The Development of A Web-Based Independent Learning Platform using SECI Model

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Abstract: The limitation of time, cost, and manpower have been the main problems in facilitating post-training learning. Based on this issue, the research aims to develop a web-based learning platform based on knowledge management system as a learning supplement for independent post-training learning. The development of the application adopted the SECI model which stands for Socialization, Externalization, Combination, and Internalization. The system will record data used as an indicator for making decisions on the material and giving automatic recommendations for each participant. The methodology used in this study is a model proposed by Davidson-Shiver, Rasmussen, dan Lowenthal that consists of Analysis; Evaluation Planning; Concurrent Design which includes design, development, initial implementation, and formative evaluation; Full Implementation; and Summative Evaluation and Research. There are 2 data analysis techniques, qualitative data analysis to measure the accuracy of utilization procedures; and quantitative data analysis to measure technical quality in the form of media validity and learning outcomes. Based on the material expert validation, the material obtained a percentage of 98.75% which is very feasible; media expert validation gained a percentage of 81.25% with a very feasible category; small group trials obtained a percentage of 81.5% in the very feasible category; and product testing obtained a percentage of 87.125%. The results of pre-test and post-test data processing showed an average increase in learning outcomes of 41.53%, with a completeness level of learning outcomes at 90% in the very effective category. As a result, the data inferred that the media is very decent and effective to be used as a supplement for independent post-training learning.

Keywords: Knowledge management; Personalized learning; Progressive web learning; SECI model; Training

Introduction

Education and training are a process of fostering understanding and knowledge in a group of people regarding facts, rules, and methods that are organized by prioritizing coaching, honesty, and skills (Rustandi, 2019). In its implementation, some training institutions will arrange the agenda within a certain period as there will be several training stages from before (pre) to after (post) training. All stages aim to optimize the training results. In general, pre-training activities aim to convey the overview of training materials. While post-training is in the form of mentoring as enrichment of the learning material that has been delivered.

The most common post-training learning concept is using a learning media as a solution to gain knowledge and provide detailed assistance on training materials. However, the implementation showed that the post-training assistance didn't work effectively as it was done independently by each participant without any structured concepts, coaching, and strategies. The limitations of time, space, cost, and assistance were considered as the main contributing factors.

In addition, there is no consistent and standardized learning strategy to ensure the quality of the entire stages of training activities. As a result, it leads to learning strategies incompatibility for each training participant. Considering the importance of post-training

learning, there should be a strategy to achieve the goal of training thoroughly. For that reason, the authors offer a solution by developing web-based learning platform based on knowledge management (KM) using SECI Model as a strategy for determining the right steps to implement the post-training program.

In general, knowledge management is an integrated system consisting of people, processes, and technology. These three pillars are interrelated and inseparable. Knowledge management (KM) is a process of identifying, discovering, and disseminating intellectual assets (Bratianu, 2021). The statement refers to how someone's knowledge can also impact the formation of knowledge of other learners. It should be underlined that knowledge is divided into two types, namely tacit knowledge, and explicit knowledge (Alavi & Leidner, 2001; Abubakar et al., 2019; Agrawal & Mukti, 2020). Tacit knowledge is closely related to an individual's personal understanding of a phenomenon. Meanwhile, explicit knowledge is a series of knowledge that has been articulated in a real and formal form, such as books and articles. The two types of knowledge are crucial resources for developing the learner strategic moves with the aim to reach its potential position and make use of its capabilities.

The implementation of knowledge management in learning is by assisting learners to enhance their resources in obtaining and processing them into knowledge. It starts from the process of knowledge creation, acquisition, transfer, transformation, and implementation (Dneprovskaya et al., 2020). Knowledge management in education and training has been widely recognized as effective in enhancing professionalism. Astorga-Vargas et al. (2017) identified the role of KM through its application during the education and training process in companies, especially those related to technical skills. Researchers found that the implementation of KM was an effective step in helping to improve the quality and distribution of knowledge among learners. The exchange of knowledge, both formally and informally, that occurs within a group, can help each person improve their performance and productivity.

In addition, Frolova et al. (2021) also found that KM has a significant and positive influence on developing creativity. This is done by applying a knowledge management model to build a practical model that can encourage individual motivation in developing a culture of creativity and continuous learning. In addition, the concept of a business based on an approach of continuous learning will help the business to survive in anticipating other competitive strategies (Silamut & Petsangsri, 2020).

