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Developing Mobile Career Learning Model for Electronics Engineering Vocational High School

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ABSTRACT

Vocational high school learning is directed to encourage student readiness in mastering certain work competencies as well as developing their careers in the world of work. Entering the era of the industrial revolution 4.0, the role of vocational high school as education for occupation as well as education for career development is facing increasingly complex problems. Optimization of learning activities both vocational learning and career learning in vocational high school should to be done to improve students' skills and abilities to adapt to the world of work that rapidly changing. A new learning model that can bridge students with work careers available in the world of work is needed, especially in electronics engineering vocational schools which have close links with the industrial world 4.0. Therefore, this study aims to develop and reveal the feasibility of mobile career learning model that integrates vocational learning and career learning in electronics engineering vocational high school. This research utilized the research and development method that adapts to the Holistic 4D model, which includes four stages of development: define, design, and develop with three levels of holistic design and an interactive cycle, namely analysis, design, and evaluation. The data collection used observation sheets and questionnaires that have been validated by experts. The data analysis used the descriptive method. The results of the study are as follows. (1) The developed mobile career learning model integrates vocational learning activities and career guidance by utilizing mobile career learning media applications. (2) The developed mobile career learning model is feasible and can be used for the career development of vocational high school students with electronics engineering competence.

Keywords*:* career development, electronics engineering, mobile career learning.

INTRODUCTION

Vocational education is education that aims to develop the capabilities of students so they can carry out certain work positions and develop their careers [1], [2] [3]. Vocational education in Indonesia that prepares students to work as operators is called vocational secondary education. One form of vocational secondary education in Indonesia is Sekolah Menengah Kejuruan (vocational high school) [3]. Vocational high schools are oriented to prepare skilled workers who have the abilities according to the needs of the wold of work. Following with its objectives, vocational high school has a role as education for occupation [3] as well as a function as education for career development [4]. Vocational high schools provide education tailored to the types of jobs available in the world of work [5]. The implementation of learning is generally delivered face-to-face through learning in classrooms, workshops, and school-based laboratories, as well as through hands-on experience in the workplace (internship programs). Learning in vocational high school is directed to encourage student readiness in mastering certain work competencies so that they can work and live independently in society and/or continue their education to a higher education level and improve their competence [4].

The electronics engineering expertise program is one of the expertise programs held at vocational high school in the field of technology and engineering expertise. This skill program consists of mechatronics engineering, industrial electronics engineering, audio-video engineering, power electronics and communication engineering, and medical instrumentation. Learning in Electronics engineering expertise - mechatronic engineering expertise competencies include control systems and robotics which are characteristics of the industrial revolution 4.0 [6]. Thus, a workforce with electronics engineering expertise, especially mechatronics engineering competence, will be needed along with the development of robotics and automation technology in various industries and manufacturing operations. However, entering the era of the industrial revolution 4.0, modern technologies began to replace jobs initially done by human power [7]. The implementation of automation in Indonesia expects to replace 23 million jobs while creating 27 million to 46 million new jobs in the same period in 2030, with 10 million jobs of which are new types of jobs that do not currently exist [8]. In this era, vocational high school as education for occupation and education for career development faces increasingly complex challenges.

Learning activities in vocational high schools have an important role so that students have the readiness to fill job needs while developing careers in the era of the industrial revolution 4.0. In order to develop their careers, students need to learn about themselves, the things they prioritize and about the development of the world of work [9]. So that learning needs to be directed to help students have the ability to plan and prepare for their career, responsibility and self-assertion about the future, interest in exploring possibilities and the environment in the future, and confidence in the ability to solve real career problems. [10].

The results of observations made at the electronic engineering vocational school at SMK SMTI Yogyakarta, SMKN 3 Wonosari, and SMKN 7 Semarang, show that the vocational learning that has been carried out is not structured in directing students to recognize occupations suitable for themselves and occupations related to the learning carried out. Students tend not to have confidence in career decisions or have the readiness and adaptability to develop their careers. This indicates that the role of vocational high school as education for occupation as well as education for career development has not been implemented optimally. If this continues, the uptake of vocational high school graduates in the job market can become an increasingly difficult problem.

The high unemployment rate for vocational high school graduates in Indonesia has been going on from year to year [11]–[13]. Young workers with secondary education are at risk of the unemployment trap [14]. The mismatch of skills taught in schools with required skills as well as a lack of skilled graduates is often presented as the cause of the high unemployment rate. However, these discussions often lack an analysis of the dynamics of the workforce or the constraints that occur during economic development [15]. So concerns about students' skills and their ability to adapt to the rapidly changing industrial world often do not have solutions related to learning for student's career development, especially learning to increase students' readiness to face structural obstacles that will be faced in the world of work.

