Information gathering is required during this stage to support additional study and Analysis. The steps involved in data collection are as follows: (1) Check out SEforRA.com; (2) Enter the keywords "meaningful learning," "distance learning," "e-learning," and "m learning;" (3) Put 2012 in the first box under "custom range" and 2022 in the second box. To gather information pertinent to addressing our study questions, the authors, at this point, read the article in its entirety. All the fields from the report are displayed in Table 2.

Table 2 Data Extraction from the Fields

No.	Type	Description
1	Scimago JR Quartile	Journal rank
2	Year	Date of publication of the paper
3	Author	Writers of the article
4	Title	The paper's title
5	Country	The Initial author's home country
6	ID	An individual study identification number
7	Tools	The study's technology
8	Evaluation type	Case studies, experiments, and others
9	Academic level	Education at higher levels, secondary levels, and in primary levels
10	Main result	What is the main result of the paper?
11	Main finding	What is the main finding of the paper?
12	Impact on academic performance (RQ 1)	Evidence of an impact, whether positive or negative
13	The main objective (RQ 2)	What is the paper's main goal?
14	Learning strategy (RQ 3)	What strategy was

All search results by Scimago journal rank are in Table 3. All articles published by the country are in Table 4. Figure 1 shows how the articles were selected in three phases. In phase 1 articles needed is 2,599 from 10,000. In phase 2, there are 229 articles required. The last, There are 21 articles selected. Figure 2 shows the chosen studies' year of publication. The most appealing articles were in 2017.

Table 3. Search Results by Scimago Journal Rank

Year	Scimago Journal Rank						Number of Articles
	Q1	Q2	Q3	Q4	NQ	NI	
2012	192	45	31	16	70	300	654
2013	181	45	78	14	24	340	682
2014	225	52	44	19	11	391	742
2015	241	47	45	17	22	354	726
2016	219	54	57	11	10	396	747
2017	220	52	54	23	19	380	748
2018	203	125	57	11	18	455	869
2019	225	114	53	34	21	487	934
2020	229	133	74	36	21	663	1156
2021	300	138	89	18	10	879	1434
2022	306	129	98	27	30	718	1308
Total results							**10000**

Table 4. Articles Published by The Country

Country	Number of Articles
South Africa	3
Saudi Arabia	1
Brazil	1
China	2
Finland	1
Israel	1
Canada	1
Kansas	1
Malaysia	1
Philippines	1
Portuguese	1
New Zealand	2
Turkey	1
Taiwan	2
Texas	2
Total	**21**

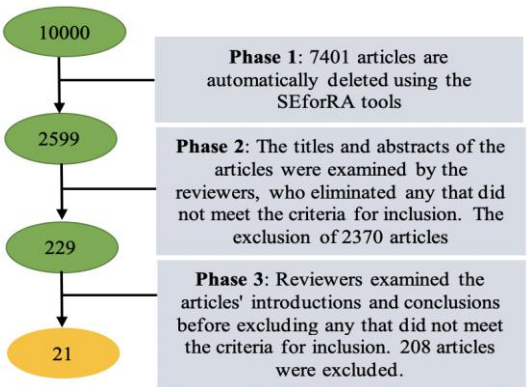

Figure 1. Article Selection Stages

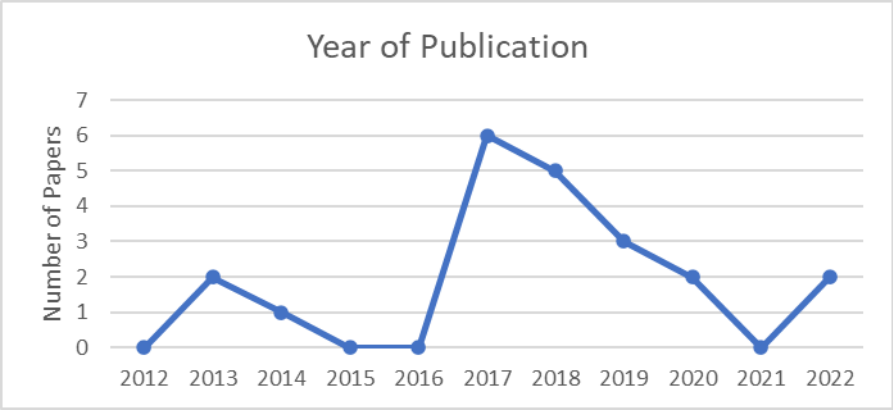

Figure 2. The Selected Studies' Year of Publication

The Synthesis

At this stage, a synthesis of the data collected in the previous phase had carried out. The results of the synthesis will answer the predetermined research questions.

Write up

This article serves as a log of all research activities, from the first stages to the final manuscriptized version of the findings that follows the guidelines.

RESULT AND DISCUSSION

Result

The results of the literature review, which was based on 21 papers that were chosen, are summarized in this stage. Table 2 displays the attributes taken from each study.

The publication year and country of issue

The year of publishing should be considered as the first characteristic. Figure 2 displays the distribution of papers by publication year. The years with the fewest publications throughout the studied period were 2012, 2015, 2016, and 2021 (n = 0), while 2017 (n = 6) had the most publications. An overall number of publications by the country is shown in Table 4, and the review also includes the article's first author's address. China, New Zealand, Taiwan, and South Africa had two publications each. South Africa had the most publications overall (n = 3)

Research subjects

To recommend meaningful distance learning in educational contexts for this study's goal, we looked at the practices and categorized them as shown in Table 5. Strategies using other technologies are the most widely used. Some technologies are more specifically classified as "other technologies." Among them are video, virtual reality, and digital storytelling tools.

Table 5. Strategy Used

Strategy	Number of Articles
e-learning	4
m-learning	2
Web-based learning	2
LMS	1
Other Technologies	12
Total	**21**

Research questions

First research questions

The first research question is, **"Does meaningful learning in a distance learning setting promote student motivation for learning activities?"** This question is the first research topic examining whether meaningful learning can increase student motivation. The author awards a code to each article based on two factors: (a) whether or not meaningful distance learning has a positive or negative effect, and (b) whether or not the article presents an empirical evaluation of meaningful learning outcomes. The authors also coded the article as "no evaluation" in cases where meaningful learning was explained without consistent evaluation. The results are shown in Table 6.

