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Development of an Augmented Reality-Based Student Attitude Assessment Model (ASSAR) as an Effort to Strengthen the Graduate Profile in the Implementation of

Desarrollo de un Modelo de Evaluación de Actitudes Estudiantiles Basado en Realidad Aumentada (ASSAR) como Esfuerzo para Fortalecer el Perfil del Egresado en la Implementación del Aprendizaje Profundo en Escuelas de Formación Profesional

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ABSTRACT

Introduction: in the digital era, integrating technology into education has become crucial, particularly for improving student competency assessment. Vocational schools, which aim to prepare work-ready and competitive graduates, require innovative approaches to enhance learning and evaluation processes.
Method: this study developed and tested the effectiveness of the Augmented Reality-Based Student Attitude Assessment Model (ASSAR) to support the implementation of deep learning in vocational education. The research employed a Research and Development (R&D) design following the ADDIE model, consisting of Analysis, Design, Development, Implementation, and Evaluation stages.
Results: the findings indicated that the ASSAR model was valid, reliable, and practical for use in vocational education. Expert validation demonstrated high content validity (Aiken's V > 0,80), supported by additional analyses showing strong construct validity and high internal consistency (Cronbach's Alpha > 0,85). Teachers evaluated the model as feasible and efficient, while students reported increased engagement and authenticity through the AR-based interface. The product also achieved Technology Readiness Level (TRL) 7, confirming its applicability in real educational settings. Further expert evaluation through a Focus Group Discussion reaffirmed these results, with four experts rating both the graduate profile materials and the AR-based learning media as highly eligible (Aiken's V = 0,81–0,94).
Conclusions: the ASSAR model enhanced the objectivity, authenticity, and efficiency of attitude assessment, supporting vocational schools in producing graduates equipped with both technical competence and professional character to meet the challenges of Industry 4.0 and Society 5.0.

Keywords: Augmented Reality (AR); Attitude Assessment; Deep Learning; Vocational Education; Educational Innovation; Student Graduate Profile.

RESUMEN

Introducción: en la era digital, la integración de la tecnología en la educación se ha vuelto esencial, especialmente para mejorar la evaluación de las competencias estudiantiles. Las escuelas de formación profesional, cuyo objetivo es preparar graduados competentes y listos para el trabajo, requieren enfoques innovadores que fortalezcan los procesos de enseñanza y evaluación.
Método: este estudio desarrolló y evaluó la eficacia del Modelo de Evaluación de Actitudes Estudiantiles Basado en Realidad Aumentada (ASSAR) para apoyar la implementación del *deep learning* en la educación

vocacional. La investigación adoptó un diseño de Investigación y Desarrollo (I+D) siguiendo el modelo ADDIE, que comprende las fases de Análisis, Diseño, Desarrollo, Implementación y Evaluación.

Resultados: los resultados indicaron que el modelo ASSAR era válido, confiable y práctico para su uso en la educación vocacional. La validación de expertos mostró una alta validez de contenido (Aiken's V > 0,80), respaldada por análisis adicionales que confirmaron una fuerte validez de constructo y una alta consistencia interna (Alfa de Cronbach > 0,85). Los docentes evaluaron el modelo como factible y eficiente, mientras que los estudiantes reportaron un aumento en el compromiso y la autenticidad del aprendizaje a través de la interfaz de realidad aumentada. El producto también alcanzó el Nivel de Madurez Tecnológica (TRL) 7, lo que confirma su aplicabilidad en contextos educativos reales. Una evaluación adicional realizada por expertos mediante un grupo focal reafirmó estos resultados, ya que los cuatro especialistas calificaron tanto los materiales del perfil de egreso como los medios de aprendizaje basados en RA como altamente adecuados (Aiken's V = 0,81–0,94).

Conclusiones: el modelo ASSAR mejoró la objetividad, autenticidad y eficiencia de la evaluación de actitudes, ayudando a las escuelas de formación profesional a formar graduados con competencias técnicas y carácter profesional, preparados para afrontar los desafíos de la Industria 4.0 y la Sociedad 5.0.

Palabras clave: Realidad Aumentada (RA); Evaluación de Actitudes; *Deep Learning*; Educación Vocacional; Innovación Educativa; Perfil del Egresado Estudiantil.

INTRODUCTION

The rapid development of digital technology has brought significant changes to the global education system, including in Indonesia. Education is now entering a new era in which technology is no longer merely a supporting tool, but a catalyst for transforming teaching and learning processes.[1] In the context of vocational education, this transformation requires teachers and students to adapt quickly and creatively to technological advancements. The integration of technology into learning is expected not only to enhance efficiency but also to enrich students' learning experiences. Amid these changes, vocational schools (*Sekolah Menengah Kejuruan, SMK*) face the major challenge of preparing graduates who are work-ready, adaptable, and possess strong character.[2] This aligns with the demands of the Fourth Industrial Revolution and Society 5.0, which emphasize a balance between technical competence and human values.[3]transformations of technology-based learning and non-cognitive skills need. This situation makes it difficult for teachers of Indonesian vocational education apply 21st century skills. This study aimed to analyze the level of difficulty of teachers and students in vocational education and analyzing the differences in the difficulties faced in vocational education. This research used survey research with a quantitative approach. A total of 178 people participated in the study consisting of two public vocational high schools and two private vocational schools with the distribution of respondents consisting of 155 students and 23 teachers. Collecting data using a questionnaire in the form of a statement of difficulties faced by teachers and students, including creativity skills, critical thinking, problem solving, communication, collaboration, and digital literacy or information and communication technology (ICT) Therefore, vocational education requires a new approach that positions technology as a means to develop holistic competencies.