Learning for career development will be ideal if it can bridge students with work careers available in the world of work. Including linking the characteristics of students who are Generation Z with the characteristics of the world of work in the industrial revolution era 4.0. Generation Z students tend to be more independent and able to access the required information quickly and easily through various digital information devices that are currently available [16]. Meanwhile, the emergence of modern technologies in the era of the industrial revolution 4.0 has further increased human-machine interaction in the world of work. Workers in the industrial revolution 4.0 era work in a work environment that implements a digital-based automation system that is controlled, computed, scalable, transparently, and widely accessible. [17].

The use of digital devices and human-machine interaction in vocational learning in vocational high school has been formed in the application of e-learning and mobile learning which are used to improve the quality of learning. The adoption of mobile devices in career learning increases students' motivation to seek career information according to their interests and talents as well as makes career information services more enjoyable [18]. However, based on observations, the application of e-learning and mobile learning in vocational high schools with electronics engineering expertise, especially mechatronics engineering competence, is currently not being maximized to integrate vocational learning and career learning (both are carried out separately and not integrated). As a result, work-related learning carried out during vocational learning has less impact on increasing students' career development abilities, and conversely, career learning that is carried out does not have an impact on increasing self-awareness of students' learning to actively participate in vocational learning that is beneficial for their career development.

Therefore, a new learning model that can integrate vocational learning and career learning in vocational high schools is needed. This study aims to develop a mobile career learning model that can integrate vocational learning and career learning, as well as reveal the feasibility of the developed model to vocational high school learning. This research is further limited to electronic engineering vocational schools with mechatronic engineering expertise. The mobile career learning model was developed using learning media in the form of a mobile-based application. This media had chosen because smartphones have become a device that is commonly used both for work-related activities and to support learning activities [19], [20]. The learning model developed is expected to help designers of electronic engineering vocational high school learning in facing the challenges of the world of work in the era of the industrial revolution 4.0.

METHODS

This study uses research and development methods with development procedures referring to the 4D Holistic model according to Reigeluth & An. The 4D Holistic model consists of 4 development stages, namely the Define, Design, Develop and Deploy stages, with three levels of holistic design and an interative cycle, namely analysis, design, and evaluation. The define stage is the stage of determining the input for the design and development processes. The design and develop stages are part of the process, and the output is the deploy stage or the dissemination of the development results [21].

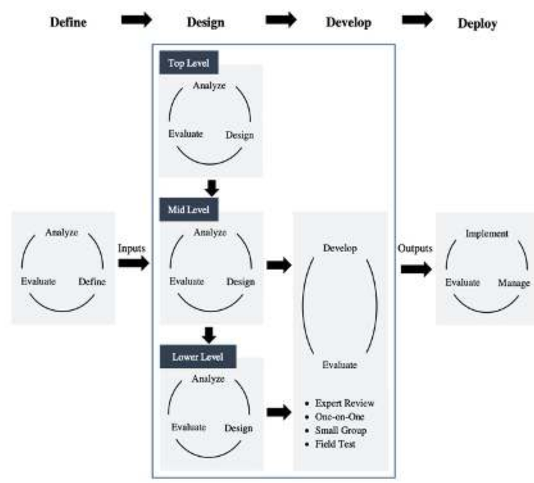

Figure 1. The Holistic 4D model development stages

This 4D Holistic development procedure was then adapted in this research and development stage, as shown in figure 2. The Define stage consists of performance analysis and instructional needs assessment activities. Performance analysis is carried out to identify learning problems and to decide on the types of interventions that can address them. Performance analysis activities were carried out through observations to electronic engineering vocational learning in SMK SMTI Yogyakarta, SMKN 3 Wonosari, and SMKN 7 Semarang. Instructional needs assessment aims to generate instructional objectives in the development project.

The instructional needs assessments stage was carried out using a questionnaire method to 32 teachers of mechatronics engineering vocational schools from 10 SMKs with accreditation categories A, B, C and not yet accredited in Central Java and Yogyakarta provinces, namely SMKN 1 Bawang, SMKS PL Leonardo Klaten, SMKN 2 Sukoharjo, SMKN 2 Wonogiri, SMKS Wisudha Karya Kudus, SMKN Nurul Barqi, SMKN 7 Semarang, SMK Ki Ageng Pemanahan, SMKN 3 Wonosari and SMK SMTI Yogyakarta. The questionnaire was administered online using a google form, which was sent via school e-mail. Through the define stage, the requirements for the product to be developed are obtained.

The Design stage consists of three sub-stages, namely top-level design, mid-level design, and lower-level design. Each stage includes a cycle of analysis, design, and evaluation. The results of the design are then evaluated through the design assessment stage. The design assessment stage was carried out using the Delphi technique and involved 13 experts with the background of lecturers, principals, teachers, career experts, software experts, and successful alumni. Product designs assessment questionnaires are sent online via email.