Table 6 Information about the Publications that Address Student Performance

Evaluation	Articles in total (%)
No evaluation	6 (29%)
Positive with evaluation	10 (48%)
Positive without evaluation	5 (24%)
Negatively with evaluated	0 (0%)
Negatively without evaluated	0 (0%)
Total	**21 (100%)**

As has been reported in other studies, the importance of encouraging meaningful learning in increasing student motivation (Huang & Chiu, 2015a; Kamal Afify, 2018; Mystakidis et al., 2019; Niknam & Thulasiraman, 2020). This report is also reflected in distance meaningful learning, with 72% positive results (48% with and 24% without evaluation). It proves that meaningful learning can be implemented traditionally and with technology (Huang & Chiu, 2015a; Kamal Afify, 2018; Mystakidis et al., 2019; Niknam & Thulasiraman, 2020). Employing digital concept maps in meaningful learning, as in Aşiksoy's (2019). According to the results of the post-test on the physics conception and problem-solving inventory, Aşiksoy (2019) concluded that meaningful learning through digital concept maps could boost student motivation also conducted semi-structured interviews were also performed with the experimental group and obtained positive results.

Second research questions

Regarding the second research question, **"What is the primary purpose of establishing a meaningful learning model in a distance learning environment?"**. Table 7 displays the outcomes. The articles' goals are clear. Based on the goal of the meaningful learning strategy, the authors divide the papers in this literature review into five categories.

Table 7 The Main Purposes of Using a Meaningful Learning Model

Purpose	Number of articles (%)
Using meaningful learning to help students understand concepts	5 (24%)
Using meaningful learning to support self-regulation	4 (19%)
Using meaningful learning to increase motivation	3 (14%)
Using meaningful learning for pedagogical improvement	3 (14%)
Using meaningful learning to help educators develop learning	6 (29%)
Total	**21 (100%)**

Articles that help educators (24%) are meaningful learning models developed to facilitate educators by integrating technology (George & Sanders, 2017; Huang & Chiu, 2015b; Kärki et al., 2018). To help teachers make better-informed choices regarding pedagogy to promote learning, Lee (2017) builds relevant learning components using technology. The

main goal of his research is to fill in these gaps by creating a technology-scale meaningful learning instrument (MeLTS), which was designed to evaluate high school students' understanding of increasing knowledge in evaluating meaningful learning (Ross & Underwood, 2013) and knowledge about online learning (Tsai et al., 2013).

Third research questions

The final question focuses on the strategies of meaningful learning. Table 5 shows the main strategies found in the article. The main strategies that are widely used are other technologies (12 articles).

Most studies (48%) show evidence in their findings about whether meaningful learning can motivate students to learn. These results are consistent with the existing research objectives (section 4.2), where 85% of research (articles that use meaningful learning for students in understanding concepts to support students in self-regulation and help increase motivation) is aimed at assisting a meaningful learning process for students. Learners. Only six studies (29%) were aimed at assisting educators (see Table 7).

Discussion

Torda (2020) shows how distant learning increases the efficacy of "Flipped Classroom" learning in medical research and makes it possible to use it as a more sophisticated and potent learning tool in one of these projects. Many other instances of distance learning have numerous pedagogical strategies that have been proven effective, including blended learning, independent learning, Massive Open Online Courses (MOOCs), social/peer-based approaches, simultaneous learning, or various combinations of these (Darling-Hammond & Hyler, 2020; Tømte et al., 2015).

Some studies (29%) claim that technology can help educators integrate meaningful learning. These studies show positive results that educators report regarding their knowledge of technology use and meaningful learning (George & Sanders, 2017; Kamal Afify, 2018; Kärki et al., 2018), development of assessment instruments in meaningful learning (Lee, 2017), and helps educators' knowledge in the integration of other learning objects (Koh, 2017).

CONCLUSION

This article overviews existing research on technology-integrated meaningful learning in blended learning environments from 2012 to 2022. The use of technology in meaningful learning is the main topic of this study, considering the most popular way and whether technology aids teachers in addition to learners. We conclude that technology-based meaningful learning models as evidenced to improve student performance in learning activities (48% of publications). Utilizing technology-based meaningful learning strategies is almost entirely done to help and encourage students throughout the lesson. Nearly 72% of studies in our evaluation (Table 6) concluded that meaningful learning with technology offers advantages for student performance. This study evaluates the potential benefits to teachers of relevant learning approaches based on this technology. The numerous papers included in this review indicate that this technology-based meaningful learning approach aims to give teachers the knowledge to enhance their pedagogy. Our findings support this statement by showing evidence that relevant learning models assist teachers in their pedagogical comprehension (29% of articles). Finally, we found that the key to effective learning models integrating technology is technological media, such as learning videos, learning tools, and learning audio. The literature review identified two significant flaws in research on technology-based meaningful learning models, particularly the shortage of academic studies on Ausubel's principles for these kinds of learning. The model emphasizes meaningful learning, that is to say: outlines the principles of consolidation, integrative reconciliation, progressive differentiation, advanced organizing, and the lack of development of educator-focused tools. Applying meaningful pedagogical ideas with the incorporation of technology can enhance teaching and learning. The teacher's involvement is still essential and crucial for effectively implementing technology in the classroom. The outcomes of this exploratory study have several consequences for anyone involved in remote education, including administrators, teachers, instructional designers,

and policymakers, who want to ensure that students have meaningful educational experiences. The contribution of this review can be very beneficial to society since they combine information from the primary studies examined in this study to provide knowledge about efficient learning strategies in distance learning environments. Table 8 contains details on the article selection.

Appendix A. Summary of selected papers

Table 8. Summary of All Papers Retrieved in This Review

Reference	RQ1	RQ2	RQ3	Study Overview
(Ross & Underwood, 2013)	Negative without evaluation	Using meaningful learning to help educators develop learning	Using ILT (Innovative Learning technology)	This paper presents technology as a tool to create meaningful learning opportunities.
(Tsai et al., 2013)	Positive without evaluation	Using meaningful learning to help educators develop learning	Using web-based learning	This paper outlines meaningful online learning that focuses on developing platforms for meaningful learning.
(Huang & Chiu, 2014)	Positive with evaluation	Using meaningful learning to help students understand concepts	Using mobile learning	This paper presents the idea of an evaluation model for CAML (Context-Aware Mobile Learning)
(George & Sanders, 2017)	Positive without evaluation	Using meaningful learning to help educators develop learning	Using TPACK	This paper outlines a basic sketch for setting up professional development to help teachers better use ICT in designing assignments.
(Lee, 2017)	Positive with evaluation	Using meaningful learning to help educators develop learning	Using MeLTS	This paper presents the idea of developing meaningful learning instruments with technology scale (MeLTS)
(Koh, 2017)	Positive with evaluation	Using meaningful learning to increase motivation	Using electronic learning	This paper proposes the idea of meaningful learning within the framework of e-learning technology.
(Luo & Kalman, 2017)	No evidence	Using meaningful learning to help students understand concepts	Using video	This paper presents ideas for designing meaningful learning using 12 step
(Nel, 2017)	Positive without evaluation	Using meaningful learning for pedagogical improvement	Using LMS	This paper reflects a collaborative approach to pedagogical transformation with LMS technology.
(Henry et al., 2017)	No evaluation	Using meaningful learning for pedagogical improvement	Using web-based learning	This study examines the effects of Cada Dia Welsh (CDW), a social learning strategy that is an online web platform, on students' learning outcomes.
(Kärki et al., 2018)	Positive with evaluation	Using meaningful learning to help educators develop learning	Using mobile learning	This paper presents an analysis of meaningful learning using ActionTrack in mobile learning.
(Kamal Afify, 2018)	Positive with evaluation	Using meaningful learning to help educators develop learning	Using digital concept maps	This paper presents an e-learning content design idea based on an interactive digital concept mapping.

