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GENDER EQUALITY EDUCATION THROUGH AUGMENTED REALITY (AR)-BASED FLASHCARDS IN LEARNING SOCIAL STUDIES EDUCATION IN SCHOOLS AS AN EMBODIMENT OF SUSTAINABLE DEVELOPMENT GOALS (SDGs)

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Abstract

This research aims to provide gender equality literacy to students through an augmented reality (AR)-based application with flashcard media. Using the Design Based Research method with a qualitative approach via the waterfall model. The research results show that the use of flashcards in AR applications that are easy to visualize via cell phone can help teachers convey theory and understand the concept of gender equality which is considered abstract to be interactive and easy to understand. The results of expert validation regarding the quality of AR Flashcard-based gender equality applications in social studies education learning show that AR Flashcards are declared good because they make it easier for students to understand the material with interesting learning content. This has an impact on increasing understanding, interest, and motivation to learn in students.

Keywords: AR, Flashcards, Gender equality, Social studies education learning, Sustainable development goals.

1. Introduction

One of the topics in social studies is gender equality. Gender equality is a social discourse that develops along with changes in society such as gender inequality, discrimination against women, exploitation, and violence. Many reports relating to gender have been well-published [1-6]. Until now, gender-based discrimination is still widespread and appears in various forms. Stereotypes depicting women as weaker than men reinforce gender inequality in society. In addition, patriarchal culture exacerbates this situation, causing women to continue to experience oppression and exploitation [7]. Based on The Global Gender Gap Index 2020 report, the gender gap in Indonesia is still ranked 85th out of 153 countries with a score of 0.70 [8]. This means that the country needs to make many serious efforts. Thus, Indonesia's gender inequality index can be improved as an effort to eradicate gender inequality. Gender influences the differences in roles, behaviour, mentality, and emotional characteristics between men and women that have developed in wider society [9]. The issue of equality is a sensitive matter because women have limited space compared to men [10]. The study of gender is essentially not just a distinction between men and women, but also how gender can draw barriers between women and men from the cultural side of society and social construction [11-13]. Therefore, the problem of gender equality must be eliminated, Thus, both men and women can contribute to development, economic, and political [14, 15].

Gender equality is included in the 2030 Sustainable Development Goals (SDGs) agenda, which consists of 17 sustainable development goals and 169 measurable targets. SDGs have been confirmed and agreed upon by 193 member countries, including Indonesia [16]. SDGs are a media that focuses on implementing change in society which presents a sustainable view to the global community in areas that have never been touched before [17, 18]. Gender equality is the 5th goal of the SDGs [19]. Research discussing the SDGs broadens the view of education to address sustainable development, social transformation, and empowerment [20-28]. Then, gender equality is part of the global target to be achieved in SDGs 2030. Education regarding gender equality focuses on socializing and educating the public about gender issues. This education needs to be carried out immediately for students through the use of technology. Thus, learning is more interactive and effective.

One example of learning technology is augmented reality (AR). It is a part of Virtual Environment technology. AR is interactive, enriching the user's experience and perception of the real world in real-time and three dimensions [29]. AR technology is expected to become an interactive medium in social studies education learning. Many reports of AR have been well-documented [30-32]. One of the examples of the use of AR is via flashcards. It can combine virtual objects in three dimensions into real objects. It can protect the environment in real-time [33, 34]. Apart from that, AR can also use all senses, including hearing, sight, smell, and even touch [35]. AR can be applied in teaching campus activities participated in by Merdeka Belajar students [36, 37]. Thus, there is a continuity of research programs and teaching campuses in easily embedding gender equality material. Thus, involvement between prospective teachers and students in mastering skills and competencies is increased. Thus, including SDGs in the national curriculum is very important [38-40].

This research aimed to develop gender equality education through AR in learning in schools. Thus, this learning can facilitate students in interesting and

interactive Social Studies Education learning. The novelties of this research are (i) focusing on gender equality material and implementing flashcard-based AR, which is still rarely done by researchers [41], (ii) including photos of Indonesian female heroes accompanied by their struggles as an initiation for gender equality, and (iii) providing material and true and false quizzes to make it easier for users to understand the material. AR can create a quality learning environment through varied media presentations such as sound, text, graphics, and animation [41, 42]. AR is a learning medium and has three main components: computers, head-mounted displays, and markers to visualize real objects [43]. AR is an effective learning media based on Android. The utilization of Vuforia as an AR Software Development Kit on smartphones can help people learn various things in detail including gender equality [44, 45].

2. Literature Review

2.1. Differences between AR in general and Flashcard-based AR

The term AR began to be used when a researcher from Boeing, Thomas Preston Caudell created an AR application to view assembly diagrams in the industrial world [46]. AR is a technology that can provide interactive collaboration between the real and virtual worlds by displaying three-dimensional animations [47].

Another definition states that AR is a technology that combines virtual objects into a real environment that can be seen by users in real-time in a medium or space [48]. So AR can be concluded as a technology that has the potential to combine real and virtual objects which are then expressed in three-dimensional animation to create pseudo reality and projected in real-time [49].

