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DESIGN AND DEVELOPMENT OF ANDROID SCIENCE APPLICATION *'APPS STD 5'*: AN ALTERNATIVE FOR MASTERING THE ENERGY CONCEPT OF SCIENCE YEAR FIVE IN PRIMARY SCHOOLS OF MALAYSIA

REKA BENTUK DAN PEMBANGUNAN APLIKASI SAINS ANDROID 'APPS STD 5': SATU ALTERNATIF UNTUK PENGUASAAN KONSEP TENAGA SAINS TAHUN LIMA DI SEKOLAH RENDAH MALAYSIA

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Abstract: This study aimed to design and develop a prototype of the android application called *'Apps STD 5'* for year five students to learn science in the topic of energy at primary school. This application helps teachers diversify alternative teaching methods so that fifth-year students can master the concepts of energy with the help of applications and technology of mobile devices in interactive, animation, and multimedia. Next, allow students to relate existing knowledge with the concepts of Science learned to be applied in the context of daily life. A total of seven experts from different fields and positions have been involved in the design and development process and evaluate the Android applications that have been developed. The findings of the study that application developers should consider four key points when developing Android mobile applications. The four items are content, mobile technology equipment, media materials, and multimedia elements. The Android Science Application *'Apps STD 5'* developed in line with the response of the Ministry of Education Malaysia (MOE) in the Malaysian Education Development Plan (2013-2015) in the seventh shift, which is to utilize information and communication technology (ICT) and digital devices in education to improve the quality of learning in Malaysia towards the 21st Century Learning dimension.

Keywords: Android Applications, Mobile Applications, M-Learning, Energy, Science

Abstrak: *Kajian ini bertujuan untuk membangunkan satu prototaip aplikasi Android yang dikenali sebagai aplikasi android 'Apps STD 5' untuk pelajar mempelajari mata pelajaran sains dalam topik tenaga tahun lima di sekolah rendah. Aplikasi ini membantu para guru untuk mempelbagaikan kaedah pengajaran sebagai langkah alternatif agar murid tahun lima dapat menguasai konsep tenaga dengan bantuan aplikasi dan teknologi peranti mudah alih dalam bentuk interaktif, animasi dan multimedia. Seterusnya, memberi peluang kepada*

pelajar untuk mengaitkan pengetahuan sedia ada dengan konsep Sains yang abstrak untuk diaplikasikan dalam konteks kehidupan seharian. Seramai tujuh orang pakar dari pelbagai bidang dan jawatan telah terlibat dalam proses reka bentuk dan pembangunan aplikasi android yang telah dibangunkan. Dapatan kajian menunjukkan bahawa pembangun aplikasi perlu mempertimbangkan empat perkara utama iaitu isi kandungan, peralatan teknologi mudah alih, bahan media dan elemen-elemen multimedia. Aplikasi Android Sains ini mempunyai potensi untuk dikembangkan sejajar dengan seruan Kementerian Pendidikan Malaysia dalam Pelan Pembangunan Pendidikan Malaysia (2013-2015) pada anjakan ketujuh iaitu memanfaatkan teknologi maklumat dan komunikasi (TMK) bagi meningkatkan kualiti pendidikan di Malaysia dan pengaplikasian pendidikan digital di Malaysia untuk menuju ke arah dimensi Pembelajaran Abad ke-21.

***Kata Kunci**: Aplikasi Android, Aplikasi Mudah Alih, M-Pembelajaran, Tenaga, Sains*

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INTRODUCTION

Today, the education sector is the primary key in forming a nation and country to develop social and economic sectors. The use of Information and Communication Technology (ICT) in education can take advantage of the advancement of modern and advanced technology in the digital era as a catalyst in developing the world of education (Höft, Bernholt, Blankenburg & Winberg, 2018). Using software or applications (software), mobile devices (hardware), as educational technology equipment, learning and facilitation can be delivered effectively and efficiently.