The Develop stage consists of two parts. The first part is product development which includes developing a mobile career learning model, mobile application media and learning modules according to a predetermined design. The second part is formative evaluation using a questionnaire method which includes expert review and operational trials. Expert reviews include content reviews and media reviews. The operational trial activity involved 64 students and 8 teachers of mechatronic engineering competency skills at SMK N 7 Semarang. The Deploy stage is the stage of dissemination and product development that requires further research. This stage includes the implementation and summative evaluation stages to determine the effectiveness of mobile career learning.

The process of collecting data in this study used the method of observation and questionnaires. Instruments for data collection in this study include observation sheets, learning needs assessment questionnaires, design assessment questionnaires, questionnaires for material experts, questionnaires for media experts, user teacher response questionnaires, and student user response questionnaires.

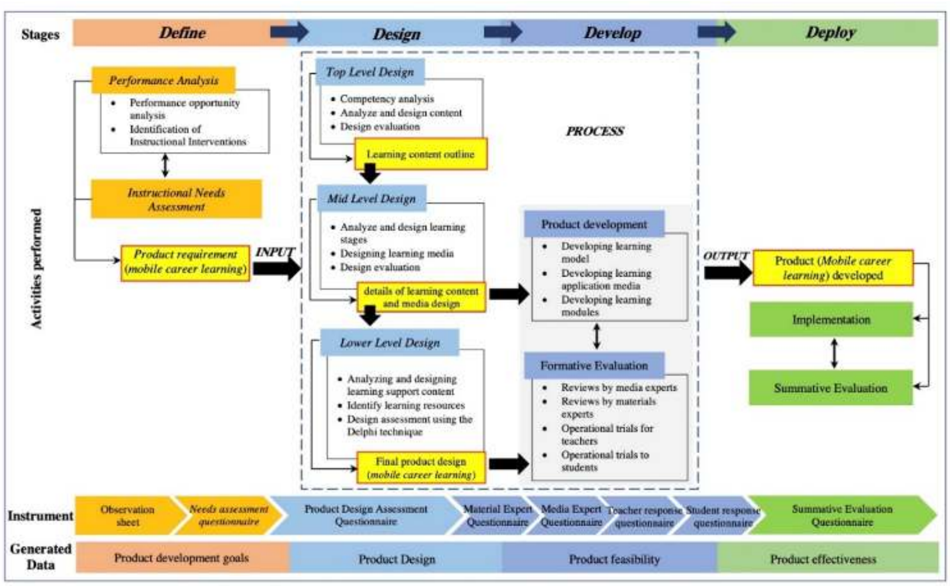

Figure 2. Schematic of research and development of mobile career learning

Observation sheets are used in performance analysis activities. Performance analysis that is carried out includes analysis of performance opportunities and identification of instructional and non-instructional interventions. The aspects observed include the physical environment of the school, academic and social life situations, teaching and learning activities, learning facilities, and career guidance services. The indicators for each aspect on the observation sheet refer to constructivism theory [22], and adapt the things that need to be considered to apply constructivism approach in vocational education [23]. Indicators for aspects of the physical environment of the school are the location of the school, classrooms, workshops/ laboratory, and other facilities. For aspects of academic and social life situations, the indicators include student characteristics, teacher characteristics, teacher-student interactions, and student-student interactions. Indicators for aspects of teaching and learning activities include curriculum and syllabus, lesson planning, learning processes, and learning assessments. The indicators for the learning facilities aspect are the learning media used, internet access, and e-learning. Meanwhile, indicators for career guidance services aspect are career learning, career information systems, and career assessments. The performance analysis results indicated the need of instructional interventions in existing learning.

The performance analysis results are then followed up with instructional needs assessments activities to assess in more detail the implementation of current learning and the instructional problems that occur. Aspects used in the instructional needs assessment questionnaire include vocational learning planning, vocational learning processes, and vocational learning assessments. The indicators for each aspect refer to John Dewey's democratic learning theory [24], [25] and Savickas' career development theory [10], [26] (that also use the constructivist approach) which is adapted to the needs of industry 4.0. The indicators for each aspect are cybergogy, heutagogy, peeragogy and the integration of each learning aspect with career learning [17]. The results of the instructional needs assessment were used to determine the requirements of the new learning model needed. Particularly in determining how the new learning model could optimize vocational and career learning. Design assessment questionnaires were used at the design assessment stage. Aspects in the product design questionnaire include opinions on product design, conformity of product specifications, and comments and suggestions for improvement. The results of the design assessment questionnaire become a reference in developing the mobile career learning model product that fits the needs.