AR has various types including.; (i) Marker AR which requires a physical marker, such as an image or QR code, to activate AR content such as AR flashcards which use images to display additional information.; (ii) Markerless AR which does not require physical markers.; (iii) Projection-based AR which can project digital information onto physical surfaces [50].

The types of AR are shown in Fig. 1. AR technology combines the real world with digital elements [51]. The differences between AR in general and AR flashcards are shown in Table 1.

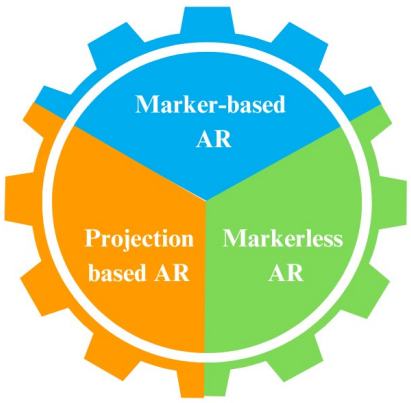


Fig. 1. Types of AR.

Table 1. Differences in AR in general with flashcard-based AR.

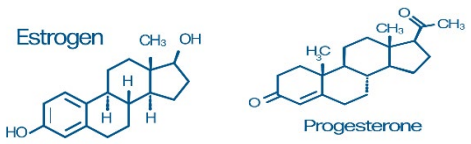
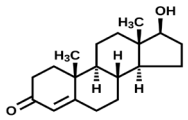
Aspect	AR in general	AR in Flashcards
Objective	Learning is more interactive, and interesting and makes it easier to visualize abstract information.	Helps the teaching and learning process, increases interest and motivation to learn, and makes it easier to understand concepts and subject matter.
Content	Provides various types of content, such as 3D objects, videos, animations, and sounds.	Providing more specific content, which can be in the form of text, images, and audio that is relevant to the learning material.
Benefit	Can increase user engagement, providing a more effective and enjoyable learning experience.	Makes it easier to understand the concepts of learning material and helps students learn independently and interactively.

2.2. Science's view of gender equality

Gender equality is a complex and layered issue, involving social, cultural, economic, and biological aspects. In recent decades, significant progress has been made in efforts to achieve gender equality, but the biological differences between men and women remain an interesting and controversial matter. Science views gender equality as the biological differences between men and women. Especially in terms of hormones and body shape, these differences are caused by genetic and chromosomal factors [52]. Differences in scientific views can be seen from four aspects, namely:

Hormones, where men have testosterone, while women have estrogen and progesterone as the main hormones. These hormonal differences influence various physical and physiological aspects, such as muscle mass, fat distribution, and reproductive function [53]. Hormones also affect mental health. For example, hormonal fluctuations in women can affect mood. [54]. Hormonal differences between men and women are presented in table 2.

Table 2. Differences in male and female hormones.

Gender	Hormones
Woman	
Man	

The body shapes of men and women are different in terms of shoulders and muscles. Men generally have a higher percentage of muscle mass compared to body fat, especially in the upper part of the body, including the shoulders, so men tend to be more physically active and do more exercise that can increase muscle strength, such as lifting weights, which can enlarge and increase muscle mass. strengthening shoulder muscles [55]. Therefore, men have bigger and more muscular shoulders,

while women generally have a higher percentage of body fat compared to muscle mass, especially in the lower body, so women are less physically active but do more exercise that increases flexibility. and resistance, such as yoga or aerobics, which may not result in significant shoulder muscle growth, making the majority of women have narrower, slimmer shoulders and smaller muscles [56]. The differences in body shape between men and women are presented in Table 3.

Table 3. Comparison of muscles and shoulders in men and women.

Aspect	Man	Woman
Shoulder		
Muscle		

Brain, in the human brain there are four parts and there are three different levels from the top of the brain stem and the fourth is tucked at the back. The human brain also has two sides, each side has a different function [57]. French neurologist Paul Borca discovered that Broca's and Wernicke's areas in the human brain can influence a person's language abilities [58]. Broca's and Wernicke's areas, which are directly connected via nerve pathways to biological organs, are responsible for regulating language processing and understanding aspects of speaking. Men have 12,000 words reserves every day, while women have up to 25,000 words reserves, which causes women to be more talkative than men. Meanwhile, in women, Wernicke's area is larger, so women often have better and more regular language skills. This is influenced by vocabulary, speaking speed, and language comprehension [59]. The difference in brain volume between men and women is shown in Fig. 2.

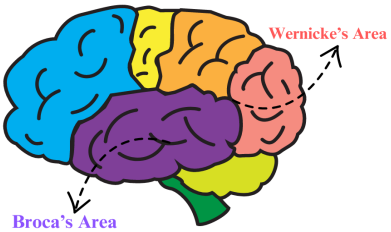


Fig. 2. Broca's area and Wernicke's area of the brain.

