Ubiquitous Learning in Occupational Health and Safety Learning Media Based on Android with Augmented Reality Technology for Vocational Education

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Abstract:

The development of progressively cutting edge innovation cannot stay away from the effect on education. This research means fostering a product and test the practicality of the product. This research uses the ADDIE development model by Dick and Carey; there are five phases: analyze, design, develop, implement, and evaluate. The method of data collection in this research uses research instruments. The instrument is validated by expert judgment to obtain it as a valid instrument and can be used as a measuring tool in research. The instrument uses a questionnaire with four answer options. This research uses the descriptive analysis technique to know the feasibility level of learning media. Data analysis techniques are performed after obtaining data from students, media and material expert. Design and development were carried out on applications called "K3-AR" on android smartphones with augmented reality technology that comes with an operating guidebook. The development of learning media has been successfully developed to have evaluated with "Very Worthy" category results based on feasibility assessments by material experts and media experts. Responses by students also showed "Excellent" results based on aspects of the display, presentation of materials, language, benefits, and aspects of graphics as a technology-based learning medium.

1. INTRODUCTION

The development of increasingly advanced technology cannot be avoided the impact in education. The role of technology in education has four aspects: as part of the curriculum, as a feature of the educational plan, as a method for helping instructing, and as an apparatus to fortify the whole learning measure [1]. The main goal of vocational high schools is to provide students with jobs that focus mainly on skills. The mission of a vocational high school is defined as: prepare young people for education, improve personal ability, provide labor, and improve the knowledge, ability, and ability of labor [2]. To prepare vocational high school graduates to be ready to work by following the under necessary skills of learning media that support learning activities. Learning media that is used fittingly in the learning system will turn into a more successful and proficient help apparatus in accomplishing the learning objectives [3]. The printed module will make students unable to learn without the module. Today's students carry smartphones more frequently when going anywhere than books or modules [4].

Smartphones are a form of technological application that is currently in high demand. A smartphone is a mobile device equipped with an operating system such as a computer so that it can realize multimedia forms with high mobility. Based on observations that have been carried out in vocational high schools in Yogyakarta, the use of learning media using smartphones especially in occupational health and safety subjects has not been applied.

Learning media is used in the form of power points, job sheets, or print sheets. Ubiquitous learning is another instructive worldview made conceivable partially by computerized media's affordances [5].

Ubiquitous learning is genuinely sensible for learning since it takes advantage of the innovative progression in the teaching and learning measure. Technology can engage the learning framework, support correspondence settings, survey learning works out, direct resources, and make learning materials [6]. The utilization of learning media dependent on android joined with augmented reality technology, particularly in word-related wellbeing and security subjects, can cause understudy interest so that learning inspiration likewise increments.

Augmented reality is a technology that combines virtual data with the real world. The specialized means it utilizes incorporate mixed media, 3D demonstrating, continuous following and enlistment, wise communication, and detecting. The rule is to apply PC-created virtual information, similar to message, pictures, 3D models, music, video, etc, to this current reality after reenactment. Thusly, the two kinds of information complete each other, to achieve the update of the real world [7]. The advantages possessed by augmented reality technology including interactive, effective use, can be applied in various media, simple object modeling, the preparation does not cost too much, and easy in operation [8]. In this research, augmented reality was implemented in work-induced accident materials and personal protective equipment featuring three-dimensional objects.

Ubiquitous learning in related to help from the computerized world is perceived as a commonsense way to deal with situating understudies in genuine learning conditions [9]. In this research, the development of learning media can help students understand occupational health and safety materials because it is very important to be the basic thing taught to vocational high school students. The International Organization for Standardization (ISO) 45001 explains that occupational health and safety is a very necessary situation in the work environment to protect the workforce from work accidents. The development of learning media can attract students to learn and realize that occupational health and safety are important to apply and this learning media can also help teachers to support learning activities.

2. LITERATURE REVIEW
2.1. Vocational Education

Vocational education is education with a curriculum that is tailored to the fields and expertise of students [10]. [11] The term vocational education is general and joins each sort of guidance that hopes to the getting of capacities related to a particular calling, workmanship, or business or that gives the significant arrangement and the legitimate capacities similarly as specific data, so understudies can rehearse a calling, craftsmanship or development, independently of their age and their readiness level, whether or not the planning program contains extra parts of general education. [12] The principal points of vocational education are viewed as the accompanying: (a) to improve the learners who have finished the most significant level of optional schooling; (b) to foster the expert information and abilities needed for the act of a calling; (c) to assess the members' instructive level, with the goal for them to become serious experts later on [13]; (d) to help the understudies in their delicate acclimation to the progressions in the useful methods; (e) to give particular

preparing introductory or proceeding; (f) to fulfill the constantly changing requirements of the work market; (g) To develop the combination of the understudies in proficient life and in local area too; (h) to add to the procurement of conservative information and abilities that the association and advancement of a calling requests; and (i) to serve to the partner with the codes of social characteristics, the joining of culture through capable socialization and the creation of a direct and social code that include the master deontology.

