

Development of Mobile Learning-Based Educational Media to Enhance Understanding of Service Quality in Customer Service

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Received : 06 June - 2026

Accepted : 13 July - 2026

Published online : 17 July - 2026

Abstract

In the modern business landscape, mastering service quality is a crucial competency for vocational graduates entering the workforce. This study aims to develop valid, practical, and effective mobile learning-based educational media to improve students' understanding of service quality in customer service at SMK Negeri 1 Malang. The research problem focuses on students' low understanding of the concept of customer service quality as well as the limitations of educational media that support flexible and interactive learning. This study employed the Research and Development (R&D) method using the 4D model, which includes the define, design, develop, and disseminate stages. The research subjects consisted of 10th-grade students in Class MPLB 2 at SMK Negeri 1 Malang. Data collection techniques included an expert validation questionnaire, a user response questionnaire, and pre- and post-tests. The results showed that the developed learning media was categorized as acceptable based on evaluations by subject matter experts and media experts. Furthermore, the media was deemed practical based on the students' positive responses during the learning process. The effectiveness test results showed an increase in students' understanding of service quality material, as indicated by N-Gain scores in the moderate to high categories. The findings suggest that mobile learning can serve as an alternative learning medium that supports more flexible, interactive, and contextual vocational learning in customer service courses at vocational high schools.

Keywords: Customer Service, Learning Media, Mobile Learning, Service Quality, Vocational Education.

1. Introduction

Current developments in vocational education demand not only mastery of academic competencies but also students' ability to apply service skills in accordance with the needs of the workforce. Specifically, within the Management of Offices and Business Services (MPLB) program, customer service competencies are a crucial aspect as they are directly linked to graduates' readiness to engage in professional interactions within the industry. However, the customer service learning process at SMKs still faces various challenges, particularly regarding the understanding of service quality concepts, which are contextual and application-oriented. Research findings indicate that a teaching approach that remains teacher-centered causes students to struggle with understanding service concepts in depth and in a practical manner (Subiyakto et al., 2021). This situation results in students' limited ability to solve customer service case studies that require quick and accurate decision-making. Furthermore, the limited availability of interactive learning media prevents students from gaining learning experiences that closely resemble real-world workplace situations (Mudasir, 2024). Therefore, customer



service education requires a more contextual and experience-based approach so that students can fully grasp service quality competencies.

The issue of service quality education is increasingly relevant in the context of vocational education because service quality is one of the key indicators of graduate competencies in the fields of office management and business services (Camilleri, 2021). The concept of service quality is not only related to the ability to provide service but also involves aspects of responsiveness, assurance, empathy, reliability, and tangibility, which students must understand in an integrated manner (Alzola & Robaina, 2005; Parasuraman et al., 1988). In teaching practice, these concepts are often taught theoretically without adequate contextual simulations, causing students to struggle to connect theory with real-world customer service practices (Khairiyah & Putri, 2024). Previous research indicates that interactive simulation-based learning can enhance student engagement in understanding service concepts in a more practical way (Rani et al., 2025). However, the implementation of mobile learning-based instructional media for service quality material in vocational high schools remains relatively limited and has not been extensively developed for this specific purpose. These limitations mean that the learning process has not yet fully addressed the need for workplace-based customer service competencies. Consequently, there is a need for innovative instructional media capable of integrating service quality concepts with contextual learning experiences based on mobile technology.

Based on preliminary observations and interviews with customer service teachers at SMK Negeri 1 Malang, it was found that some students still struggle to understand service quality indicators, particularly regarding responsiveness and assurance. This situation is evident in the students' low ability to complete customer service case studies, as well as learning assessment results that have not met the minimum proficiency targets. Teachers also explained that instruction is still dominated by lecture-based methods and the use of conventional teaching materials, causing students to tend to be passive during the learning process. Additionally, students struggle when asked to analyze customer service situations that require decision-making based on real-world workplace conditions. These issues indicate that customer service instruction requires media capable of visualizing cases and providing interactive simulations so that students can understand the application of service quality in a more contextual manner (Husaen & Yuliani, 2023). Low learner engagement in the learning process also indicates that the learning media currently in use do not fully support the characteristics of the digital generation, which is more adaptable to mobile technology (Surawan & Saputra, 2025). Therefore, the development of mobile learning-based educational media is essential to address the need for more flexible, interactive, and contextual learning.