One of the current priorities in educational reform is the implementation of deep learning.[4] This approach is not merely oriented toward academic results, but focuses on reflective thinking processes and meaningful understanding. According to the Indonesian Deep Learning Academic Paper the national learning paradigm must shift toward deep learning, emphasizing meaningful, conscious, reflective experiences that engage learners' emotions and intrinsic motivation. Deep learning encourages students not only to understand concepts deeply but also to connect them with real-life contexts, collaborate with others, and innovate to solve problems.[5]

The implementation of deep learning requires a conducive learning ecosystem, broad partnerships, and effective digital technology support.[6] It demands that learners actively explore, discover, and connect knowledge with real-life experiences. Teachers no longer act as the primary source of knowledge but as facilitators and guides who help students reach deeper understanding.[7] To support this type of learning, technologies that enable holistic interaction, reflection, and assessment are needed. Among these technologies, Augmented Reality (AR) holds significant potential. Augmented Reality (AR) is a technology that merges virtual objects with the real world in real time through digital devices such as smartphones or tablets.[8] It enables students to interact with digital models within real-world contexts, creating immersive and contextual learning experiences. In education, AR has proven effective in improving conceptual understanding, motivating students, and enhancing learning engagement. AR also promotes active learning, allowing students not only to receive information but also to explore and discover knowledge independently.[9] Various studies have shown that AR strengthens critical and creative thinking through interactive simulations. However, most uses of AR in schools have focused on cognitive outcomes, with limited attention to the development and assessment of student

attitudes an essential component in shaping graduates with strong character and global competitiveness.

A key aspect of deep learning is the development of a comprehensive graduate profile, which reflects not only students' academic achievements but also their values, character, and attitudes.[10] In Indonesia, this concept is articulated through the *Profil Pelajar Pancasila* (Pancasila Student Profile), adapted as the Graduate Profile across educational levels. The profile encompasses eight dimensions faith and piety, citizenship, critical reasoning, creativity, collaboration, independence, health, and communication.[11] Each dimension represents a 21st-century skill essential for students to face global challenges. Strengthening the graduate profile thus becomes central to meaningful and contextual education. Achieving this requires both learning and assessment systems capable of capturing students' attitudinal development comprehensively.

Assessing student attitudes in schools particularly in vocational settings remains a major challenge. Traditionally, attitude assessment has relied on direct observation or questionnaires, both of which are prone to subjectivity and lack accuracy in capturing behavioral change.[12] Furthermore, teachers' administrative workload often limits the depth of assessment they can conduct. As a result, attitude evaluation tends to be formal and fails to represent students' actual character.[13] This situation underscores the need for an assessment system that combines objectivity with the efficiency and flexibility of digital technology. The integration of Augmented Reality (AR) offers a promising solution to these limitations. Through AR, teachers can design learning and assessment scenarios that replicate real-world situations digitally.[14] For example, students can engage in virtual simulations of industrial work environments or social interactions requiring teamwork, responsibility, and integrity. Students' responses within these simulations can be observed, recorded, and analyzed in real time to evaluate their attitudes. This approach aligns with the principle of authentic assessment, which evaluates learners' abilities within real-world contexts. Thus, AR serves not only as a learning medium but also as an evaluative tool that objectively and contextually measures attitudinal competence, enriching the deep learning process and strengthening students' affective dimensions.[15]

In vocational education, attitude assessment plays a crucial role because industries demand workers who are not only technically skilled but also possess strong work ethics.[16] Vocational graduates are expected to demonstrate professional behaviors such as discipline, responsibility, collaboration, and adaptability. Research shows that many vocational graduates struggle to enter the workforce not due to a lack of technical skills but because of weak professional attitudes and soft skills.[17] Therefore, attitude assessment should be viewed not as a complementary component but as a core element of vocational competency formation. Through an AR-based assessment model, students can be trained and evaluated simultaneously within contexts that mirror real-world working environments, turning assessment into an effective medium for character education.

Strengthening attitudes in vocational education also aligns with Indonesia's national agenda to develop high-quality human resources.[18] Despite ongoing reforms, vocational graduates still represent the highest unemployment rate in the country, revealing a persistent gap between school-taught competencies and industry needs.[19] One key cause of this gap is the limited integration of character education and systematic attitude assessment within vocational curricula. Hence, innovation in assessment systems has become a necessity to ensure that graduates are not only technically capable but also mature in character and attitude.

The application of AR in attitude assessment also supports Project-Based Learning (PjBL) and Problem-Based Learning (PBL), which serve as the foundation of deep learning.[20] These approaches encourage students to engage with complex situations that require collaboration, creativity, and ethical decision-making.[21] Through AR-based simulations, students can practice these values in realistic contexts, while teachers can observe how they communicate, collaborate, and solve problems.[22] Such assessments provide not only quantitative data but also qualitative evidence of students' behavioral development. With digital support, the assessment process becomes more efficient without reducing observational quality, making AR-based models highly relevant for modern vocational education.

Theoretically, technology-based attitude assessment must meet three key criteria such as authenticity, objectivity, and continuity.[23] Authenticity ensures that assessments reflect real-world situations, objectivity eliminates bia, and continuity enables long-term monitoring of students' progress. AR technology supports all three simultaneously by recording students' digital interactions and providing automatic feedback accessible at any time.[24] Teachers can then use this data to track behavioral changes over time, transforming assessment into a continuous learning process rather than a one-time activity.