(Lopes & Vieira, 2018)	Positive without evaluation	Using meaningful learning to increase motivation	Using didactic material and videotapes	This study describes a teaching and learning process where virtual environments and settings serve as learning spaces.
(Aguayo et al., 2018)	No evaluation	Using meaningful learning to support self-regulation	Using Virtual Reality	This article offers a first-passage virtual reality (VR) simulation for purposeful learning.
(McNaught, 2018)	No evaluation	Using meaningful learning for pedagogical improvement	Using video	This report presents evidence of significant learning occurring throughout Africa.
(Tsai et al., 2019)	Positive with evaluation	Using meaningful learning to support self-regulation	Using web-based learning	This research describes online learning that combines web-mediated meaningful learning (ML) and activity-based learning (ABL)
(Mystakidis et al., 2019)	Positive with evaluation	Using meaningful learning to help students understand concepts	Using electronic learning	This article describes the fundamentals and characteristics of in-depth, meaningful learning that may be applied in project management in real-world settings and incorporated into e-learning quality techniques.
(Asiksoy, 2019)	Positive with evaluation	Using meaningful learning to help students understand concepts	Using online learning	This article illustrates a Google Classroom setting with computer-based concept mapping (CBCM).
(Niknam & Thulasiraman, 2020)	Positive with evaluation	Using meaningful learning to increase motivation	Designing a learning pathway system (LPR)	This paper presents the idea of developing an educational program for staff perioperative.
(Peñalba et al., 2020)	No evaluation	Using meaningful learning to help students understand concepts	Using concept maps based on computer	This paper outlines the potential of digital storytelling to promote historical comprehension.
(Lidor et al., 2022)	Positive with evaluation	Using meaningful learning to support self-regulation	Using web-based learning	This paper outlines the findings of a review of school changes that involved change agents at both the frontal and virtual levels.
(Hsbollah et al., 2022)	Positive without evaluation	Using meaningful learning to support self-regulation	Using tool digital storytelling	This paper analyzes the problem-based learning (PBL) methodology to provide instructive learning.

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Cognitive load in high school students during online learning amidst the Covid-19 pandemic: A qualitative study in Bantul, Indonesia

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ABSTRACT

The public doubts that learning can be meaningful and in-depth if done online. Moreover, the implementation of online learning still has weaknesses from upstream to downstream. This research focuses on the cognitive load in students when online learning begins to be carried out massively in Indonesia due to the Covid-19 pandemic. This qualitative study aims to identify high school students' experiences in Bantul while learning online during the pandemic. Data were collected for four months through observation, in-depth interviews, and documentation. The collected data were transcribed, coded, and analyzed for themes using cognitive load theory and learning technology. The results illustrate that high school students in Bantul experience extra effort in learning through online platforms due to the novelty of the online learning experience, distractions, subject matter presentation, and the impact of cognitive load on students' learning. This research enriches innovative strategies for managing online learning by learning technology science. It has contributions to the need to train teachers and students to carry out learning in an independent mode. Online learning, when managed by accommodating good theory and practice of learning technology, proves to be a strategic learning mode, especially amidst the challenges of the Covid-19 pandemic.

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INTRODUCTION

Improving the quality of learning is one of the themes raised by researchers to investigate how learning in schools can improve based on considerations of learning conditions and learning methods (Reigeluth, 1993). Learning will always be based on learning objectives for students, so learning design has an essential position in learning success (Dick et al., 2015). Like an interrelated and binding chain, quality learning begins with managing students as raw inputs with various powerful methods to achieve targeted results. The learning outcomes are one of the benchmarks for the quality of learning.

Online learning was implemented massively in Indonesia during the Covid-19 pandemic. This situation makes the education community in Indonesia unprepared because the learning space is limited. Restrictions on access to face-to-face learning support have implications for adjusting all components to carry out online learning, posing problems and support (Afriansyah, 2020). This non-ideal situation changes things, from changing paradigms to implementing innovations (Trilisiana, 2020).

Online learning existed long before the presence of the Covid-19 pandemic. Open University is an institution in Indonesia that has implemented online learning for students who have difficulty reaching space and time. What was implemented by Open University, at first, was underestimated among Indonesian academics, but now online learning has become a trend that is welcomed with joy (Rahman et al., 2020).

Online learning research is studied based on the perspective of mental health (Fitria & Saputra, 2020; Isrokatun et al., 2022), eye health (Putri et al., 2021), and academic resilience (Hernawan et al., 2021). Besides academic stress, previous researchers examined the cognitive load during online learning using a quantitative approach (Thahura & Tutdin, 2021). A qualitative approach must be taken to strengthen cognitive load studies in online learning. Concerns during online learning on how well our students master learning objectives to the application level in the real world need to be proven. The level of understanding in scientific and social fields must not be enough to memorize information or procedures.

The concept of rote learning becomes irrelevant in deep learning (Marton & Säljö, 1976; Degeng, 2013). Deep learning (deep learning) grows on individual awareness to realize what he understands and does not just want to get the best grades from exam results (Jhala & Mathur, 2019) and makes individuals have the character of diligent learners (Anwar, 2017). Deep learning can be achieved through learning by creating (Fullan & Langworthy, 2014), project-based (Miller & Krajcik, 2019), and case-based to provide a real-world experience (Jhala & Mathur, 2019; Santosa et al., 2020). Deep learning should be realized in offline and online conditions because the primary key lies in pedagogical practice and not just technological sophistication (Chaeruman et al., 2019; Chaeruman et al., 2020).

The community doubts whether learning can be meaningful and in-depth if it is carried out online. Community complaints are captured qualitatively and quantitatively, occupying a latent position on human quality in learning. Students experience stress while studying at home online (Palupi, 2020; Muzakki, 2020). Stress occurs not only in students but also in Indonesian teachers and adults in the 'moderate' category due to the outbreak and social media fatigue (Yuwono, 2020). The subjective feelings of social media users appear as if they feel tired, bored, and less motivated due to too much content found on social media. These feelings are suspected to be due to the sizeable cognitive load received, while the ability to process information is still relatively lacking (Rahardjo et al., 2020).