The use of mobile learning in vocational education holds great potential because it supports flexible learning and provides a more personalized and adaptive learning experience (Muaddab et al., 2026). Mobile learning allows students to access learning materials anytime and anywhere, so the learning process is not limited to formal classrooms (Subiyakto et al., 2021). Research shows that the use of mobile learning can increase learning motivation, student engagement, and the effectiveness of understanding practice-based learning materials (Subiyakto et al., 2021). Furthermore, mobile learning is considered capable of accommodating the learning needs of the digital generation, who are more accustomed to using mobile devices in their daily lives (Amalia et al., 2025). In the context of customer service education, the integration of mobile learning can provide case-based service simulations so that students not only understand the theory but are also able to practice contextual customer service decision-making skills. The use of mobile technology in learning is also in line with the needs of vocational education, which emphasizes a balance between

conceptual mastery and practical skills (Mukhadis et al., 2021). Therefore, the development of mobile learning on service quality is relevant for improving the quality of customer service education in vocational high schools.

Previous research indicates that the development of mobile learning has primarily focused on improving general learning outcomes, learning motivation, and the effectiveness of technology-based learning. Surawan and Saputra (2025) explains that most mobile learning research still emphasizes improving general learning outcomes without developing learning contexts specific to customer service competencies. Another study conducted by Rani et al. (2025) places greater emphasis on the integration of mobile applications into blended learning but has not yet developed customer service simulations based on real-world workplace cases. Meanwhile, research by Mudasar (2024) indicates that mobile learning can enhance learning interactivity but has not specifically developed service quality materials for vocational education. These conditions indicate that research on the development of mobile learning to improve understanding of service quality in customer service at vocational high schools (SMK) remains very limited. Furthermore, most previous studies have not integrated an interactive simulation approach based on real-world customer service case studies into mobile learning media. Thus, there is a research gap highlighting the need to develop mobile learning media that is more contextual, practical, and relevant to the customer service competency needs in vocational education.

The novelty of this study lies in the development of mobile learning media that integrates service quality content with interactive customer service simulations based on real-world work scenarios. The developed media not only presents conceptual material but also provides a contextual, decision-making-based learning experience in customer service. The integration of customer service simulations into mobile learning is the key distinguishing feature compared to previous studies, which tended to focus on the delivery of content and general cognitive-based evaluation (Surawan & Saputra, 2025). Additionally, the learning platform is designed to align with the characteristics of vocational high school students, employing a flexible, interactive, and user-experience-based learning approach. The development of this media also integrates service quality indicators such as responsiveness, assurance, empathy, reliability, and tangibility into customer service simulation activities. Thus, the developed media not only enhances students' conceptual understanding but also trains their ability to handle customer service situations that closely resemble real-world workplace conditions. This innovation is expected to make a substantive contribution to the development of vocational learning media based on mobile learning.

This study aims to develop mobile learning-based instructional media that is valid, practical, and effective in enhancing students' understanding of service quality in the customer service course at SMK Negeri 1 Malang. Additionally, this study aims to test the media's feasibility through validation by media experts and subject matter experts, as well as to measure improvements in students' understanding through the implementation of the developed instructional media. Theoretically, this study expands the body of research on the implementation of mobile learning in service quality instruction within vocational education. Practically, the developed media can be used by teachers as an alternative for more contextual and flexible interactive learning in customer service instruction. The development of mobile-based learning media is also expected to increase student engagement in the learning process, thereby making the learning process more active and meaningful (Husaen & Yuliani, 2023). Furthermore, this media can serve as a learning solution tailored to the characteristics of the digital generation and the needs of the customer service-oriented workforce. Thus, this study

offers relevant academic and practical contributions toward enhancing the quality of technology-based vocational education.

2. Literature Review

This research is based on constructivists theory, research findings indicate that a teaching approach that remains teacher-centered causes students to struggle with understanding service concepts in depth and in a practical manner (Subiyakto et al., 2021). This situation results in students' limited ability to solve customer service case studies that require quick and accurate decision-making. Furthermore, the limited availability of interactive learning media prevents students from gaining learning experiences that closely resemble real-world workplace situations (Mudasir, 2024). Therefore, customer service education requires a more contextual and experience-based approach so that students can fully grasp service quality competencies.