Questionnaires for material experts, questionnaires for media experts, user teacher response questionnaires, and student user response questionnaires use ini formative evaluation. Questionnaires for material experts and questionnaires for media experts use in expert review stage. Aspects that are reviewed in the content review include aspects of product relevance and aspects of usefulness. While the aspects reviewed in the media review include usefulness, usability, attainability, aesthetic and emotional impact [27]. User teacher response questionnaires, and student user response questionnaires use in operational trial stage. The aspects used in the operational test questionnaire include product relevance, usefulness, design, and usage. Indicators for each aspect regarding the stages and content of learning refer to the constructivism approach (particularly the theory of John Dewey and Savickas) that is related to the concept of relevant and useful learning. While the indicators for each aspect related to learning media refer to the concept of information technology for user-centered learning [27]. The test results in each aspect are used to determine the feasibility of the learning model developed, which can then be evaluated and improved into a better product.

After the instruments were constructed with aspects based on related theories and concepts, the validity of the instrument is then tested using the expert judgment method involving two vocational education experts. The test results are used as input to improve the instruments so that it is feasible to collect data during research activities.

The research questionnaire is a closed questionnaire with four categories of answers and the following scoring criteria.

Table 1. Scoring Criteria

No.	Categories of Answer	Score
1.	SS	4
2.	S	3
3.	TS	2
4.	STS	1

Determination of requirements product development obtained through descriptive analysis of quantitative data obtained from instructional needs assessment with consideration of the performance analysis results to determine priority learning needs that become the objectives of the development project.

The level of product feasibility obtained through descriptive analysis of quantitative data obtained from expert review activities and operational trials. Determination of feasibility is based on calculating the scores obtained for each aspect and then categorized with the provisions as in the following category table.

Table 2. Feasibility category criteria

No.	Average Score	Categories
1.	>3.25 - 4.00	Very feasible
2.	>2.50 - 3.25	Feasible
3.	>1.75 - 2.50	Less feasible
4.	1.00 - 1.75	Not feasible

RESULT AND DISCUSSION

The product developed in this research study is a mobile career learning model for electronic engineering vocational schools with mechatronic engineering expertise competencies. The stages of development, concepts, and feasibility of the developed mobile career learning model describe as follows.

A. Stages of Development

This research activity begins with the Define stage, which includes performance analysis and instructional need assessment activities. The results of the performance analysis show that there are learning problems that require instructional intervention, namely the generational difference between students and teachers, the limited collaboration skills of students in learning activities, students can not determining to learn according to their needs, e-learning is less efficient because held with many platforms, students' career learning is not structured, students do not have confidence in career decisions, there are no student career assessment activities, career guidance has not directed students to recognize the occupation that suits them, and the delivery of career information is still limited through Bursa Kerja Khusus (BKK). These results indicate that the application of the constructivism approach to learning in vocational schools has not been maximized, especially in the implementation of vocational learning and career guidance services.

The constructivism learning approach is a learning approach that is more suitable for vocational learning in adapting the world of work in the industrial era 4.0 [24]. The constructivist approach equates learning with the process of creating meaning from experience. The constructivist approach emphasizes authentic learning with real experience. So to understand the learning that has occurred within an individual, the actual experience must be considered [22].

The results of the performance analysis show that vocational learning and career guidance services are not integrated with real experience about the process of developing a career related to the field of expertise that students' are studying. Students are less able to build personal interpretations of the world of work and the process of career development, both through learning experiences and individual interactions. This results in work-related learning that is carried out during vocational learning having less impact on increasing students' career development abilities, and career learning that does not have an impact on increasing self-awareness of students' learning to actively participate in vocational learning that is beneficial for their career development.

Based on the results of the performance analysis, the needs for instructional interventions in existing learning are formulated, which include learning that accommodates different learning styles, forming student learning networks, involving students in determining learning activities, implementing e-learning that can cover all stages of learning, as well as linking career learning to vocational learning in the form of guiding students in making career decisions, facilitate career assessment activities, provide occupational information, train students to reflect on themselves and their learning activities and provide career information in every vocational learning. The results of the performance analysis that indicate the need for further instructional interventions become the basis for conducting an instructional needs assessment.

The instructional needs assessment that was carried out assessed more specifically the application of the learning paradigm of cybergogy, heutagogy, and peeragogy in learning planning, learning processes, learning assessment, and career learning in electronics engineering vocational high school. Instructional needs assessment helps define the scope of a development project based on data to avoid wasting resources unnecessarily. Based on the instructional needs assessment, data on the ideal conditions that become the learning needs of the electronic engineering vocational high school was obtained. The list of learning needs is then re-analyzed by referring to performance analysis results as well as the review of John Dewey's democratic learning theory and Savickas' career development theory to determine the priority needs and the main goals of development. So that the product development objectives are obtained as follows (1) growing and improving students' career development abilities; (2) increasing students' abilities in determining learning activities according to their learning needs; (3) increasing student participation as active learners in learning; (4) improve students' ability to reflect and evaluate learning outcomes; (5) build students' habits of forming learning networks among peers; (6) build students' habits of accessing career information; (7) assist students in planning and making good career choices; and (8) growing self-awareness of lifelong learning. The product development objectives determined then become the basis (input elements) for the design stage.

