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Enhancing teaching materials development course with the ICARE learning model in e-learning

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ABSTRACT

Using e-learning in higher education has many important benefits and advantages in todays world of education. Therefore, this research aims to develop e-learning based on the introduction, connection, application, reflection, extend (ICARE) learning model for developing teaching materials courses in the Faculty of Education, Universitas Pendidikan Ganesha. The Hannafin and Peck development model was adopted as a foundational method, and the digital content developed was subjected to formative evaluation methods, including i) expert validation, ii) individual assessment, and iii) small group evaluation. To ascertain the quality of the developed content, the research engaged 3 expert evaluators, each specializing in media, instructional design, and content. Concurrently, individual evaluation was carried out with 3 students, followed by a small group evaluation involving 9 additional students. Data collection techniques involved both observational measures and questionnaire-based inquiries. The expert assessment showed that the design, media, and content dimensions all fell within the "very good" category. Student reactions, as measured through both individual and small group evaluations, consistently aligned with the "very good" category. Therefore, the attractiveness and practicality of electronic learning (e-learning) fell under the "very good" classification, due to the implementation of the ICARE learning model as the foundational design principle.

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1. INTRODUCTION

Development of science and technology, particularly in information and communication technology (ICT), is exerting a profound influence on the landscape of modern education [1]. In this digital era, the significance of learning content cannot be overstated. The advent of information and internet technology necessitates a metamorphosis in instructional materials that aligns with the characteristics of the intended audience or students. Within this context, electronic learning (e-learning) emerges as an invaluable avenue for content delivery, transcending temporal and geographical limitations, thereby ensuring accessibility to education at any juncture [2]. Electronic learning, known interchangeably as online learning or e-learning, represents a structured method for both formal and non-formal education, facilitated through technological means. This pedagogical method empowers students and lecturers to actively engage in learning process using electronic media [3]. The adoption of e-learning aims to enhance student grasp of subject matter, cultivate active participation, nurture self-directed learning competencies, and elevate the caliber of instructional content [4]. E-learning presents a spectrum of advantages, including heightened comprehension

of learning materials, cultivation of meaningful discourse, promotion of autonomous learning, cultivation of discipline, enrichment of lecturer-student interaction, and facilitation of peer-to-peer engagement [5].

In the context of higher education, the skill of self-directed learning assumes ever-growing importance, particularly in equipping individuals to tackle open projects, delve into problem-solving, and fulfill coursework assignments [6]. These contexts enable individuals to be tasked with harnessing their intrinsic motivation and taking autonomous initiative, including needs analysis, goal formulation, strategy selection and application, source identification, and self-assessment of performance [7]. Therefore, a comprehensive assessment of varied factors becomes important in the adoption and integration of online systems, aiming to both enhance student performance and optimize the efficacy of e-learning model [8]. These factors include student satisfaction, lecturer expertise, technological fusion, interactivity, assessment support, and academic accomplishments. The use of an integrated model, including a broader spectrum of factors, is preferable for evaluating the societal influence, student engagement, motivation, and acceptance of e-learning framework [9]. E-learning, as a vehicle for interaction, bridges the gap between students and course content. This avenue empowers students to share information or opinions on diverse subjects intertwined with course materials or self-developmental needs. Lecturers can strategically position learning materials and assignments within e-learning platform for seamless student access [10]. In response to specific requirements, educators have the flexibility to furnish students with access to tailored learning materials and examination queries, often accessible within stipulated timeframes [11].

Pedagogical factors wield a profound impact on the success, intentions, and behaviors of students within the context of e-learning. These factors include the provisioning of enriched content and instructional materials, the employment of structured pedagogical strategies or steps, and the cultivation of an enriching learning environment. Considering that students possess diverse learning styles and preferences, offering a variety of media options and providing clear instructional guidelines represent an effective approach to ensuring sustained student engagement [12]. Factors such as attitudes, motivation, and the perceived advantages of technology exert a positive impact on student engagement in e-learning. This highlights the importance of fostering a favorable attitude toward this digital program and emphasizing its benefits [13]. Lecturers must also tailor their instructional methodologies to the online sphere, fostering avenues for interaction and engagement. In a holistic sense, student engagement remains a cornerstone for the efficaciousness of e-learning endeavors [14].