Research on integrating AR into attitude assessment remains relatively new and offers vast potential for innovation.[25] Most prior studies have focused on cognitive outcomes, with limited exploration of affective and character dimensions. Therefore, the development of the Augmented Reality-Based Student Attitude Assessment Model (ASSAR) represents a significant contribution to vocational education innovation. The model aims to help teachers evaluate student attitudes more authentically, efficiently, and accurately while fostering value awareness and work ethics among vocational students. This study thus holds both theoretical and practical value in advancing character education through digital technology.

In practice, vocational teachers across Indonesia still face challenges in accurately assessing students'

attitudes. Observations are often limited to specific moments, and many positive behaviors go undocumented. [26] Attitude, being dynamic and situational, requires continuous measurement to capture its full development. High administrative demands further constrain teachers' ability to conduct comprehensive evaluations, leading to discrepancies between assessment reports and students' actual behaviors. Consequently, developing a sustainable, objective, and easily implemented assessment system is essential to ensure a holistic graduate profile. AR technology provides an opportunity to address these challenges through adaptive and immersive assessment models. Students can be placed in virtual situations resembling real work or social environments, where they must make decisions, collaborate, and demonstrate responsibility. Each action is recorded and analyzed as an indicator of attitude. This integrated learning and assessment experience allows teachers to obtain more valid data since attitudes are observed through authentic behaviors in meaningful contexts.

The concept of AR-based assessment aligns with authentic assessment principles, which evaluate learners' abilities through real-world tasks. [27] Attitudes are not judged based on perception alone but through observable evidence of behavior. [28] Through AR simulations, teachers can assess how students respond to ethical dilemmas, teamwork conflicts, or workplace safety responsibilities, ensuring greater transparency and accountability in assessment results. [29] The feedback derived from these assessments can then be used to strengthen students' character development. Furthermore, AR enhances students' intrinsic motivation by providing emotionally and cognitively engaging learning experiences. Interactive digital environments transform learning from an obligation into an enjoyable and exploratory process. [30] Students internalize positive attitudes naturally through experiential engagement, while AR creates reflective spaces where they can evaluate and adjust their behavior. Thus, assessment becomes not merely a measurement of outcomes but an integral component of character education.

From a theoretical perspective, attitude formation aligns with the affective domain of Bloom's taxonomy, encompassing receiving, responding, valuing, organizing, and characterizing by value. [31] Attitude development occurs gradually through repeated experience and reflection. In this context, AR serves as a medium that provides varied and recurring learning experiences. [32] Students can engage in ethical simulations under different conditions time pressure, conflicts of interest, or teamwork challenges thereby strengthening ethical awareness and emotional resilience. [33] High-quality vocational education demands a balance between technical ability and work character. Industry stakeholders acknowledge that strong technical competence without professional attitude undermines productivity and teamwork. [34] Hence, attitude assessment is a critical indicator of job readiness for vocational graduates. Yet, in practice, it often remains secondary to technical examinations. With the ASSAR model, attitudinal dimensions such as discipline, ethics, and responsibility can be systematically measured and developed in vocational learning contexts.

The development of the AR-based assessment model also supports national initiatives such as SMK Revitalization and *Merdeka Belajar* (Freedom to Learn), both emphasizing technological innovation and employability alignment. [35] In this framework, assessment becomes an integral component that provides continuous feedback on student competency formation. AR enables adaptive, personalized, and enjoyable assessment processes tailored to each field of study automotive, tourism, culinary arts, or information technology ensuring relevance and engagement across disciplines. [36] Globally, immersive learning through AR has been widely recognized for enhancing soft skills such as communication, leadership, and collaboration. Reports have shown that AR-based learning can improve empathy, social awareness, and ethical decision-making by immersing students in simulated real-world scenarios. [37] In vocational contexts, AR helps students experience workplace dynamics realistically, understanding how to act professionally under pressure. [38] AR transcends entertainment it becomes a medium for value-based education, engaging the cognitive, affective, and psychomotor domains simultaneously. [39]

The development of the ASSAR model involves design, validation, and effectiveness testing stages. The model integrates pedagogical principles, educational psychology, and digital technology. The design phase includes defining attitude indicators, constructing AR scenarios, and establishing behavioral assessment mechanisms. [40] Validation by education experts and industry practitioners ensures contextual relevance and accuracy. Field testing then evaluates the model's practicality and effectiveness in vocational settings. The approach aims to produce an innovative, empirically grounded assessment model that can be widely implemented as a prototype for digital assessment in deep learning environments. [41]

This research contributes theoretically to the advancement of immersive technology-based assessment concepts. [42] It expands the understanding of how digital tools can serve not only as instructional media but also as instruments for evaluating character and attitude. The findings are expected to enrich the literature on AR-based innovation in vocational education and inform more responsive educational policy. [43] The ASSAR model offers a reference for curriculum developers and educators to design assessments that balance technical and affective domains, promoting alignment between technology, pedagogy, and national education goals.

The model's development supports the mission of universities and schools to foster research-based educational innovation. [44] For instance, Universitas Negeri Yogyakarta envisions itself as a pioneer in

educational technology innovation that enhances learning quality nationwide. This research aligns with that vision by combining scientific rigor and technological application to address real educational challenges. The model's implementation can strengthen digital assessment systems across educational levels while fostering collaboration between schools and industries. With appropriate policy support, ASSAR could become a national solution for reinforcing deep learning implementation in vocational schools.

Finally, implementing the ASSAR model provides new learning experiences that integrate technology, ethics, and spirituality in education. Through AR-based simulations, students can internalize moral and social values contextually rather than through rote instructionThis approach creates reflective learning spaces that nurture empathy, responsibility, and self-awareness. The digital assessment data can also serve as evidence-based feedback for continuous character monitoring and guidance. Ultimately, vocational education should not only produce skilled workers but also shape individuals of character who contribute positively to society.