The use of ICT in learning and facilitation has a good effect on students and teachers. It helps educators carry out learning and facilitation more efficiently, practically, and attract students while maximizing the effectiveness of learning outcomes (Intan Novitasari Sianturi & Abdurrahman, 2019). This technology also allows teachers to prepare to conduct learning and facilitation sessions because teachers can find any information they need more quickly and effectively (Kurniawati & Ermawati, 2020). Whiteboards can be converted to more sophisticated equipment such as laptops, screen displays, LCD projectors, audio-visual equipment, and mirroring equipment. Therefore, this can attract students to focus more on the learning process, especially in today's digital era, where students are very vulnerable to various developments and external information so quickly. The use of mobile devices, the internet and ICT is now very relevant in the learning and facilitation process.

The theory of constructivism pioneered by Piaget is very dominant in the science education system because of its cognitive-based approach (Kim, Kwak, & Bog, 2021). This constructivism approach is often applied in education, where teachers act as facilitators to help students make connections between existing knowledge and new knowledge and ensure active learning occurs (Renouard, 2018). Furthermore, the constructivist environment through the application of 21st-century learning can help students improve their creative thinking

abilities and even become more pragmatic when combined with the latest technological tools such as mobile devices such as smartphones, laptops, and tablets (Shaaban & Chatila, 2020). Therefore, the Ministry of Education Malaysia encourages 21st Century Learning through mobile devices and mobile applications.

This study aims to develop an android application named *'Apps STD 5'* on the topic of energy for primary school students based on expert opinion. Furthermore, the study will answer four main questions which are, (i) Based on the expert's opinion, what is the content in the '*Apps Std 5*' android application for the topic of Energy? (ii) Based on expert opinion, what mobile technology equipment is suitable for using the Science *'Apps Std 5'* android application for energy topic? (iii) Based on the expert's opinion, what is the appropriate media material for the design of the '*Apps Std 5*' android application for the topic of energy? and, (iv) Based on the expert's opinion, what are the necessary elements in the design of the '*Apps Std 5'* android application for the topic of energy? The questions mentioned above will answer what are the things that need to be considered by researchers to build a science android application for primary school students in Malaysia.

MATERIAL AND METHODOLOGY

The design of this study takes the approach of study design and module development or DDR (Design and Development Research) to produce a teaching and learning mobile application. This design rationale is used because it is a specific product development process that involves the entire design and development process: analysis, design, development, implementation, and documented evaluation (Richey & Klein, 2014).

This design and development study uses various methodologies and various approaches (multi-method resources) in determining the methodology (Richey & Klein, 2014). According to Fairuzzah & Khadijah (2016), there are three phases in the study of design and development: the needs analysis phase, design phase, and evaluation phase. Therefore, this research paper only discusses the findings of the design and development phase study. In the design and development phase, the android application *'Apps STD 5'* is carried out with seven experts in various fields, namely Science, Curriculum and Pedagogy, Multimedia, Information Technology, and Communication (ICT). The semi-structured interviews were conducted using interview protocol questions. In the design and development phase of the android application *'Apps STD 5,'* the researcher uses a semi-structured interview method conducted with the appointed experts.

The implementation of this study on the mobile application development process takes the design modification (Alijah Ujang, 2016), which involves several phases, namely; (i) analysis phase, (ii) design phase, (iii) evaluation phase, where it involves different study participants for specific phases. The study's findings only focus on the design and development phases for this study, as shown in Table 1. Table 2 shows the list of areas of the experts involved. They are made up of Science, Curriculum and Pedagogy, Multimedia, Information Technology, and Communication. They are also experts who have been involved for more than ten years in their respective fields.

