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Development of A Career Understanding Application for Elementary School Students Based on Augmented Reality

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Abstract: This research aims to develop an augmented reality-based career understanding of media for elementary school students. The research and development procedure consists of 7 steps out of 10 main steps, namely: (1) potential and problems, (2) data collection, (3) product design, (4) design validation, (5) product/design revision, (6) products trial, (7) product revisions. Data were collected using a questionnaire consisting of (1) an expert validation questionnaire (guidance and counseling media expert, career guidance and counseling expert, Indonesian language expert), and (2) a small group trial questionnaire (elementary school teachers). Data analysis uses qualitative analysis to analyze data from expert validation and small group trials distributed through the instrument. The research results show that the research product in the form of augmented reality-based career understanding media containing content from 17 professional fields is suitable for use to improve elementary school students' career understanding, considering that this product has been validated through expert validation and small group trials. The implications of the results of this study emphasize the importance of career understanding in elementary schools, to shape children's future aspirations based on augmented reality (AR) as an interactive media for career guidance services in schools, thereby increasing students' interest in various job professions that change career guidance service methods to be more modern as well as developing students' technological competencies in facing the digital era as part of Generation Z and Alpha. Practically, guidance and counseling teachers can improve students' understanding of various professions through AR technology that facilitates understanding of the duties and responsibilities of job professions, schools can also integrate this application into a technology-based curriculum, encourage project-based learning, and inspire students' creativity and innovation in exploring and designing future careers.

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Introduction

Career and work development have undergone major changes such as globalization, climate change, and especially rapid technological advances, changing the essence of work (Hirschi, 2018) both professions/careers/jobs that have been known for a long time (conventional) and modern professions/careers. Johnson's findings 24 years ago noted that future jobs will be more contractual, temporary assignments, and decentralized work locations (Johnson, 2000). Specific career development and interventions must begin in elementary school and be maintained throughout high school and even into post-secondary education and the work environment (Gysbers, 2013; Porfeli & Lee, 2012). Career changes in the technological era influence Generation Z and Alpha to understand various professions,

both conventional and new. Therefore, the paradigm of work and career development needs to be reviewed to ensure the success of students' future careers, schools must provide a diverse curriculum so that students can develop skills that are relevant to the needs of the 21st-century workforce (Curry & Milsom, 2017; Lent, 2018).

Early childhood in elementary school may be an ideal time for career interventions because of the low pressure to decide or commit to a particular course of action (Porfeli & Lee, 2012). Providing career literacy interventions for students requires providing essential career information (Blackhurst et al., 2003), and this process early on reinforces for students the important connection between academic achievement and future endeavors by ensuring that elementary school students are (a) aware of their personal interests, talents, and aspirations, (b) knowledgeable about the world of work, and (c) able to use that information when considering academic and career-related decisions (Rojewski, 2021). Holland's findings highlight the importance of school counselors assisting with children's school and career choices in postsecondary school (Holland, 2015), helping students explore themselves and identify potential careers through appropriate learning experiences (Welde et al., 2016). Introduction to the types of postsecondary schools and jobs early in elementary school is essential for students to understand their interests and talents. Without this introduction, students may have difficulty identifying their career interests and competencies, which can lead to confusion later in life.

The use of appropriate guidance and counseling media can be used as an effective tool (Wantu et al., 2023) including career information media as a means that should have been prepared in schools to be used to help students understand their careers. Technology-based guidance and counseling media can attract students' interest (Hulukati et al., 2019), help identify students' careers (Fathullah et al., 2022), and provide job content in the arts through pocketbooks (Hulukati et al., 2024), and pocketbook media can also improve students' career understanding in elementary schools (Rahim et al., 2023). Therefore, guidance and counseling media can be used as one of the tools in providing career guidance services to students.