Finally, implementing the ASSAR model provides new learning experiences that integrate technology, ethics, and spirituality in education.[45] Through AR-based simulations, students can internalize moral and social values contextually rather than through rote instruction. This approach creates reflective learning spaces that nurture empathy, responsibility, and self-awareness, while digital assessment data serves as evidence-based feedback for continuous character monitoring and guidance. Ultimately, vocational education should not only produce skilled workers but also shape individuals of character who contribute positively to society. In line with this vision, the main objective of the present study was to develop an interactive Augmented Reality (AR)–based educational medium designed to strengthen students' attitudes and soft skills within the context of vocational education.

The development of the Augmented Reality-Based Student Attitude Assessment Model (ASSAR) represents a strategic innovation for strengthening the implementation of deep learning in vocational schools. The model integrates digital technology with character education within the framework of 21st-century learning.[46] Through ASSAR, assessment evolves beyond measurement it becomes a reflective and value-based learning process. AR enables students to learn through authentic experiences within safe and engaging virtual environments, fostering both competence and conscience in the next generation of vocational graduates.

METHOD

This research and development (R&D) study utilized the ADDIE model Analysis, Design, Development, Implementation, and Evaluation as a systematic framework for producing a pedagogically sound and technologically robust augmented reality (AR) learning medium.[47] The ADDIE model was selected because it enables the development of educational interventions through clearly defined phases that support iterative refinement, instructional alignment, and empirical validation.[48] Its structured approach is particularly suited for designing media intended to influence complex constructs such as students' attitudes and soft skills, as it accommodates expert review, prototype testing, and calibration of content accuracy and usability prior to large-scale implementation. Figure 1 illustrates the model's sequential stages.
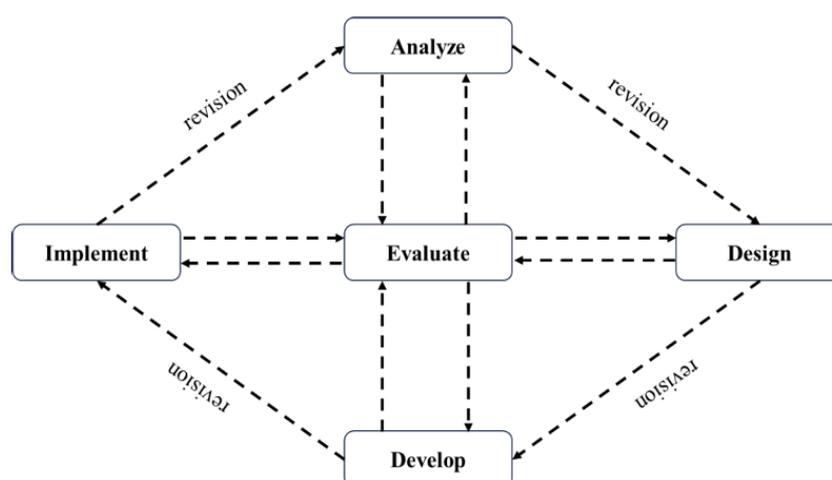

Figure 1. Stages of the ADDIE Model Development

In the Analysis stage, the study identified core instructional challenges in vocational schools, specifically the lack of systematic approaches for developing students' attitudes and soft skills. Data were gathered through classroom observations, teacher interviews, and curriculum document reviews. Although exploratory in nature, these procedures enabled the researchers to identify discrepancies between expected graduate competencies

and existing instructional practices. The analysis produced a set of content priorities and pedagogical problems that directly informed the AR design specifications. These findings served as a methodological justification for focusing the intervention on strengthening the eight dimensions of the student graduate profile, which encompass essential attitudes and soft skills required in vocational education.

The Design stage translated the analytical findings into a conceptual blueprint for the AR medium. This phase produced detailed storyboards, user interface prototypes, and instructional sequences that mapped interactive features to the eight targeted competency dimensions. Learning activities were intentionally structured to promote engagement, reflection, and collaboration three mechanisms shown in prior research to influence affective and interpersonal skill development. Additionally, research instruments were developed during this phase, including expert validation sheets, student and teacher questionnaires, and structured observation checklists. These instruments were designed to evaluate accuracy of content, usability, and pedagogical relevance, and later served as the basis for empirical assessment of the media's quality.

In the Development stage, the initial prototype of the AR learning media was produced based on the design framework. The prototype underwent iterative refinement cycles to calibrate technical functionality with the intended instructional design. The resulting product was a mobile-accessible AR platform that allowed students to engage with real-world vocational scenarios through augmented simulations. This stage also included internal testing to identify interface issues, interaction problems, and content inconsistencies prior to classroom implementation, thereby strengthening the reliability and feasibility of the final prototype.

The Implementation stage consisted of two sequential trials. The first phase involved a small-scale test with ten students and three teachers, designed to examine readability, usability, and practicality under controlled classroom conditions. Qualitative feedback from this phase informed revisions to interaction flow, interface clarity, and activity pacing. The second phase engaged a larger group of vocational students familiar with technology-enhanced learning. Data collected included student and teacher responses regarding practicality, as well as pre- and post-test measurements of students' attitudes and soft skills. These measures allowed for initial examination of the intervention's potential effects, although the absence of a control group limits causal inference an important methodological limitation acknowledged in this study.