Previous research serves as a reference for surmounting the challenges encountered by both lecturers and students in the context of e-learning, making it an enhanced engagement and intrinsic value. Lecturers are required to embark on innovative pedagogical trajectories, possibly unexplored in their repertoire, that amalgamate technology as a primary conduit for disseminating knowledge within instructional strategies and materials [15]. Furthermore, the crux of pedagogy profoundly influences intent, behavior, and success in the domain of e-learning. This sphere encapsulates cogent and methodical instructional methods, the enrichment of content or instructional materials, as well as the cultivation of an environment that enhances student performance [16]. E-learning furnishes higher institutions with the avenue to refine pedagogical strategies and uplift student learning outcomes. Higher education students, who are well-acquainted with the nuances of technology and armed with the knowledge of meeting their specific requisites, are poised to derive substantial benefits from the mechanisms underpinning e-learning [17].

In the past decade, the integration of e-learning has permeated the fabric of universities and colleges on a global scale. This evolution has brought forth a fusion of conventional teaching methods, allowing students to harness the digital program that orchestrates course, curricula, dialogues, assignments, and assessments through the internet [18]. Universally, educational institutions have committed resources to development and maintenance of e-learning. Renowned platforms such as moodle and blackboard have gained traction as prominent conduits for this digital program. Simultaneously, many universities have delved into the creation of bespoke e-learning tailored to their unique requisites [19]. However, the practical implementation of this digital program has not been fully optimized by lecturers at higher institutions. The use of e-learning in universities often leans towards the translation of conventional classroom experiences into online domains. The process of constructing pedagogical materials within e-learning mandates a synthesis of established learning theories to ensure optimal outcomes.

Comprehending various learning methods stands as a pivotal task for instructional developers to judiciously select the appropriate pedagogical strategies. The duration of teaching methods should be driven by the desire to invigorate student motivation, facilitate learning, cultivate holistic personal development, cater to individual differences, foster profound understanding, prompt interactive discourse, deliver constructive feedback, nurture context-driven learning, and foster engagement throughout learning process [20]. An imperative exists to amplify the potency of e-learning, augmenting their capacity to administer remote learning content while concurrently monitoring student progress. Currently, many digital platforms only focus on traditional practices in learning process without considering individual disparities including

learning styles, needs, preferences, and objectives [21]. The introduction, connection, application, reflection, extend (ICARE) model emerges as a formidable contender among the array of learning paradigms, heralding the potential to foster and enrich student engagement. The ICARE model is underpinned by a constructivist ethos, positioning students as active agents of their learning journey. Within this framework, the model prioritizes the cultivation of practical competencies that accrue benefits for both students and educators. By adhering to the stages outlined in the ICARE method, students are empowered to actively and purposefully partake in their educational exploration [22]. The model serves as a conduit to instill diligence within the study habits of students and to draw insightful conclusions from the lessons they engage with [23]. Bolstering the significance of acquired knowledge, the model underscores the utility of applying learned principles to real-world scenarios, thereby heightening the profundity of learning experience [24]. E-learning is developed using a moodle-based learning management system (LMS). The inherent advantages of LMS allow lecturers to easily distribute assignments, materials and other learning documents [25]. Moodle offers a variety of learning features, including discussion forums, assignment uploads, online exams, automatic grading, scheduling, and reporting. This allows teachers to create rich and varied learning experiences [26]. In this effort, the development research utilized moodle LMS, which is known for its ability to increase student engagement in e-learning and positively influence their thinking skills and innovative talents [27]–[29].

2. RESEARCH METHOD

2.1. Research design

This research employed a research and development framework [30], underpinned by the Hannafin and Peck model [31]. The selection of the Hannafin and Peck model stemmed from its distinct orientation toward development of instructional products. This model comprised three main stages, firstly, the needs assessment phase, secondly, the design phase, and thirdly, development and implementation phase. These stages were intrinsically interwoven with concurrent evaluation and revision. To offer a more nuanced grasp, the schematic representation of the Hannafin and Peck model could be observed in Figure 1.