Studying from home via mobile devices reaps distraction in cases common in students' lives. Students share devices with family members, have difficulty focusing on lessons, are distracted by social media activities while studying, help parents work at home, and have difficulty accessing the internet (Afriansyah, 2020). The challenges faced by Indonesian students are phenomena that occur everywhere. Previous work on identifying why students experience distraction was highlighted by Curum and Khedo (2021) regarding the causes of poor adaptation of dynamic content during online learning at the theoretical level. Learning through the internet at the surface level, which provides content knowledge, makes students not give more effort to in-depth understanding (Ahad et al., 2018).

Identifying what students feel during online learning is of interest, as is the issue of cognitive overload. What Rahmat and Hindriana (2014) did long before the pandemic, comparing concept-integrated learning strategies as an experimental class, they found a link between Intrinsic cognitive load (ICL) and Extraneous cognitive load (ECL) with a large Germane cognitive load (GCL). The greater the intrinsic load (the burden of processing information when working memory takes place), as well as the additional load (all irrelevant learning elements), will affect the magnitude of the German load (the load that allows students to focus consciously on understanding and recalling learning content).

There have been many studies outside that focus on measures of brain performance when processing learning materials, such as using hypertext (Antonenko & Niederhauser, 2010) which turns out to reduce the cognitive load and through subjective judgments after solving algebraic problems (Ayres, 2006). Research related to working memory capacity on extensive mental effort has also been carried out, which resulted in recommendations for episodic/distance learning with less comprehensive mental effort (Chen et al., 2018). This qualitative research focuses on the cognitive load and the extent to which high school students in Bantul carry out and interpret cognitive load when studying online during a pandemic.

Meaningful Learning Through Online Learning

Ideally, the 21st-century learning environment involves three essential components: learning strategies, learning contexts, and integrating technology, media, and learning materials (Smaldino et al., 2015). The learning strategy becomes a pedagogical aspect that reflects the direction of learning design based on contexts, such as face-to-face, online, and blended learning. Integrating technology, media, and learning materials supports these strategies. A smart learning environment (an innovative environment) can be implemented flexibly during a pandemic that penetrates the formal lines of education administration (Trilisiana, 2020). It is because online learning under certain conditions requires face-to-face meeting sessions with a touch of the psychological aspects of students.

Before the term online learning became popular, learning with the help of an internet connection was labeled as distance learning, online learning, e-learning, mobile learning, and asynchronous learning. The opposite context of online learning is offline learning which is interpreted as learning directly by interacting and face-to-face in the real world. Smaldino et al. (2015) compared online and offline distance learning and face-to-face instruction.

Specific characteristics of online learning have been linked to aspects of the personal characteristics of individual students. The more personal the learning design, the more positive the impact on learning performance (del Valle & Duffy, 2009; Smaldino et al., 2015). Individual adaptation is a requirement that underlies the development of a learning management system. No matter how sophisticated an e-learning system is, if it is not designed using pedagogy, such as paying attention to student characteristics and learning theory, learning through devices will be boring (Chaeruman et al., 2019).

In addition to considering a variety of personal characteristics, online learning must provide evocative online activities such as opportunities for discussion through online forums and chats, quizzes tailored to learning objectives, and assignments appropriate to performance loads (Surjono et al., 2019). Involving experience as an online learning activity will hone students' reasoning power (Santosa et al., 2020).

Cognitive Load Theory

The cognitive load developed since 1998 has three categories: intrinsic cognitive load, extraneous cognitive load, and germane cognitive load Sweller et al. (2019). In simple terms, intrinsic cognitive load is the burden of processing information when working memory takes place, additional/foreign loads are all irrelevant learning elements, and Germane load allows students to focus their attention consciously to understand and recall learning content.

The instructional design discipline's main goals should be the cognitive load categories implicated in reducing extraneous load and increasing Germane load by developing scheme construction and automation (Orru & Longo, 2019). In other words, cognitive load theory recommends that extraneous load be reduced by reengineering learning activities when the intrinsic complexity of the task remains unchanged (Curum & Khedo, 2021). Simultaneously, as the extraneous cognitive load decreases, the scattered cognitive resources must balance the load. Reengineering the learning activities can reflect clear teaching so students can process class information more deeply (Bolkan, 2016).

METHOD

The method used in this study is qualitative. The type of qualitative research method used is phenomenology, an exploration of the general meaning of several individuals for their various life experiences related to concepts or phenomena (Creswell, 2015). Students as informants were selected purposively based on the appointment of key informants (teachers) using the same considerations as when selecting key informants. The number of informants was determined by a snowball, in the sense that interviews with informants were stopped if the data obtained was considered sufficient, in the sense that it was following the research objectives. This research involved four teachers and 30 high school students across Piyungan, Pundong, Sedayu, and Sewon districts.

The researchers could trace were five public schools located (the senior high schools) in four sub-districts in Bantul, namely in Piyungan, Pundong, Sedayu, and Sewon. There are a total of 19 public schools in Bantul in 17 districts. The selection of the area was based on the distribution of the Bantul area from all directions of the compass. School characteristics are relatively similar: public schools and implementing central and regional government policies regarding online learning during a pandemic.

Researchers monitored online learning at the school from an e-learning website used by teachers and students for four months, from June to October 2021. Researchers obtained special permission to participate in online learning spread across Whatsapp and Google Classroom chat groups in various fields of study, such as language, science, social, and sports. Researchers conducted in-depth interviews with teachers and students as key informants in this study. The students interviewed were in grades X, XI, and XII, with the highest number of class XI students at 76%. There were four teachers studied and 30 students. The students who were observed and interviewed were spread across various courses so that the researchers got stable data.

The research was conducted in schools in Bantul. The researchers started by working with schools with specific characteristics in common, such as similarities in online learning patterns or similarities in learning management. The number of schools was expanded according to the need to find data consistency/consistency. The choice of location in Bantul was due to the characteristics of being in an area with a moderate income category when compared to regencies and cities in DI. Yogyakarta. This assumption underlies the families in Bantul in the middle class in facilitating learning for their children.

Table 1. Techniques and Grid of Data Collection Instruments

No	Instrument Types	Activities/Topics
1	Online class observation sheet	Observations of online learning by teachers and students.
2	Individual performance observation sheet	Observation of student responses when practicing problem-solving skills such as working on questions and answering questions.
3	The key informant interview guide	School policies in Bantul regarding online learning during the pandemic, learning management patterns.
4	Informant interview guide	Students' perceptions (knowledge, feelings, and responses), online learning habits and activities, learning motivation, learning instructions, supporting facilities.
5	Sensitive issues written interview guide	what do teachers and students personally do?
6	Supporting documentation	Learning tools, activity photos, activity documents, and student achievement. Student works.