Furthermore, mobile learning is considered capable of accommodating the learning needs of the digital generation, who are more accustomed to using mobile devices in their daily lives (Amalia et al., 2025). In the context of customer service education, the integration of mobile learning can provide case-based service simulations so that students not only understand the theory but are also able to practice contextual customer service decision-making skills. The use of mobile technology in learning is also in line with the needs of vocational education, which emphasizes a balance between conceptual mastery and practical skills. Therefore, the development of mobile learning on service quality is relevant for improving the quality of customer service education in vocational high schools.

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Based on these various theories and previous studies, this media can serve as a learning solution tailored to the characteristics of the digital generation and the needs of the customer service-oriented workforce. Thus, this study offers relevant academic and practical contributions toward enhancing the quality of technology-based vocational education.

3. Methods

3.1. Research Design and Development Model

This study employs a Research and Development (R&D) approach using the Four-D (4D) development model developed by Thiagarajan, Semmel, and Semmel (Thiagarajan et al., 1974). The 4D model was selected because it features systematic development stages suitable for producing valid, practical, and effective learning products for use in the context of vocational education. The use of this model allows the media development process to be carried out in stages, starting from the identification of learning needs to the validation of the product before it is implemented with students. Developmental research in the field of education is not only oriented toward the creation of products but also toward testing the quality and effectiveness of those products in solving real-world learning problems in the field (Basuk & Ummah, 2020). In this study, the development stages focused on define, design, and develop, while the disseminate stage was not carried out extensively due to time constraints. The development focus was directed toward product validation and limited pilot testing to determine the feasibility of mobile learning media in enhancing students' understanding of service quality in customer service. Thus, the 4D model is considered relevant for supporting the development of contextual mobile learning-based instructional media that align with the learning needs at vocational high schools.

3.2. Implementation of the 4D Development Stages

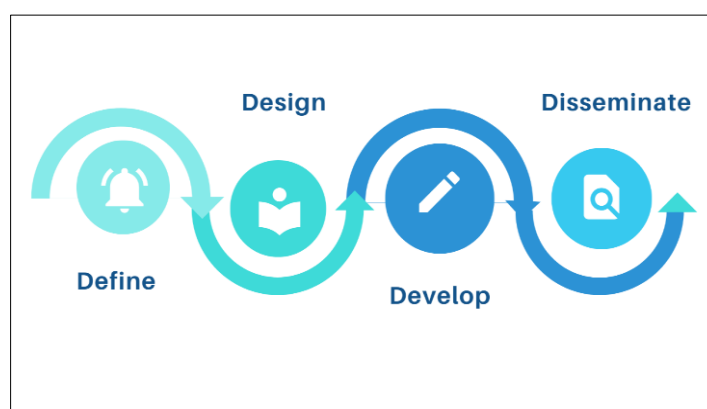


Figure 1. The 4D Model Stages of Research and Development

To ensure clarity in the research process, the study adopted the 4D development model as a structured framework for systematic innovation. As shown in Figure 1, the model goes through four stages, namely Define, Design, Develop, and Disseminate which defined afterwards.

3.2.1. Define

The define stage was conducted to identify learning needs and issues arising in the customer service learning process at the school. During this stage, the researcher conducted classroom observations, interviews with customer service subject teachers, and an analysis of the curriculum related to service quality learning outcomes in the customer service subject. The results of the observations showed that instruction was still dominated by lecture-based methods and the use of conventional teaching materials, resulting in students being less active in understanding the contextual application of service quality. Additionally, teachers reported that students struggled to complete customer service case studies requiring the ability to analyze situations and make appropriate service-related decisions. An analysis of student

characteristics also showed that the majority of students were more interested in using visual and interactive learning media accessible via mobile devices. The define phase also includes an analysis of service quality concepts specifically the indicators of responsiveness, assurance, empathy, reliability, and tangibility as the foundation for developing the content of learning media (Basuk & Ummah, 2020). Thus, the define phase serves as the primary foundation for designing learning media that align with the actual needs of customer service education at vocational high schools (SMK).