Career understanding for students needs to be implemented through a series of career development programs that are directed at helping students develop career competencies, are psycho-educational, and must be integrated as an important part of the school curriculum through coordination and collaboration between guidance and counseling teachers/counselors, and class teachers in schools (Dugger, 2016). Implementation of career development programs in elementary schools will be more meaningful, especially supported by technological advances that can not only be used as opportunities but also as challenges.

The rapid development of digital technology has given birth to many new types of professions/jobs. The actual impact of new or future technologies on jobs and careers is debatable (Lent, 2018). In the current era, career understanding regarding the types of professions/careers/jobs that are introduced from an early age to students is not balanced between students who live in big cities and students who live in small towns and rural/rural areas. Students who live in small urban areas and rural/rural areas of course have limited facilities in accessing various types of professions/careers/jobs that can be found through digital technology. However, it is predicted that this condition will change in line with development developments carried out in various regions. Students can gain an understanding of careers by introducing professions/careers/jobs through various print media and digital technology-based media. Career information can be found through cyber or digital technology, both in the school environment, family environment, peers, and living

environment. The various media available can be used as a forum for increasing students' understanding of various professions/careers/jobs.

The use of appropriate guidance and counseling media can be used as an effective tool (Wantu et al., 2023) including career information media as a means that should have been prepared in schools to be used to help students understand their careers. Technology-based guidance and counseling media can attract students' interest (Hulukati et al., 2019), help identify students' careers (Fathullah et al., 2022), and provide job content in the arts through pocketbooks (Hulukati et al., 2024), and pocketbook media can also improve students' career understanding in elementary schools (Rahim et al., 2023). Therefore, guidance and counseling media can be used as one of the tools in providing career guidance services to students.

Career information services are services that provide students with an introduction to various types of professions and careers included in several career families so that they can get to know the types of professions/careers/jobs through the help of various career media available at school. Career information services that can develop students' understanding of careers in elementary schools are seen as an important element as an important part of the education of all students (Berns, 2010; Ebert & Culyer, 2011). The combination of information systems in guidance and counseling services is realized in the form of instructions in the process of career decision-making, assessment, prediction of future success, planning assistance, and development of future strategies (Zunker, 2016).

Changing trends in educational technology show that mobile technology and analytics have a more consistent trend throughout the 2011-2021 period than pedagogy or theory (Dubé & Wen, 2022). The same thing happens in Indonesia, directly in AR research based on research methods, AR research is dominated by research and development (40%), literature review (23%), experiments (13%), mixed methods (8%), surveys (4 %), classroom action research (4%), and correlational (3%) (Firmantara et al., 2023). The popularity of mobile devices globally, the widespread use of AR on mobile devices such as smartphones and tablets has become a growing phenomenon (Nincarean et al., 2013), the use of AR content can help accelerate and improve students' learning process (Permana et al., 2022).

To meet the needs of elementary schools that do not yet have guidance and counseling teachers who play a role in student career development, augmented reality-based career understanding media was developed. It is hoped that this media can be used by teachers to help understand careers, especially for students in elementary schools. This augmented reality-based career understanding media displays digital content integrated with mobile technology (smartphones), and the artificial environment reinforces it with physical objects (Tacgin, 2020). This research aims to produce media for understanding elementary school students' careers based on augmented reality. This research expects that the augmented reality-based media produced can be effective in introducing various career choices to elementary school students so that it can improve students' understanding of professions from an early age and support the process of recognizing interests and self-potential, which ultimately helps students in preparing for appropriate educational and career paths in the future.

Research Method

The research and development procedure consists of 7 steps out of 10 main steps, namely: (1) potential and problems, (2) data collection, (3) product design, (4) design validation, (5) product/design revision, (6) products trial, (7) product revisions, (8) usage trials, (9) product revisions, and (10) mass products (Sugiyono, 2019). The data source

consists of 3 experts, namely: (1) a Guidance and Counseling Media Expert, (2) Career Guidance and Counseling Expert, and (3) an Indonesian Language Expert, as well as (4) five elementary school class teachers in Gorontalo Province for small group trials. Data were collected using a questionnaire consisting of (1) an expert validation questionnaire (guidance and counseling media expert, career guidance and counseling expert, Indonesian language expert), and (2) a small group trial questionnaire (elementary school teachers).