Primary data sources were obtained directly from key informants and informants who were then told and assessed based on their subjectivity regarding effort and cognitive load when learning online during a pandemic. Secondary data sources were obtained through documentation and literature, namely by documenting findings with a camera device, studying supporting documents

for school learning, and scientific books related to cognitive load problems in high school students. The validity of the data in this study is expressed as the level of research credibility. Such as data triangulation techniques, clarifying bias.

Table 1 shows the data collection technique used in this study was carried out using (a) involved/participating observation techniques adapted from Surahman et al. (2021) and can be seen in Table 2, (b) in-depth interviews with key informants and informants which were conducted formally and informally; and (c) documenting findings using camera equipment and sound recordings and studying supporting documents for learning in schools.

Table 2. Online Observation Protocol

Aspect	Observation activities
Teaching process	a. Learning Opening;
	b. Learning materials Delivery;
	c. Learning Closing;
	d. Lesson plan.
Student learning activity	a. Student response from teachers' feedback;
	b. Student interaction with friends and learning materials.
Learning assessment process	a. Assessment instrument;
	b. Assignments processes;
	c. Assignments method;
	d. Checking students' answers and progress;
	e. Providing feedback.
Distance learning platform reliability	a. Kind of online learning platform;
	b. Internet network power during the online learning;
	c. Digital devices control used.

Based on the data collection technique, the data collection instruments were determined, which consisted of online class observation sheets, individual performance observation sheets, key informant interview guides (deputy principals and teachers), informant interview guides (students), written interview guides on sensitive issues, as well as a documentation guide to support online learning activities.

Data analysis in this study is inductive, a comment that starts from the data obtained and then develops into assumptions (Creswell, 2015). Researchers always raise questions during data analysis as triggers, as shown in Table 3. These questions were born from inductive logic in qualitative research in general.

Table 3. The list of Research Trigger Questions

No.	Question
1	What themes usually arise from the responses and behavior of research subjects related to the research focus?
2	Are there any deviations from these themes?
3	Does finding after finding suggest additional data to be collected?
4	Do the themes found form patterns?
5	Do the patterns emerging from the qualitative data analysis corroborate the same findings?

RESULTS AND DISCUSSION

Results

This study raises several themes that the researchers succeeded in extracting based on the primary data explored during the research. The emerging themes are presented in Table 4. These themes are derived from the results of interview transcripts, field observation notes, and documentation.

Table 4. Emerging Themes

No	Emerging Themes	Description
1	Online learning destruction	a. Notifications of entertainment applications and games on Smartphone devices and computers; b. Family members at home asking for help and activities; c. From internal students (drowsy); d. Insufficient internet signal.
2	Online learning makes it difficult for students	a. Not able to learn independently; b. The teacher gives materials and assignments without adequate explanation; c. Chased by task deadlines.
3	Student extra effort	a. Repeatedly reading the material text; b. Watching other people's explanations (besides the teacher) via Youtube; c. Read other relevant material via Google; d. Follow tutoring; e. Ask seniors and teachers.
4	Cognitive load	a. Learning materials; b. Learning effectiveness; c. Learners capabilities.
5	Tasks that burden students	a. Make videos; b. Summarize; c. Do many questions.

Online learning platform

The research subjects had their first online learning experience since the pandemic. Both teachers and students are learning to adapt to new study habits during the COVID-19 pandemic. Teachers and students use Google Classroom, the Jogja Learning website, and the school's Learning Management System (LMS) to access course materials and assignments. The communication media used by teachers and students are WhatsApp and e-mail. Here are some LMS screenshots (Figure 1, Figure 2, Figure 3) of how online learning is facilitated for students.