3.2.2. Design

The design phase involved developing a mobile-learning-based instructional media design tailored to the learning objectives and characteristics of the students. In this stage, the researchers developed the structure of the service quality content, the application interface design, the media navigation flow, and the presentation of customer service simulations based on real-world case studies. The learning media were developed using the Google AppSheet platform, allowing flexible access via students' smartphones without requiring the installation of additional applications. The media design was developed with consideration for ease of use, interactivity, material readability, and user engagement in the learning process. Additionally, the media is equipped with an evaluation feature based on interactive quizzes and customer service decision-making simulations designed to train students' contextual thinking skills. The media design process also draws on the principles of multimedia learning, which emphasize the integration of text, images, and simulations to enhance the effectiveness of conceptual understanding (Rani et al., 2025). Therefore, the design phase is focused on producing an engaging, flexible, and relevant instructional media design tailored to the needs of customer service-based vocational education.

3.2.3. Development

The development stage involves product validation, media revision, and limited pilot testing with students. Validation is conducted by subject matter experts and media experts to assess the product's suitability based on content, language, visual presentation, navigation, interactivity, and the media's alignment with learning objectives. Feedback and suggestions from the validators were used as the basis for revising the product before its implementation with students. After the revision process was completed, the media was pilot-tested with 34 students in Class X MPLB 2 to determine its effectiveness in improving students' understanding of service quality. The pilot test used a pretest-posttest design to measure improvements in students' understanding before and after using the learning media. The media was implemented in case-study-based customer service lessons so that students not only learned concepts but also engaged in contextual simulations of customer service decision-making. The development phase is a crucial step because it determines the final quality of the media before it is used more widely in vocational education (Purmadi et al., 2022). Thus, the development process focuses not only on the validity of the product but also on the effectiveness of the media in supporting improvements in students' understanding.

3.3. Research Setting and Subjects

The study was conducted at SMK Negeri 1 Malang with 34 students from Class X MPLB 2 as the research subjects. These students were selected because they were currently studying service quality as part of their customer service course. Additionally, preliminary observations indicated that most students had difficulty understanding service quality indicators, particularly regarding responsiveness and assurance in case-study-based customer service scenarios. The fact that these students actively use smartphones was also a key consideration

in the development of mobile learning-based media. This study also involved one subject matter expert and one media expert to validate the quality of the content and the design of the developed media. The involvement of validators aimed to ensure that the resulting learning media met standards for content appropriateness, language, presentation, interactivity, and ease of use (Subiyakto et al., 2021) Thus, the research subjects were selected based on their relevance to the needs of developing mobile learning-based customer service learning media.

3.4. Research Instruments

The research instruments consisted of a test, an expert validation questionnaire, and a learner response questionnaire. The test was used to measure the increase in learners' understanding of service quality material before and after using the learning media. The test consisted of 20 multiple-choice questions designed based on cognitive indicators, for levels C2 and C3, covering the ability to explain, interpret, and apply service quality concepts in customer service situations. The question matrix was developed based on the indicators of responsiveness, assurance, empathy, reliability, and tangibility. The expert validation instrument used a 1-4 Likert scale covering aspects of content appropriateness, media presentation, interactivity, navigation, and learning suitability. Meanwhile, the student response questionnaire was used to determine the level of practicality and acceptability of the learning media based on students' experiences during the learning process. Before use, the research instruments first underwent content validity testing by expert validators to ensure their alignment with the research objectives (Husaen & Yuliani, 2023). Thus, the research instruments were systematically designed to generate valid and reliable data for evaluating the quality of the developed learning media.

3.5. Data Collection Techniques

Data collection techniques in this study included observation, interviews, tests, questionnaires, and documentation. Observations were conducted in the initial stage to identify the conditions of customer service learning as well as the characteristics of students in the learning process. Interviews were conducted with customer service subject teachers to obtain information regarding learning problems, media needs, and students' difficulties in understanding service quality material. Tests were used to measure improvements in students' understanding through pretests and posttests administered before and after the use of the learning media. Meanwhile, questionnaires were used to gather data on media expert validation, content expert validation, and student responses to the use of mobile learning media. Documentation involved collecting student grades, photographs of learning activities, and supporting documents related to media development. The use of various data collection techniques aims to enhance the accuracy and completeness of research data so that the research results are more objective and scientifically accountable (Rani et al., 2025). Therefore, data collection techniques were designed comprehensively to support the evaluation process of the developed learning media.

