

Development of Interactive Learning Media on Quantum Physics Learning Material Based on Instagram Filters: Testing Comprehension and Feasibility

Iqbal Maulana Saputra¹, Anindita Putri Canina Pitono², Auliya Windi Natriansyah³, Entin Halimah Subekti⁴

^{1,2,3,4} *Physics Education Program, Faculty of Mathematics and Natural Sciences, State University of Yogyakarta, l. Colombo Yogyakarta No.1, Sleman, Special Region of Yogyakarta, 55281, Indonesia*

Corresponding author. Email: iqbalmaulana.2022@student.uny.ac.id

ABSTRACT

Quantum physics learning media based on Instagram filters is created to encourage active participation of learners in the learning process by utilizing interactive features of Instagram filter to assess the percentage of understanding of quantum physics learning material by testing through Instagram filters as a learning medium by uploading learning materials in the form of questions on images, and evaluate the feasibility of the Instagram filter-based learning media. This research is a development research (R&D) using the 4-D model (Define, Design, Develop, Disseminate). In the Define stage, an initial analysis is conducted, involving information retrieval from various literature sources to determine the urgency and establish several main objectives for creating the filter. In the Design stage, material selection and initial design are carried out. In the Develop stage, validation is performed by physics lecturers and high school physics teachers, followed by limited trials and field trials. In the Disseminate stage, the Instagram social media platform is used for dissemination as a self-learning source at several schools. As the result, an interactive Instagram filter learning media has been created for use, with a comprehension percentage after the use of quantum physics learning material based on Instagram filters obtained at 81.33%, which, when categorized according to the score interpretation table, falls into the category of very well understood. The feasibility results of the Instagram filter-based learning media product and the feasibility percentage range from 84% to 89.33%, indicating that this learning media is highly feasible for use.

Keywords : Instagram; Learning Media; Quantum Physics



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I. INTRODUCTION

From a global and historical perspective, physics has provided more universal methods to assist humanity in analyzing and solving complex problems in life. This is due to its long track record of successfully creating new knowledge that is applied to various human experiences on a broad scale, thereby driving technological development even across other disciplines [1]. Physics is also the heart of the development of information and communication technology that has fundamentally transformed human life in the last decade.

However, physics as a school subject still receives a poor reputation, being perceived as boring, difficult to learn, and not appealing to the majority of students [2, 3, 4], especially with modern physics or quantum physics topics. Physicists, educators, and even enthusiasts of physics in general face significant challenges in their efforts to present physics education in a more creative, innovative, and meaningful manner. This is crucial to captivate and instill interest in the younger generation [5].

However, the current development of modern science and technology is a result of advancements and research in the field of physics on these topics [6]. Nevertheless, many lectures or educational approaches tend to neglect these concepts, as students and even university-level learners have traditionally perceived quantum

physics as highly abstract, conceptually challenging, and demanding a grasp of other disciplines such as advanced reasoning and mathematical skills. Learning quantum physics is often seen as requiring more time, reflection, and understanding to absorb the fundamental principles of the subject [7, 8, 9].

Learning media has emerged as a component that involves teaching materials and equipment, serving as a step for educators or prospective educators in facilitating the clear delivery of information from instructors to learners. This aims to make the material easily understandable, thereby facilitating the enhancement of the learning process, including learning outcomes. It also strives to be more engaging and enjoyable for students [10, 11]. One avenue for achieving this is through the utilization of digital technology, which represents a rapidly advancing aspect in this era.

The application of digital technology in learning media is still relatively uncommon, especially among 12th-grade students in high school. Conventional learning media, such as printed books and presentation materials delivered through PowerPoint, are still in use. However, by integrating learning with digital technology, teaching should ideally become more effective both quantitatively and qualitatively. The use of technology-based media has significant potential for easy development due to its inherent appeal in implementation. It is important to note, though, that the digital technology employed in learning media should align with the learning objectives and be familiar to the students who will be exposed to that learning medium.