The application of knowledge management in web-based learning platforms also shows a significant increase in the self-learning process. Silamut and Petsangsri (2020) examined the integration of knowledge management supported using technology to open wider access for learners to increase digital literacy. It is also considered relevant to improve employees' skills as well as elevate their career paths. Knowledge management becomes a strategy, technology, and media that support the goals. The combination can help learners in developing and distributing knowledge as well as improving their competitive advantage (Gao et al., 2015).

A model commonly used in the implementation of knowledge management in learning process is the SECI model. Nonaka (1994) reveals that the processes and interactions are divided into four stages of knowledge conversion. It is known as Socialization, Externalization, Combination, and Internalization (SECI). The model provides a more holistic view of how knowledge is created, transferred, and stored. The application of the SECI Model is also in accordance with the rapid development of increasingly competitive data and knowledge.

Therefore, the use of the SECI Model can help learner to create, transfer, and store knowledge more effectively, especially for independent post-training learning. The implementation of SECI in learning can be realized through the development of a progressive web application (PWA) that works best for desktop and mobile devices. The use of this application is feasible for fact material, concept material, principle material, and procedural material. The design of a web-based learning platform using knowledge management system (KM LMS) aims to overcome the learning style, accessibility, mentoring, and learning personification issues.

According to the results of previous studies and the analysis of post-training, the authors developed a web-based learning platform using SECI Model as a supplement for independent post-training learning. The utilization of knowledge management in the context of learning can facilitate learners in comprehending their own learning needs. As such, every training participant can follow and have post-training assistance in accordance with their abilities, characteristics, and needs. In the end, the authors hope that the application can increase the learning outcomes and help the participants better understand the material.

Method

The development of a web-based learning platform using SECI model in this study uses a popular web development model proposed by Davidson-Shiver et al.

(2018). The proposed model matches with the research characteristics which is to develop a web-based knowledge management system for training needs. Davidson-Shiver et al. (2018) explained that web development consists of several processes that include: 1) Analysis; 2) Evaluation Planning; 3) Concurrent Design which consists of design, development, initial implementation, and formative evaluation. These phases are repeated indefinitely; 4) Full Implementation; and 5) Summative Evaluation & Research.
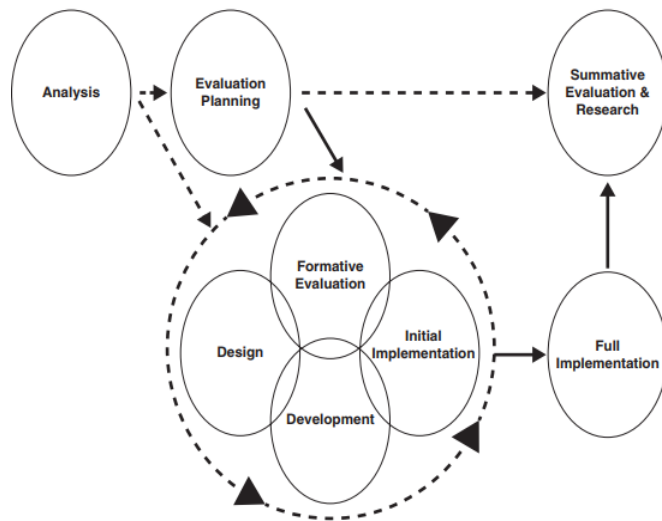

Figure 1. Web-based learning design model (Davidson-Shiver et al., 2018)

First, the analysis stage is a process of analyzing the system of web-based learning platform that consists of several stages, including 1) needs analysis, 2) targets and contributors, 3) product specifications, 4) learning resource content, and 5) budget. As a result, these processes create the design for application development. Second, the evaluation planning for the development of a web-based knowledge management system is limited to formative evaluation. The evaluation instruments include effectiveness, efficiency, and attractiveness. The result of the evaluation stage is suggestions, comments, and ratings used as a reference for product improvements. In addition, testing of learning outcomes was also carried out by giving a test to the participants.

Third, there are four main things at the concurrent design stage including 1) learning design using knowledge management with the SECI model, 2) the design of user interaction, and 3) the design of user interface and web user experience. Fourth, the authors implemented the blueprint to be the web-based knowledge management system at the development stage. The web development used the framework of Codeigniter version 3. The stages started with designing the user interface and user experience, setting the role of

each type of user, uploading the material, and adding other features needed for the app development.