3.6. Data Analysis Techniques

Data analysis was conducted using quantitative descriptive methods to assess the validity, practicality, and effectiveness of the mobile learning-based instructional media. Data from the expert validation were analyzed using the percentage of feasibility scores based on a Likert scale to determine the media's validity category. The media feasibility criteria were categorized as highly valid, valid, moderately valid, and less valid based on the percentage of scores obtained from the expert validators. Data from student responses were analyzed to determine the level of practicality and acceptability of the media during the learning

implementation process. Meanwhile, pretest and posttest data were analyzed using the N-Gain calculation to determine the increase in students' understanding of service quality material after using the learning media. The N-Gain analysis was used because it can demonstrate the level of improvement in learning outcomes more objectively by comparing students' initial and final scores. The analysis results were then categorized into high, moderate, and low levels of improvement to determine the effectiveness of the developed learning media. Thus, the data analysis technique in this study was designed to provide a comprehensive overview of the quality and effectiveness of mobile learning media in improving students' understanding of service quality.

4. Results and Discussion

4.1. Research Results

4.1.1. Define Stage

The Define stage was conducted to identify learning needs, student characteristics, and issues arising in service quality instruction within the customer service course at SMK Negeri 1 Malang. Activities during this stage included classroom observations, interviews with subject teachers, curriculum analysis, and analysis of student characteristics.

The observation results showed that the learning process was still dominated by lecture-based methods and the use of conventional teaching materials, such as printed modules and verbal explanations from teachers. These conditions caused students to be less active in the learning process and to experience difficulties in understanding the application of service quality concepts in contextual customer service situations. The greatest difficulties were found in the responsiveness and assurance indicators, particularly when students were asked to analyze customer service case studies.

Furthermore, interviews with teachers revealed that students tend to be more interested in using visual and digital learning media via smartphones than conventional learning media. This indicates a need for learning media that is more flexible, interactive, and suited to the characteristics of the digital generation.

Based on the results of this needs analysis, the researcher developed mobile-learning-based instructional media capable of integrating service quality material with case-study-based customer service simulations. The development of this media was aimed at helping students understand service quality indicators including responsiveness, assurance, empathy, reliability, and tangibility in a more contextual manner.

The results of the define phase indicate that customer service education requires innovative learning media capable of increasing student engagement, providing a more realistic learning experience, and supporting self-directed learning via mobile devices. Therefore, the define phase serves as the foundation for designing learning media relevant to vocational education needs.

4.1.2. Design Phase

The design phase involved the development of a mobile-based learning medium named the Service Quality App. During this phase, the researcher developed the medium's user interface design, content structure, app navigation, and case-study-based customer service simulations. The learning media was developed using the web-based Google Apps Script platform so that it can be accessed flexibly via a smartphone without the need to download additional applications. The media product can be accessed online via the link <https://bit.ly/servquaL>.

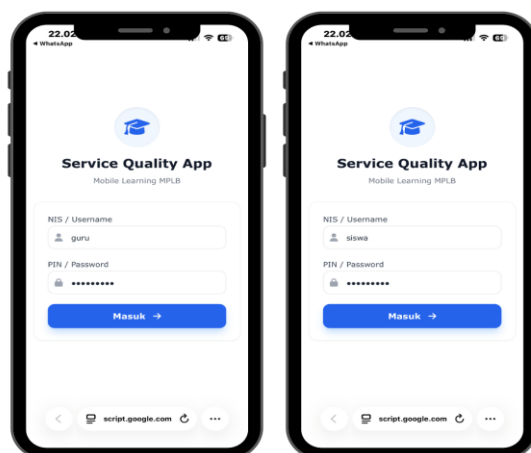


Figure 2. Service Quality App Home Screen

The Service Quality App's home screen in Figure 2 features a clean design dominated by white with formal blue accents. Blue was chosen to convey a professional impression while representing academic identity, complemented by a graduation cap icon above the app title (Service Quality App - Mobile Learning MPLB). This design is optimized for mobile devices to ensure accessibility and visual comfort for students during their learning. This app is designed to be flexible, accommodating two distinct user roles within a single integrated system. This differentiation ensures that data access rights and the menus displayed after login are tailored to each user's specific role. Technically, the use of the Google Apps Script platform, as indicated by the URL, signifies that the Service Quality App is a highly accessible and efficient web app. Without the need for additional installation, users can access it directly via their smartphones.