2.2. Ubiquitous Learning

Ubiquitous learning or u-learning is another learning worldview. It is supposed to be an extension of past taking in standards from traditional figuring out how to electronic-learning (e-learning) and from e-learning out how to mobile learning (m-learning) and presently moving to u-learning [14]. Six attributes of m-learning have been adjusted by different scientists to be important for the u-learning qualities. The attributes are criticalness of learning need, a drive of information procurement, the versatility of picking upsetting, the intelligence of learning measure, arranging of educational activities, and reconciliation of educational substance [15]. The attributes of u-learning are: (a) permanency, the data stays except if the students intentionally eliminate it; (b) openness, the data is consistently accessible at whatever point the students need to utilize it; (c) promptness, the data can be recovered quickly by the students; (d) intuitiveness, the students can collaborate with companions, educators, and specialists proficiently and successfully through various media; (e) setting mindfulness, the climate can adjust to the students' genuine circumstance to give satisfactory data to the students [16].

2.3. Occupational Health and Safety

The International Organization for Standardization (ISO) 45001 explains that occupational health and safety is a very necessary situation in the work environment to protect the workforce from work accidents. The application of occupational health and safety is the obligation of everyone who works, including students while conducting practical activities in Vocational High School. Students are required to know the same health and safety work as the industry to be implemented when carrying out fieldwork practices or work.

Occupational health and safety are generally portrayed as the investigation of the assumption, affirmation, evaluation, and control of dangers arising in or from the workplace that could obstruct the prosperity and flourishing of workers, thinking about the possible impact on the including organizations and the general environment. The frequency of mishaps and business-related illnesses and wounds in most word-related areas is still unfortunately high; there is subsequently a dire requirement for preventive and defensive measures to be initiated at work environments to ensure the security and soundness of laborers. Word-related mishaps and sicknesses not just purpose incredible torment, enduring and demise to casualties, yet additionally, compromise the existences of different laborers and their dependents. Word related mishaps and illnesses additionally result in (a) deficiency of gifted and incompetent yet experienced work; (b) material misfortune, for example, harm to apparatus and hardware well as ruined items; and (c) high functional expenses through clinical consideration, installment of pay, and fixing or supplanting harmed apparatus and gear [17].

Occupational health issues emerge to a great extent from risky components in the workspace. Since most unsafe conditions at work are on a basic level preventable, endeavors ought to be focused on essential anticipation at the work environment, as this offers the most practical procedure for their disposal and control. The arranging and plan of working environments ought to be pointed toward setting up workplaces that are helpful for physical, mental, and social prosperity. This implies playing it safe to stay away from word-related sicknesses and wounds. Work environment security and wellbeing projects should target dispensing with the risky or unfortunate working conditions and perilous demonstrations which represent practically all word-related mishaps and illnesses. This can be accomplished in various ways: designing control, plan of safe work frameworks to limit chances, subbing more secure materials for perilous substances, managerial or authoritative strategies, and utilization of individual defensive hardware [17].

2.4. Augmented Reality

Augmented reality framework can be characterized as an incidental blend between a real-world and virtual article that can interface continuously and has three dimensions of virtual item enlistment. Augmented reality alludes to a wide range of advancements that project PC-created materials, like text, pictures, and video, onto clients' impression of this present reality. At first, specialists characterized expanded reality as far as explicit working with gadgets, for example, head-mounted displays (HMDs) [18]. [19] The execution of augmented reality by three qualities: (a) the mix of real-world and virtual components, (b) which are intuitive continuously, and which (c) is enlisted in 3D (i.e., the display of virtual objects or data is inherently attached to real-world loci and direction). Likewise, characterize augmented reality frameworks as those which join "genuine and computer-generated data in a genuine climate, intelligently and progressively, and [which align] virtual objects with actual ones" [20]. Augmented reality is "human-PC communication, which adds virtual objects to real faculties that are given by a camcorder progressively" [21]. Augmented reality is an innovation "which permits PC produced virtual symbolism to precisely overlay actual objects continuously" [22].