Genetics is a branch of biology that explains the similarities and differences in characteristics inherited by living things. Genetics explains the hereditary relationship between parents and offspring and the role of genetic material [60]. In the process of meiosis division, males produce two types of gamete cells, namely X and Y, while females only produce one type of gamete cell, namely, This Y chromosome contains the SRY gene which determines testicular development and

other masculine characteristics. Meanwhile, women only have one type of sex chromosome (X) [61]. To find out the genetic differences between men and women, we can see in Table 4.

Table 4. Comparison of male and female genetics.

Gender	Chromosome Genetics
Male	
Female	

2.3. The SDGs

The SDGs pillar is a program regarding sustainable development that has 17 goals and 169 measurable targets. SDGs have been confirmed and agreed upon by 193 member countries, including Indonesia. A total of 17 SDGs goals or pillars include: (i) No poverty.; (ii) No hunger.; (iii) Good health and well-being.; (iv) Quality education.; (v) Gender equality.; (vi) Sanitation and clean water.; (vii) Affordable and clean energy.; (viii) Decent work and economic growth.; (ix) Industry, innovation, and infrastructure.; (x) Reducing inequality.; (xi) Sustainable cities and communities.; (xii) Responsible consumption and production.; (xiii) Climate action.; (xiv) Life under water.; (xv) Life on land.; (xvi) Peace, justice and strong institutions.; and (xvii) Partnership to achieve goals [62]. An image of the SDGs goals is shown in Fig. 3.

Fig. 3. SDG's 2030 goals.

2.4. Gender Equality

Gender equality is one of the focuses of the SDGs, one of which is the fifth point, namely achieving gender equality, and empowering women and girls. This aims to provide equal rights to women and men. The hope is that with gender equality,

everyone can be empowered to fulfil their needs without discrimination, eliminate all forms of violence, and ensure that every woman has a role in every leadership role [63]. Gender equality is a concept that emphasizes equal rights and opportunities for men and women. in all aspects of life, both at the individual and structural levels. This means ensuring that all individuals, regardless of gender, can play a full role and participate in various fields such as politics, law, economics, social culture, education, and national defence and security. Gender equality is a human rights principle and a prerequisite for society-centred sustainable development and is an end in itself [64]. Thus, achieving gender equality at various levels becomes the main goal, and is a concern in terms of development initiatives.

Gender equality in Indonesia was initiated by female figure, such as Ratu Kalinyamat, Keumalahayati, Cut Nyak Dien, Dewi Sartika, and Kartini, where they fought for women's equal rights, one of which was to get an education [65]. Apart from that, Indonesian women currently have important wars and are involved in the political stage, one of which is the legislative body [66]. Women have a very important role and contribution in developing the economy to achieve gender equality in Indonesia through entrepreneurship, both micro, small, medium, and large [67].

3. Research Methodology

This research was conducted using the Design Based Research (DBR) approach. DBR was used to produce social studies education textbook products using AR technology via flashcard media for the Junior High School level. This research has development steps consisting of three steps, namely pre-production, production, and post-production steps [68]. The approach taken is qualitative [69]. The model used is the Waterfalls classic model and is systematic, and sequential in building software [70]. The advantage of using the waterfall model is that it can identify requirements long before programming begins and limits changes to requirements as the project progresses [71]. The steps are shown in Fig. 4.

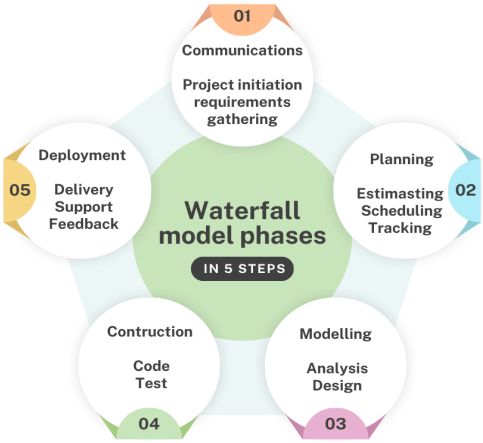


Fig. 4. Waterfall model stages.

In this research procedure, the activities we have carried out include problem identification, and searching for data sources related to the solution that we will

design in the system [72]. At the planning stage, several analyses are used to design the system, namely functional requirements and non-functional requirements, which will be continued at the modelling stage to design a prototype and also the application system design architecture. Next, the construction stage is a stage in creating code. as a translator of designs in a language that can be recognized by computers. Followed by making a mobile application with Flutter for testing, the final stage is deployment which aims to implement the system for users to develop and implement the application [73].

3.1. Participants

Participants in this research were Junior High School students in the city of Bandung. Based on the data produced regarding the school population, there are 54 schools at the Junior High School level in Bandung Indonesia and a sample of 4 schools.

3.2. Research procedures

The research procedure used DBR for three years, which had been adapted and modified in four stages: (i) Preliminary Study.; (ii) Preparation of Conceptual Model.; (iii) Validation and revision of the Conceptual Model.; and (iv) Model Implementation [74]. The steps of the research procedure are shown in Fig. 5.