One of digital technology that widely used, especially among Indonesian students, is Instagram. Instagram is a photo and video-sharing application that enables users to share their visual content with others and follow other accounts to view the photos and videos they share. Since its launch in 2010, as of October 2023, Instagram has amassed 111.19 million active users in Indonesia, with the largest user demographic falling within the 18 to 24 age range, constituting 38.9% of the user base [12]. It is noteworthy that the lower limit of this age range (18) still corresponds to the school-age category.

There are several features in this application, such as stickers, music, post editing, and filters. One prominent feature on Instagram is the HeadQuizz filter or quiz question filter. The HeadQuizz filter is an Instagram filter designed for creating quizzes. This filter displays questions on the screen, and users can answer them by moving their heads left or right or by waiting for a few seconds until the correct answer appears on the screen.

Several previous studies have utilized the Instagram social media platform as a learning tool. Nugroho and Ruwanto (2017), in their research on "Development of Instagram-based Social Media Physics Learning Media as a Self-learning Source to Improve Motivation and Academic Achievement of 11th Grade High School Students," uploaded photos and videos on the topic of wave effects. The developed product, according to validators, falls into the moderate category, capable of enhancing student learning motivation, which falls within the moderate category with a standard gain (g) value of 0.43, and improving student achievement, categorized as moderate with a standard gain (g) value of 0.61 [13]. Furthermore, Purnamasari and Pujianto (2022), in "Interactive Physics Learning Assisted by Instagram Media to Improve Learning Motivation and Mastery of High School Students' Physics Concepts," have also produced an interactive physics learning medium assisted by Instagram that is deemed suitable for enhancing learning motivation and mastery of students' concepts. Students showed enthusiasm in participating in lessons when using this medium compared to conventional PowerPoint, resulting in an increased motivation score of 0.34 with a moderate category and improved concept mastery with a moderate category [14]. Additionally, Susetya and Harjono (2022) in "Development of Augmented Reality-based Instagram Filter as Science Learning Media to Improve Elementary School Students' Learning Outcomes" utilized an Instagram filter based on Augmented Reality as a learning medium for sixth-grade elementary school students in the subject of plant reproduction. This approach enhanced student learning outcomes without the use of control and experimental groups, expressing an average increase in learning outcomes from pretest and post-test data, shifting from 63.67 to 82.33 [15].

Based on several previous studies, no specific research has utilized the Instagram filter released in 2017 as a learning tool for quantum physics topics targeting both students and university-level learners. However, the introduction of quantum physics content through Instagram features could serve as an added attraction for students and university-level learners, offering a more engaging learning medium that has the potential to enhance motivation for learning quantum physics. The teaching of quantum physics content through Instagram filters is also crucial, as it aligns with curriculum objectives and educational goals.

Hence, this quantum physics learning media based on Instagram filters is created to encourage active participation of learners in the learning process by utilizing interactive features of Instagram filters, particularly the HeadQuizz-based questions; to assess the percentage of understanding of quantum physics learning material by testing through Instagram filters as a learning medium by uploading learning materials in the form of questions on images; and to evaluate the feasibility of the Instagram filter-based learning media product.

II. METHOD

This research aims to develop and introduce physics learning media on quantum physics materials based on Instagram filters for grade 12 students and physics department students. The research method used is Research and Development (R & D), which is a research method used to research so as to produce new products which are then studied for the effectiveness of the product [16]. The resulting product is expected to add insight, increase motivation and achievement in learning physics, especially quantum physics material.

The research design used is a 4D model (four-D Model). The stages of the 4D model include the defining stage (define), the design stage (design), the development stage (develop), and the dissemination stage (disseminate). In this research, lecturers act as assessors and advice givers to improve and perfect the products developed. According to Thiagarajan's model, the stages of development research can be seen in figure 1.

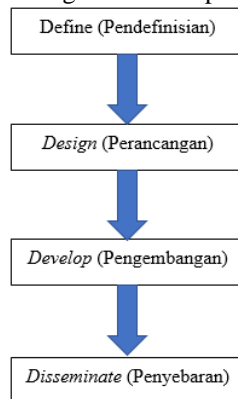


Fig. 1. Thiagarajan model development procedure

Define

At this stage, all group members discuss to explore ideas for learning media forms that are suitable, interactive, easy to use, and still rarely used for quantum physics subject matter. Before deciding on the final idea in the form of this Instagram filter, each group member also conducts an initial analysis in the form of searching for information from several literature sources to find urgency and set some main goals for making filters. Including, ensuring that this media is completely new to use. The underlying stage of definition has been outlined in the background as the main reason this form of Instagram filter-based learning media is defined.