Augmented reality addresses the forefront of current culture's social-innovative turn of events. Augmented reality applications are being made by autonomous gatherings and associations all around the world for use inside numerous divergent fields [18]. The objective of augmented reality is to utilize three dimensions virtual objects as devices to upgrade clients' impression of, and cooperation with, this present reality, by causing three dimensions virtual objects to show up consistently inside the three objects climate of the real world [23]. However, augmented reality advancements can be intended to cooperate through numerous sensory channels (for example auditory, visual, olfactory, and haptic) which renders definitions zeroed in just on visual information lacking to manage future improvements in augmented reality [24].

Given the intriguing turns of events and the show usefulness of augmented reality as a further developed UI innovation, augmented reality has tremendous possible ramifications and various advantages for the expansion of educating and learning conditions [25]. For instance, augmented reality can: (a) draw in, animate, and inspire understudies to investigate class materials from various points [26] (b) assist with showing subjects where understudies couldn't attainably acquire certifiable direct insight (e.g. astronomy and geography) [27]; (c) upgrade joint effort among understudies and educators and among

understudies [25]; (d) cultivate understudy inventiveness and creative mind [28]; and (e) assist understudies with assuming responsibility for their learning at their own speed and on their way [29], and (f) establish a credible learning climate appropriate to different learning styles [30].

3. RESEARCH METHOD
3.1. Types of research
This type of research is research and development (R&D) with ADDIE as a method of development. The ADDIE development model is a development model that is systematically structured and structured to produce a product. This research aims to develop a product and test the feasibility of the product.

3.2. Time and place of research
This research was conducted on June 2021 at a vocational high school in Yogyakarta, Indonesia.

3.3. Subject research
This research involved two experts consisting of media experts and subject matter experts. The experts are lecturers in the Department of Electrical Engineering Education, State University of Yogyakarta, and the 10th grade-students majoring in Electrical Power Installation Engineering at vocational high school in Yogyakarta as media users.
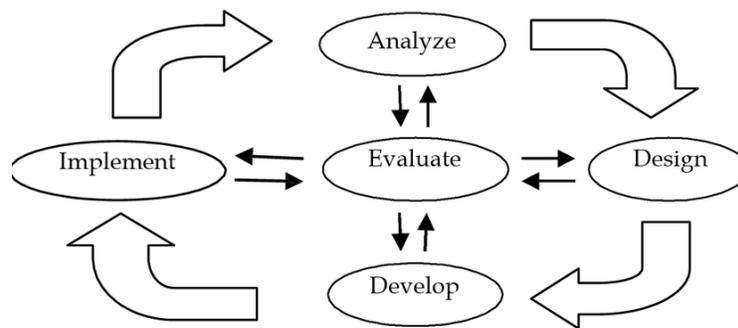
3.4. Research procedure

Figure 1. ADDIE Development Method

3.4.1 Analyze
The research procedure is carried out using the ADDIE approach. The procedure begins with the stage of analysis of problems and needs in the development of learning media so that it can be solved with the right solution. This stage includes the analysis of basic competencies to then be used as a reference in the development of learning media, material in media development by following per under indicators of achievement competence. Learning media contains occupational health and safety materials, occupational diseases, work accidents, personal protective equipment, signs safety, as well as occupational health and safety in the use of tools hands or power tools.

The needs analysis stage that includes supporting software for application includes Unity 3D, Vuforia SDK, Microsoft Visual Studio 2019, and the Android SDK. Applications need to be equipped with a guidebook operation that contains instructions for application usage, function information application user interface display, and markers of work accident forms, and personal protective equipment to facilitate the use of media in activities learning. The stage of preparing a development process plan includes the creation of learning media in the form of applications equipped with guidebook operation guidelines based on basic competencies that have been determined, then the design of the application and the guidebook operation made interesting with the consistency of navigation buttons, typefaces, and colors. The media is then invalidated by material experts and media experts as media refinement material learning so that the learning media deserves to be implemented to the students.

3.4.2 Design

The design phase of android-based occupational health and safety learning media with augmented reality includes (a) application flowchart design, created to facilitate application development, and describes the stages of application development in a structured manner; (b) the design of the application storyboard, containing the design of the application display to be made includes the design of the display and navigation buttons. Storyboards are created to facilitate the development of applications in a structured manner; (c) the preparation of the basic framework of the operating manual containing the first six parts is a introduction that describes two parts, namely a general explanation or description of applications and application development objectives, The second is the instructions for the use of applications that describe two parts, namely the instructions for downloading and installing applications on smartphones using QR Codes or links and instructions to use the camera to scan marker images so that 3D objects are successfully displayed, The third is the appearance of the application user interface that explains the information of the menu parts and the function of navigation buttons contained in the application, The fourth is a marker image that contains a 2D image of a work accident and personal protective equipment that can display 3D objects if students scan images using the camera on the scan menu, The fifth is a cover that contains a summary of the contents of the operating manual and developer expectations after students use the application, and the last is a bibliography that contains reference sources in the process of preparing an operating guidebook.