The instrument used was an interview protocol question. The first interview question is related to the content that needs to be placed in the android application *'Apps STD 5'* for the

energy topic. Second, is the mobile technology equipment suitable for using android application Science *'Apps STD 5'* for energy topic. The third question is the appropriate media material to be used in the design of the Science *'Apps STD 5'* android application for the topic of energy, and the fourth question is the necessary elements in the design of the Science *'Apps STD 5'* android application for the topic of energy. Next, interview data were analyzed using thematic analysis.

Table 1: The study methodology is based on the main phases of the study

Phase	Research Objective	Study Participants	Method	Instrument
Design and Development	To develop the Science android application 'Apps STD 5' for Energy Science year five based on expert opinion	Seven experts	Interview	Interview Protocol

Table 2: List of experts and fields

Phase	Study Participant	Field
Design and Development	1	ICT (Teacher)
	2	Science (Teacher)
	3	Science (Teacher)
	4	Multimedia (Lecturer)
	5	Curriculum & Pedagogy (Lecturer)
	6	STEM (Officer)
	7	Curriculum & Pedagogy (Officer)

APPS STD 5 ANDROID APPLICATION

In this phase, the skills and knowledge in operating an actual mobile device are tested. The information obtained from the needs analysis phase forms the basis of this development. In addition, this phase explains the overall view of the content, mobile technology equipment, suitable media materials to use, and the necessary elements in the *'Apps STD 5'*. This design phase is implemented in the following four steps:

Formation and Objective Evaluation

The design process begins with determining the learning outcomes or objectives to be achieved after completing the learning and facilitation process in this energy topic. Learning outcomes are the things that are expected to happen to the user after exploring the entire android application. Learning outcomes are written describing learning domains involving three aspects, namely (i) cognitive: application of learned knowledge; (ii) Psychomotor: a person's skills and ability to perform a movement; (iii) Affective: Emphasize aspects of feelings, attitudes, and interests during the learning and facilitation process. Learning outcomes should also be explicit that can be measured and specified in line with the Curriculum Standard Document and Assessment set by the Curriculum Development Division, Ministry of Education Malaysia (MOE).

Selection of Teaching Strategies

Choosing teaching strategies to deliver lessons that are easy to understand and appropriate to users' needs and teaching content is essential to ensure the smooth process of delivering content to users. There are various types of teaching strategies that teachers can use to maximize the learning and facilitation of the 21st-century learning model process, for example, tutorials, discussions, games, simulations, role-play, and problem-solving. The chosen teaching strategy should be matched to the needs and profile of the user from the needs analysis phase. In this study, the teaching strategies used are tutorials, enrichment, reinforcement, training, mind testing, games, and quizzes.

Learning and Facilitation Media

The selection of learning media and facilitation is vital to adapt to the teaching strategies that have been set. The selection of learning media and facilitation should meet users' needs and align with current technology. Various teaching media can be used, such as animation, multimedia, graphics, and so on. In this study, the researcher chose simple teaching using mobile devices such as smartphones, Chromebooks, notebooks, and tablets as intermediate media. Researchers design android applications based on 21st-century learning model design, Sharples M-Learning Model, and Constructivism Theory, which involves selecting appropriate software and compatible mobile devices. In developing this android application, the researcher applied the activities individually and in groups in line with the 21st-century learning model, Sharples M-Learning Model, and Constructivism Theory as a pedagogical approach in learning and facilitation activities.

Integration of Materials and Media

Once the content is set, strategies and approaches are determined, teaching delivery methods are selected, and media are produced. Finally, all these elements need to be integrated to form a mobile application that can function and be used by the target group. This stage is the fundamental stage of development. All previously provided design specifications will be coded in the programming language selected for the entire design phase.

Once the mobile application is ready to be designed, it will be tested to detect errors during the coding process. Any parts that do not meet the application of the specified specifications will be redesigned and tested again. In developing this android mobile application, the design and testing process must be done repeatedly to strengthen the mobile application to get good results quality and meet the standard standards and free from technical errors. The researcher has transferred the information in the flow chart and storyboard to the programming code at this design stage. Two approaches are often used for organizing materials and media, namely, using a programming language (authoring) or authoring language (authoring). Programming refers to the techniques used to design and build programs, programs, or instructions that a system can operate. The use of programming languages is difficult to control. Therefore, an alternative that is often used to replace programming languages is to use authoring language.