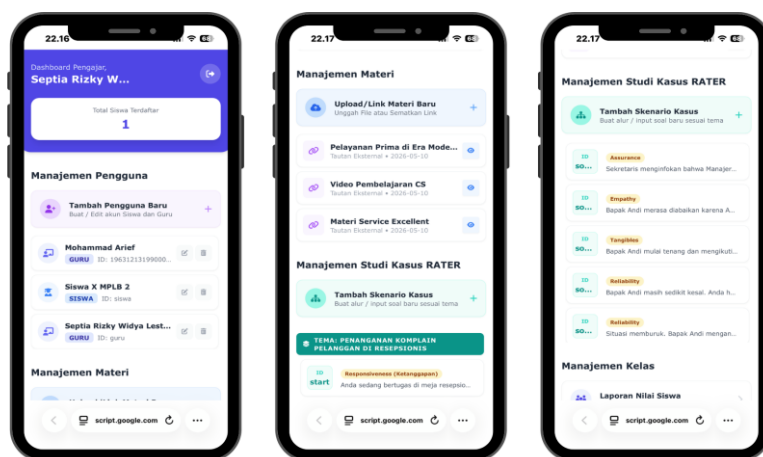


Figure 3. Service Quality App's Teacher Dashboard

The Service Quality App's teacher dashboard in Figure 3 serves as a practical control center for managing all instructional and classroom administrative activities. The teacher dashboard interface is divided into several functional panels presented in a continuous layout. At the top of the page (header), the system displays the identity of the currently logged-in teacher (Teacher Dashboard) along with a logout button. Directly below that is a concise data card presenting statistics on the number of students active in the system (Total Registered Students). This feature makes it easy for teachers to monitor class participation levels in real time. This panel grants teachers full access to manage accounts within the app. Using the Add New User button, instructors can create or update both teacher and student accounts. To

support the delivery of theoretical concepts before students perform simulations, a Materials Management panel is provided. Instructors can insert new teaching materials via the Upload/Link New Materials feature, whether in the form of digital files or external links (such as Customer Service instructional videos or articles on Service Excellence). RATER Case Study Management Feature (Branching Scenario Core): This panel is a core component of the app that facilitates the creation of branching scenarios. Instructors can formulate contextual case studies in the field of MPLB using the Add Case Scenario button. These cases are grouped and specifically labeled based on the five dimensions of service quality: Responsiveness, Assurance, Empathy, Tangibles, and Reliability.

The student dashboard is designed as an interactive self-learning space comprising three main, integrated pages. The main home page (left) displays a personalized header showing the student's account information, a Case Study Analysis Score performance tracker for score transparency, and three main navigation menus. When a student selects the Module Materials menu (center), the system directs them to a list of theoretical references and operational Customer Service instructional videos that can be accessed asynchronously, while the Select Case Study Topic page (right) presents contextual scenario-based simulations such as handling complaints at the reception desk which specifically designed to test students' critical thinking and problem-solving skills in real-world Office Management and Business Services (MPLB) contexts.

4.1.3. Development Phase

The development stage is carried out through an expert validation process, media revision, user testing, and testing the effectiveness of the learning media. This stage aims to determine the level of validity, practicality, and effectiveness of the Service Quality App media before it is used in learning.

A. Expert Validation of Content

Content expert validation was conducted by teacher of the Fundamentals of Office Management and Business Services course to assess the appropriateness of the content, language, and contextual relevance of the learning media.

Table 1. Results of Content Expert Validation

No.	Aspect	Percentage	Criteria
1.	Content Suitability	86.67%	Acceptable
2.	Contextual Assessment	80.00%	Acceptable
3.	Language Quality	80.00%	Acceptable
Average		82.22%	Acceptable

Source: Data processed by the researcher (2026)

Based on the validation results by subject matter expert in Table 1, the Service Quality App received an average score of 82.22%, which places it in the acceptable category. The score of 80% in the contextual assessment aspect indicates that the material presented is relevant to students' real-world situations. In terms of content appropriateness, the learning material scored 86.67%, indicating that the material is highly consistent with the learning objectives and curriculum. This is supported by a score of 80.00% in the language appropriateness aspect; the use of precise vocabulary and effective sentence structure helps minimize cognitive load (extraneous load), allowing students to focus fully on mastering core concepts. Thus, the Service Quality App has substantially met high pedagogical quality standards for implementation as a tool for both self-directed and classroom-based learning.