The Evaluation stage integrated both formative and summative components. Formative evaluation occurred throughout each ADDIE phase to allow ongoing refinement of design, content, and interactivity. Summative evaluation was conducted through a Focus Group Discussion (FGD) involving four subject-matter experts, who assessed feasibility, pedagogical alignment, and user satisfaction. Expert validation results were analyzed using Aiken's V formula, a widely used method for quantifying expert agreement on assessment items. This analytical step provided evidence for the content validity of the AR-based media and strengthened the methodological rigor of the development process.

$$V = \sum \frac{s}{n(c-1)}$$

Information:
S = r-lo
r = the rating given by experts
lo = the lowest possible rating (1)
n = the total number of experts
c = the highest possible rating (5)

Table 1. Feasibility Test Success Criteria	
Value	**Validity**
> 0,81	High
041 – 0,80	Moderate
< 0,40	Low

RESULT

The findings of this study are presented according to the five stages of the ADDIE development model. Each stage illustrates the systematic process undertaken to design, develop, and evaluate AR-based interactive media aimed at strengthening the Student Graduate Profile of vocational school students.

Analyse

During the Analysis data were collected through classroom observations, interviews with teachers and students,

and an extensive review of relevant literature. The results revealed that learning activities in vocational schools were still predominantly focused on cognitive achievement, while the cultivation of students' attitudes and soft skills received limited attention. [5] Teachers reported difficulties in providing engaging learning experiences that could effectively foster non-cognitive competencies. Likewise, students expressed the need for more interactive and technology-enhanced learning tools that could support the development of these essential skills. Based on the findings, it was identified that Augmented Reality (AR)-based interactive learning media would be an appropriate solution, as it offers accessibility anytime and anywhere while promoting experiential and value-oriented learning. The analysis concluded that such technology could enhance not only students' engagement but also their behavioral and attitudinal competencies within vocational learning environments.

Design

The Design served as the blueprint phase of the study, transforming the findings from the analysis into concrete instructional and technological plans. The goal was to develop AR-based interactive learning media that effectively conveyed the eight dimensions of the Student Graduate Profile while engaging students in reflective and experiential learning. The design process focused on ensuring alignment between pedagogical goals, interactivity, and visual appeal, resulting in a product that was educationally meaningful, technologically reliable, and We have revised it

accessible for vocational students. The design process consisted of four main steps. The first involved developing instructional content based on the eight graduate profile dimensions faith and piety, citizenship, critical reasoning, creativity, collaboration, independence, health, and communication. Each dimension was simplified into behavioral indicators and contextualized within authentic vocational learning scenarios such as teamwork, ethics, and discipline.
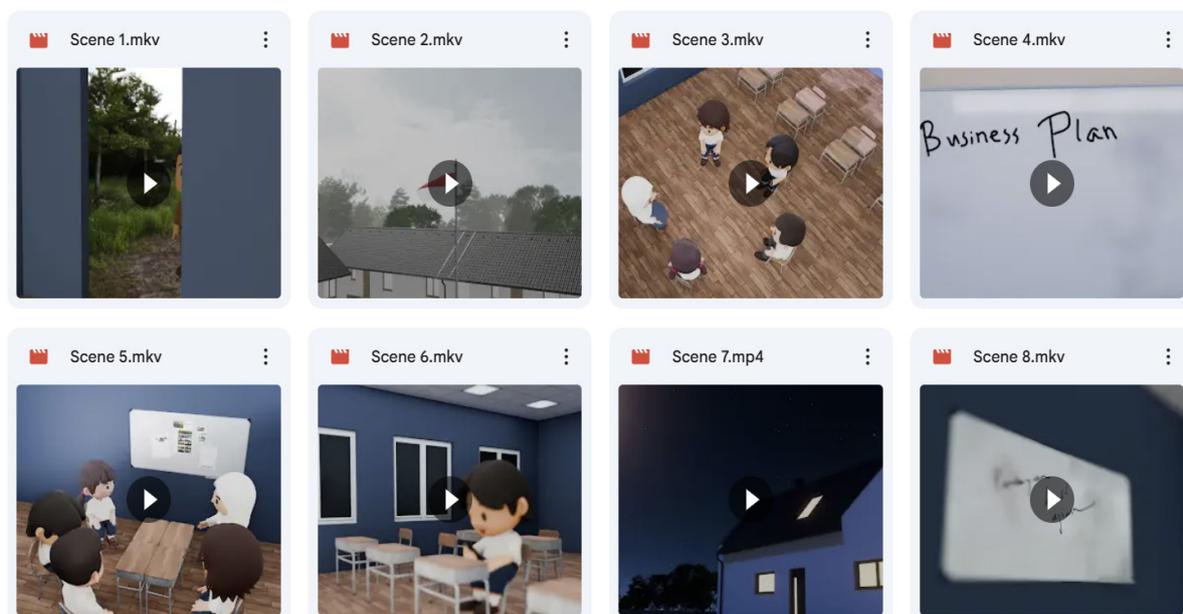

