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Development of Learning Tools Based on Hybrid-Creative Problem Solving (H-CPS) Strategy to Improve The Critical Thinking Skills of Prospective Physics Teachers

Sutrio[1]*, Ahmad Busyairi[1], Susilawati[1], Gunawan[1], Nina Nisrina[1], Elda Elfara Zianturi[1]
[1]Physics Education, University of Mataram, Mataram, Indonesia
*Corresponding Author: sutrio_trio@unram.ac.id

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Abstract: This study aims to develop a learning device based on the Hybrid-Creative Problem Solving (H-CPS) Model to improve the critical thinking skills of prospective physics teachers. The development model refers to the 4D approach (Define, Design, Develop, and Disseminate). The learning devices developed include H-CPS learning design, learning videos, student worksheets, and critical thinking skills test instruments. The device validation process was carried out by three experts who are competent in their fields. The validation results showed that all devices were declared valid, although several minor suggestions for improvement had been accommodated. The research findings showed that the learning devices and test instruments developed had a high level of validity and reliability, and showed great potential in providing meaningful and effective learning experiences for students. Based on these results, this study recommends the implementation of limited trials or wider trials to ensure the effectiveness of their implementation before being disseminated and used more widely in higher education environments.

Keywords: Hybrid Learning, Creative Problem Solving, Critical Thinking Skills, prospective physics teachers

INTRODUCTION

The development of the world of education today is faced with increasingly complex challenges. Education is not only aimed at transferring knowledge but also to equip students with essential 21st-century skills, one of which is critical thinking skills (Kurniawan et al., 2020; Ariadila et al., 2023). Given the importance of these skills, several developed countries such as Canada, the United States, Australia, and New Zealand have included critical thinking skills in their educational curriculum (Prayogi et al., 2018a; Howard, 2018; Verawati et al.2018). These skills include the ability to analyze information, evaluate arguments, identify assumptions, and make decisions based on rational and logical thinking (Ennis, 1985; Arends, 2012; Paul & Elder, 2006; Junining et al., 2022; Howard, 2018). Therefore, the development of critical thinking skills in education is a very important and relevant issue to discuss. Teachers as agents of change have a very strategic role in producing a generation that is intelligent and able to adapt to the development of the times. Therefore, prospective teachers are expected to not only have in-depth knowledge of the fields they teach, but also the skills to analyze, think critically, and develop solutions to problems that arise in the classroom (Kartikawati et al., 2023). Building critical thinking skills in prospective teachers since higher education is a must to prepare them to face the challenges of education in the future.

However, based on the research results, shows that the critical thinking skills of prospective teacher students are still low. The research results of Kassiavera et al., (2019); Farcis, (2019); Makhrus et al., (2020); and Safitri et al., (2021) show that students' critical thinking skills, especially in solving physics problems, are still very low. The results of this study indicate that the learning activities implemented at the University so far have not been able to improve students' critical thinking skills. Learning activities that are not oriented toward critical thinking activities can lead to low critical thinking skills in students (Soden, 1994); Bloomer, 1998; Anderson et al., 2001). Therefore, it is important to design learning methods that not only prioritize the delivery of information, but also encourage students to actively think critically, reflect, and apply their knowledge in real contexts. One of the learning

strategies whose activities are oriented toward improving critical thinking skills, especially in the context of problem-solving, is the Creative Problem Solving (CPS) strategy. CPS is a problem-solving strategy whose process involves creative and critical thinking activities to produce diverse and innovative solutions to the problems being solved (Isaksen, 1995; Puccio et al., 2005). This strategy does not only emphasize finding one solution, but also a deep, reflective, adaptive, and open thinking process to various alternative possibilities that arise. In CPS, students are faced with an unstructured problem, which requires them to identify the problem, seek information, analyze data, and develop solutions. CPS is designed to encourage students to think critically, work together in groups, and develop communication and collaboration skills. In the context of prospective teacher education, CPS can help them hone their analytical, problem-solving, and critical thinking skills, which are very important for them to bring into the classroom when they later become teachers.