Fifth, the initial implementations aimed to ensure that the design of a web-based knowledge management system can be accessed online via a computer or smartphone without any problems. Moreover, the testing was to ensure every app feature, learning resource, technical function, and user access runs well. The implementation is applied on the website which can be accessed at https://km.tep.or.id. Sixth, there are several stages for the formative evaluation which include 1) design validity of the developed web-based learning platform using SECI model. The validations were done by a media expert, a material expert, and training participants, 2) learning outcomes, and 3) utilization evaluation to measure the accuracy and suitability of the media according to instructions and guidelines.

Result and Discussion

The result of the research is a web-based learning platform using a knowledge management system. This app is used as material enrichment for the post-training stage. Through knowledge management-based learning, participants can learn according to their individual characteristics and needs. In addition, the implementation of web-based knowledge management in learning allows participants to build a concept of using technology as a medium to develop and share knowledge.

Conventionally, the implementation of knowledge management system has been widely used since it was first coined by Drucker (1993) to identify and find access in the process of forming, using, and disseminating knowledge. Quarchioni et al. (2020) and Khatun et al. (2021) revealed that there is an increasing trend toward the use of knowledge management systems in higher education institutions. Further, Suroso et al. (2017) and Ishak et al. (2020) stated that knowledge management can improve the performance of learning development. However, it hasn't been widely implemented for learning matters.

The urgency of developing a knowledge management system in learning answers the challenges of learning needs related to character and learning styles; material diversity; and the difficulty in analyzing personal abilities. With the presence of a website, it supports the need to analyze every learner's ability, starting from the process of knowledge acquisition, storage, exchange, and dissemination (Salleh, 2010).

In general, there are three functions of E-learning, namely supplement, complement, and substitution (Siahaan, 2003). The position of KM LMS is as a learning

supplement, meaning that the use of a web-based knowledge management system functions as a supplement because there is the freedom to determine and choose whether to utilize the existing learning resources or not. However, regardless of the absence of obligations, participants who access additional materials will certainly gain additional insight and knowledge.

Figure 2. The user interface of the web-based knowledge management system

The Design of Learning System

The main learning strategy used in this application is the SECI model which includes socialization,

externalization, combination, and internalization. In general, the system will process each participant's learning data to compile and recommend the material needed for each.

The learning flow starts with user registration. After that, participants can log in and take a learning style assessment, choose the material according to their priority preferences, and take a pre-test to evaluate their understanding and knowledge. The system will automatically arrange a learning menu according to the results of the learning styles analysis, material priority choices, and abilities of each participant. Participants start the learning process based on the system recommendations. After finishing the learning process, participants can take a post-test to measure their learning progress. Finally, participants can write down their learning outcomes on the forum. The learning process will be run repeatedly by each participant.

In addition, the learning process in this KM LMS also encourages the concept of personalized learning. It is a model that pays attention to and empowers the different ways of learning in every individual Zhang et al. (2020) revealed that the concept of personalized learning has a significant impact on various fields, especially education.

The use of personalized learning aims to introduce the uniqueness and diversity in each student, such as learning styles, thinking skills, interests, learning abilities, and attitudes (Sahabudin & Ali, 2013). A learning environment that is personally regulated is considered more effective and encourages someone to discover more new things (Estes, 2004). This is in line with a study by Clarke et al. (2003) that when students are facilitated with an appropriate learning environment, it will encourage them to find more information.

The Implementation of SECI Model to Web-Based Learning Platform

Nonaka (1994) revealed that the process of knowledge creation and interaction are divided into four stages of knowledge conversion. This process is known as Socialization, Externalization, Combination, and Internalization (SECI).

The first stage of socialization is social interaction in general, in which individuals exchange information and experiences or have discussions. In the implementation of the web-based knowledge management system for post-training participants, the socialization process is the stage where participants exchange information and discuss it on the forum. The interaction occurs in an informal context that allows participants to share experiences. This process describes the stages of socialization in which individuals share tacit knowledge

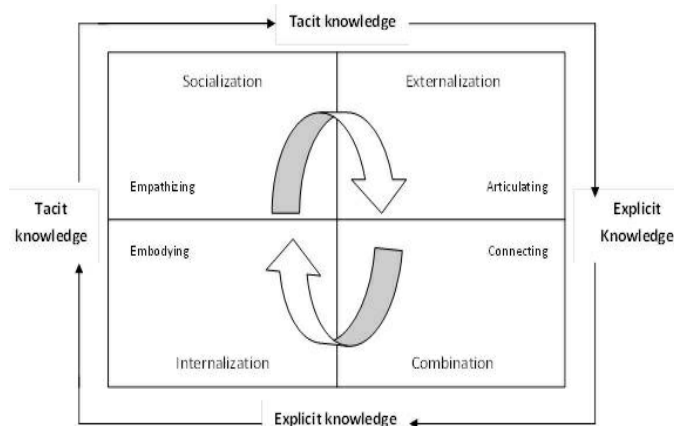according to their respective experiences and backgrounds.