Design

After determining the form of learning media in the form of Instagram filters, each group member discussed to determine the initial design of Instagram filters in the form of display designs, filter forms in the form of questions to provoke knowledge, and what questions will be used.

Applications or websites that we use to design Instagram filters include:

Canva serves as a place for forming or designing designs and channeling ideas, especially in making quiz questions that will be used in Instagram filters.

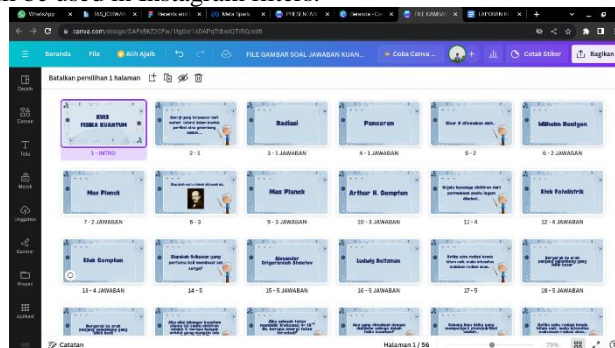


Fig. 2. quiz design creation through canva

Figma as a place to improve the design in terms of image size and resolution so that later the image files used are of higher quality and there are no errors when entered into programming.

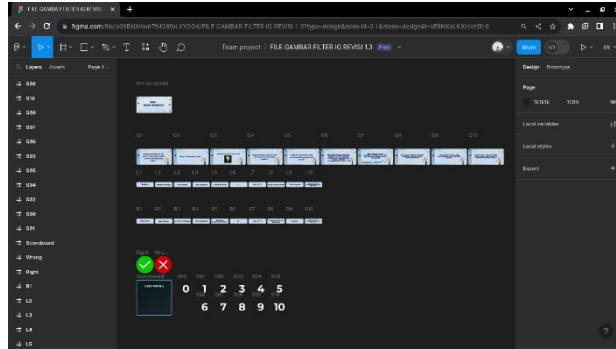


Fig. 3. design refinement through figma

The SparkAr application functions as a place to create or program quiz filters using pre-designed designs to the creation of quantum physics quiz filters based on Instagram filters that will later be used for learning media.

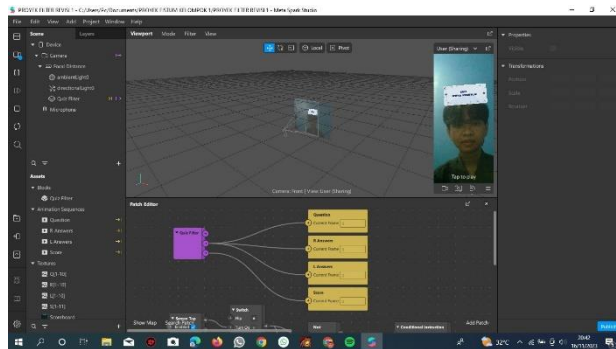


Fig. 4. filter programming through SparkAr

This website serves to upload filter programming on the meta spark website which later when it has been successfully approved by the manager, the filter can be used officially and can be used at any time by its users.

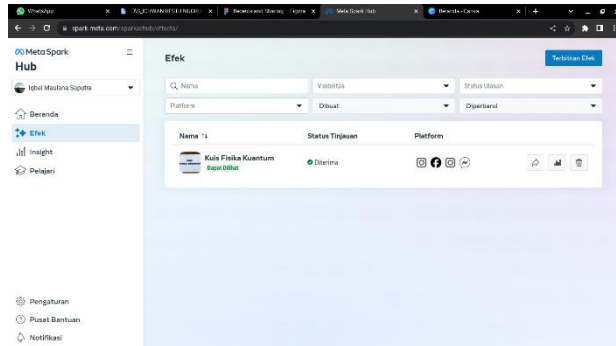


Fig. 5. upload quiz filters via Meta Spark

The Instagram application serves as a place to use Instagram filter-based learning media, the quiz filter feature that we have created can be searched and used by anyone on the Instagram application, especially in the filter feature.