B. Media Expert Validation

Media expert validation was conducted by faculty member specializing in instructional media to assess the quality of the presentation, layout, and technical aspects of the instructional media.

Table 2. Results of Expert Validation of Instructional Materials

No.	Aspect	Percentage	Criteria
1.	Graphic Design Feasibility	80.00%	Eligible
2.	Media Quality	80.00%	Acceptable
3.	Media Layout	80.00%	Acceptable
Average		80.00%	Acceptable

Source: Data processed by the researcher (2026)

Validation results by instructional material expert in Table 2 indicate that the Service Quality App received an average score of 80.00%, placing this medium in the acceptable category. The highest score was observed in the graphic design category at 80.00%. This high score indicates that the use of high-contrast, sharp visual elements in the media functions effectively as cognitive cues that help students process important information without being burdened by irrelevant decorative elements (extraneous load). In line with this, the aspects of media quality and layout each received a score of 80.00%. This systematic placement of instructional elements supports the spatial contiguity principle, whereby the integration of information into students' working memory becomes easier because text and images are placed in close proximity. With a reliable system, students feel they have full control over their learning process, so technical obstacles no longer hinder the achievement of learning objectives. Thus, the Service Quality App has met quality standards including aesthetically, technically, and pedagogically for use on a broader scale in education.

C. User Testing

After undergoing validation and revision, the learning media was pilot-tested with 34 10th-grade students in MPLB 2 to determine the media's practicality and acceptability.

Table 3. Results of the User Testing Validation

No.	Aspect	Percentage
1.	Ease of Use	85.83%
2.	Usefulness	86.67%
3.	Appeal	88.89%
Average		87.13%

Source: Data processed by the researcher (2026)

Based on the results of the user trial in Table 3, the Service Quality App digital media received a very positive response with an overall average of 87.13%. Engagingness was the aspect with the highest score (88.89%), indicating that the media's visuals and interface were highly appealing. Usefulness reached 86.67%, indicating that this medium is considered effective in supporting the learning process. Ease of use stood at 85.83%, meaning users were able to operate the medium without significant technical difficulties. These results show that the mobile learning-based educational media developed has a high level of practicality and is well-received by students.

D. Effectiveness of the Learning Media

The effectiveness of the learning media was analyzed using the N-Gain Score calculation based on the students' pre-test and post-test results.

Table 4. Results of the Calculations for Pre-test, Post-test, and N-Gain Averages

No.	Assessment Components	Results
1.	Number of Students	34 Students
2.	Average Pre-test Score	68.38
3.	Post-test Average	92.06
4.	Average N-Gain Score	0.77
5.	N-Gain Percentage	76.89%
6.	N-Gain Category	High

Source: Data processed by the researcher (2026)

Based on the analysis results in Table 4, the students' average pre-test score of 68.38 increased to 92.06 on the post-test. The N-Gain calculation yielded a score of 0.77, falling into the "high" category. This improvement in learning outcomes indicates that the Service Quality App is effective in enhancing students' understanding of service quality material. The effectiveness of the app is influenced by several factors, including flexible access to learning, interactive presentation of material, and the use of case study simulations that help students understand the contextual application of customer service concepts. Students can access learning materials anytime and anywhere via their smartphones, making learning more flexible. Additionally, the customer service simulation feature based on branching scenarios provides a more realistic learning experience and increases student engagement in the learning process. The results of this study are consistent with previous research indicating that mobile learning can improve learning motivation, student engagement, and learning outcomes because it provides a more flexible and interactive learning experience. Thus, the mobile learning-based instructional media developed in this study is deemed valid, practical, and effective for use in teaching service quality within the customer service course at vocational high schools.