3.4.3 Develop

At the development stage, android-based applications with augmented reality are being developed using software including (a) Unity 3D version 2019.4.18f1 which serves as a data processor, including application interface design, three-dimensional objects in the form of images of accident forms due to work and tools personal protection, program code, text, image illustration, and so on, (b) Vuforia Software Development Kit that serves as an organizer and three-dimensional object scanning tool has been created, (c) Android SDK that serves as a development software for android, (d) Microsoft Visual Studio 2019 which serves as software in the writing of program code, and (e) Blender that works software for designing 3D objects and animations.

Black box tests are performed to find outperformance in applications based on application details such as the appearance of the application user interface such as (a) The

appearance of the initial page of the application includes the main menu, material menu, evaluation menu, menu about the application, (b) Key functions on the application among them are navigation buttons and music buttons, and (c) Flow compatibility function on the application so that it can be known whether the application is running accordingly with its function. This test was conducted on android brand smartphones Samsung A10 with Android version 9.0. After the black box test using the instrument, it can be known that the overall function of the application can run well.

Compatibility tests are also performed to check if the application is developed capable of running on smartphones with operating systems, RAM, camera, and screen resolution are different. The results of the compatibility test are shown in table 1:

Table 1. Compatibility Tests Result

Device Name	Specifications	Testing		
		Installation	Basic Application Functions	Augmented Reality Function
Samsung Galaxy A10	**Operation Systems:** Android 9.0 **RAM**: 2 GB **Screen Resolution**: 720 x 1520 pixels HD+ **Camera**: 13 MP	Success	Success	Success
Asus Zenfone Pro Max M1	**Operation Systems:** Android 9.0 **RAM**: 4 GB **Screen Resolution**: 1080 x 2160 pixels **Camera**: 13 MP/16 MP	Success	Success	Success
Samsung Galaxy A51	**Operation Systems:** Android 11 **RAM**: 6 GB **Screen Resolution**: 1080 x 2400 pixels **Camera**: 48 MP	Success	Success	Success
Samsung Galaxy A31	**Operation Systems:** Android 10 **RAM**: 4 GB **Screen Resolution**: 1080 x 2400 pixels **Camera**: 48 MP	Success	Success	Success

At this stage, there is also a feasibility test reviewed from the material and media aspects by material media experts to find out the level of product feasibility before it is implemented to students. Validation by material experts is done to find out the level of eligibility material development media learning occupational health and safety based on android with augmented reality. Aspects assessed cover four aspects including the feasibility of content, language, presentation, and benefit. The handles used amounted to 25

statements using the Likert scale category with four answer options. Score adjusted at level categories eligibility. Here is a table of validation results by material experts:

Table 2. Validation Results by Material Experts

Aspects	Max. Score	Material Expert Score		Average	Percentage
		1	2		
Content	28	26	21	23.5	84%
Eligibility	24	22	19	20.5	85%
Language	28	26	22	24	86%
Presentation	20	19	18	18.5	93%
Benefit	100	93	80	86.5	
Total Percentage		93%	80%	87%	

Validation by media experts is done to find out the level of eligibility development of occupational health and safety learning media android with augmented reality. Aspects that it is considered to cover four aspects including the presentation format, language, consistency, and aspects of graphics. The handles used amounted to 25 statements use the Likert scale category score four answer options. Score adjusted at the category of eligibility level. Here is a table of validation results by media experts:

Table 3. Validation Results by Media Experts

Aspects	Max. Score	Media Expert Score		Average	Percentage
		1	2		
Presentation	24	20	23	21.5	90%
Format	32	27	29	28	88%
Language	28	25	25	25	89%
Consistency	16	14	14	14	88%
Graphics Aspects	100	86	91	88.5	
Total Percentage		86%	91%	89%	

3.4.4 Implement

This stage was carried out with the number of respondents to 36 students of Grade 10th Majors Electrical Power Installation Technique in SMK Negeri 3 Yogyakarta. The implementation aims to find out the student's response to the learning media. After the trial is conducted on the learning media, students can fill out the response questionnaire. The results of filling the next response questionnaire are used as a reference to make improvements. The assessment uses a questionnaire with a Likert scale category score of 1-4 and a total of 20 statement items which include five aspects including the display aspect with 2 statements, the material presentation aspect with 5 statement items, the language aspect with 5 items statement, benefit aspect with 3 statement items and graphic aspect with 5 statement items. Here is a table of assessment results by students:

Table 4. Assessment Results by Students

Aspects	Display	Presentation	Language	Benefit	Graphics	Total
Max. Score	8	20	20	12	20	80
Average	6.81	16.42	16.86	10.31	16.89	67.28
Percentage	85%	82%	84%	86%	84%	84%

3.4.5 Evaluate

The last stage is an evaluation that aims to formulate improvements to the learning media through response questionnaires that are distributed to students. Data on the results of the questionnaire is then processed to find out the success of the development of learning media that has been done. Improvements to the learning media are made if there are shortcomings or discrepancies so that the creation of a viable product and the achievement of development goals.