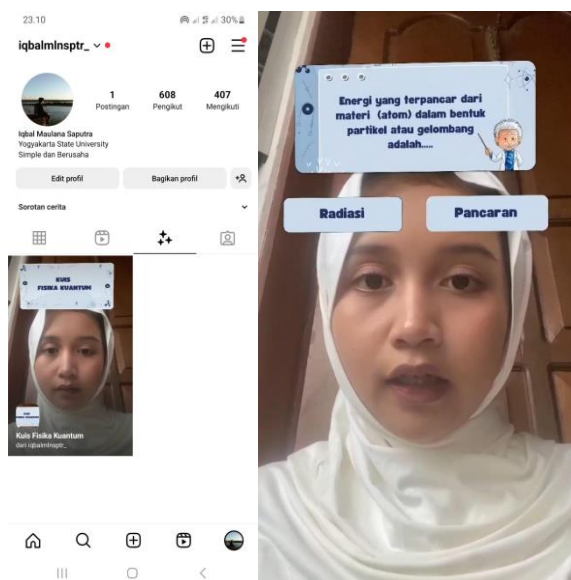



Fig. 6. quiz filter on instagram app

The creation of this learning media was not carried out with a quantitative structured validation test because since the beginning some of the questions used have been adjusted by referring to the 2013 curriculum which is still used for physics subjects for grade 12 high school / MA students equivalent or students of the class of 2023/2024. The preparation of questions has also gone through several stages of adjustment, assisted by the direction of physics teachers from MAN 4 Bantul and MAN 1 Wonosobo using the textbook used, namely 'Physics Student Book for Senior High School / MA Class XII Specialization in Mathematics and Natural Sciences' by Pujianto et al published by the publisher Intan Pariwara (2016) resulting in the following list of questions:

Table 1. List of Questions Table

No	Question	Answer Options		Correct Answer
		Left	Right	
1	The branch of science that studies the behavior of atoms / particles is	Quantum physics	Mechanical Engineering	Quantum physics
2	What does light dualism mean in quantum physics?	Just as a particle	As particles and waves	As particles and waves
3	If a photon has a frequency of 4×10^{14} Hz, what is the energy of that photon? (use $h = 6.64 \times 10^{-24}$)	2.65×10^{-19} J	1.06×10^{-19} J	2.65×10^{-19} J
4	Which of the following is the scope of quantum physics?	Molecule	Atom	Atom
5	What is the principle that expresses the wavelength relationship of an energy?	Planck's Principle	Aufbau Principle	Planck's Principle
6	The symptom of the release of electrons from the surface of a metal is called	Compton effect	Photoelectric effect	Photoelectric effect
7	The names of the characters below are: 	Max Planck	Arthur Compton	H. Max Planck
8	X-rays are discovered by	Wilhelm Rontgen	Max Planck	Wilhelm Rontgen
9	When a blackbody radiation rises, the maximum intensity of the radiation will be	Move towards a larger wavelength	Move towards smaller wavelengths	Move towards smaller wavelengths
10	The energy emitted from matter (atoms) in the form of particles or waves is	Radiation	Radiance	Radiation

(Source: Ref [17])

Next, the display design stage is carried out using the Canva application. Several design alternatives have been created, revised, and selected the most representative and obvious ones to display as instagram filters. After the design is set, each question that has been arranged will be tried to be included on each design slide.

Develop

The results of the development of Instagram social media along with the uploaded media must go through a validation stage that aims to fix the initial design of the media. Learning media from the design stage in the form of videos and images, student response questionnaire sheets, student motivation questionnaire sheets, pretest sheets, and posttest sheets. Validation is carried out by expert lecturers and physics teachers at school, but not in the form of quantitative questionnaires because it is carried out in direct consultation sessions.

There are several revisions that have been made to this learning media. The first revision was made to improve the learning media based on the validation results. Validation is carried out by physics lecturers and teachers who produce feasibility scores, student response questionnaires, student motivation questionnaires, pretests, posttests, and input and suggestions.