1) Expert Validation Questionnaire
   The validation questionnaire for guidance and counseling media experts consists of 8 questions with a rating scale of 1 to 5. The validation questionnaire for career guidance and counseling experts consists of 8 questions with a rating scale of 1 to 5. The Indonesian language expert validation questionnaire consists of 5 questions with a rating scale of 1 to 5.
2) Small Group Trial Questionnaire
   The small group trial questionnaire consists of 13 questions with a rating scale of 1 to 5.

Quantitative analysis was conducted to measure the validity of the guidance and counseling media developed based on expert opinions in the three fields and from small-group trial users. The values given by the experts were processed to determine the level of validity of each aspect assessed in the developed media by calculating the average value of each statement added up. This average score was then interpreted to assess whether the media had met the criteria expected by the experts. Qualitative analysis was conducted to collect feedback from expert opinions and small group trial users in the form of open responses to provide further insight into the strengths and weaknesses of the developed media. All of this data analysis was used to improve or perfect the guidance and counseling media before being widely implemented.

Results and Discussion

Steps I and II. Potential and Problems, and Data Collection

In this step, research activities are focused on identifying various potentials and problems encountered in schools related to efforts to help elementary school students understand careers. Based on the results of interviews with Guidance and Counseling teachers in elementary schools, the data obtained was that there was no availability of career-understanding media in the form of Android applications that were easy for students to use, considering that currently, students have become users of Android application media such as mobile phones. Career understanding media are currently available. This is just a pocketbook for elementary school students' career understanding. This data shows the need for the development of augmented reality-based media to help improve elementary school students' career understanding. Career understanding media for elementary school students is considered very important because the world of careers/work is currently increasingly developing, many types of jobs are disappearing and have been replaced by many new types of jobs.

Step III. Develop initial product design

The activity at this stage is to develop an initial product design in the form of an augmented reality-based career understanding media. This media explains various types of work. The activity begins with preparing various materials needed to develop the initial product design. The various materials needed to develop the initial product design include:

1) Literature and Theory References

A literature review covering theories about careers, child psychology, and augmented reality technology that are relevant to the development of career guidance media for elementary school children.

2) Development Software
   Applications and software that support the creation of augmented reality content using Unity 3D, ARCore, and Adobe Illustrator graphic design tools.
3) Hardware
   Hardware such as computers that support AR development, and smartphones that support AR technology for product testing.
4) Guidance Content
   Career guidance content that includes information about 17 professions that will be integrated into AR-based media to be given to students in improving elementary school students' career understanding.
5) Data Collection Instruments
   Questionnaires are used to collect data from experts and users related to expert validation and product trials.

Step IV. Design validation

This activity includes: (1) developing a validation instrument for the initial design of the product that has been developed. The validation instruments developed include validation instruments from career guidance and counseling experts, guidance and counseling media experts, and Indonesian language experts, (2) before being used to validate products, the instruments have been validated through peer validation, namely validation from fellow researchers, and (3) implementation of validation by guidance and counseling experts, media design experts, and Indonesian language experts. Validation results are used to carry out product revisions. The data resulting from expert validation is explained as follows.

Table 1. Validation data from career guidance and counseling experts

Statement	Evaluation					Revision	
	1	2	3	4	5	Yes	No
Contains information about careers					✓	-	✓
Up-to-date career information					✓	-	✓
Suitability to the developmental characteristics of elementary school-age children					✓	-	✓
Clarity of career information				✓		-	✓
Complete career information				✓		-	✓
Ease of understanding information by elementary school students					✓	-	✓
Fulfills career aspects that students must understand					✓	-	✓
Benefits of career information					✓	-	✓

Table 1 shows that the average validation score for guidance and counseling experts is 4.75, with a rating category of "Good". Thus, there is no need to revise aspects of career guidance and counseling in augmented reality-based career understanding media.