3.5. Data, instruments, and data collection techniques

The method of data collection in this research uses instruments and validated by expert judgment so that it is obtained as a valid instrument and can be used as a measuring tool in research. Likert scale presented for a genuine or speculative circumstance understudy, members are approached to show their degree of concurrence with the given assertion (items) on a measurement scale [31]. The instrument uses a questionnaire with four answer options namely 4 (Excellent), 3 (Good), 2 (Bad), 1 (Very Bad).

3.6. Data analysis technique

The data analysis technique used in this research is a quantitative descriptive data analysis to know the level of feasibility of learning media. Data analysis techniques are performed after obtaining data from students, media and material experts. The results of the data analysis obtained are then calculated by converting the results of the calculation into percentage form. Media eligibility percentage categories can be seen in Table 5.

Table 5. Media Eligibility Percentage Category

Score in Percentages (%)	Category
0 – 25%	Very Unworthy
>25% - 50%	Less Worthy
>50% - 75%	Proper
>75% - 100%	Very Worthy

3.7. SWOT Analysis

The development of learning media obviously has advantages and disadvantages so that SWOT (Strengths, Weaknesses, Opportunities, and Threats) examination stage is required seems when learning media are utilized along with other similar. Strengths in learning media, media is outfitted with augmented reality innovation, the current materials adjust to the essential capabilities of word related wellbeing and security and there is an assessment menu that should be possible by understudies, just as the consistency of learning media which lies in the showcase plan like design, route buttons, and text size. Weaknesses in learning media, learning media has not been tried for its adequacy in light of the fact that

in this review it is simply restricted to an achievability test. The learning media has not been outfitted with a conversation discussion to oblige understudies in posing inquiries identified with word related wellbeing and security materials on fundamental occupational health and safety subjects.

Opportunities in learning media, viability tests should be completed so it very well may be seen that learning media can be utilized work on the nature of learning. The expansion of a conversation gathering is likewise required as a discussion for understudies to pose inquiries so they can build understudies' information identified with occupational health and safety subjects. Threats in learning media is the huge application limit turns into a threat in this development in light of the fact that not all understudies' cell phones have an enormous limit.

4. RESULTS AND DISCUSSION
4.1. Results

This research resulted in a product that is an application with the name "K3-AR" on android smartphones that comes with an operating guidebook. The K3-AR application and the operating guidebook is shown in Figure 2 and 3. The overall function of the display and navigation buttons, K3-AR applications can work very well. The operating guidebook was made to make it simpler for understudies to utilize the application and output markers to raise three-dimensional objects.

Figure 2. K3-AR Application   Figure 3. Guidebook Operation

Assessment results provided by students, material and media experts result in assessments with very worthy categories. Diagrams of assessment results by material and media experts are shown in Figure 4 and 5.
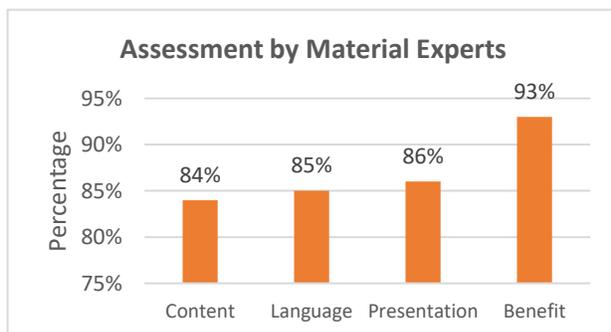
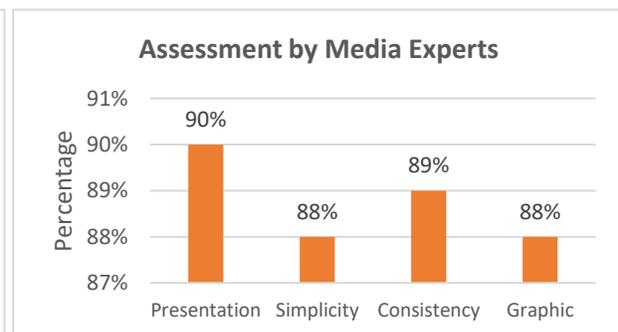