Limited field testing was conducted to determine the effectiveness of Instagram learning media. Testing was carried out on grade XI students by collecting student responses from the learning. The students' responses were used to improve Instagram filter learning media.

The second revision was made to improve the quality of Instagram social media as a source of independent learning. Revisions are made based on the results of limited trials that find flaws and weaknesses. These shortcomings and weaknesses were corrected in the second revision so as to produce a higher quality product. These higher quality products are ready to be tested in the field, namely at MAN 4 Bantul and MAN 1 Wonosobo.

Products that have been tested on a limited and revised basis, then tested in the field widely (operational field tests). Operational field tests are carried out to obtain products that are suitable for use in learning.

Disseminate

The final stage of the 4-D model is deployment. At this stage, learning media is disseminated and promoted to the learning targets of grade 12 high school / MA equivalent students or students of the class of 2023/2024 to try learning media. Then, an online questionnaire was sent to find out the feasibility of using the learning media as well as knowing the understanding, as well as the responses of learning targets regarding the quantum physics learning media based on the Instagram filter.

Data collection was carried out disseminate by distributing online questionnaires through whatsapp and X social media. The data taken was collected to determine the feasibility of using the learning media as well as knowing the understanding, as well as responses to learning targets regarding the quantum physics learning media based on the Instagram filter. Before filling out the online questionnaire, each respondent was given an Instagram filter link to try first.

The data analysis techniques used to represent the results of this project are quantitative tailored to the project objectives and the 4D research model.

As explained in the previous description, namely the develop stage, the creation of this learning media is not carried out with a quantitative structured validation test because from the beginning some of the questions used have been adjusted with reference to the 2013 curriculum which is still used for physics subjects for grade 12 high school / MA equivalent students or students of the class of 2023/2024 with several adjustments assisted by MAN 4 Bantul and MAN 1 Wonosobo teachers

For this reason, the first stage of data analysis is only used to calculate the feasibility results of making learning media for respondents with the criteria of students majoring in physics class of 2023 and high school students / equivalent grade 12 as many as 15 people based on indicator 3 eligibility using a google-form instrument with a likert scale of 5 which is divided into each question as follows:

Table 2. Indicator 3 Eligibility

Qualification Aspects	Question item number	Indicator
Display	1	Design used
	2	Inconspicuous color selection
	3	Clarity of instructions and writing in easy-to-read questions
Media Usage	4	Ease of access to download media
	5	Smooth use of media

	6	Flexibility of media use
Compatibility with the Material	7	Represents the quantum physics material of grade 12 high school
	8	In accordance with the core material taught in books, LKS, and schools
	9	Contains the concept of introduction to quantum physics in general / basic

From each answer, it is then classified based on 5 levels of answers using a Likert scale of 5 as shown in the table below:

Table 3. Eligibility Classification Based On Likert Scale 5

Level	Information
5	Very Worth It
4	Proper
3	Pretty Decent
2	Not Worth It
1	Very unworthy

(Source: Ref [16])

Referring to Ernawati & Sukardiyono [18], from the data obtained, it can be seen the weight of each response and its average score with the following formula:

$$\bar{x} = \frac{\sum x}{N} \tag{1}$$

Explanation:

\bar{x} : average score

$\sum x$: total score for each

N : number of respondents

The test results can also be expressed through calculations based on the following formula:

$$Result = \frac{Total\ score}{Maximum\ score} \times 100\% \tag{2}$$

The results of the feasibility calculation are then categorized based on the value of the feasibility indicators in the following table:

Table 4. The Percentage Of The Feasibility Of The Learning Media Test

Percentage	Category
81% - 100%	Very Feasible
61% - 80%	Feasible
41% - 60%	Moderately Feasible
21% - 40%	Not Feasible
<21%	Not Feasible at All

(Source: Ref [19])

In addition, the second data analysis is the percentage of respondents' understanding based on the number of questions that have been answered correctly in the following equation:

$$Percentage\ of\ understanding = \frac{Total\ right\ answer}{Total\ question} \times 100\% \tag{3}$$

The percentage results are then categorized according to the following score interpretation table:

Percentage	Category
81% - 100%	Very understanding
61% - 80%	Understand
41% - 60%	Quite understand
21% - 40%	Lack of understanding

<21% Very lack of understanding

(Source: Ref [20])

After determining the feasibility and understanding the results, the next step involves outlining the responses from the respondents as a form of interactivity and a step towards the development of this quantum physics learning media project based on Instagram filters.