Table 2. Validation data from guidance and counseling media experts

Statement	Evaluation					Revision	
	1	2	3	4	5	Yes	No
Convey messages effectively				✓		-	✓
Messages are easy for elementary school students to understand					✓	-	✓
Contains messages about career/work					✓	-	✓
Covers various careers/jobs that elementary school				✓		-	✓

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students need to understand			
Interesting for elementary school students	✓	-	✓
The image represents the message conveyed	✓	-	✓
Media can provide information about careers/employment for elementary school students	✓	-	✓
Overall media effectiveness	✓	-	✓

Table 2 shows that the average validation score for media design experts is 4.75, with a rating category of "Good". In this way, there is no need to revise the design aspects of augmented reality-based career understanding media.

Table 3. Validation data from Indonesian Language Expert

Statement	Evaluation					Revision	
	1	2	3	4	5	Yes	No
Use effective sentences				✓		-	✓
Use appropriate, correct, and common diction for the alpha generation				✓		-	✓
Using enhanced spelling					✓	-	✓
Use interactive language					✓	-	✓
Sentences are easy to understand for elementary school students					✓	-	✓

Table 3 shows that the average validation score for Indonesian language experts is 4.6, with a rating category of "Good". Thus, there is no need to revise the aspect of using Indonesian in augmented reality-based career understanding media.

Step V. Product Revision

The activity at this stage is to revise the initial product based on data obtained from expert validation. Based on the results of expert validation, it can be concluded that there is no need for revisions to the augmented reality-based career understanding media products that have been produced through this research.

Step VI. Product trial

This activity consists of (1) preparing product trial instruments, (2) validating small group test instruments through peer validation, and (3) carrying out small group trials. Small group trials were carried out by 5 elementary school teachers, who assessed the following aspects: (1) appropriateness of content, (2) effectiveness, (3) interactive, (4) efficient, and (5) creative. The results of the small group trial are shown in table 4 below.

Table 4. Small Group Trial Results

Statement	Respondent Assessment					Information
	R1	R2	R3	R4	R5	
Accuracy of the concepts displayed	5	5	5	5	5	
Suitability of the image and approach used	5	5	5	5	5	
Media can be used to explain material	5	5	5	5	5	
Media used to broaden students' insight	5	4	5	5	4	Media provides insight, but if students are not used to being stimulated by work in everyday life, it creates confusion for students.
All buttons from the learning media can be used properly	5	5	5	5	5	
The letters displayed are easy to	5	5	5	5	5	

read and always face the screen						
The sounds produced by the media can be understood	5	5	5	4	4	The dubbing sound is too formal, it is better to use language that is easier for children to understand.
The displayed image provides information	5	4	4	5	5	The image is still 2 dimensional.
Learning media is easy to use anywhere	5	4	5	5	5	Because they use Android, the school must provide flexibility for students to bring cell phones to school.
Learning media is easy to carry	5	5	5	5	5	
Media attracts students' attention to learning	5	5	5	5	5	
Learning media is fun to use	5	5	5	5	5	
Media helps students be more active in learning	5	5	5	5	5	

Step VII. Product Revision

Based on table 4, the results of small group trials which were tested on 5 teachers provide an illustration that the career understanding media as a whole is appropriate but in certain parts, it needs to be improved according to input, such as the dubbing sound is too formal, it is better to use language that is easier for children to understand, it is necessary to increase the image to 3-dimensional (3D). Meanwhile, regarding insight, it is considered that it is best to cooperate between teachers and parents to provide insight to children regarding the daily work professions closest to the child. The use of cellphones in schools requires supervision from the school and parents in utilizing augmented reality-based career understanding media. The results of this research and development resulted in an understanding of careers in augmented reality-based media products based on the results of previous research on career pocketbooks (Rahim et al., 2023). There are 33 types of work that have been designed in the form of Augmented Reality, as shown in table 5 below.