Figure 2. Flashcard AR

Figure 3. Graduate Profile AR Object Asset

The second step focused on creating eight short video scenarios that visually represented the desired attitudes and soft skills. Each video depicted realistic vocational situations and included both positive and negative examples of behavior, followed by reflective prompts to reinforce moral and professional understanding. The third step was the development of 3D Augmented Reality (AR) objects, each symbolizing one of the eight dimensions such as a light bulb for creativity and a handshake for collaboration.[37] When scanned through the AR interface, these objects displayed brief animations and explanations to strengthen conceptual understanding and engagement. Finally, all components were integrated into a cohesive AR prototype that combined the materials, videos, and 3D assets into a single, interactive application. The interface was designed with intuitive navigation, consistent aesthetics, and accessibility across mobile devices. Iterative feedback from teachers and multimedia experts ensured that the prototype was pedagogically coherent and suitable for classroom implementation.[31] Overall, this stage established a strong foundation for the subsequent development phase. By merging pedagogical design with technological innovation, the AR-based prototype provided an engaging and authentic learning environment that fostered both cognitive and attitudinal growth among vocational students.
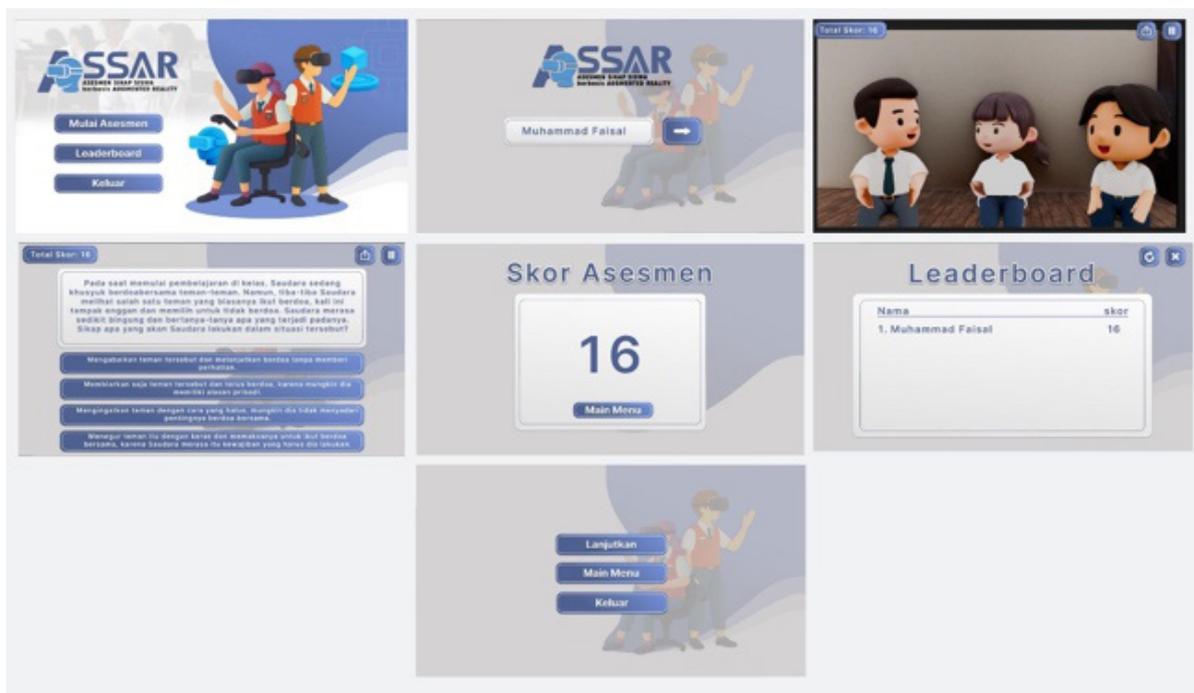

Figure 4. AR-Based Interactive Graduate Profile Media Prototype

DEVELOPMENT

The development stage resulted in a fully functional AR-based interactive learning medium designed to enhance students' attitudes and soft skills in accordance with the Student Graduate Profile.[11] The final product, illustrated in figure 5, was transformed from the earlier prototype into a stable and accessible application that integrated multimedia and interactive components. The application's main interface, introduced after an initial login page, displayed eight icons representing the dimensions of the graduate profile. Each icon directed students to a set of learning resources, including instructional texts, short video scenarios depicting appropriate behaviors in vocational settings, and an AR scanner feature that activated 3D objects symbolizing the targeted dimensions.[37] The system's design emphasized intuitive navigation and visual clarity, allowing students to explore values such as collaboration, integrity, and creativity through engaging multimodal interactions. A detailed visualization of these integrated features is shown in figure 6.