Figure 4. Assessment Diagram by Material Expert   Figure 5. Assessment Diagram by Media Expert

Figure 4 shows the aspect of content feasibility gets 84%, the language aspect gets 85%, the presentation aspect gets 86%, and on the benefit aspect gets 93% so that the total overall assessment gets 87% with the category "Very Worthy". Figure 5 shows the aspect of presentation format gets 90%, the language aspect gets 88%, the consistency aspect gets 89%, and on the aspect of the graph gets 88% with the total overall assessment gets 89% with the category "Very Worthy". Students' response obtained results with very decent categories. The student response diagram can be seen in Figure 6.
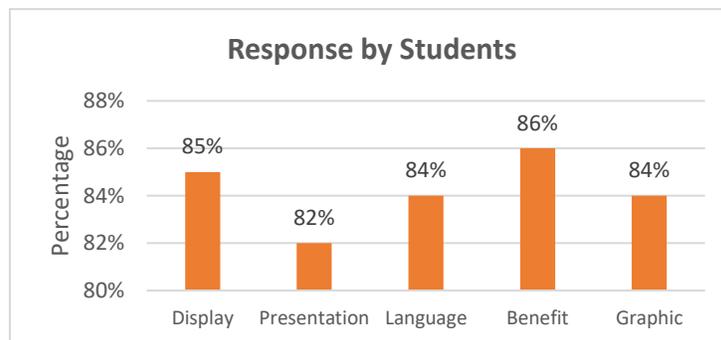
Figure 6. Response Diagram by Students

Figure 6 shows on display aspect gets 85%, in the aspect of the presentation of the material gets 82%, in the aspect of language get a percentage of 84%, on the aspect of benefits get a percentage of 86%, and on the aspect of graphic get a percentage of 84% with the category "Excellent".

4.2. Discussion

Ubiquitous learning advances have been effectively applied to learning exercises in different fields like natural science, sociology, and languages, in that the learning intentions and premium of the understudies have been raised, just as great learning execution being introduced [32]. The development of learning media based on android with AR technology can help students understand occupational health and safety materials.

The assessment by material experts showed 84% on the feasibility aspect of content with the category "Very Worthy" due to the conformity of the material with basic competencies and student needs. The content of material on the media comes from an accurate, complete, reliable, and clear source. The percentage in the language aspect is 85% with the category "Very Worthy" because the sentences in the material in the application are easy to read and understand so that the information contained in the material is clear. Percentage in the aspect of presentation 86% with the category "Very Worthy" because the purpose is clear, the information presented is easy to understand, and the instructions for the use of media are clear and easy to understand. Percentage on the benefit aspect of 93% with the category "Very Worthy" because the learning media facilitates and helps the learning process.

The assessment by media experts showed 90% in aspects of the presentation format with the category "Very Worthy" due to the exact font size and appropriate layout. Color composition with background and writing on the media is good. Percentage 88% on the aspect of convenience with the category "Very Worthy" because the navigation button works

well by following per under its function and is clear. Easy-to-use media as well as instructions for use help media use. Percentage 89% in the aspect of consistency with the category "Very Worthy" because the size and shape of letters are consistent in each section and the location and function of the navigation keys are consistent. Percentage 88% on the aspect of the graph with the category "Very Worthy" because the display design is appropriate, the color used in each function is appropriate. Low-resolution images have been replaced with higher resolutions so that they look clearer.
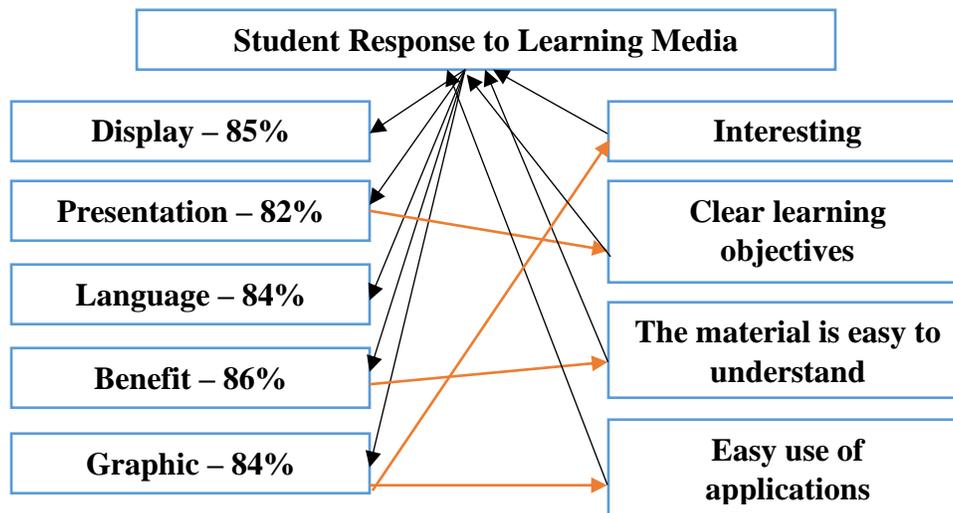
Figure 7. Relationship Analysis of Student Response Outcomes