Tabel 5. Career Understanding Media Products Based on Augmented Reality

Professional Field	Jobs
Education	Teacher, Counselor, Lecturer
Information Technology	3D/4D Graphic Design
Agriculture	Microbiologist, Farmer
Economics and Business	Accountant, Banking
Humanities	Writer, Archaeologist, Librarian
Natural Science	Geoscientist
Health	Pharmacist, Physician
Art and Design	Artist, Photographer
Politics and Law	President, Judge
Military	Soldier, Police Officer
Social	Firefighter, Civil Servant
Technique	Architect, Geologist, Mechanic
Entertainment	Singer, Dancer
Broadcasting	Journalist
Transportation	Machinist, Captain, Pilot
Gastronomy	Chef
Sport	Referee

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The appearance of this media is shown in figures 1(a), (b), and (c).

(a) (b) (c)

Figure 1. (a) Career Understanding Media Application (Preliminary View). (b) Markers (cards) Career Understanding Media. (c) Examples of Using Career Understanding Media Applications

Understanding careers for elementary school students is the starting point that determines their career development at the next stage, which will also contribute to them obtaining and even creating jobs independently. Understanding careers for elementary school students is very important to prevent unemployment, which is still a big problem in Indonesia. The augmented reality-based career understanding media developed through this research is one of the guidance and counseling service media regarding career information that can be used by Guidance and Counseling teachers or class teachers in elementary schools as a medium for providing career understanding to students so that from an early age they have an understanding of various types of professions or jobs that are currently popular because students' ability to understand the world of work/career requires assistance through career guidance and counseling (Fathullah et al., 2022). Students, especially elementary school students, need to understand the many types of new professions or jobs that are emerging and becoming a forum for the economic cycle in Indonesia so that they can independently determine a future direction that is based on their potential.

Teachers have an important role in developing children's career understanding from an early age. This career development effort requires media that makes it easier for children, especially elementary school-age children, to understand the world of careers, in addition to helping teachers guide children's career understanding. Augmented reality-based career understanding media has been produced through this research with the hope of becoming a tool for teachers in helping students understand types of work. Guidance and counseling in primary schools play an important role in the career development of children. However, attention to the availability of guidance and counseling teachers at the elementary school level is still lacking. This is because until now, the structural position of guidance and counseling teachers or counselors at the elementary school level has not been determined, so guidance and counseling services are the responsibility of class teachers. Guidance and counseling materials can be combined with teaching materials through thematic learning (Dirjen GTK, 2016). The existence of guidance and counseling teachers/counselors in schools is considered very important because school counselors can provide guidance and counseling service interventions to increase career self-efficacy and college readiness in elementary school children (Allen et al., 2019). Counselors in elementary schools have the

function of developing careers to ensure that all students graduate from college and are ready for a career in the future (Knight, 2015).

According to Rahim et al., (2021), children's career development needs to be carried out from an early age for the following reasons: First, career development activities at an early age are closely related to fundamental things in individual career development, namely the introduction of talents, interests, ideals, intellectual abilities, natural tendencies, and physical characteristics, as well as an introduction to the world of work. Theory and practice show that the role of talents, interests, ideals, intellectual abilities, natural tendencies, and physical characteristics is very important for individuals in planning, choosing, and making career decisions, in addition to their understanding of the world of work; Second, the importance of career development from an early age is related to efforts to develop individual careers on an ongoing basis. The foundations for career development that have been laid from an early age will help children/individuals in making career plans, choices, and decisions in later years, namely in elementary, middle school, high school, and college.