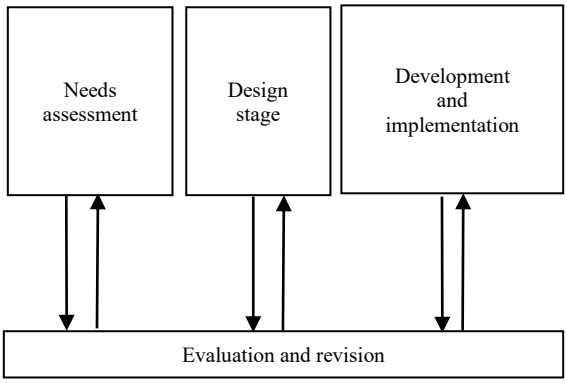

Figure 1. Hannafin and Peck development procedure diagram

The needs assessment stage involved a comprehensive analysis of requisites for developing learning products. This initial stage assumed immense significance, acting as the fulcrum upon which learning product took shape congruent with the context and characteristics of the intended audience. The needs assessment stage included the following activities, i) scrutiny of learning process, ii) in-depth analysis of content, and iii) comprehensive examination of the attributes characterizing the target audience.

Subsequent to the need's assessment, the design stage surfaced in prominence. This phase necessitated meticulous consideration of various aspects, particularly the selection of learning model to be woven into e-learning construct. Within this context, three pivotal undertakings emerged, i) selecting the content, ii) designing integrated e-learning with the ICARE model, and iii) formulating instructional media that harmonized with e-learning framework.

Development and implementation stage involved the translation of the design into a physical form, resulting in a prototype of e-learning product. The diverse elements concretized in the design stage, including content selection, model selection, and media design were manifested within the contours of the digital program. The e-learning product developed during this phase progressed to the implementation phase, where it underwent meticulous validation by experts and rigorous testing by the target audience (comprising the

students). The essence of this validation and testing hinged on garnering invaluable feedback, which served as the lodestar for honing any lingering inadequacies within the instructional media.

Evaluation and revision remained constant companions across every phase of development. The needs assessment stage experienced an evaluation of outcomes from the needs analysis, thereby determining the hierarchical sequence of challenges detected within the domain. In the design stage, scrutiny extended to the architecture and instructional media intrinsic to e-learning platform, subsequently culminating in refinements. Development and implementation stage entailed a comprehensive evaluation, thereby harmonizing the digital program with the discerning observations of experts and users (students).

2.2. Research subjects

The focal point of this research was e-learning product meticulously validated by three experts, including a media expert, a design expert, and a content expert. Following this rigorous validation, the product underwent testing within a controlled environment, with the involvement of three students. The feedback from these individual assessments served as a reference to refine e-learning framework. Subsequently, the fine-tuned e-learning construct encountered a more extensive trial with nine students participating within small group settings.

2.3. Data collection

Data were collected through the synergistic fusion of observational methods and questionnaires. This duality of methods was employed during the preliminary research and e-learning design. Questionnaires proved instrumental in aggregating data from experts, individual tests, and small group tests. The validity test instrument grid for the product was presented in Table 1.

Table 1. Instrument for product validity test

Formative evaluation stage	Aspect	Total
Media expert	1. Text	18
	2. Images	
	3. Videos	
	4. E-learning organization	
Design expert	1. Objectives	22
	2. Student characteristics	
	3. Methods	
	4. Message design	
	5. Evaluation	
Content expert	1. Content	12
	2. Evaluation	
Individual evaluation	1. E-learning interface	10
	2. Attractiveness	
	3. User-friendliness	
Small group evaluation	1. E-learning interface	10
	2. Attractiveness	
	3. User-friendliness	

The questionnaire filled out by the content expert was meticulously structured based on the principles and perspectives espoused by theory underpinning learning software design [32]. Parallelly, the questionnaire intended for the media expert was tailored to the standards or comprehensive rubrics pertinent to e-learning design [33]. Overall, expert testing is an important step in the development of high-quality and effective learning products. This helps ensure that the product can provide maximum benefits to learning participants or users.

2.4. Data analysis

Data were analyzed using various instruments such as questionnaires and observation sheets. The questionnaire resulted in two types of data, including quantitative and qualitative data. The quantitative data, represented by scores from both experts and students were analyzed using quantitative descriptive analysis techniques. Meanwhile, the qualitative data, including inputs, commentary, and enhancement suggestions were subjected to scrutiny employing qualitative descriptive methods. The observation sheets produced qualitative data that served as a reference in e-learning design. The quantitative statistical analysis results, in the form of scores, were further converted using a scale, as shown in Table 2. If all experts and students provide scores between 90–100, then e-learning revision is not required.