Empirical evidence on the effectiveness of the CPS strategy in improving students' critical thinking skills is shown by the results of research conducted by Rahmawati, (2013); Pebrina et al., (2020); Rahmah et.al., (2023). Several of these research results indicate that the CPS strategy can improve students' critical thinking skills. In addition, the results of research by Maharani et al., (2021); and Oktavia et al., 2025 show that the integration of the CPS strategy in distance learning is also effective in improving students' critical thinking skills. However, one weakness of the Creative Problem Solving (CPS) strategy lies in the relatively long time required in the implementation process. This is due to the stages that students must go through to explore problems, develop creative ideas, and evaluate solutions in depth. In the context of learning in higher education, the limited time for face-to-face meetings is a challenge in itself for optimizing the implementation of this strategy. Therefore, in this study, the CPS strategy was designed to be integrated into hybrid learning. This integration is expected to provide more space and flexibility of time for students to complete the CPS stages independently or collaboratively, without being limited by the duration of conventional lectures. This integration allows prospective physics teachers to study the subject matter independently outside the classroom through media such as learning videos, articles, or other resources. Class time is then used for more interactive activities, such as discussions, problem-solving, and collaboration between students. This learning pattern, is expected to accelerate the process of assimilation and accommodation in the cognitive structure of students so that the learning process in the classroom runs more effectively.

Based on the background description above, the development of learning tools based on the H-CPS strategy is an important step to improve the quality of learning in higher education. Good learning tools not only function as aids in the teaching and learning process, but also as a means to create a more effective, interesting learning experience, and in accordance with the expected educational goals. This study aims to develop learning tools based on the H-CPS strategy to improve the critical thinking skills of prospective physics teachers.

METHODS

The ultimate goal of this study is the development of a learning plan based on the H-CPS strategy, interactive videos, student worksheets, and critical thinking skills test instruments. The research and development (R & D) stage in this study uses the 4-D model (Define, Design, Develop, Disseminate) (Thiagarajan et al., 1974).

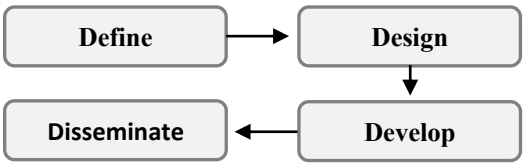

Figure 1. Development Stages

The research activity begins with the define stage. Simply put, this stage is the needs analysis stage. There are five activities carried out at the define stage, namely: front-end analysis, learner analysis, task analysis, concept analysis, and specifying instructional objectives. The next stage is the design stage. At this stage, the learning device begins to be designed referring to the results of the definition that has been done previously. After going through the design stage, it is continued with the development stage. The development stage is the main stage of this research. At this stage, the researcher begins to develop learning devices based on the H-CPS strategy, learning videos, student worksheets, and

critical thinking skills test instruments. In addition, at this stage, a validity test is also carried out on the learning device being developed. The validity of the learning device is based on the consideration (judgment) of 3 (three) experts.

The instruments used in this study consist of a validation sheet. The validation sheet is used to determine the validity of the learning device that has been developed. The validation data results are analyzed by determining the average score of all validators and then interpreted using the following criteria.

Table 1. Validity criteria for learning devices

Average Score	Category
$3{,}75 < \bar{X} \leq 4{,}00$	Very valid
$2{,}50 < \bar{X} \leq 3{,}75$	Valid
$1{,}75 < \bar{X} \leq 2{,}50$	Quite valid
$1{,}00 \leq \bar{X} \leq 1{,}75$	Not valid

FINDINGS AND DISCUSSION

Define

The initial stage of this research and development is defined. There are two main activities carried out at this stage, namely front-end analysis and Learner Analysis. Front-end analysis is the process of collecting and analyzing information to understand learning needs and requirements before designing and developing a program or learning device. The goal is to understand the context of the problem and identify the reasons behind the development of learning devices. The results of the initial analysis were carried out by examining common problems that occur in Higher Education. Several research results show that the critical thinking skills of students in Indonesia are low. Research conducted by Kassiavera et.al., (2019); Farcis, (2019); Makhrus et.al., (2020); and Safitri et.al., (2021) shows that students' critical thinking skills, especially in solving physics problems, are still very low. The results of this study indicate that the learning activities implemented in Higher Education so far have not been able to improve students' critical thinking skills. Two main factors are indicated as the cause of the low critical thinking skills of students, namely curriculum and learning. The curriculum is designed with the target of mastering fairly broad material so that lecturers are more focused on completing the delivery of all teaching materials according to the specified time. This has an impact on the low level of depth of material that can be absorbed by students during classroom learning. In addition, the use of learning models and methods that are not oriented toward critical thinking activities can also cause low critical thinking skills in students (Soden, 1994); Bloomer, 1998; Anderson et al., 2001).