The implementation of these design elements demonstrated the effectiveness of combining pedagogical structure with immersive technology to foster attitude formation and soft skills development. The interactive format encouraged learners to observe, reflect, and internalize behavioral models presented through realistic school and workplace scenarios. The 3D AR features, in particular, provided a tangible and memorable representation of abstract values, while the video narratives contextualized these values within everyday vocational experiences.[6] This blend of digital interactivity and moral reflection not only enhanced student engagement but also supported deeper comprehension and retention of key attitudes aligned with the Student Graduate Profile. Thus, the development stage successfully produced an innovative, pedagogically coherent, and technologically functional learning medium ready for classroom implementation and further evaluation.
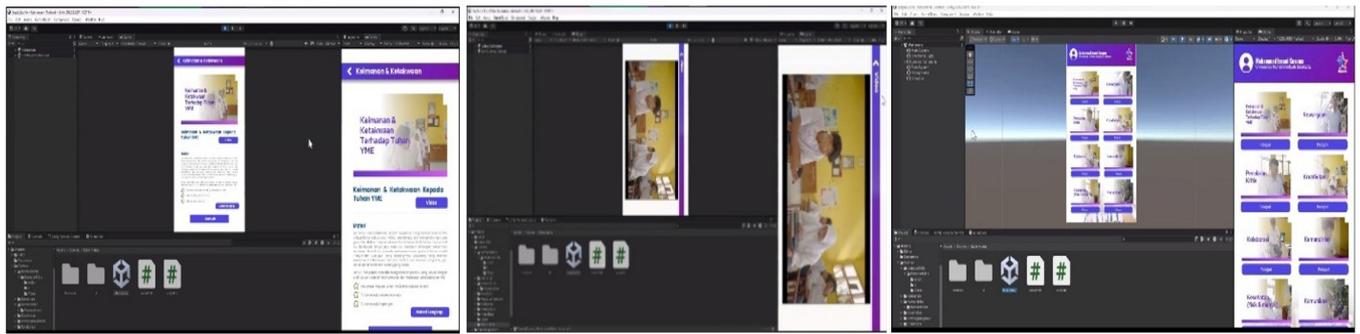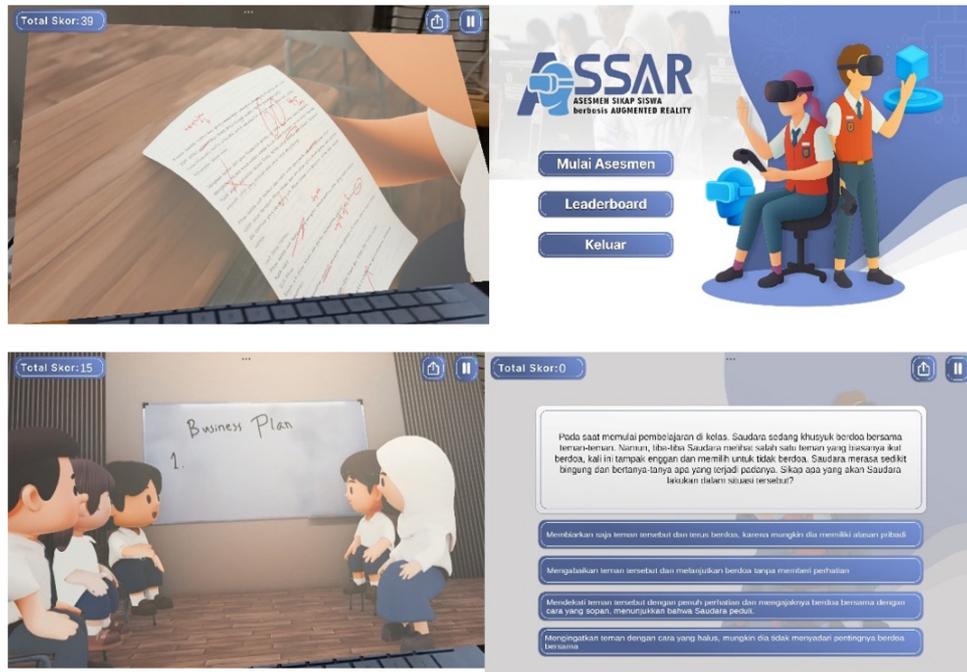
Figure 5. AR-Based Interactive Media Development

Figure 6. AR-Based Interactive Media Features

Implementation

The implementation phase was conducted on a limited scale to evaluate the readability, usability, and practicality of the developed AR-based interactive learning media. The trial took place at SMK *Tamansiswa 1 Imogiri*, involving ten students and three teachers as participants. This stage aimed to determine whether the AR learning materials could be effectively understood and applied by users in a real classroom setting. The implementation process began with user orientation, where participants were introduced to the media features and guided through its functions. Observations were made during the learning sessions to monitor student interaction, engagement levels, and ease of navigation within the application. The overall process was documented to capture both behavioral responses and verbal feedback from students and teachers. This limited implementation served as an initial validation of the product's functional and pedagogical feasibility before broader testing.

The findings revealed that students found the AR-based media intuitive, engaging, and easy to operate. The digital interface enabled them to independently explore the eight dimensions of the Student Graduate Profile, which included cognitive, affective, and behavioral aspects.[13] Students reported that the AR features particularly the combination of text materials, video scenarios, and 3D interactive objects helped them better understand abstract concepts related to values and soft skills. The integration of visual and experiential learning elements fostered curiosity and motivation, leading to a more meaningful learning experience. During classroom observations, students displayed enthusiasm and active participation while engaging with the AR simulations.[45] Many expressed enjoyment in interacting with the 3D objects and found the scenarios relatable to their everyday vocational learning experiences. This response demonstrated that AR can effectively support both conceptual understanding and affective engagement in vocational education.

Teachers' feedback further strengthened the evidence of the media's practicality and educational relevance.

They agreed that the AR learning media could be easily integrated into existing lesson plans without requiring significant adjustments.[41] Teachers also observed that the use of AR encouraged students to reflect more explicitly on their attitudes and soft skills, such as collaboration, discipline, and responsibility. The immersive nature of the media enabled teachers to observe these non-cognitive competencies more clearly during class activities. In addition, the AR-based design provided opportunities for formative assessment, allowing teachers to identify students' strengths and areas for improvement in real time. Teachers highlighted that the learning process became more student-centered and interactive, reducing their reliance on conventional lecture-based methods. These findings collectively confirmed that the developed AR media not only enhanced learning engagement but also offered a practical tool for assessing attitudinal development in vocational education contexts.

Evaluation

Based on the implementation results that have been carried out, the next stage is an evaluation to see the feasibility of the materials and media that have been developed. Testing was carried out by experts through a Forum Group Discussion by looking at Aiken's V value. The results of the test from four experts showed that the graduate profile material was assessed as eligible with a v-value of 0,81-0,94 and AR-based learning media was also assessed as eligible with a v-value of 0,81-0,94. The results of the calculation of the feasibility test of materials and media are presented in table 2 and table 3.