The design stage consists of top-level design, mid-level design, and lower-level design. At the top-level design stage, we analyze the scope and objectives of product development and analysis the essential competencies of vocational learning. The grand design of a mobile career learning model developed is the taught content, the sequence, and how to teach it. The results of the design are evaluated by vocational learning experts and the necessary revisions were made. At the mid-level design stage, the outline of the learning content was re-analyzed to become a reference in designing more detailed learning stages, including the sequence, objectives, application methods, and learning media used. The mid-level design stage aims to provide more detailed clarity about the vision for each learning stage determined at the top-level stage. The results of the design are evaluated with vocational learning experts and the necessary revisions were made. At the lower level design stage, an analysis of learning support content is carried out, including career guidance content and analyzing the required learning module content. The design of the mobile career learning model evaluated based on the assessments and suggestions of experts and practitioners becomes a reference in developing the mobile career learning model product at the develop stage.

The develop stage consists of product development adn formative evaluation. The results of the product development of the mobile career learning model and the measurement of product feasibility are described in the following sub-content. The last stage in this development research is the deploy stage. This stage includes the implementation of the mobile career learning model and summative evaluation that requires further research to determine the effectiveness of the mobile career learning model for the career development of students.

B. Concept of the Mobile Career Learning Model

The mobile career learning model integrates vocational learning activities and career guidance by utilizing information technology in the form of mobile career learning media applications. The mobile career learning model is based on a constructivist approach that emphasizes that the learning process is an active process of constructing knowledge, namely, associating new information with previous experiences. To understand the learning that occurs in students, the mobile career learning model pays attention to authentic learning with real experience [22].

The mobile career learning model is more specifically based on John Dewey's vocational learning theory, which leads to a more student-centered learning model in which students actively direct their learning [24], [25]. The mobile career learning model is also based on Mark L. Savickas, where learning is directed to help students have the ability to plan and prepare their career, responsibility and self-assertion about the future, interest in exploring future possibilities and environments, and confidence in the ability to solve real career problems [10]. The mobile career learning model focuses on increasing students' awareness of the importance of active involvement in career development, including a critical perspective on the content accessed and on developing competencies needed in the world of work. Career learning in mobile career learning plays an important role in empowering students to be more active in the career decision-making process and engage in activities that can enhance their employability [28].

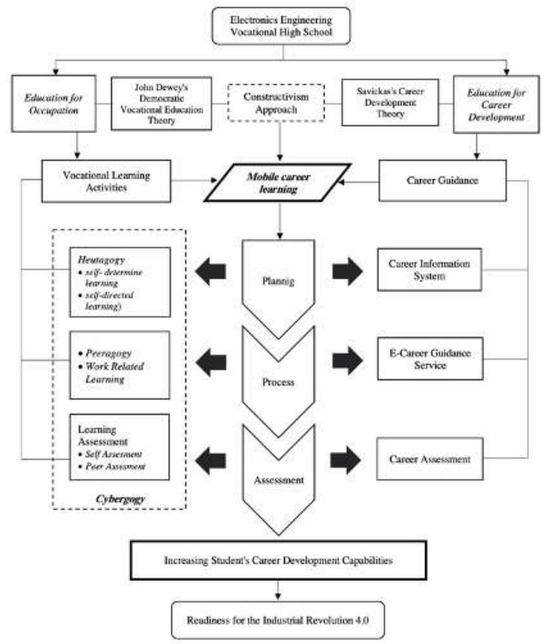

Figure 3. Conceptual framework of mobile career learning learning model

The mobile career learning model applies the principles of heutagogy, peeragogy, and cybergogy learning paradigms. Mobile-based learning embodies the application of heutagogy principles, including aspects of learner agency, self-efficacy and capability, reflection and metacognition, and nonlinear learning [29]. Applying the principle of peeragogy in vocational learning effectively increases students' understanding if the learning process is properly monitored and facilitated [30]. Through the mobile career learning model, students can share learning resources (such as information and data) and empower themselves to actively and proactively seek to learn to solve complex problems. The use of mobile applications allows the reduction of traditional boundaries in learning that requires collaboration [31].

The use of cyber technology in the mobile career learning model is also carried out because the developed technology can facilitate the career choice intervention process, especially in job exploration and matching self-information with work information [32], [33]. Efficiency, usefulness, and sensitivity of human-machine interaction can also improve career perception, and deep interaction design can significantly improve the construction of individual capabilities in their career journey [34]. The cybergogy paradigm can also increase participation in lifelong learning [35].

The mobile career learning model consists of learning stages that include learning planning activities, learning processes, and learning assessments. Learning planning activities in the mobile career learning model include analyzing job needs/ job information, selecting competencies to be taught, and preparing learning plans. The learning process with the mobile career learning model includes the stages of delivering career guidance materials and career information as apperception, carrying out work-related learning, providing access to learning materials, facilitating the formation of student learning networks, and providing career guidance services. Learning assessment activities in the mobile career learning model include assessing learning activities, providing feedback on learning outcomes, and conducting career development assessments. The mobile career learning media application facilitates the implementation of the learning stages using the mobile career learning model. The stages of learning with the mobile career learning model are shown in figure 4.