The use and utilization of augmented reality-based media can help motivate students, attract attention, and help them understand difficult subjects, as well as provide additional information to students (Singaravelu, 2022). The use of augmented reality in students generates enjoyment and interest due to the visual feedback provided by augmented reality, enthusiasm towards the use of innovative technological tools, and curiosity when students see and interact with virtual objects in 3D, but augmented reality can also trigger negative emotions such as anxiety and stress, in some cases due to unfamiliarity with the use of augmented reality technology and in other cases due to the learning tasks involved in its use (Gómez-Rios et al., 2022; Hsu, 2017). The use of augmented reality in education is to help motivate students, attract attention, and help them understand difficult subjects, as well as provide additional information to students (Singaravelu, 2022). Augmented reality is also a medium for introducing culture to elementary school students (Hamim et al., 2016). The impact of augmented reality on students' mental models of science and scientists is increasingly profound (Ponners & Piller, 2019), appearing to stimulate students to think about scientific ideas, make deeper connections between scientific concepts, and encourage students to have a more active learning style with increased transitions between inquiry activities (Radu et al., 2023).

The use of media in assisting children's careers is not only left to guidance and counseling teachers or class teachers in elementary schools but requires assistance from parents. Studies prove that parents who study with their children using interactive augmented reality book technology have a cohesive conception and tend to use an in-depth approach (Cheng, 2017). Therefore, the augmented reality-based career understanding media produced through this research can be used by parents and children at home to explore various types of careers that are developing in society.

Mahr et al., (2023) recommendations suggest that further research into augmented reality is needed to understand this technology from a broader perspective. Although the results of augmented reality studies in the context of learning and teaching have shown good functions and results, when and how learning and teaching with augmented reality can provide benefits must be the focus of future research. Study designs beyond media comparison approaches (Buchner & Kerres, 2023) are also needed to dig deeper into this.

Conclusion

Based on the findings and data obtained in this research, it can be concluded that the research product in the form of augmented reality-based career understanding media

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containing content from 17 professional fields is suitable for use to improve elementary school students' career understanding, considering that this product has been validated through expert validation and small group trials. The implications of the results of this study conceptually highlight the importance of early career recognition and understanding, especially in elementary schools, to shape children's future aspirations. Augmented reality (AR) technology acts as an innovative educational tool that makes learning more interactive and in-depth, thereby increasing students' interest in various job professions. The integration of technology into the curriculum in elementary schools shows that technology can be the main medium in the learning process, changing traditional learning methods to be more modern. The AR approach supports the theory of contextual learning, which connects career guidance materials with real-world simulations, making career guidance services more relevant.

In addition, the development of technological competencies at an early age is important to prepare students to face the digital era as part of Generation Z and Alpha. Furthermore, practical implications Guidance teachers can improve students' understanding of various job professions through augmented reality (AR) technology that facilitates understanding of the tasks and responsibilities of job professions, allowing students to have interests and plan careers early on. This application changes career guidance services to be more interactive and interesting and can be tailored to students' interests, making learning more personal and relevant. Schools can integrate this application into a technology-based curriculum, encourage project learning, and inspire students' creativity and innovation in exploring and designing future careers.

Recommendation

Based on the results of the study on the development of an Augmented Reality (AR)-based career understanding application for elementary school students, recommendations for Guidance and Counseling teachers/Counselors and parents are very important to ensure that this application can be utilized optimally in supporting children's career development. Guidance and Counseling teachers/Counselors are advised to integrate this application into the career guidance program at school, monitor and evaluate its use regularly, and provide additional support for students who may have difficulty using the application or who need more information about careers, which can be done through individual or group guidance sessions.

In addition, it is important for Guidance and Counseling teachers/Counselors to work together with class teachers and receive training in the use of technology so that this application can be implemented effectively. Meanwhile, parents are advised to actively monitor and accompany their children when using this application at home and encourage open discussions about the careers that their children are interested in. Parental support in the form of additional information, direct experience, and a balance between the use of technology and other activities is also very important. Through the active involvement of Guidance and Counseling teachers/Counselors and parents, this application can be an effective medium in helping students understand and plan their future careers from an early age.

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