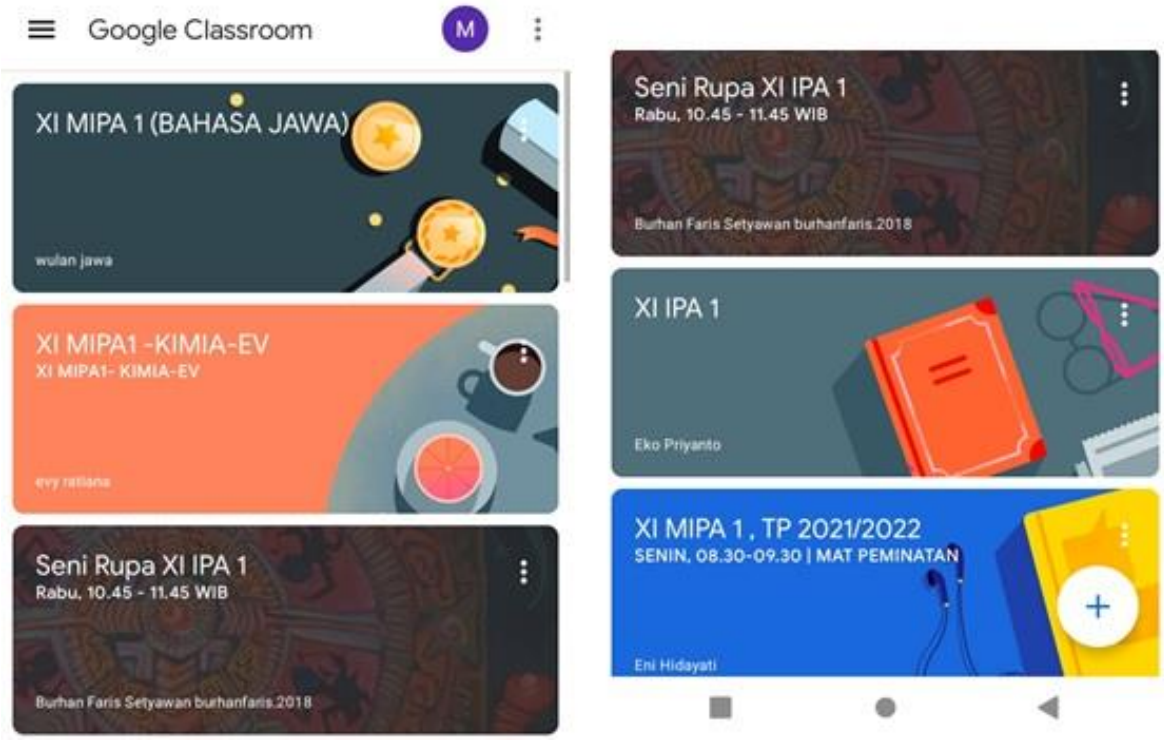

Figure 1. The list of Subjects Created by Teachers Using Google Classroom

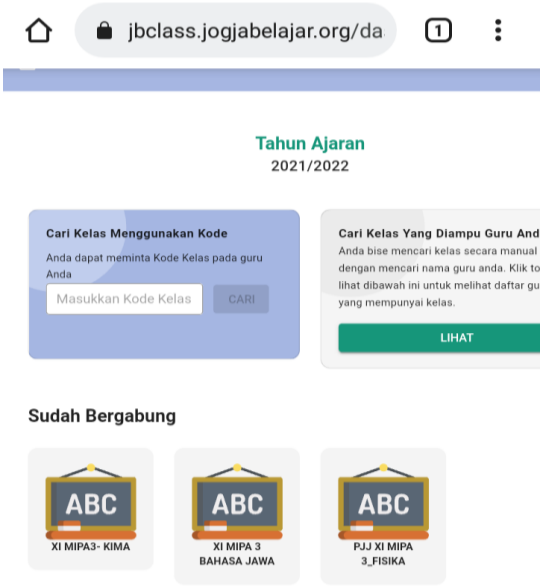

Figure 2. The list of Subjects Created by Jogja Belajar

Online learning is conducted face-to-face via the Zoom Meeting and Google Meet applications. Learning meetings are interpreted as providing comfort when the teacher greets and encourages students. Especially if the teacher explains the material and gives assignments without forcing students to complete them with a short deadline because students need time to understand both. Students feel comfortable when the teacher reminds them to do assignments according to the allotted time so they do not forget or get absent from assignments. Even though online learning activities are crowded, students are helped by notifications informing them of the latest activities, as seen in Figure 4.

Learning that students consider not to provide comfort when the teacher does not greet and immediately gives relatively many assignments to students. Tasks that are given and not explained confuse students, especially if no confirmation is given that the task is tucked into one subject matter. Students' perceptions are still oriented towards reading or listening to subjects if there are assignments or questions. The student's habit harms the teacher's assessment and the student's learning comfort.

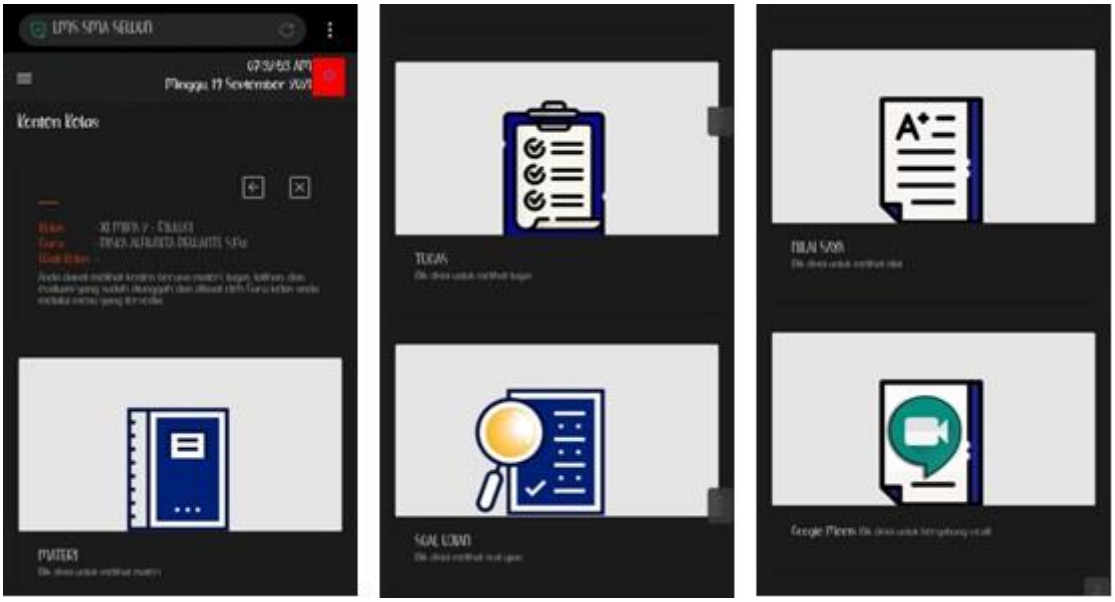

Figure 3. School's Learning Management System

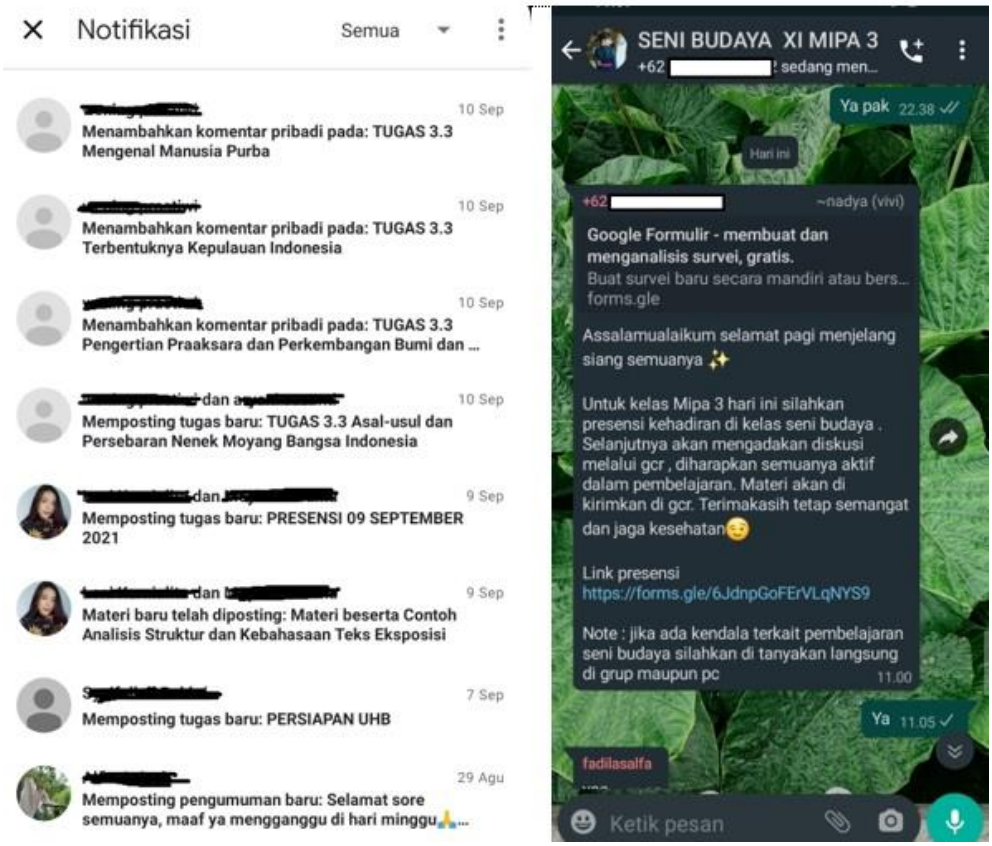

Figure 4. Notification of Assignments and Learning Activities

Students admit that studying during a pandemic is not easy. The difficulty that students experience is how to self-manage to explore independently. Mainly if the media for delivering learning messages from the teacher is limited to text format, students admit that when the teacher gives material text while explaining it via Zoom recorded in the video, it can make it easier for students to learn to understand. For students' understanding to continue to deepen, most students suggest giving practice questions. When media is presented in the independent learning process, students are happy and try to build motivation for learning enthusiasm. Conversely, students feel foreign to the lesson when learning messages are packaged in a limited format, such as text.