Table 2. Conversion of achievement levels with a 5-point scale

Achievement level (%)	Qualification	Description
90-100	Excellent	No need for revision
75-89	Good	Slightly revised
65-74	Satisfactory	Revised adequately
55-64	Poor	Many things need revision
0-54	Very poor	Repeat creating the product

3. RESULTS AND DISCUSSION

The research results were presented based on development stages used, following the Hannafin and Peck model comprising three crucial stages: i) needs assessment, ii) design, and iii) development and implementation. This model promotes the use of technology to facilitate learning. This is in line with technological developments in education and helps create a more interesting and relevant learning experience. This model can also be applied in various learning contexts, including classical learning, online learning, and project-based learning. This provides flexibility in designing learning experiences. This model emphasizes a clear and effective way of organizing information, which makes it easier for learning participants to understand and access the material [34].

In the needs assessment stage, a comprehensive analysis was conducted on multiple facets including course materials, student characteristics, and learning resources. The developed course focused on instructional materials development and consisted of the following aspects: i) concepts of learning materials, ii) types of instructional materials, iii) content of instructional materials, iv) principles of instructional materials design, and v) steps involved in developing instructional materials. Based on the results of learning style questionnaire distributed to 96 students hailing from 4 distinct instructional materials course it was discovered that 68 students exhibited a visual learning style, while 18 students favored an auditory learning style, and 10 students showed a kinesthetic learning style. Regarding learning resources, it was determined that all students had access to both laptops and smartphones. The analysis of students' learning style characteristics of students and the availability of learning resources was presented in Table 3.

Table 3. Analysis of learning style characteristics and availability of learning resources

Class	Learning resources	Learning style characteristics	Total
A	Available laptop and smartphone	Visual	19
		Audio	6
		Kinesthetic	2
F	Available laptop and smartphone	Visual	17
		Audio	3
		Kinesthetic	3
H	Available laptop and smartphone	Visual	16
		Audio	4
		Kinesthetic	3
L	Available laptop and smartphone	Visual	16
		Audio	5
		Kinesthetic	2
Total			96

In the design stage, a clear learning step and materials in digital format must be meticulously prepared. These learning steps and materials needed to be efficiently organized within a program mapping format to facilitate accessibility and use during development of the online module. Program mapping, essentially a table, involved learning steps and materials for a single semester. Each component was thoughtfully linked to the relevant materials [35]. E-learning program mapping, aligning with the ICARE model and grounded in the Moodle LMS, included the following elements, i) learning model steps, ii) varieties of learning materials, and iii) Moodle LMS (Mobile App) features (resources and activities). Table 4 presented e-learning program mapping using the ICARE learning model within the Moodle LMS framework.

In development stage, learning materials were implemented in a variety of media formats, including e-books, videos, animations, and multimedia. These transformed instructional media were subsequently integrated into Moodle-based e-learning, tailored to each phase of the ICARE model. Universitas Pendidikan Ganesha served as the platform for this used e-learning. The results of e-learning development stage were visually observed in Figure 2. In the evaluation stage, testing was conducted by experts and users (students), as shown in Figure 3.

Table 4. E-learning program mapping with the ICARE learning model

ICARE model stages	Learning materials types	Moodle LMS features	
		Resource	Activities
Introduction	1. E-book	1. Attendance	1. Lesson
	2. Video (MP4)	2. Books	2. Forum
		3. Forum	
Connection	1. E-book	1. Books	1. Books
	2. Video (MP4)	2. Forum	2. Forum
	3. Document (Pdf)	3. Assignments	3. Assignments
Application	1 E-Book	1. URL	1. Workshop
	2 Video (MP4)	2. Forum	2. Journal
	3 Document (Pdf)	3. Assignments	3. Assignments
Reflection	1 E-Book	1. Quiz	1. Quiz
	2 Document (Pdf)	2. File	2. Assignments
	3 Quiz	3. URL	3. Reflection
Extension	1 Document (Pdf)	1. File	1. Journal
	2 Video (MP4)	2. URL	2. Assignments