III. RESULTS AND DISCUSSION

RESULTS

In this project, quantum physics learning media based on Instagram filters has been created which is conceptualized and represents the main material or topics that will be conveyed to target users by designing visual and interactive filters using the Spark AR application. By involving 15 respondents, consisting of 12th grade high school students and university students, this project created an interesting and appropriate learning experience with quantum physics material in the form of HeadQuiz or a filter in the form of a question quiz. The results of the percentage of respondent satisfaction after testing the filter display, media use, and suitability with the material, are depicted in the following bar diagram. It is hoped that this filter will be effective in providing a positive learning experience and in accordance with the needs of the target audience.

The following is the number of respondents who were successfully collected based on the target:

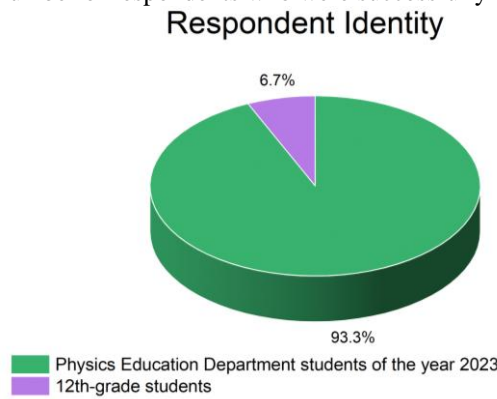


Fig. 7. circle diagram of respondent identities

From the three aspects of feasibility tested, almost entirely indicate a feasible percentage. As shown in the bar chart below:

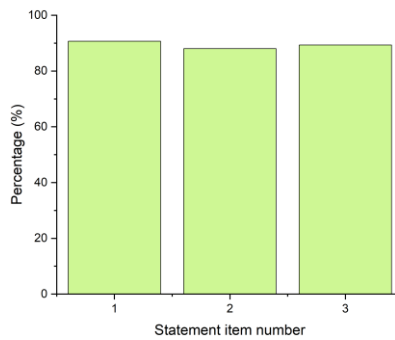


Fig. 8. bar chart of the feasibility of learning media in terms of appearance

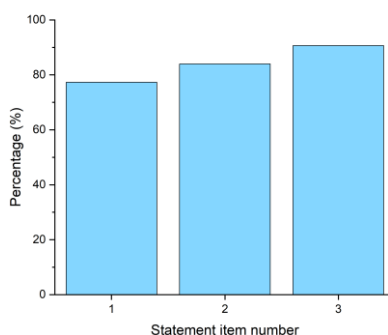


Fig. 9. bar chart of the percentage feasibility of learning media in terms of media usage

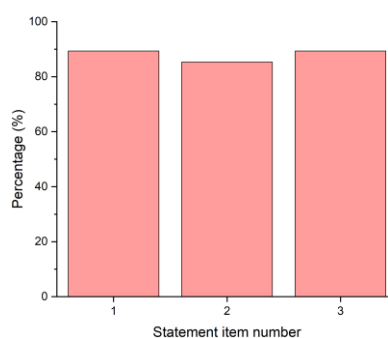


Fig. 10. bar chart of the feasibility of learning media in terms of alignment with material

DISCUSSION

This article raises the theme "Quantum Physics Learning Media Based on Instagram Filters" which aims to encourage active participation of learners in the learning process by utilizing interactive features of Instagram filters, particularly the HeadQuizz-based questions; to assess the percentage of understanding of quantum physics learning material by testing through Instagram filters as a learning medium by uploading learning materials in the form of questions on images; and to evaluate the feasibility of the Instagram filter-based learning media product. The concepts raised in this learning media have been explained clearly, describing the main material and topics that will be conveyed to users. In an effort to determine target users, this project provides clear direction by targeting grade 12 high school students and college students. This aims to ensure that the learning content presented is appropriate to the level of understanding and needs of the target audience.