Writing language software does not require too much programming skills to produce a quality educational android mobile application. Therefore, the integration used in the design

process of this educational android mobile application is the authoring language. Authorship language is an intermediary that connects text, graphics, animation, audio, and video into a multimedia presentation. The authoring language also allows interactive elements to be added to a developed mobile application. All program codes will ensure that the mobile device used understands each given command can be handled internally by the authoring language without requiring the user to think logically, instructions or syntax as needed as the programming language. However, to develop complex mobile applications, the authoring language also provides its programming facilities named as a scripting language, for example, used in MIT App Inventor 2. In this study, researchers use MIT App Inventor 2 authoring software used online to develop the *'Apps STD 5'* android application.

This authoring software contains features that allow multimedia elements to be combined, such as text, graphics, animation, sound effects, audio, digital video, and graphics to produce the following interactive techniques:

Audio - Can play two audio tracks simultaneously. Audio can also play on the third track and beyond with the use of Lingo.

Animation - Can provide the most suitable environment for animation construction without the need for script language.

Interactivity - Uses sophisticated Lingo language to produce practical, interactive functions.

Video - Ability to make full-motion video recording using Lingo.

Overall, the main activities in this phase involve selecting the contents of the android mobile application *'Apps STD 5'* and the collection of media, and the integration of materials and media. The activity begins with scriptwriting and constructing a flow chart and storyboard before translating it into the appropriate authoring language. By choosing the authoring language in MIT App Inventor 2 as the design development site for this android application, *'Apps STD 5'*. The researcher can develop the android mobile application in an interactive and digital environment.

RESULTS AND DISCUSSIONS

The following are the results of interviews with all seven experts:

Content

After the interview session was conducted with the informants consisting of seven experts, the researcher conducted the interview based on the theme and subtheme. The first theme is the content in the android application *'Apps STD 5'*. All informants agree that the content in the android application should refer to the Curriculum and Assessment Standard Document developed by the Curriculum Development Division, Ministry of Education Malaysia (MOE). Three informants agreed that the content in the form of energy should include energy sources, types of energy, and changes in energy and energy applications. Here are the comments from informants 1,3 and 4:

> *"... It is easier to summarize the content in the existing topic that is the topic of energy is taken important content and use interesting icons to determine the title of a particular topic in the topic ...".* (R1TB1IKB50).

"... The content that needs to be in a science android application is energy sources, types of energy, energy change and energy applications in daily life...." (R3TB1STB40), (R3TB1JTB40), (R3TB1PBB41) and (R3TB1ATB41).

"... In my opinion, if for primary school the content that should be in an android application for energy topics are the types of energy and how those energies can change based on certain situations..." (R4TB1JTB43) and (R4TB1PBB43).

Also, aspects of evaluation and assessment should be considered in this android science application's design and development process. The aspects of assessment and assessment must be applied in current learning and facilitation to evaluate student performance (Domingo & Garganté, 2016). Furthermore, in the 21st-century learning model, assessment is a critical feature that must be present for teachers to implement in the learning and facilitation process (Palmatier, Houston & Hulland, 2017).

Informant 3 stressed that there are several examples of assessment that Science teachers can practice in learning and facilitation, namely quiz methods, project work, portfolios, and self-reflection according to the suitability of students. Informant 6 also stressed that reinforcement and enrichment training should be given tokens, marks, and rewards for students when answering correctly. Here is the response from Informants 3 and 6 on the matter:

"... Appropriate assessment instruments are such as Quiz, Project work, portfolio and self-reflection..." (R3TB1PTB59).