Table 2. Graduate Profile Material Feasibility Test Results					
Item	V-Value	Criteria	Item	V-Value	Criteria
1	0,88	Feasibility	6	0,81	Feasibility
2	0,88	Feasibility	7	0,94	Feasibility
3	0,94	Feasibility	8	0,88	Feasibility
4	0,94	Feasibility	9	0,88	Feasibility
5	0,88	Feasibility	10	0,94	Feasibility

Table 3. Results of the Feasibility Test of AR-Based Interactive Media		
Item	V-Value	Criteria
Media Readability	0,88	Feasibility
Media Display	0,88	Feasibility
Ease of Use/Practicality	0,94	Feasibility
Media Quality	0,94	Feasibility
Layout	0,88	Feasibility
Topography of Media Content	0,81	Feasibility
Content Accuracy	0,88	Feasibility
Relevance	0,94	Feasibility
Interactivity	0,88	Feasibility
Attractiveness	0,94	Feasibility
Language Clarity	0,88	Feasibility
Technical Performance	0,88	Feasibility

The findings of this study confirmed that AR-based interactive educational media is feasible, practical, and effective in developing vocational students' attitudes and soft skills in alignment with the Eight-Dimension Graduate Profile. The validation process produced a high Aiken's V value above 0,8 indicating that the product successfully met the required standards of both content accuracy and design quality. Teachers and students provided highly positive feedback, emphasizing that the AR-based media was easy to use, engaging, and seamlessly integrated into classroom learning. The most significant outcome was the measurable improvement in students' attitudes and interpersonal abilities after implementation, showing that AR-based learning effectively nurtured competencies beyond the cognitive domain. These results demonstrated that technology-supported learning could simultaneously enhance motivation, reflection, and behavioral transformation. The developed media therefore served as a pedagogical tool capable of combining academic understanding with character and skill formation.

DISCUSSION

The implementation results revealed that the use of AR in vocational classrooms significantly improved students' communication, collaboration, responsibility, and adaptability. Students became more active and independent in group tasks and demonstrated better cooperation and discipline when interacting through the AR platform. Teachers observed that the immersive features of the media encouraged students to apply moral and professional values naturally during learning activities.[46] This change reflected the role of AR as not only a tool for knowledge delivery but also a medium for attitude cultivation and behavior modeling. The learning process became more authentic and participatory, where students could connect lessons with real-world vocational experiences. Furthermore, the assessment of soft skills became more objective because teachers were able to observe students' behavior directly during AR-based simulations. The evidence of improvement across non-cognitive dimensions proved the effectiveness of AR media in supporting holistic educational outcomes.

The integration of the Eight-Dimension Graduate Profile into the AR media framework provided structured guidance for holistic student development.[42] Each dimension faith and piety, citizenship, critical reasoning, creativity, collaboration, independence, health, and communication was embedded within authentic activities, video scenarios, and 3D interactive elements.[48] This design ensured that learning was not limited to abstract moral instruction but translated into concrete experiences that students could engage with actively. By participating in digital simulations, learners were able to internalize key values through practice and reflection. Teachers confirmed that this structured model helped them monitor students' progress across all eight domains in a more systematic and consistent way. The approach effectively transformed policy-driven educational ideals into practical classroom applications that foster intellectual, ethical, and social competencies simultaneously. Consequently, AR-based learning emerged as a model that aligned with broader educational transformation goals while meeting real classroom needs.

From a theoretical perspective, this research broadened the scope of AR implementation from its traditional focus on cognitive and technical learning to include affective and interpersonal development.[30] The product design successfully demonstrated that technology can support the emotional, moral, and social growth of students when applied within the right pedagogical framework. From a practical standpoint, the developed model provided teachers with a ready-to-use and adaptable instructional tool for assessing attitudes alongside technical skills. The combination of immersive visuals, authentic assessment, and reflective prompts made the learning experience both engaging and measurable. While the results were encouraging, several challenges remained regarding the expansion of the model to other disciplines, the readiness of teachers to adopt AR-based tools, and the need for sufficient digital infrastructure.[39] Addressing these issues will be essential for ensuring scalability and sustainability in wider educational contexts.

The study demonstrated that AR-based interactive learning media is a transformative educational innovation for vocational schools.[5] The developed model effectively operationalized the Eight-Dimension Graduate Profile, bridging the gap between technical proficiency and soft skill development.[12] Students not only acquired knowledge but also practiced attitudes essential for professional success such as collaboration, integrity, and creativity. Teachers gained access to a digital system that supported both teaching and assessment in a more authentic and objective manner. The AR-based approach fostered learning that was reflective, participatory, and value-oriented, ultimately preparing students to face the demands of an increasingly complex and competitive world. The results affirm that integrating immersive technology into education can strengthen not just academic achievement but also the human dimensions of learning, shaping graduates who are both competent and character-driven.

CONCLUSIONS

This study demonstrated that AR-based interactive learning media represents a feasible, practical, and effective educational innovation for vocational institutions. The developed product met high standards of quality and was well received by teachers and students, who found it engaging and meaningful in improving attitudes and soft skills. The integration of the Eight-Dimension Graduate Profile within authentic and immersive AR scenarios enabled students to develop essential competencies such as communication, collaboration, responsibility, and adaptability in real-life contexts. The intervention not only enhanced technical learning but also strengthened non-cognitive aspects of student development that are vital for professional readiness. Theoretically, this research expanded the pedagogical use of augmented reality to include affective and interpersonal learning dimensions, while practically, it provided a replicable model for vocational schools to link technology with holistic character formation. The approach aligned with national and global educational agendas that promote the integration of technical, cognitive, and socio-emotional skills for future-oriented learning. Further investigations are encouraged to explore the long-term effects and scalability of AR-based learning models in diverse vocational disciplines to fully harness their transformative potential in preparing graduates who are competent, ethical, and socially responsible.

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CONFLICT OF INTEREST

None.

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