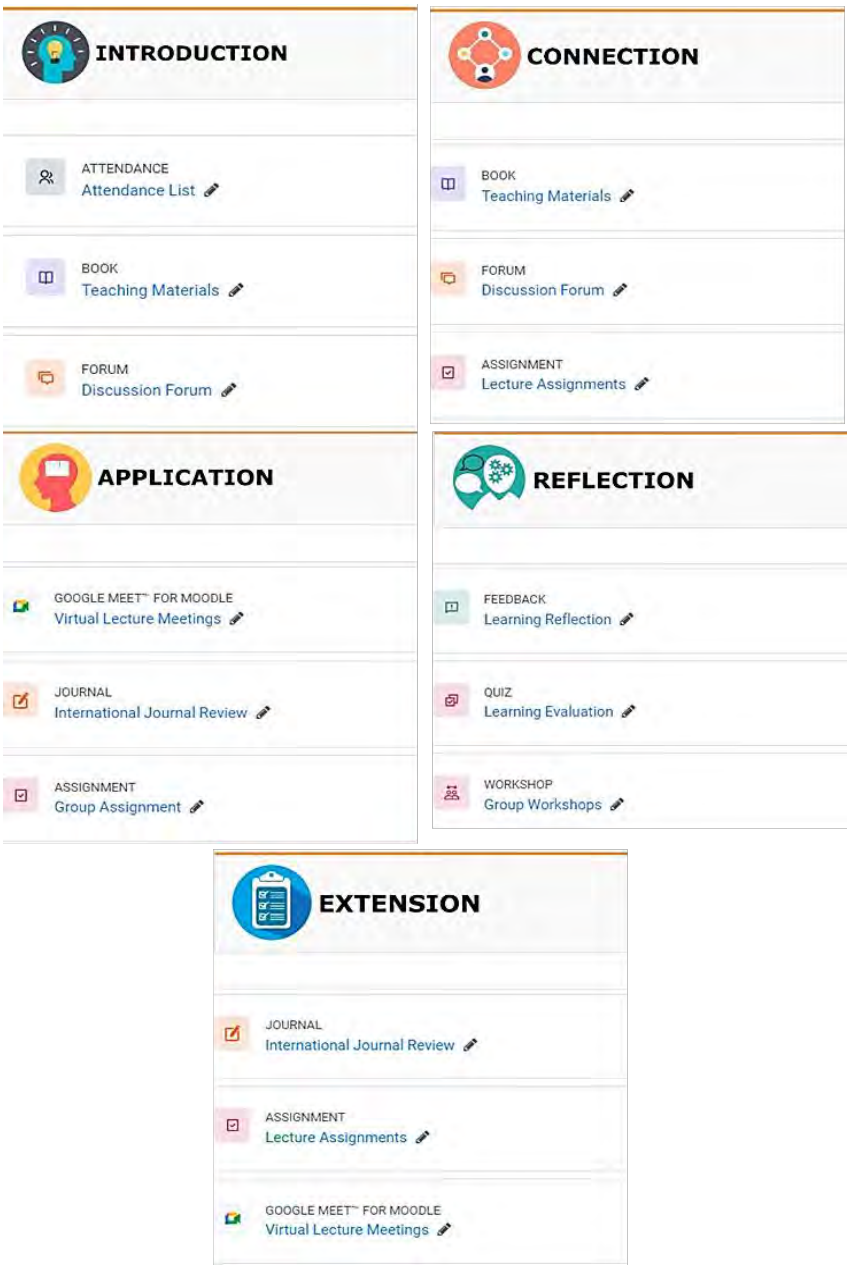

Figure 2. E-learning interface with the ICARE learning model

Based on Figure 3, the results of e-learning validity assessment indicated that the media aspect fell within the 'excellent' category, while the validity of the instructional design aspect was classified the 'good.' Moreover, the attractiveness of digital content based on student testing conducted in both individual and small group stages fell within the 'good' category. The subjects involved in this research comprised a limited sample size, primarily a small group. Therefore, these results were applicable to subjects sharing similar characteristics with this research cohort. The feasibility of implementing e-learning with the ICARE model within the instructional materials development course was substantiated by its structured stages.

In the Introduction phase, lecturers comprehensively elucidated the content of lessons, including a clear delineation of objectives and anticipated outcomes. This stage involved actively engaging students by showing various phenomena relevant to contextual learning, thereby encouraging observation and fostering inquiry into these presented phenomena. Furthermore, motivation was instilled at this juncture to cultivate student interest in forthcoming materials. Such preparatory measures served to mentally and physically prime students for learning, a pivotal factor that significantly contributed to the likelihood of learning success [36].