"... In the application, there is reinforcement and enrichment training, after that, is Reward if there is a question that needs to be answered correctly and given a token or mark to...." (R6TB1PTB54).

Next is the teaching strategy. Teaching strategies need to be emphasized when developing android applications. Effective teaching strategies can streamline the learning and facilitation process. The concept of learning must be in line with the concept of development in learning presented (Nagata & Abad, 2017).

Informant 5 suggested that teaching strategies should be implemented comprehensively to be given a broad picture in explaining a learning concept. According to him, students' self-concept learning suggestions can be exposed to various challenges in questions at various levels, and various skills can be applied. Informant 7 added that each activity applied in the teaching strategy should not be too long and be accompanied by notes as support. It is because the time offered for Science subjects is limited. Here are the responses from Informants 1,5 and 7 when asked about appropriate teaching strategies to apply.

"... Provides materials such as internet and notebooks and uses self-learning methods as well as group discussions..." (R1TB1SPB82).

"... If the energy chapter it should start thoroughly because apps can provide a broader picture in explaining a learning content..." (R5TB1SPB49).

"... Teachers need to provide students with a variety of information because nowadays, much information can be obtained because through self-learning, students are exposed to various challenges, questions of various levels and skills..." (R5TB1SPB81).

"... Activities provided do not be too long and have short notes as a stopper and so on" (R7TB1SPB48).

An element that is no less important is the teaching method. In addition to effective teaching strategies, methods appropriate to students' cognitive level should be considered so that the learning and facilitation sessions conducted are directed and focused. According to Informant 2, teaching methods should meet the characteristics enshrined in the 21st Century Learning Model centered on students and materials such as quizzes, downloading videos, and pictures. As 21st-century learning must be implemented in all subjects in schools in Malaysia, it coincides with the call from MOE.

Informant 3 argued, while using the android application, teachers can use game methods, discovery inquiry, and project-based learning (PBL) that meet the characteristics of 4C's, namely collaborative, creativity, communication, and critical.

While Informant 5 added that the blended learning method could be applied as a teaching method by teachers based on the database that has been provided. Blended learning is face-to-face learning that also incorporates online teaching technology methods [10]. Blended learning also encourages students to take control of their learning.

Informant 6, on the other hand, suggested including the elements of entertaining learners and learning while playing so that students can improve their understanding, skills, and values. Here are the responses from informants 2, 3, 5, and 6:

"... Learning methods that teachers can apply in 21st-century learning suitable for use while running learning and facilitation using android application Science is labeling objects, answering quiz questions through Kahoot, Pikes, and quizzes, and downloading videos or pictures..." (R2TB1KPB73)

"... Appropriate methods are like learning through games, discovery inquiry and project-based learning..." (R3TB1KPB55)

"... Students can follow blended learning methods and take assessments based on the database provided by the teacher in the apps used..." (R5TB1KPB87)

"Android android applications developed also need to emphasize the element of entertaining learners where while playing students will be able to explore the topic. Next can improve knowledge, understanding, skills and values... " (R6TB1KPB47)

Mobile Technology Equipment

Based on previous studies, mobile technology equipment is a tool or catalyst to facilitate the PdPc process. According to Qian & Clark (2016), the technological equipment used in teaching sessions will smooth the learning process. Abdullah et al. (2018) also stressed that mobile technology equipment is a cognitive tool to facilitate students' understanding of learning content. According to informant 1, smartphones, mobile tabs, notebooks, and surfaces can be used in m-learning Science. According to him, Chromebooks, notebooks, and laptops can also be used as teaching technology tools.