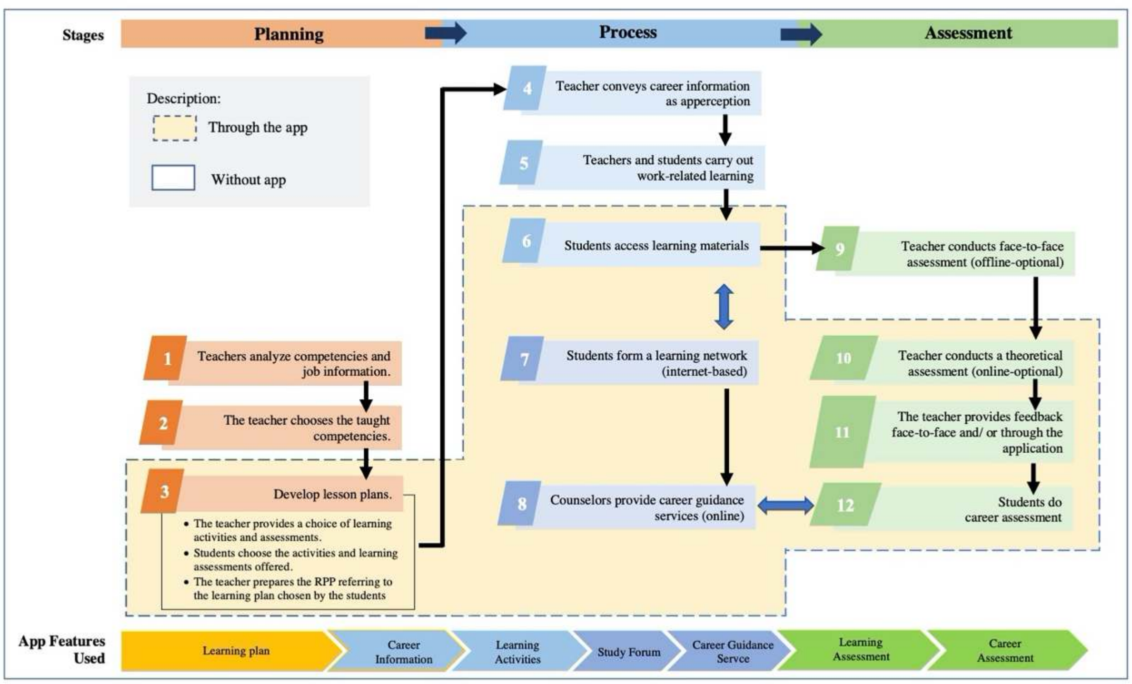

Figure 4. Stages of the mobile career learning model

The application of the mobile career learning model for vocational learning builds a new learning system that involves the participation of stakeholders including schools, students, teachers/ facilitators, counselors, admins, technology expert staff, content providers, industry, and the evaluation team. These stakeholders have a role in realizing successful mobile career learning, including providing technical support, facilitating mobile career learning implementation, and implementing regulations that encourage standardization implementation. The relationship of these stakeholders can be illustrated in figure 5.