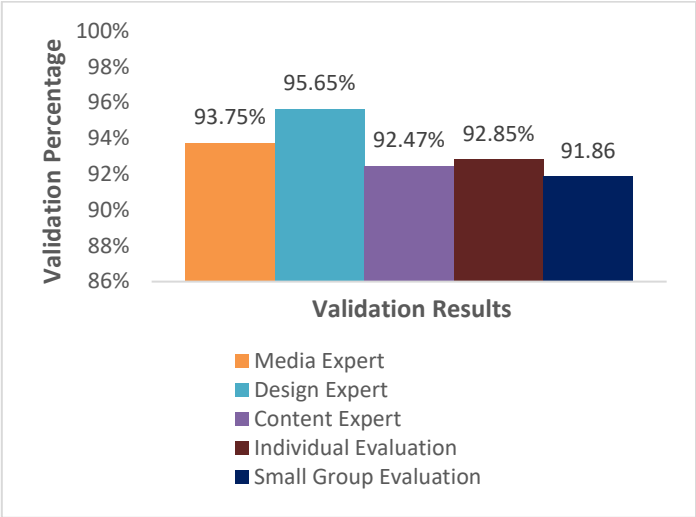

Figure 3. Expert and user testing results

In the connection stage of the lesson, lecturers aimed to bridge newly acquired knowledge with familiar concepts from students previous learning or personal experiences. Lecturers employed shows and encouraged discussions, prompting students to recollect what these students remember from their previous educational experiences. This stage primarily emphasized the cultivation of conceptual understanding, achieved through active students involvement in planning and executing activities independently or collaboratively. These activities might include real-world applications rooted in inquiry-based learning. The method accommodated diverse learning styles, fostering heightened student engagement [37].

The application phase granted students the opportunity to put into practice the knowledge and skills they have acquired regarding the subject matter. The stage was intentionally designed to be the lengthiest within the instructional process, as it necessitated student engagement in experiments or the application of their knowledge within authentic real-world contexts. This distinction was significant compared to the application examples presented in the preceding connection stage. A student-centered e-learning system served as a crucial catalyst for ensuring learning success [38]. Furthermore, all student activities inherently involved information-seeking and problem-solving, fostering self-confidence, and development of higher-order intellectual abilities [39].

The reflection phase offered a platform for summarizing materials, allowing students to contemplate what they have learned. The role of lecturers extended to assess the extent of learning achievement. Reflective or summary activities could involve group discussions, where students were prompted to present or explain their newfound knowledge. Alternatively, students could engage in independent writing exercises to synthesize their learning outcomes [40]. Reflection might also involve a brief quiz, with lecturers posing questions rooted in the lesson content or session. An important aspect of reflection was affording students opportunities to articulate their learning. Reflection and feedback mechanisms empowered students to measure their progress, consider alternative learning strategies, and project their further learning needs [41].

In the extension phase, lecturers furnished participants with post-learning activities aimed at reinforcing and broadening their acquired knowledge. These extension activities might include additional reading materials, assignments summarizing forthcoming lesson content, or practical exercises. The provision of supplementary instructional materials and their diverse deployment within e-learning was intricately linked to the motivation of students and could significantly enhance their problem-solving abilities [42].

Based on student responses in the trial activities, e-learning employing the ICARE instructional model for instructional materials development showed distinct and well-structured learning phases, characterized by robust interactivity. Therefore, this digital program effectively engaged students, sustaining their active participation in learning process. This indicated a heightened motivation and a promising harbinger for improved learning outcomes. Significant visual elements of this product included its aesthetically pleasing design, user-friendly navigation, and a harmonious blend of text and background colors. Each module within this e-learning platform integrated images, animations, videos, and multimedia, all serving to enhance student comprehension of materials. Enrichment activities were available to accommodate students with a higher learning pace and completion rates. Additionally, the enriched content, including multimedia, was quickly updated by lecturers. Students participated in monitoring, communication, and collaboration in the learning process. Furthermore, students downloaded materials, completed assignments, and quizzes, as well as actively engaged in chats and discussion forums.

The developed e-learning using the ICARE instructional model distinctly showed systematic and structured learning steps, permitting students to independently master materials based on their preferences [43]. The stages of the ICARE Model in this digital program fostered knowledge expansion and stimulated the cultivation of critical perspectives toward the subject matter by posing tasks that required students to seek answers from various sources [44].

4. CONCLUSION

In conclusion, e-learning system developed using the ICARE instructional model within the framework of the Hannafin and Peck model has yielded substantial results. Expert validation attested to the exceptional validity of the digital content, including media quality and instructional design, which both attained an 'excellent' rating. The assessment of users or students conducted during individual and small group testing stages consistently rated the attractiveness and usability of e-learning materials as ‘excellent. The incorporation of the ICARE model in e-learning design yielded valid, engaging, and readily comprehensible materials for students. Therefore, this digital program fashioned with the ICARE was well-suited for implementation within higher education.

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