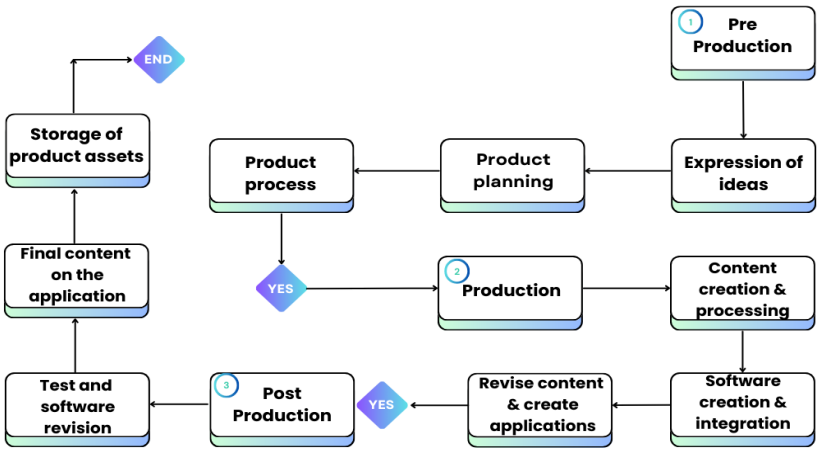


Fig. 5. The flow of research steps.

3.3. Data collection techniques and data analysis

Data collection techniques used include literature study, observation, interviews, and focus group discussions. Qualitative data analysis is carried out through the following steps: (i) Data reduction.; (ii) Carrying out certain categorization and classification.; (iii) create data displays in tabular form.; (iv) conducting in-depth cross-site data analysis.; and (v) presentation of findings and conclusions [75]. Quantitative analysis was carried out for data collected through questionnaires, using descriptive statistical analysis [76]. Apart from that, this system is assessed by experts to determine the level of validity of the software/information system being developed, so a rating scale measurement scale is used [77]. The steps for qualitative data analysis are presented in Fig. 6.

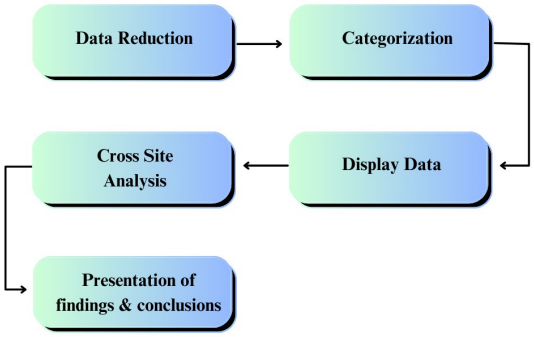


Fig. 6. Steps for qualitative data analysis.

4. Results and Discussion

4.1. Concept and application of gender equality education through AR flashcards in social studies education learning

The use of AR can be used as a learning medium to convey material virtually in the classroom. This allows students to learn both experientially and kinaesthetically which aims to turn the learning space into a highly interactive one [78]. Additionally, AR can be connected to mobile devices such as Android to increase accessibility. Even with AR media, it can concretize abstract concepts, encourage collaborative learning, achieve technology-based learning goals, and increase student interest and motivation to learn [79].

AR-based technology provides a variety of information such as images using the visual trace method [80]. AR applications continue to develop. Thus, they can be used in every learning material, one of which is gender equality educational material in Social Studies Education learning. The AR-based gender equality application through Flashcard media is made physically into a card that can be played by students as a learning medium. Cards or Flashcards are integrated into a system in real-time with markerless techniques and virtual buttons through an Android-based system and visualization in the form of AR [81, 82].

AR is a technology base that is often used for educational media. Through the application of gender equality, researchers develop innovations for Social Studies Education learning media to educate. Gender equality material is following the independent curriculum as an effort to support the realization of (SDGs). The application preparation stages are carried out in three stages including pre-production, production, and post-production [83]. The following is a description of the stages of preparing the application.

4.1.1. Pre production

The pre-production stage begins with processing ideas that focus on providing an understanding of gender equality. Thus, students can absorb the information as a whole. Technically, the concept that was born from the researchers' thoughts was translated into a mobile interface application to make it easier to understand gender equality [84]. Next, a planning stage is carried out which can determine the results of making the application, to create a clear work workflow that includes stages in content work by considering time estimates, aesthetic value, and fast methods of

work [85]. In making AR, it provides legality to Vuforia Developer with an educational software license [86]. There are various assets needed to create AR which are presented in Table 5.

Table 5. Asset requirements in AR production planning.

Asset Requirements	Asset Type	Software
Text	Fonts	All
Graphic	Knob, Background, Markers, Book cover, Logos, Interfaces	Adobe Illustrator
	Edit Photo, Texture	Photoshop
3D models	Model Raden Dewi Sartika Nyak Dien Cut Model Model Raden Ajeng Kartini Base and Decoration	Cinema 4D/Blender
Software creation	Asset Collection	Unity and Visual Studies

4.1.2. Production

The second stage is the production stage of an AR Flashcard-based gender equality application. The researcher created a background design for the panel layer requirements. This background asset was designed using pen tools with an organic triangular shape. Next, colour several parts of the plane using gradient contrasting colours, then take the data asset in the form of a PDF file type. Thus, the researcher can use the plugin feature in Illustrator, namely import all to jpg. Thus, all files can be exported in the form of a single image [87, 88].