Another difficulty is the internet signal constraints. Even though students have received internet quota assistance to support online learning from the Ministry of Education and Culture, the student's domicile affects internet access speed. Infrastructure is still a technical obstacle that can be overcome in several ways in teaching-learning. Learning can be accessed with a delay so that students can repeat the subject matter as they like. Assignments and training can also be given for 1 or 2 hours or several days.

Online learning distraction and difficult

Online learning makes it easy for students to be distracted or distracted from their focus on education because students usually learn using mobile phones integrated with social networking applications that contain friendship and entertainment content. Students become less focused on online classes when they are more interested in chats in Whatsapp groups that discuss gossip; for example, students addicted to online games and open game applications more often than online learning applications.

The following online learning disruption comes from home. "Studying at home does not mean you can have more time to study" (FS, a student in the Piyungan area). Students having roles at home, such as children, brothers, sisters, nephews, or grandchildren, can be disrupted because parents ask students to look after younger siblings when they work, help parents trade, or ask for

other help. Students become exhausted because of this. When studying online, students need additional energy to focus, easily understand instructions, and learn from the teacher.

Except for three students, almost all students needed extra effort to understand and translate assignments from the teacher. It is not enough for students to read once. They must repeat it by accessing other varied learning resources (not depending on the teacher's source). Students do business by finding out from search engines such as Google, participating in additional online learning such as Ruang Guru, watching similar content from Youtube, and constantly asking teachers, friends, and older siblings so that students understand better.

Students feel enthusiastic about exploring the lesson as a follow-up to the teacher's teaching when the teacher implements learning using various delivery media. Students' favorites for further learning a subject are direct teaching strategies combined with problem-based learning. Students feel that teachers who explain through video conferencing and challenge students can encourage students to explore further material. Conversely, most students feel lazy to explore if the teacher's strategy encourages students to be free to study independently without being given clear directions. In addition to strategy, types of subjects or subject matter are also in the spotlight of students. Subject matter that students like tends to make them want to learn more deeply. Students like subjects that tend to be easy for students to master. Give examples to the teacher to make it easier for students to learn more.

Student cognitive load

Types of subject matter content can be in the form of concepts, theories, procedures, and facts. Each type of material has specific characteristics, so the material's presentation must be managed appropriately—presentation of the material in concepts and theories on the research subject classes, from general to specific. The teacher provides material through text, hyperlinks, voice notes, and video recordings or one of the four.

Teachers who present learning by organizing content from easy to difficult tend to be liked by students. Students admit that it is easier to understand the concept if given from the easiest and accompanied by examples. On the other hand, students find it challenging to learn an idea if it is not presented sequentially, let alone given examples and exercises. The sequence of learning activities is often inconsistent for the one-semester learning period. The teacher presents digital learning material that comes from material that others have developed. The smear results from everywhere were then adjusted to the semester learning plan. The deepening of the source material that the teacher has collected is not comprehensive, so students often find foreign terms or confusing content from sources that the teacher has not validated.

The weakness in the teacher's unpreparedness in providing digital resources that students need to study is the beginning of students' strenuous efforts in learning. New information becomes more difficult for students to understand because learning resources are not credible and learning strategies are inappropriate. Students read the text the teacher gave, but they use memorizing strategies rather than interpreting them. Students memorize, but it is not sure that they understand how to apply these concepts to conditions or problems in different contexts.

The presented learning material is too complex and perceived by students as confusing. For example, abstract material such as Mathematical formulas are trained with too frequent assignment schemes. The assignments given are in the form of answering multiple-choice and essay questions. Project-based assignments are not plentiful during online learning. Tasks that are too repetitive without adequate explanation are felt by students as a burden. Student recognition is as follows:

"I am often chased by assignment deadlines, so I do not understand the material." (DAT, students in the Sewon area); "I have difficulty translating subject matter during meetings when the teacher often gives assignments without explaining." (BAS, students in Sedayu area). The material packaged into text only makes students complain of confusion. Especially if the subject matter is relatively new to students and is presented with video media less relevant to student learning needs.

"My difficulty is not being able to summarize (determine what is important/less important) in the text given. Also, I cannot develop the material or examples of questions given in development, so when I find questions with HOT questions that have never been given an example,

I find it difficult to work on it." (FR, students in the Pundong area); "There are teachers who only provide material in text only so that we as students have trouble and look for our references to pursue the material, and there are some teachers who rely on YouTube videos from other people, as a result, we are also in trouble because the material from Youtube is different from the assignments given by the teacher." (FS, a student in the Piyungan area)

It is because students have to put more profound mental effort into understanding the material, especially in ambiguous statements and poorly explained content. Moreover, screen displays such as Google Classroom, Whatsapp, and Jogja Belajar Site are unfamiliar to students.

The cognitive load on students comes from three essential elements related to learning materials, learning effectiveness, and students' abilities. Learning materials have the characteristics of different learning objectives. Old material students have mastered initial knowledge ready to be used as a bridge to learning new things. In general, teacher research subjects know this learning principle, but teachers find it difficult to translate it into online learning activities. Like the confession of teacher "A" who found it challenging to introduce new formulas to students simply because he could not use the whiteboard feature when sharing screens via Zoom. Interactivity in synchronous meetings is minimal when the material presentation is displayed because the teacher only relies on textual presentation.

The type of material will be easy to understand, depending on the interactivity elements that strengthen the material. The material in a schematic or flowchart should be presented in a detailed drawing. In the cases found in this study, there was learning in the classroom where the teacher presented pictures, but minimal information directly referred to the parts of the picture. This makes it difficult for students to guess the picture accurately because the interactivity of the elements in the image presentation is unsuitable.

The learning method used in some cases is appropriate. For example, the teacher facilitates students to listen to a speech, so the teacher makes learning activities to listen to the podcast of an Indonesian artist, between learning objectives and learning activities appropriately connected. In other cases that are not suitable, it is shown that there is no connection between the learning objectives and the strategies used by the teacher. Like in one school where teachers do not carry out synchronous meetings, do not provide video experiments, and only provide textual material to achieve the learning objectives of chemical reactions.

Even so, the characteristics of students' abilities determine how burdened the students are in processing information. In the case of a child considered intelligent by his environment, the child can understand new learning because he may have good initial knowledge. The speed of processing information cannot be separated from intelligence and past experiences that are inherent in every student. As the researchers found, in the same class, the materials and learning methods were the same, there were variations in students who acknowledged that learning was relatively easy to follow, and some felt very difficult.