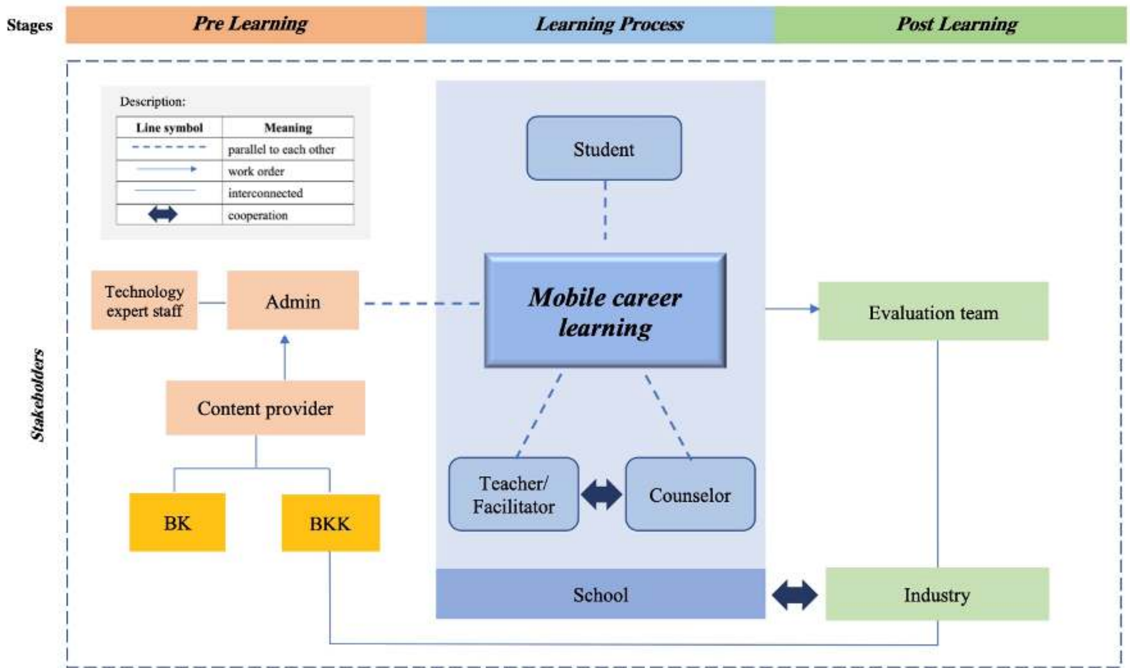

Figure 5. Stakeholders in mobile career learning

The role of stakeholders also plays an important role in ensuring the suitability of content in mobile career learning. So learning content can empower students to be more actively involved in activities that can improve their work abilities and play a more active role in the career decision-making process [28]. The principles of learning content in mobile career learning include: 1) self-learning; 2) diversity; 3) social justice; 4) counseling theory and practice; 5) use of technology, 6) career assessment; 7) labor market information, social and economic trends; and 8) assessment [9].

One of the important parts of the career development process for students is the availability of information on labor trends and occupational trends that will help students map their direction in the future. Entering the digital era, generation Z's career development tends to be influenced by social media and other forms of technology-based interaction. Public figures (influencers) on social media who have roles in certain jobs can also inspire and influence students in making their career decisions [36]. However, career information on the internet and social media are potentially inaccurate, difficult to understand, or even unavailable [37]. Therefore, digital technology in mobile career learning aims to facilitate the career choice intervention process, especially in job exploration and matching self-information with available jobs in the world of work [32], [33]. Career development content delivered through mobile career learning is expected to provide career information that is more accurate, easy to understand, and directed. However, finding sources and obtaining data are keys elements of a career information system [38]. The school has an ethical responsibility for continuing the storage and updating of this information [9].

The mobile career learning application developed is an Android-based mobile application for students and a supporting application in a web-based application for teachers. Learning applications include learning plan features, learning activities (including assessments activities), career information, career assessments, study forums, and career guidance services. The mobile career learning media application users in the mobile career learning model are students, teachers/facilitators, counselors, and admins. In learning activities, learning media applications users are students, teachers/facilitators, and counselors. At the same time, the admin acts as the manager of the application, including managing classes, subjects, and regulating access for teachers and students according to their respective classes. Each application user uses a specific account to be able to access the application.

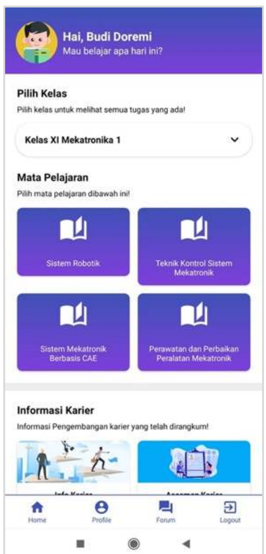

Figure 6. Display of the mobile app for students

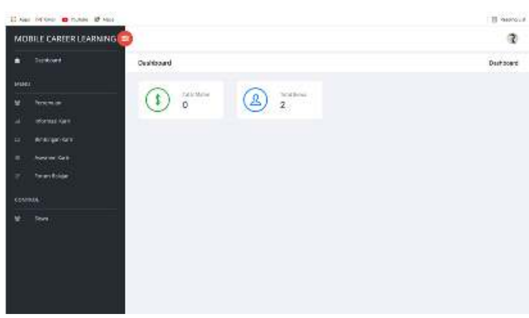

Figure 7. Display of web-bases application for teachers

Figure 8. Display of web-bases application for Admin

To support mobile career learning implementation, a mobile career learning module has also been developed. The mobile career learning module is structured to make it easier for users to apply the mobile career learning model to vocational learning, especially for electronics-mechatronic engineering skills. The mobile career learning module developed consists of a mobile career learning guidebook for teachers and a mobile career learning guidebook for students. The mobile career learning module is designed to be flexible in its use so that it can be adapted to school conditions or certain learning situations and conditions, depending on the needs of teachers in learning. The mobile career learning module can be used as a reference in applying the mobile career learning model and planning a combination of the mobile career learning model with other learning models (e.g., project-based learning).