The .... :t with the category "Excellent" due to the attractive display of learning media and the colors used in the appropriate media. Based on student responses to questionnaires, the appearance of the application attracts students' interest in using this application. Percentage of 82% in aspects of the presentation of material with the category "Excellent" because the purpose and instructions in the learning media are clear. Clear learning objectives direct students to achieve an understanding of basic competencies in occupational health and safety materials. The upcoming development is expected to present a sequence of materials so as not to confuse students. Percentage of 84% in the aspect of language with the category "Excellent" because sentences in the learning media are easy to understand. The language used directs students' learning interests further towards the materials in the application. Percentage of 86% on the benefit aspect with the category "Excellent" because the learning media facilitates the explanation on the occupational health and safety subjects. Percentage of 84% in the aspect of graphics with the category "Excellent" due to the design of the display of learning media accordingly and the appearance of clear images.

5. CONCLUSION

The development of learning media with augmented reality to help professional understudies in Yogyakarta in concentrating on occupational health and safety materials has been effectively evolved with black box test results on all capacities in the application, just as fruitful compatibility test results on a few gadgets have been assessed. with the aftereffects of the "Very Worthy" classification dependent on a practicality evaluation by material and media specialists. master. Understudy reactions additionally showed "Very

Good" results dependent on parts of display, presentation of material, language, benefits, and graphic aspects as innovation based learning media.

REFERENCES

[1] R. Raja and P. C. Nagasubramani "Impact of Modern Technology in Education," *Journal of Applied and Advanced Research,* vol. 3, no. 1, pp. 33-35, 2018.

[2] B. A. Altan and H. O. Altıntas, "Professional Identities of Vocational High School Students and Extracurricular Activities," *Journal of Education and Training Studies,* vol. 5, no. 7, pp. 46-52, 2017.

[3] Y. D. Puspitarini and M. Hanif, "Using Learning Media to Increase Learning Motivation in Elementary School," *Anatolian Journal of Education,* vol. 4, no. 2, pp. 53-60, 2019.

[4] K. I. Ismara, A. Suharjono, D. Supriadi, "Ubiquitous Learning in Occupational Health and Safety for Vocational Education*," International Journal of Evaluation and Research in Education (IJERE),* vol. 10, no. 1, pp. 285-292, 2021.

[5] B. Cope and M. Kalantzis, "Ubiquitous learning: An agenda for educational transformation," *Proceedings of the 6th International Conference on Networked Learning*, pp. 576-582, 2010.

[6] C. Mohd, F. Shahbodin, and N. C. Pee, "Exploring the potential technology in personalized learning environment (PLE)," *Journal of Applied Science and Agriculture*, vol. 9, no. 18, pp. 61-65, 2014.

[7] Hu Tianyu, "Overview of augmented reality technology," *Computer Knowledge and Technology*, pp. 194-196, 2017.

[8] I. Mustaqim and N. Kurniawan, "The Development of Learning Media Based on Augmented Reality (in Bahasa)," *Jurnal Edukasi Elektro,* vol. 1, no. 1, pp. 36-48, 2017.

[9] S. W. Hsieh, Y. R. Jang, G. J. Hwang, and N. S. Chen, "Effects of teaching and learning styles on students' reflection levels for ubiquitous learning," *Computers & Education*, vol. 57, no. 1, pp. 1194-1201, 2011.

[10] Suryani, L, and Hamdu, G, "Education for Sustainable Development in Science National Exam Questions of Elementary School," *ASEAN Journal of Science and Engineering Education*, vol 1, no. 1, pp 1-6. 2021.

[11] Kotsikis, V. *Educational Administration and Policy*. Athens: Ellin, 2007.

[12] Sapfo, M. "The Contribution of Vocational Education and Training in the Preservation and Diffusion of Cultural Heritage in Greece: The Case of the Specialty "Guardian of Museums and Archaeological Sites," *International Journal of Humanities and Social Science,* vol. 2, no. 24, pp. 51-58, 2012.