Also, informants 2, 6, and 7 supported that smartphones and laptops can also be used as Science m-learning tools by applying smart mirroring with the help of LCD projectors. Finally, informants 3, 4, and 6 added that tablets could also be used as a replacement for smartphones and laptops. Here is the response from the informants on the mobile technology equipment that can be used:

> *"... Smartphones, mobile tabs, notebooks, and surfaces. The school supplies Chromebooks and Notebooks, so teachers and students can use them. If you want to use a laptop, it can be because it is easy to move... "* (R1TB1TPB56, R1TB1TLB56, R1TB1SUB56, R1TB1CBB50, R1TB1NBB50 and R1TB1KRB51).
>
> *"... Download pictures using Bluetooth, use the smart mirroring application to project pictures directly using the projector to students using a smartphone or laptop..."* (R2TB1TPB55 and R2TB1KRB55)
>
> *"... The most suitable mobile technology equipment to use is a tablet or smartphone"* (R3TB1TPB44 and R3TB1TLB44).
>
> *"... In my opinion, the appropriate mobile technology equipment to be used in Android science applications for energy topics is smartphones or tablets..."* (R4TB1TPB48 and R4TB1TLB48)
>
> *"... In my opinion mobile technology equipment suitable for use in a science android application for energy topics, I recommend mobile technology that is either using a smartphone or tablet..."* (R6TB1TPB61 and R6TB1TLB61).
>
> *"... Suitable devices are smartphones, tablets, notebooks and laptops..."* (R7TB1TPB54, R7TB1TLB54, R7TB1NBB54, and R7TB1KRB54).

Media Material

For the aspect of media materials that can be used in the Android Science application, *'Apps STD 5'* application developers need to consider this so that the application developed is interactive and appropriate for the age of the students (Frydrychova, 2015). The syllabus should be studied first so that the content in the application does not stray from the context required by the MOE (Azmiza Ahmad, Saemah & Ruslin, 2014). Media material should look neat (Mehrvarz, Heidari, Farrokhnia, & Noroozi, 2021), focused (Yadegaridehkordi & Alaa, 2017), and transparent (Gaigher, 2019) so that no problems arise while using the android application.

For this theme, informants 1 and 5 argue that application developers need to combine media materials in graphics, animation, video, 3-dimensional techniques that reveal elements of reality. For example, informants 2 and 4 said that the appropriate media material in a Science android application is video and quiz. At the same time, Informant 3 concluded that the PowerPoint presentation is also suitable for use because it has an attractive visual display and can include audio.

Informants 6 and 7 also suggested that digital materials through educational applications with the editing of audio, pictures, text, graphics, video, and exciting animations could be included to look more attractive to students who are still in childhood, such as Year 5 students. Here is the view of the informants:

"... Combines elements of graphics, video and 3D techniques as well as server scripting programming language and animation and graphic elements that reflect elements of reality..." (R1TB1VB62, R1TB1GB62, R1TB1ANB67 and R1TB1GRB67).

"... Besides, suitable media materials used in designing Science android applications for Energy topics are youtube, class tool, quiz, Kahoot..." (R2TB1VB64 and R2TB1KUB64).

"... Suitable media materials to use are like PowerPoint Presentations. Apart from the attractive visual display with robust and effective audio support... "(R3TB1GB47 and R3TB1AUB51).

"... In my opinion, the most suitable media material to use in designing android applications for the topic of Energy is a video or other visual forms..." (R4TB1VB54).

"... When it comes to media, we need to understand that media can be graphic animation in apps, it can be software, and it can be the gadget itself..." (R5TB1ANB67 and R5TB1GB68).

"... Appropriate media materials used in designing android applications have digital materials educational applications by inserting audio recordings can be produced using certain software directly into the computer. Among the audio editing software that can be used are, such as, Sound Recorder (Windows) and Sony Sound Forge, Audacity, FL Studio, and so on. In addition, teachers can include multimedia elements such as text, graphics, audio, video and animation..." (R6TB1AUB71, R6TB1AUB73, R6TB1GB78, R6TB1AUB78, R6TB1VB78 and R6TB1ANB78).

"... In my opinion, the appropriate and suitable media to use in the application is Video, multimedia, photos, audio and so on..." (R7TB1VB59, R7TB1GB60 & R7TB1AUB60).