4.1.4. Dissemination Stage

The dissemination stage of this study has not yet been carried out on a large scale due to time constraints. However, the developed learning media has been introduced to customer service teachers at SMK Negeri 1 Malang as an alternative digital learning tool. In addition, the Service Quality App was pilot-tested on a limited basis with 10th-grade students in Class MPLB 2 and received positive feedback from users. The research results indicate that the app has the potential for broader application in customer service instruction at vocational high schools. The developed learning media can also serve as a reference for the development of mobile learning in other vocational subjects that require contextual simulations and case-study-based learning. Overall, the development of the Service Quality App using the 4D model demonstrates that mobile learning-based educational media can serve as a learning solution relevant to students' needs in the digital age and support improved understanding of service quality in customer service.

4.2. Discussion

The research results show a significant increase in students' understanding following the use of mobile learning-based instructional media for service quality material. The average pre-test score of 68.38 increased to 92.06 on the post-test, with an N-Gain of 0.77 in the high category. These findings indicate that mobile learning can create a more interactive and

contextual learning experience, making it easier for students to deeply understand the concept of customer service quality. From a digital learning perspective, improved learning outcomes are influenced not only by the visual presentation of material but also by the medium's ability to foster students' cognitive engagement through flexible and repetitive learning access.

The success of mobile learning-based instructional media in enhancing understanding of service quality is inseparable from the application of the 4D development model, which includes the Define, Design, Develop, and Disseminate stages. The 4D model provides a systematic framework for designing instructional media that is not only technically oriented but also takes into account learners' contextual learning needs. The process of expert validation, media revision, and phased implementation shows that media development can produce learning products that are more effective and better suited to user needs.

The findings of this study indicate that the use of mobile learning-based instructional media can significantly improve students' understanding of service quality material. These results align with various previous studies confirming that mobile learning contributes to improved learning outcomes, student engagement, and learning flexibility in the context of vocational education as well as higher education. Nevertheless, scholarly literature on mobile learning also presents mixed evidence. Some prior studies have reported null findings or significantly lower N-Gain scores, frequently attributing these limitations to digital distractions, cognitive overload, or a lack of a structured pedagogical framework within the application. This study successfully addresses these common pitfalls and stands out because it focuses specifically on service quality learning, which strategically integrates conceptual understanding with interactive, case-based customer service simulations.

This study occupies a unique position regarding the integration of mobile learning into service quality instruction at vocational high schools (SMK), a topic that has been relatively under-explored in previous research. The study demonstrates that mobile learning can serve as a pedagogical medium capable of bridging the gap between conceptual learning needs and practical service delivery in the workplace. Furthermore, this study offers a practical contribution in the form of an innovative learning medium that teachers can utilize in digital-based customer service instruction.

This study has academic implications for the development of mobile learning research in vocational education, particularly in service quality instruction. It demonstrates that mobile-based learning is not only effective as a medium for delivering content but also capable of creating a more contextual and adaptive learning experience. Future research could focus on integrating artificial intelligence, adaptive learning, and virtual simulations to enhance students' learning experiences in a more personalized and authentic manner.

5. Conclusion

This study demonstrates that the development of mobile learning-based instructional media for service quality content in customer service addresses the need for more adaptive, flexible, and contextual learning in the vocational high school (SMK) environment. The results show that the developed media met validity criteria through evaluations by subject matter experts and media experts, met practicality criteria based on user feedback, and were proven effective in enhancing students' understanding of customer service quality concepts. These findings indicate that the integration of mobile learning technology not only serves as a means of digitizing learning but also acts as a pedagogical medium capable of strengthening a more interactive learning experience oriented toward the needs of the workplace. In an academic context, this study provides a practical contribution in the form of a media development model

that can serve as an implementable reference for teachers and researchers in developing technology-based learning in the field of customer service. The successful implementation of these learning materials also demonstrates that the nature of vocational education requires media that allow students to learn independently and repeatedly at their own pace. Thus, this study reaffirms that mobile learning holds strategic potential in supporting the transformation of 21st-century competency-based vocational education.

Implicitly, the results of this study open up opportunities for broader learning media development through the integration of adaptive assessment features, learning analytics, and enhanced customer service simulations based on industry case studies. Future research is expected to test the effectiveness of the media across a more diverse range of schools and to combine experimental approaches to achieve a stronger level of generalizability. Furthermore, the development of mobile learning-based media should also focus on integrating artificial intelligence and personalized learning to enhance the quality of students' learning interactions more profoundly. With this development direction, learning media will not only serve as a tool to support learning but also become the foundation for a more innovative, relevant, and sustainable transformation of vocational education.

6. References

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