[13] Zarifis, G. "Vocational Education and Training Policy Development for Young Adults in The European Union: A Thematic Analysis of The EU Trend of Convergence Towards

Integration, Drawn from The VET Policies Adopted in Three Member States," *Research in Post-Compulsory Education,* vol. 5, no. 1, pp. 91-113, 2000.

[14] S. Yahya, E. A. Ahmad, and K. A. Jalil, "The Definition and Characteristics of Ubiquitous Learning: A Discussion," *International Journal of Education and Development using Information and Communication Technology,* vol. 6, no. 1, pp. 117-127, 2010.

[15] Chen, Y.S., Kao, T.C., Sheu. J.P. and Chiang, C.Y, "A Mobile Scaffolding-Aid-Based Bird Watching Learning System," *Proceedings of IEEE International Workshop on Wireless and Mobile Technologies in Education,* pp. 15-22, 2002.

[16] S. Yahya, E. A. Ahmad, and K. A. Jalil, "The Definition and Characteristics of Ubiquitous Learning: A Discussion," *International Journal of Education and Development using Information and Communication Technology,* vol. 6, no. 1, pp. 117-127, 2010.

[17] Alli, B. O, "Fundamental Principles of Occupational Health and Safety", *International Labour Office, Geneva*: ILO, 2008.

[18] Kaufmann. H, "Collaborative Augmented Reality in Education," *Proceedings of Imagina 2003 Conference*, pp. 1-4, 2003.

[19] Yuen. S, Yaoyuneyong. G, and Johnson. E, "Augmented Reality: An Overview and Five Directions for AR in Education," *Journal of Educational Technology Development and Exchange*, vol. 4, no. 1, pp. 119-140, 2011.

[20] Höllerer. T. H, and Feiner. S. K. *Mobile Augmented Reality*. In H. A. Karimi, & A. Hammad (Eds.), Telegeoinformatics: Location-Based Computing and Services, pp. 392-421. CRC Press, 2004.

[21] Ludwig. C, and Reimann. C, "Augmented Reality: Information at Focus," *Cooperative Computing & Communication Laboratory*, vol. 4, no. 1, p. 4, 2005.

[22] Zhou. F, Duh. H. L, and Billinghurst. M, "Trends in Augmented Reality Traching, Interaction and Display: A Review of Ten Years in ISMAR. *Mixed and Augmented Reality, ISMAR 7th IEE/ACM International Symposium*, pp. 193-202, 2008.

[23] Azuma. R, Baillot. Y, Behringer. R, Feiner. S, Julier. S, and MacIntyre. B, "Recent Advances in Augmented Reality," *Computers & Graphics*, pp. 1-15, 2001.

[24] Hughes. C. E, Stapleton. C. B, Hughes. D. E, and Smith. E. M, "Mixed Reality in Education, Entertainment, and Training," *IEEE Computer Graphics and Applications*, pp. 24-30, 2005.

[25] Billinghurst. M, "Augmented Reality in Education," *New Horizons for Learning*, 2002. Cooperstock. J. R, "The Classroom of the Future: Enhancing Education through Augmented Reality," *Proceedings of HCI International*, pp. 688-692, 2001.

[25] Billinghurst. M, and Kato. H, "Collaborative Augmented Reality," *Communications of the ACM*, vol. 45, no. 7, pp. 64-70, 2002.

[26] Kerawalla. L, Luckin. R, Selijefot. S, and Woolard. A, "Making It Real: Exploring the Potential of Augmented Reality for Teaching Primary School Science," *Virtual Reality*, pp. 163-174, 2006.

[27] Shelton. B. E, and Hedley. N. R, "Using Augmented Reality for Teaching Earth-sun Relationship to Undergraduate Geography Students," *The First IEEE International Augmented Reality Toolkit Workshop*, pp. 1-8, 2002.

[28] Klopfer. E, and Yoon. S, "Developing Games and Simulations for Today and Tomorrow's Tech Savvy Youth," *TechTrends*, vol. 49, no. 3, pp. 41-49, 2004.

[29] Hamilton. K, and Olenewa. J, "Augmented reality in Education," Retrieved from Lecture Notes Web: http://www.authorstream.com/Presentation/k3hamilton-478823-augmented-reality-in-education/, published on 2010.

[30] Classroom Learning with AR. Trends in EdTech wiki. Retrieved from website: http://augreality.pbworks.com/ClassroomLearning-with-AR, published on 2010.

[31] Y. K. Singh, *Fundamental of Research Methodology and Statistics.* New Delhi: New Age International Publishers, 2006.

[32] Hwang, G.J. and Chang, H.F, "A Formative Assessment-Based Mobile Learning Approach to Improving the Learning Attitudes and Achievements of Students," *Computers & Education*, vol.56, no. 1, pp. 1023–1031, 2011.