Element

Elements are the basic things that an application developer should consider to ensure that an application can meet users' needs. According to Sprenger & Schwaninger (2021), the developer's element in the application produced is that it should contain pictures, text, graphics, audio, video, and animation.

Informant 6 stressed that the video elements should bring realistic, exciting, and relevant elements to the studied topic. Meanwhile, informant 7 stated that the most crucial element before an application is developed is to comply with the latest curriculum content. Therefore, application developers need to emphasize this element to not stray from the syllabus. He added that the questions posed should be at low, medium, and high levels. Accordingly, the questions constructed need to be related to the real world to relate learning to the real world.

Based on the interviews conducted by all experts, the elements that need to be included in the *'Apps STD 5'* android application should contain elements of reality and virtual nature that should be combined with elements of 21st-century learning, as stated by informants 4 and 5. Also, informants 1 and 5 argue that graphic, video, and 3 Dimensional (3D) elements should be combined with the programming language in server scripting.

Informants 2 and 5 suggested that an application used for a target group of children should have attractive colors to attract children's interest. Besides, they stressed that android applications for children should have interactive and multimedia elements to stimulate children's minds. This statement is supported by informant 3, who says an attractive visual

display should have robust and effective audio support. Informant 6 suggested that text elements should be concise and concise. The use of fonts, selection of writing styles, and colours should be appropriate, not excessive, and easy to read. The following are the responses submitted by the informants:

> *"... Combines elements of graphics, video and 3D techniques as well as server scripting programming language ..."* (R1TB13DB62)
>
> *"... Based on my knowledge and experience, the elements that need to be considered in designing a science android application for the topic of energy is to have colours that interest children, And there must also be interactive and multimedia elements…"* (R2TB1WMB68, R2TB1INB69 and R2TB1MUB69)
>
> *"... Apart from an attractive visual display with robust and effective audio support…"* (R3TB1VIB51)
>
> *"... To my knowledge and experience, the elements that need to be considered in designing android Science applications for energy topics are the aspects of creativity and 21st-century skill elements through design results, tool handling, and teamwork during the storytelling game design process interactive digital… "*(R4TB1INB60)
>
> *"... 3D digital storytelling game design activities using Touch Capacitive Technology devices are seen as potential in cultivating creativity and highlighting students' skills in line with the educational needs of the 21st century…"* (R4TB13DB63)
>
> *"... All elements are important because the level of learning and acceptance of each student's content is different. For children, people must like virtual graphics and cheerful colours; there are three-dimensional patterns. Of course, if there is an interactive and multimedia element, it is beautiful. Primary school kids must love…"*(R5TB1GB73, R5TB1WMB73, R5TB1INB74, R5TB1MUB74, R5TB13DB73 and R5TB1MAB73)
>
> *"... For text on the android application, the teacher needs to be compact but straightforward, use appropriate typeface and font. Teachers also need to ensure that the text used can be read as well as the choice of writing style and text colour… "*(R6TB1TB79 and R6TB1WMB81)
>
> *"... That is why video can bring realistic and interesting elements related to energy topics that teachers develop later…"* (R6TB1URB90)
>
> *"... Elements that need to be included in an android application Science must include a critical element that is to meet the latest curriculum content…"* (R7TB1KUB64)
>
> *"... Next, the questions must be asked according to low, medium and high level…"* (R7TB1ASB66)
>
> *"... The questions in there must be related to the real world of students. So they can explore the time of use and bring from the real world outside into the learning and facilitation Science session…*" (R7TB1KSB68)

After going through expert interviews, expert reviews, and improvements, the prototype design of the module was developed, as shown in Figures 1, 2, 3, and 4.