Next, at this stage, the researcher creates the content needed for animation by processing the static content that has been created in Adobe Illustrator and moving the static content to the Adobe After Effect application. In this stage, several needs must be prepared, such as content, logo splash screen, and image editing of gender equality symbols. The graphic file type in the form of a 3D model is converted into an fbx file type, and the video is adapted to the Android platform codec [89, 90]. The programming language used is MonoDevelop [91]. The stages in making software consist of creating a splash screen menu, main menu, AR menu, and gallery menu [92]. At this production stage, the AR workflow is described through Flashcard media in Fig. 7.

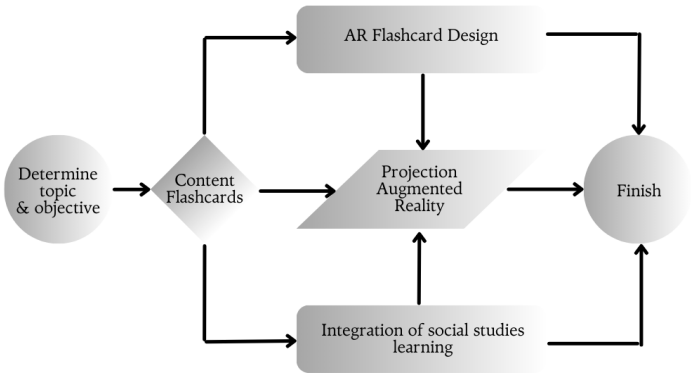


Fig. 7. AR flashcard workflow in social studies education learning.

There are several displays presented in the AR application including:

(i) *Splash Screen* The logo displayed when the application is first run lasts 11 seconds in the form of video content. The steps are to create a new scene in Unity and then add a canvas, panel, and image. The logo and process code are presented in Fig. 8.

```
Using UnityEngine.;
 usingSystems.Collections.;

 public classes splash: MonoBehaviour
{voidStart ()
{StartCoroutine(Example()).;}

IEnumerator Example()
{yield returns new WaitForSeconds(4).;
 Application.LoadLevel("major").;}}
```

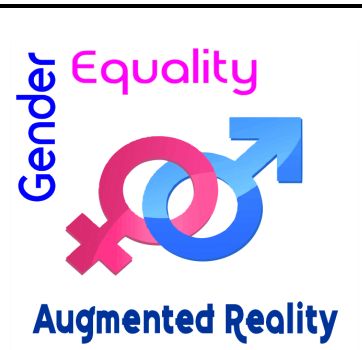


Fig. 8. Process code for opening the logo scene and application logo.

(ii) The Main Menu contains an interface display consisting of several main buttons for the reaction action process and using the camera for tracking AR objects. The main menu of the AR application is presented in Fig. 9.

Fig. 9. AR application main menu.

(iii) The interface menu displayed when entering the main menu contains data on how to use AR. The use of user interface buttons is divided into menu buttons and AR menu buttons. The user interface buttons are presented in Fig. 10.

```
publicvoidGoTomenuvr(){
  Application.LoadLevel("menuar").;}
```

```
publicvoidGoToGallery(){
  Application.LoadLevel("main_menu").;}
```

Fig. 10. User code for user interface buttons.

(iv) AR Module Integration in this subchapter explains the AR programming techniques that are integrated into the system. AR module programming is based on marker detection captured by the Android camera. The marker

detection function is the beginning of the camera process to read the Vuforia QR to display the target image [93].

(v) Marker design that has been created in Adobe Illustrator. There are seven markers made with different image patterns to display different AR objects in one AR integration. The image from this marker will be registered into a QR code by creating certain corner points contained in the marker image object [94]. The Augmented Reality marker design is presented in Fig. 11.

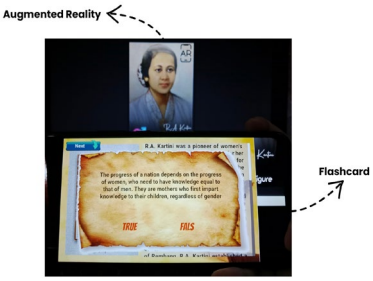


Fig. 11. AR marker design.

(vi) The markers were created using Vuforia developer (one of the big developers who concentrate on the AR field). To get a marker or QR code, first register on the site https://developer.vuforia.com/.

4.1.3. Post production

Post-production consists of four stages, namely: (i) the testing process to determine software or content deficiencies. In this process, several gadgets are tested to standardize the use of the operating system on cell phones to obtain a good screen aspect ratio. (ii) Content and Software revisions are carried out again after a thorough testing process. (iii) Building applications consisting of Os Kitkat to the latest OS. (iv) Storing all Production Assets from Unity, storage options consist of storage on laptops, personal computers, external hard disks, and internet storage [95]. Furthermore, there is a flow of the concept of AR-based gender equality education which is presented in Fig. 12.