Figure 3. Four phases of knowledge conversion based on the SECI model

The externalization stage refers to the process of documenting tacit knowledge in a tangible (explicit) form. In this stage, participants will use their tacit knowledge to answer each question in the pre-test. Furthermore, the results of the pre-test will be displayed so that participants can measure their tacit knowledge.

The knowledge that has been documented becomes explicit and measurable and then distributed and disseminated through a particular meeting. In this case, the provided materials have been adapted to the characteristics of each participant because of the web system analyzing the pre-test scores. As participants study the materials, it will be a set of explicit knowledge for themselves which can then be shared with others at a later stage.

The process of internalization refers to the transfer of explicit knowledge to tacit knowledge. Post-training participants who study material references will gain some explicit knowledge for themselves. In the next stage, they will be directed back to the forum to write down what they have learned, then other new participants will read that. This is where the transfer from explicit knowledge to tacit occurs. Information that participants write in the forum will become new tacit knowledge for others.

Product Development Result

Learners and educational technology professionals should be able to manage various elements of learning, including models, approaches, strategies, methods, and techniques of learning. That way, every stage of learning runs well, and the objectives can be fully achieved (Reni et al., 2017).

The product of this development research is a web-based knowledge management learning system that comes with guidelines in the form of video and media source code. Every post-training participant can use this product independently. Further, each user has different access according to their respective capacities.

Table 1. The Specification of the Web-Based Knowledge Management Learning System

Description	Information
Product Name	Knowledge Management Learning System
Brand	KM LMS App
Platform	Progressive Web App (Optimal for both Desktop and Mobile device)
Domain	https://km.tep.or.id
Framework	CodeIgniter 3.0
Type of Users	Participant, Instructor, Administrator, and Super Admin
Developer	Fitrah Izul Falaq

The KM LMS comes with several specifications which include (1) requiring internet access for learning style assessment; (2) providing learning resource contents; (3) presenting recommendations for learning flow and conducting independent evaluations; (4) there are 4 types of users, namely participants, instructors, administrators, and super admin; (5) each type of user has different rights and authorities; (6) the learning resource is adapted to learning styles consisting of videos, text, infographics, discussion forums, and independent test evaluations; (7) each user must register an account using an email or mobile number before accessing the learning resources; (8) there are guidelines in the form of videos, recommended articles about learning based on knowledge management, and self-evaluation.

Figure 4. An example of material analysis using the web-based knowledge management system

The Data Presentation of Validation Results

According to the previous evaluation planning, there are three data categories including 1) Validation of web-based knowledge management system design; 2)

Assessment of student learning outcomes before and after using the KM LMS; 3) Accuracy in accordance with instructions and guidelines of the media. Therefore, the authors categorized the data into two types; qualitative data to measure the technical quality that refers to the accuracy of media utilization procedures, and quantitative data to measure the technical quality that refers to the media validity and participant learning outcomes.

This quantitative data is measured based on the validator's assessment consisting of media experts, material experts, and training participants. Arikunto (2010) formulated how an assessment is done by giving scores to each subject as described below.

$$P = \frac{F}{A} \times 100\% \qquad (1)$$

Description:
P = Percentage
F = Acquired total score
A = Maximum total score

The media was assessed by a lecturer of the Educational Technology Department at Universitas Negeri Malang who has a relevant background for validation. Based on the results of media validation, the media obtained a percentage of 81.25%. Accordingly, the web-based knowledge management learning system falls in category A (76–100%) with the qualification of Very Decent to use.

The results of the data analysis will be classified according to the criteria in the Table 2.

Table 2. Eligibility Percentage (Arikunto, 2010)

Value (%)	Criteria
76 – 100	Very Decent
51 – 75	Decent
26 – 50	Less Worth
< 25	Unsuitable

The material or learning resource was assessed by a lecturer of the Educational Technology Department at Universitas Negeri Malang who also has a relevant background for validation. Based on the results of material validation, the learning resource obtained a percentage of 98.75%. Accordingly, the web-based knowledge management learning system falls in category A (76-100%) with the qualification of Very Decent to use.