Figure 1: Main Menu

Figure 2: Exercise Menu Screen Display

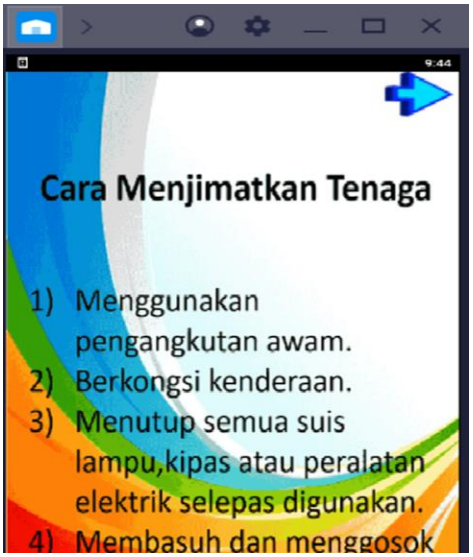

Figure 3: Additional Note

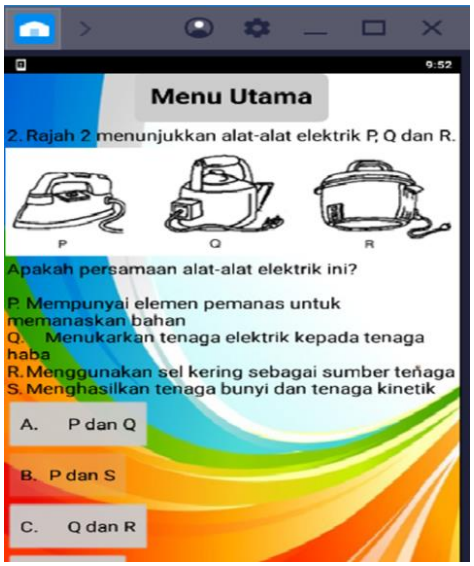

Figure 4: Interactive Quiz

Discussion of the findings of the study is based on the objective of the study which is to develop '*Apps STD 5'* android application for the topic of energy, science year 5 based on expert opinion. Overall, the researchers used a qualitative approach using a semi-structured interview method using open-ended questions to seven professional experts from the fields of educational technology, ICT, multimedia, science, and computer applications. Findings of the study show that experts strongly agree that the development '*Apps STD 5'* android application should take into account the relevant content and should refer to the Curriculum and Assessment Standards Document issued by the Curriculum Development Division, Ministry of Education Malaysia so as not to stray from the context of learning science year 5. Second, researchers need to emphasize assessment and evaluation, teaching strategies, and appropriate teaching methods while using this application in the science classroom. The third aspect is the mobile devices that are suitable to use the '*Apps STD 5'* android application for the topic of energy are smartphones, tablets, chromebooks, netbooks, surfaces, and laptops. While the fourth aspect on the use of media materials such as graphics, text, animation, video, 3D techniques, visuals, and audio is appropriate in designing '*Apps STD 5'* android application for the topic of energy, researchers need to consider the following elements: a) Elements of reality b) Virtual elements c) Programming language elements d) Interactive elements e) Multimedia elements f) Effective audio support elements g) Simple and concise text elements h) Font elements inappropriate text i) Clear writing style elements. Considering the aspects mentioned above, the *'Apps STD 5'* android application meets the criteria based on the opinion of seven professional experts. The findings of this study indicate that the design and development include aspects of content, mobile equipment used, media materials, and elements contained in a mobile application that interactive and be able to attract students to learn science.

CONCLUSION

The selection of media materials, graphics, animation, multimedia, audio, and video should be emphasized so that an application or software can be produced with quality and value to students. Pre-planned development procedures provide helpful guidance so that the application development process developed by the researcher does not stray from the targeted objectives. The *'Apps STD 5'* android application that has completed the development process will go through the stage of evaluating its usefulness and effectiveness among year five students in national schools. Feedback from expert evaluators through expert validation process evaluated from technical aspects, cosmetics, interactivity, and suitability is beneficial to researchers to ensure the continuity of this android application to achieve the study's objectives stated and targeted in this study.

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