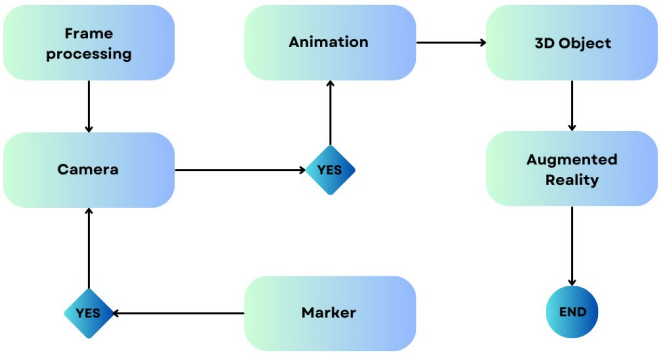


Fig. 12. The flow of AR flashcard-based gender equality education concepts in social studies education learning.

4.2. Implementation of gender equality education through AR flashcard in social studies education learning

To make social studies education learning more interesting and in-depth, especially education about gender equality, we use Flashcard-based AR technology. There are three gender equality educational materials taken as trials. In educational materials, gender equality is a concept that emphasizes equal rights and opportunities for men and women in all aspects of life, both at the individual and structural levels. Gender equality is relevant to one of the goals of the 2030 SDGs, namely the fifth point, namely Gender Equality. In this gender equality material, you can use a Project Based Learning-based learning model which is supported by AR-based learning media via Flashcards. So users can understand the abstract concept of gender equality, making learning more interactive and interesting. Gender equality in Indonesia has been initiated by female Figure, such as Ratu Kalinyamat, Keumalahayati, Cut Nyak Dien, Dewi Sartika, and Kartini. Through AR-based Flashcard media, students can analyse the struggles of heroes in Indonesia to uphold gender equality. Learning about gender equality through the services heroes presented in Table 6 and flashcards in Table 7.

Table 6. Gender equality material through visualization of the services of Indonesian female heroes.

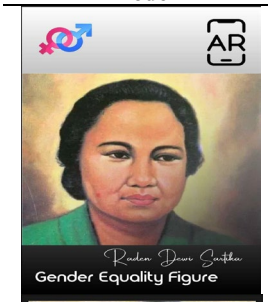
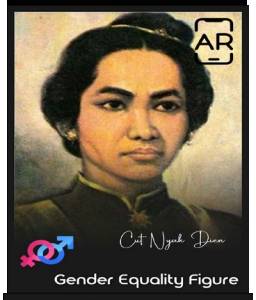
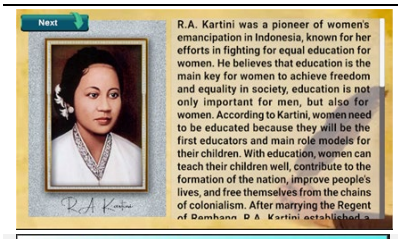
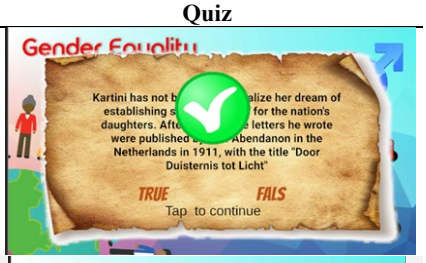
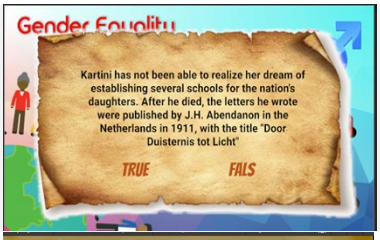
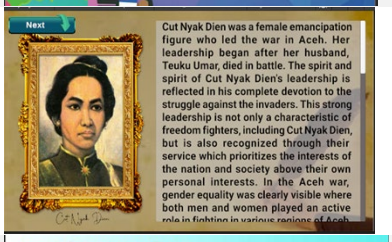
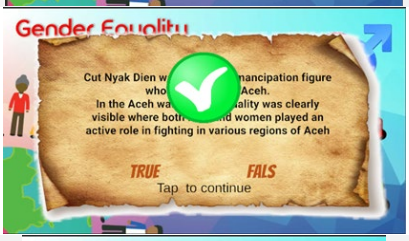
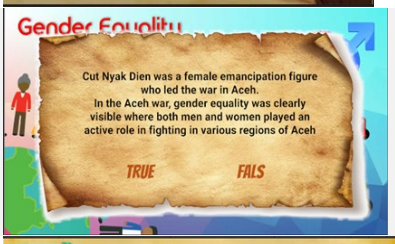
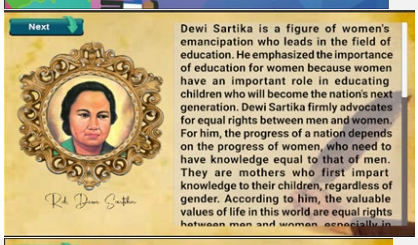
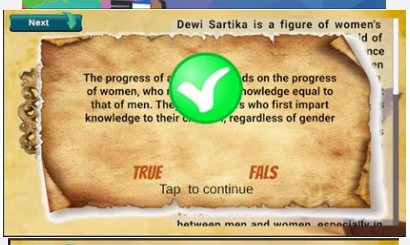
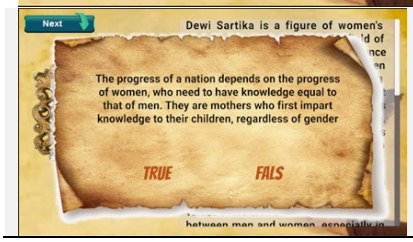
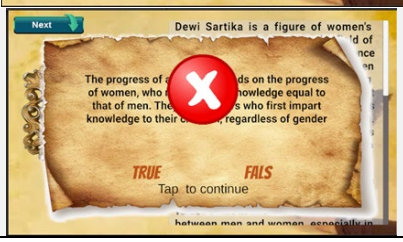
Model	Definition
	Raden Dewi Sartika is an education hero who upholds equal rights between men and women and his services in building Sakola Kautamaan Istri to create an intelligent nation in all aspects of life, both cognitive, affective, moral, and cultural. Thanks to his struggle, people can now access education properly and equally, without discrimination. As well as providing opportunities for the nation's generation to learn and work in science and technology, such as the creation of digital-based educational platforms.
	Cut Nyak Dien was a female emancipation figure who led the war in Aceh by upholding gender equality where both men and women played an active role in the fighting in Aceh. Thanks to her struggle, she proved that women could play an important role in leadership, which is following the principles of gender equality. Even now, many women can lead in the fields of technology and science, such as Dr. Eng. Rini Widiastuti, M.Sc. as an electrical engineer and CEO of PT. Exclusive Robot Design.
	RA Kartini was a pioneer of women's emancipation in Indonesia, having visionary thoughts about the importance of gender equality in various fields, including science and technology. Known for her efforts in fighting for equal education for women and her services in establishing a special learning place for women. Thanks to her struggle, Indonesian women can now receive higher education.