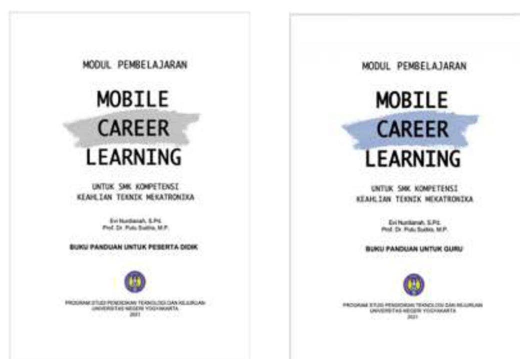

Figure 9. Display of the mobile career learning module

C. Feasibility of the mobile career learning model

The feasibility of the mobile career learning model for the career development of vocational students of mechatronic engineering competence based on an assessment by material experts shows an average overall assessment score of 3.8 with an average score of product relevance aspect is 3.71, and an average score of usefulness aspect is 3.85.

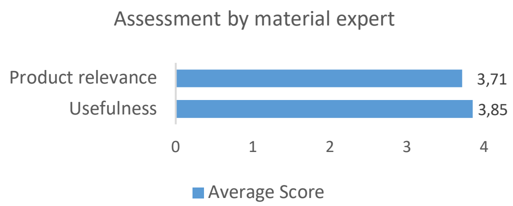

Figure 10. Score assessment by material expert

Assessment by media experts shows an average overall assessment score of 3.62, with an average score of the usefulness aspect is 3,67, the usability aspect is 3.67, the attainability aspect is 3, the aesthetic aspect is 4, and the emotional impact aspect is 3.33.

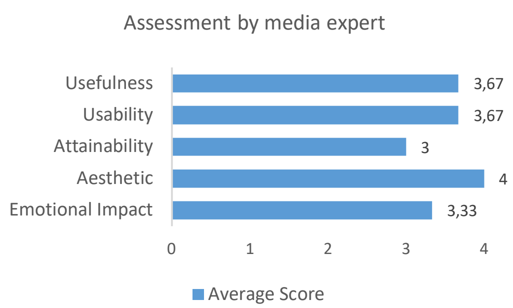

Figure 11. Score assessment by media expert

All aspects of the assessment by experts show that developing a mobile career learning model in the form of mobile applications and learning modules falls into the very feasible category.

User student responses to the mobile career learning model in the form of mobile applications and learning modules show an average assessment score of 3.22 and include it in the feasible category. The average score of the user student assessment of the product relevance aspect is 3.27, the usefulness aspect is 3.25, the design aspect is 3.17, and the usage aspect is 3.13. Student responses indicate that the mobile career learning model can be used in learning, but it needs usefulness, design, and product use improvements.

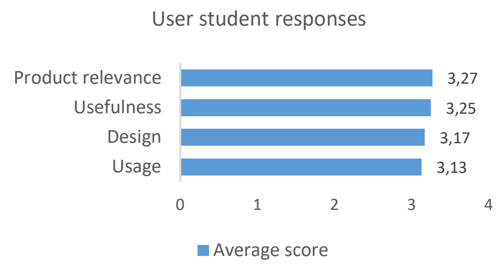

Figure 12. Score assessment by user student

Meanwhile, the response of user teachers to the mobile career learning model in the form of mobile applications and learning modules showed an average score of 3.59 and was included in the very feasible category. The average score of the teacher user assessment of the product relevance aspect is 3.56, the usefulness aspect is 3.63, the design aspect is 3.5, and the usage aspect is 3.59.

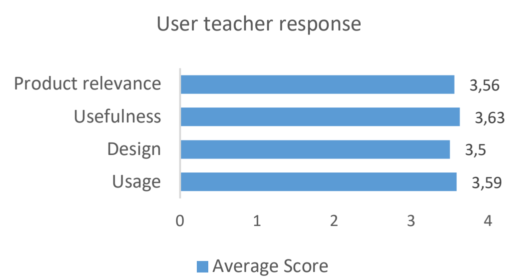

Figure 13. Score assessment by user teacher

Overall, the user teacher assessed that the mobile career learning model in the form of mobile applications and learning modules was feasible and could be used in learning.

CONCLUSION

The product of this development research is the mobile career learning model, along with mobile-based learning applications and mobile career learning modules. The development of the mobile career learning model is carried out through the define stage (performance analysis and instructional needs assessment), the design stage (top-level design, mid-level design, and lower-level design), and the develop stage (product development and formative evaluation). Based on expert reviews, the mobile career learning model developed is suitable for electronics engineering vocational high school learning with mechatronics engineering expertise competencies. The mobile career learning model also received a positive responses from user students and user teachers.

Overall, this development research produces a learning model and its learning tools that can be implemented in the learning of electronic engineering vocational high schools. However, the results of this study need to be followed up with product dissemination activities which are included in the Deploy stage (output section) in the Holistic 4D model development stage. Product dissemination can be done by implementing the product for full-scale and regular use in schools. Through this activity, the application of the mobile career learning model can be evaluated summatively for further product development and application.

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