Interactivity is the main focus in developing this learning media. A number of questions have been formulated to ensure active interaction between users and the learning content. The aim is to invite them to participate and stimulate critical thinking, so that learning becomes more dynamic and effective. At the Instagram filter design stage using Spark AR, the concept of quantum physics was implemented in a visual and interactive form. The filter design has been designed to illustrate how this concept can be realized in an engaging and educational user experience.

The next step includes creating designs and programming for Instagram filters using the Spark AR application. It shows the initial stage of technical implementation of a previously designed concept. Next, the implementation of filter design and programming is carried out in accordance with the concepts, designs and plans that have been made. The next process is filter performance optimization, ensuring that the filter can be accessed and used easily by users. At this stage, file size and filter performance are considered to comply with Instagram application standards, so that users can experience a smooth and enjoyable learning experience.

Once the Instagram filters are implemented and optimized, the project reaches the publication stage. The filter is uploaded to the Instagram platform so that it can be accessed by target users. The final step involved testing the filter with targeted users, namely 12th grade high school students and college students. Feedback from users is expected to provide an evaluation of the extent to which the filter is effective and interesting as a medium for learning quantum physics.

The Instagram filter-based quantum physics learning media project succeeded in producing an effective implementation. Filters designed and implemented through the Spark AR application provide a visual and interactive experience that combines quantum physics concepts. The respondents who were collected consisted of 14 students majoring in Physics Education class of 2023 and 1 high school student in class 12.

In the test results on the appearance aspect, the overall appearance of the Instagram filter learning media is in the very decent category with an average percentage of 89.33%. This comes from the average percentage of each question that has been answered by all respondents. Where the largest percentage of feasibility is reflected in the large percentage in the first question, namely 90.67%, which indicates that the design used is very suitable for use. Meanwhile, the second question item regarding selecting unobtrusive colors received the lowest percentage but was still at 88%, which indicates that the color selection for this Instagram filter is very suitable for use. As a result, the instructions and questions listed were also readable and were rated as very appropriate with a percentage level of 89.33%, although there was one respondent who suggested that it was necessary to simplify the questions so that the font size was not too small.

Regarding media use, all respondents can access this media and use it. There was a positive response regarding the use of media which was considered very appropriate as much as 84%, or in other words all respondents reported that the filter could be accessed very easily. Where the largest percentage of feasibility is reflected in the large percentage in the third question item regarding flexibility in media use which reached 90.67% or is in the very feasible category. However, several problems arose for several respondents when they started accessing or downloading Instagram filters on their accounts. There was a respondent who stated that he had difficulty downloading Instagram filters and even kept getting errors. That is why, the feasibility percentage for the first item regarding ease of access to download media is still at 77.33% or in the feasible category.

The final aspect tested for suitability was suitability for quantum physics learning material, with a feasibility percentage of 88% which was in the very feasible category, or in other words, all respondents felt that the filter content adequately covered the main points of the material presented. The highest percentage is found in the first and third questions, that this learning media received a very decent percentage, namely 89.33% because it represents class 12 quantum physics material and contains the concept of introducing quantum physics in general or basics. With the questions created, all respondents considered the filter to be successful in stimulating critical thinking about quantum physics material interactively. Some respondents even responded positively to this filter and suggested more variations to make it more interesting.

The enthusiasm of the respondents in using this filter was also known based on their efforts to answer each question given so as to create understanding as measured by the percentage of the number of questions answered correctly. Of all respondents, there was an average correct answer of 8 or 81.33%, which if categorized according to the score interpretation category table could be in the very understand category.

With these positive results, this project succeeded in creating learning media that is interesting, easy to access, and appropriate to quantum physics material for grade 12 high school students and college students.

IV. CONCLUSION

An interactive Instagram filter learning media has been created for use, with a comprehension percentage after the use of quantum physics learning material based on Instagram filters obtained at 81.33%, which, when categorized according to the score interpretation table, falls into the category of very well understood. The feasibility results of the Instagram filter-based learning media product and the feasibility percentage range from 84% to 89.33%, indicating that this learning media is highly feasible for use.

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