Table 7. AR-based flashcards.

Definition	Quiz
	
	
	
	
	
	

To be able to use AR-based flashcards in gender equality education, users will first be directed to download the AR application which can be accessed via the

following link: https://denia.co.id/download/gender_equality.apk. To make it easier for users, the flow of using AR-based Flashcards is shown in Fig. 13, furthermore, there is a chart of the implementation of gender equality education through flashcards in Fig. 14. Figure 14 explains the flow chart for implementing gender equality education through AR-based Flashcards. In the AR application, the screen displays the user to click Star. Then, the user prepares the camera to scan the gender equality figure markers for heroes such as Raden Ajeng Kartini, Cut Nyak Dien, and Raden Dewi Sartika. Then, a flashcard in the form of a quiz appears.

4.3. Expert validation results regarding AR flashcard-based gender equality applications in social studies education learning

AR product validation is carried out by Social Studies Education learning media content experts, IT experts, and AR experts. The validation results are shown in Table 8. The results of data analysis are used to process data from expert validation results regarding the media tested using the Gregory test. The validity result obtained with 10/13 is 0.76, where 0.76 is a high validity criterion. Thus, the validity results obtained in content testing by experts are in the high validity category.

The research results showed several research findings that can be analysed using theory and views into three points, including the following. First, an AR Flashcard-based gender equality application product that is integrated into a real-time system with markerless and virtual button techniques via an Android-based system and visualization in AR form that can be played by students as a learning medium [62].

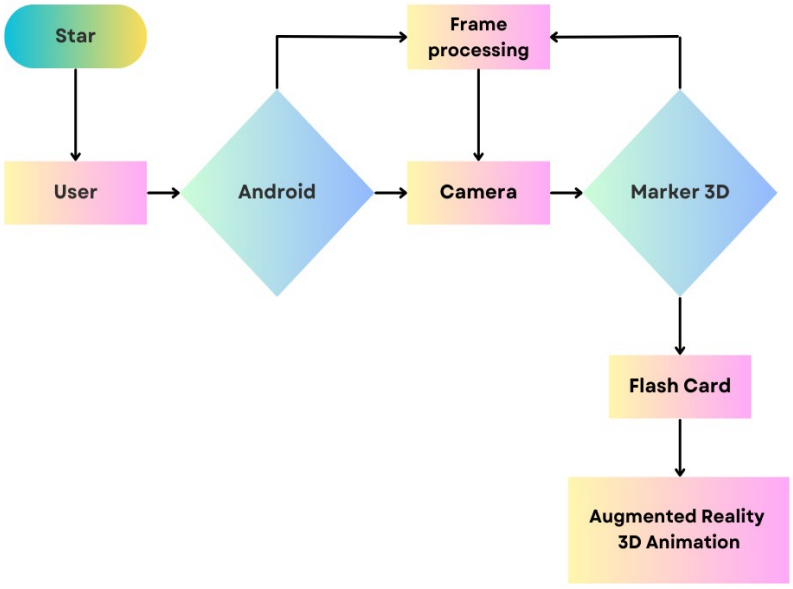


Fig. 13. The flow of using AR-based flashcards in learning social studies education.