The initial implementation was carried out to ensure that the knowledge management learning system is accessible from both desktop and mobile devices without any problems. Further, this implementation also checks that all features, learning resources, and users' accessibility runs smoothly. The number of samples for

the initial implementation is 5 people. The data analysis result shows a percentage of 81.5%. Accordingly, the web-based knowledge management learning system falls in category A (76-100%) with the qualification of Very Decent to use.

The full implementation was done to measure the validity and compatibility of knowledge management learning system to fulfill the participant's needs for post-training learning. The number of samples for the initial implementation is 20 people. The data analysis result shows a percentage of 87.125%. Accordingly, the web-based knowledge management learning system falls in category A (76-100) with the qualification of Very Decent to use.

The Data Presentation of Effectiveness Test Results

The success rate of using a web-based knowledge management system design can be seen from the results of the pre-test data (before using the media) and post-test (after using the media) to look at the participant's score progress. The learning outcomes progress can be measured by the number of participants with the Minimum Completeness Criteria (KKM) which is 70.

The formula below is used to measure the average success rate of post-training participants.

$$P = \frac{PM}{T} \times 100\% \qquad (2)$$

Description:
P = The average success rate of post-training participants
PM = Participants with Minimum Completeness Criteria
T = Total Participants

According to the calculation above, the learning outcomes are determined by the increase in participants' scores. Therefore, the level of improvement can be classified in the following qualification.

Table 3. Classification of Learning Outcome Criteria (Arikunto, 2010)

Level of Achievement (%)	Qualification
80 – 100	Very Effective
60 – 79	Effective
40 – 59	Less Effective
< 40	Not Effective

Based on the results of the participants' pre-test on the web-based knowledge management system platform, the participant's level of completeness is 20%. The KKM used in the training is 70 while the average pre-test score is 62. From the data, a total of 16 participants did not pass the minimum score while the other 4 successfully achieved the minimum score.

Based on the results of the participants' post-test on the web-based knowledge management system platform, the participant's level of completeness is 90%. The KKM used in this test is 70 while the average post-test score is 87.75. From the data, 18 participants passed the minimum score while the other 2 failed to achieve the minimum score.

Based on the result of the participants' score progress from the pre-test and post-test, it can be concluded that all participants' learning outcomes increase. The average increase is 41.53% from an average of 62 from the pre-test to 87.75 from the post-test. Based on the data analysis on the success rate of learning outcomes, the result shows a percentage of 90%. Accordingly, it falls under category A (80-100%) with the qualification is Very Effective.

As a result, based on the overall data analysis, it can be inferred that the web-based knowledge management system is decent and effective to be used as a supplement for independent post-training learning.

Conclusion

In reference to the material expert validation score, the learning resource gains a percentage of 98.75% in the very feasible category; in media expert validation, the media obtains a rate of 81.25% in the very feasible category; in small group trials, it gains a percentage of 81.5% in the very feasible category; for product testing, it obtains a percentage of 87.125%. The data analysis on pre-test and post-test results also shows an average increase in learning outcomes of 41.53% with a completeness level is 90% which is considered very effective. According to the discussion above, it can be inferred that the development of a web-based knowledge management system is very effective and decent to be used as an independent post-training learning supplement. Using this platform, every participant can learn in accordance with their characteristics which encourages the increase of the learning outcomes.

Author Contributions
Conceptualization, Fitrah Izul Falaq, Dedi Kuswandi and Henry Praherdhiono; methodology, Fitrah Izul Falaq, Dedi Kuswandi and Henry Praherdhiono; software, Fitrah Izul Falaq; validation, Citra Kurniawan and Fikri Aulia; formal analysis, Fitrah Izul Falaq; investigation, Fitrah Izul Falaq; resources, Fitrah Izul Falaq; data curation, Fitrah Izul Falaq; writing—original draft preparation, Fitrah Izul Falaq; writing—review and editing, Fitrah Izul Falaq, Dedi Kuswandi and Henry Praherdhiono; visualization, Fitrah Izul Falaq; supervision, Dedi Kuswandi and Henry Praherdhiono; project administration, Fitrah Izul Falaq;. All authors have read and agreed to the published version of the manuscript.

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