Students then make an additional effort to understand the lesson. The learning that stimulates students to learn more deeply to explore advanced knowledge is highly recommended. However, the extra efforts made by students due to the confusion of the material presented by the teacher made students experience dizziness and fatigue. Students choose learning alternatives by following tutoring packages outside of the school program.

Cognitive management in online learning systems is vital because cognitive features such as concentration levels, learning abilities, and learner attitudes are general attributes that must be maintained when interacting with learning content on digital devices.

Discussion

Based on the recognition and meaning of students from online learning experiences, a phenomenon was found that students experienced a variation in cognitive load. Working memory in students' cognitive experiences a high load on inefficient schema construction. Information presented without regard to the characteristics of working memory can increase the extraneous load, forcing students to give extra effort to stay focused, concentrated, and motivated in learning (Sweller et al., 2019). For online learning to be easy, educators must pay attention to differences in

student perceptions and learning modalities in processing information (Surahman & Surjono, 2017; Chaeruman et al., 2020). To minimize excessive working memory performance.

Information processing theory recommends involving various human senses to experience a pleasant learning environment (Curum & Khedo, 2021). A fun learning environment and learning elements are more helpful in assimilation during the learning process. Linking students' past skills and experiences with new learning plans leads to a significant and enjoyable knowledge transfer.

Learning becomes directionless when online learning is still not designed and implemented according to learning design principles. Simple things such as giving clear study instructions can make it easier for students to go through learning (Bolkan, 2016). Online learning conditions indeed became emergency learning during the Pandemic, but that does not mean that the quality of learning is difficult to reach, as long as learning is by the proper development procedures (Dick et al., 2015; Mayer et al., 2003; Miller & Krajcik, 2019).

The phenomenon of students being burdened in presenting material in text only without pieces of explanation almost evenly occurs because the application of online learning principles has not been fully implemented. Cognitive Information Processing (CIP) theory focuses on how students react to surrounding conditions and process incoming information while considering their knowledge to store new facts in memory (Mayer et al., 2003). Students can activate selective attention by selecting and processing only important information while ignoring irrelevant information. In addition, the theory states that learning materials must be organized and cut to increase working memory capacity in online learning systems.

Online learning experienced by students is difficult to remember because most of the material presented is text that students have to read repeatedly. Based on information processing theory, learning content should be designed to address essential details (Mayer et al., 2003; Curum & Khedo, 2021), for example, by adding hierarchical diagrams, flowcharts, concept maps, and many other techniques available to support the delivered online learning content. Furthermore, ending each learning session with multiple-choice questions or a self-assessment can help remember the topics studied.

Subject matter will be stored in long-term memory after the learner's memory captures the physical characteristics of the information (images) and encodes the auditory learning elements presented (Curum & Khedo, 2021). Teachers who give learning material with various modalities tend to make it easier for students to retain. Teachers who provide assignments with adequate explanations allow students to learn again and explore more deeply through their understanding to increase their knowledge retention.

In addition to presenting material, complex learning methods such as problem-based learning can increase student participation in learning (Mukti et al., 2023). This method is not difficult to apply in online learning as long as the learning sequence is designed to be a flipped classroom (Chaeruman et al., 2020). Students are enabled to make connections at any online learning opportunity.

Cognitive management in online learning systems is essential because cognitive features such as concentration levels, learning abilities, and learner attitudes are common attributes that must be maintained to properly adapt learning content on mobile devices (Curum & Khedo, 2021).

Learning effects of high students' cognitive load and recommendations

Holding students' full attention when studying online through small screen devices is usually tricky. Furthermore, the faulty design of learning materials leads to high cognitive load and negatively impacts online learning experiences. A relevant recommendation for this problem is the Split Attention principle which states that individuals learn more when information is presented in multiple forms (Mayer & Moreno, 1998). The learning material presented can be in the form of textual, images, animation, or verbal. It can encourage students to process information quickly. However, too many different learning materials presented under one interface can lead to confusion, attention shifts, and poor student performance (Curum & Khedo, 2021).

Instructional content that is too complicated can burden students with working memory because the same type of information is presented in an overlapping format that is not synergistic.

For example, material sufficiently presented with pictures does not need to be explained in detail in a textual form. This cognitive load effect is called the redundancy effect. The recommendation to avoid the redundancy effect is that the teacher provides only learning materials that students need to remember.

Giving assignments without explanation and guidance turns out to be difficult for students to complete assignments. This results in a total student cognitive load, so students expend additional effort to complete the task. Recommendations on this issue can take advantage of the sample effect. By giving examples, students can easily use their analytical abilities, especially during independent learning, when they get tasks to solve (Chen et al., 2018).

The presentation of material in online learning screens is sometimes in the form of more interactive detailed presentations. For example, pieces of information are presented in an animated format. If it is excessive, the presentation can burden students cognitively. Therefore, online learning designs should facilitate learning by providing learning elements that are not complex.

However, this study has limitations in not measuring the level of cognitive load statistically representing senior high schools in Bantul, which may be used for future research. Some of the meanings of the research subjects have not been explored more specifically related to the elements forming cognitive load on students. This research still opens the surface of cases researchers in the Bantul area can reach.

CONCLUSION

The online learning experience during the Covid-19 pandemic has been covered in the cognitive load that occurs in high school students in four areas in Bantul, namely, Piyungan, Pundong, Sedayu, and Sewon. Digest from experience during online learning awards major student themes such as online learning disorders and cognitive effort. Online learning without careful planning can attack students, especially in the discrepancy between the characteristics of learning materials, learning methods, and student abilities. The thesis regarding cognitive load when learning to dare has occurred at the high school level. The reasons for the occurrence of cognitive load are recognized based on the recognition and experience of students as subjects who are experiencing courageous learning for the first time. Teachers not used to learning dare to experience difficulties in formulating digital material presentations, so teachers tend to use other learning resources that can be accessed easily via the internet. Cognitive levels among students have not been accommodated in every step of the instructional strategy. Differences in perception resulting from differences in cognitive and socio-cultural levels determine how much working memory can work. Working memory can be burdened when the learning menu does not match cognitive effects such as the principle of split attention, redundancy, the impact of giving an example, and the effect of a more detailed explanation.

Suggestions from researchers are addressed to education policymakers, teachers, and scientific development. The facts and causes of cognitive load on students during online learning become news that deserves to be exposed to the public, so it becomes a concern for education policymakers to form training programs for teachers in designing online learning. Teachers need to acquire knowledge and skills in designing and implementing courage lessons that do not place too much cognitive burden on students. Further research can be developed regarding concrete learning principles in cellular learning.

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