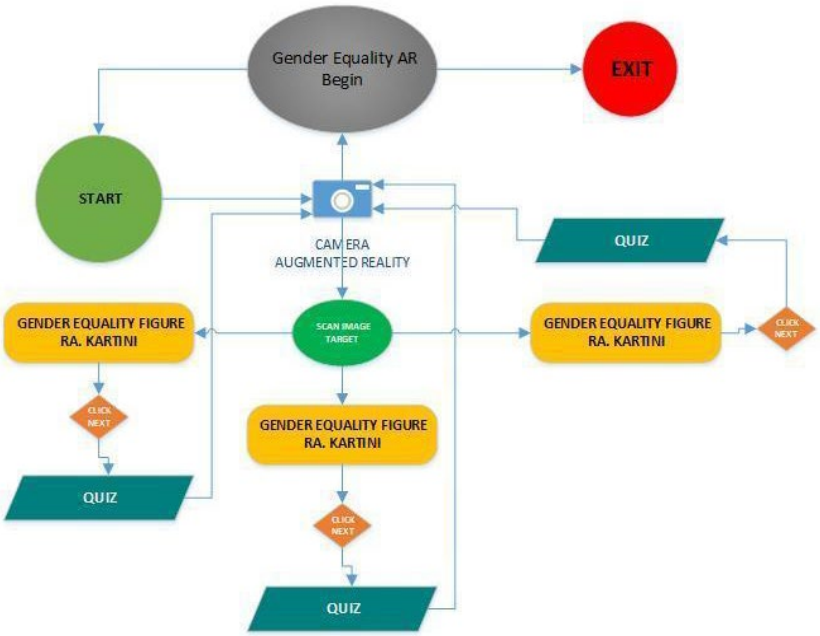


Fig. 14. Flowchart of implementation of gender equality education through AR-based flashcards.

AR has various types including: (i) Marker-based AR; (ii) Markerless AR; and (iii) Projection-based AR [30]. Through gender equality applications, researchers develop innovations as learning media to educate about gender equality. Gender equality material is following the independent curriculum as an effort to support the realization of SDGs.

The AR application prepared by researchers can be accessed via the following link: https://denia.co.id/download/gender_equality.apk**.** Second, the application of gender equality education through AR Flashcards is structured through three stages including pre-production, production, and post-production [63]. In this gender equality material, you can use a Project Based Learning-based learning model which is supported by AR-based learning media via Flashcards. So users can understand the abstract concept of gender equality, making learning more interactive and interesting. Gender equality in Indonesia has been initiated by female Figures, such as Ratu Kalinyamat, Keumalahayati, Cut Nyak Dien, Dewi Sartika, and Kartini.

Through AR-based Flashcard media, students can analyse the struggles of heroes in Indonesia to uphold gender equality. Third, expert validation results relating to the quality of the AR Flashcard-based gender equality application in Social Studies Education learning were declared good for use, this can be seen from the average score given by validation which shows a score of 0.76, where 0.76 is a high criterion. Thus, the validity results obtained in testing AR products are in the high validity category. This is supported by fun social studies learning and system development that is prepared based on good criteria. This paper also adds new information in the education, as reported elsewhere [96, 97].

Table 8. AR product validation results.

Components to be assessed	Rated aspect	Validator Score 1	Validator Score 2	Average	Tabulation
Learning Design	The AR application presented in Social Studies Education learning is easy to understand	5	4	4.5	D
Learning Design	The applications presented in Social Studies Education learning are easy to use	4	3	3.5	D
Learning Design	The appearance of the AR application presented in Social Studies Education learning is interesting	3	3	3	D
Application Quality	Animated images in AR applications are presented clearly	4	5	4.5	D
Application Quality	The AR function presented in the application works well	5	5	5	D
Application Quality	The audio presented in the animated display sounds good	5	5	5	D
Application Quality	The application can be installed on Android as well	2	5	3.5	C
Application Quality	The physical card for the marker can be seen well	3	5	4	D
Application Quality	The Marker function in AR works well	4	5	4.5	D
Application Effectiveness and Interactivity	AR applications are effective in increasing critical thinking and creativity	5	5	5	D
Application Effectiveness and Interactivity	The material in the AR-based application is following the Social Studies Education learning material	2	2	2	B
Application Effectiveness and Interactivity	AR-based applications display student interactivity	2	5	3.5	C

5. Conclusion

This research provides a general conclusion regarding gender equality education through AR flashcards. Implementation of gender equality applications in social studies education learning at the Junior High School level includes educational material on gender equality as a concept that emphasizes equal rights and opportunities for men and women in all aspects of life. And it includes aspects at both individual and structural levels. Gender equality material content on AR flashcards follows the independent curriculum as an effort to support the realization

of SDGs. By using the AR flashcards, students can analyse the struggles of heroes in Indonesia to uphold gender equality. The results of expert validation regarding the quality of AR Flashcard showed and declared good. This has an impact on increasing understanding, interest, and motivation to learn in students.

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