Learner analysis is a process carried out to understand the characteristics, needs, and skills of learners. The goal is to collect relevant information about the target audience of a learning program to be developed. By understanding participants in-depth, learning developers can design more appropriate, effective, and efficient learning experiences. Based on the results of Learner analysis by conducting a preliminary study, it show that the average understanding of students' initial concepts (schemata) is very low. This initial cognitive structure is very important for building more complex knowledge. Therefore, a learning design is needed that allows students to spend time building their initial knowledge (schemas) independently outside the classroom and in the classroom to facilitate learners in building their more complex understanding based on the potential of the initial knowledge that has been built previously. This learning pattern is expected to accelerate the process of assimilation and accommodation in the cognitive structure of learners so that the learning process in the classroom runs more effectively.

Design

There are 2 (two) main activities carried out at the Design stage, namely; format selection, and initial design. In the format selection process, researchers review literature, especially theories, and concepts that are relevant to the design of learning devices and those that will be developed. Researchers also conduct a literature review of the results of related research that has been carried out previously. Based on the results of the preliminary study and literature study, it was obtained that the learning device to be developed is a learning device based on the H-CPS strategy and learning videos to Improve the Critical Thinking Skills of Prospective Teachers. H-CPS is a combination of Creative problem-solving (CPS) strategies with hybrid learning (HL). HL is a learning method that combines direct face-to-face methods with online learning in an integrated manner, thus creating a flexible, efficient learning experience that can be accessed

from various places and times. In this model, some learning activities are carried out synchronously in class or via video conference, while others take place asynchronously through digital platforms such as LMS (Learning Management System), discussion forums, or online modules. The main objective of hybrid learning is to optimize the advantages of both forms of in-depth direct interaction learning and the flexibility and independence of online learning to improve the effectiveness and quality of learning (Susanti & Pitra, 2019). CPS is a problem-solving strategy whose process involves creative and critical thinking activities to produce diverse and innovative solutions to the problems being solved (Isaksen, 1995; Puccio et al., 2005). This strategy does not only emphasize finding one solution, but also the process of thinking deeply, reflectively, adaptively, and openly about various alternative possibilities that arise. In CPS, students are faced with an unstructured problem, which requires them to identify the problem, search for information, analyze data, and develop solutions. Thus, the combination of HL and CPS allows students to spend time learning the material independently outside the classroom and in the classroom to solve problems with the material they have previously learned (Chis et al., 2018). The learning pattern with H-CPS can be seen in the following Figure.

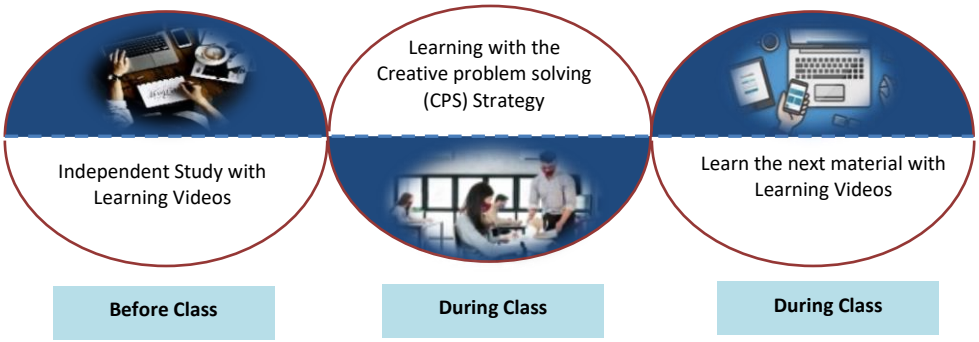

Figure 2. Strategy of H-CPS Learning Pattern

The stages of learning the H-CPS model, which is the integration of the CPS model into the Flipped Classroom learning design, are as follows.

Table 2. Stages of Hybrid-Creative Problem Solving Strategy

Stages of H-CPS		**Learning Activity**
Before Class	Self-Learning	Independent learning outside the classroom before learning in the classroom through the Learning Management System (SPADA Unram) with the help of learning videos.
During Class	Step 1: Objective Finding	Lecturers raise open-ended problems. Prospective teachers identify the goals or missions of the problem-solving process.
	Step 2: Fact Finding	Prospective teachers search for and collect information or facts relevant to the problems given.
	Step 3: Problem Finding	Prospective teachers analyze facts to formulate core problems that need to be solved.
	Step 4: Idea Finding	Prospective teachers brainstorm to determine various ideas and choose the best idea based on certain criteria.
	Step 5: Solution Finding	Prospective teachers brainstorm to determine various solutions and choose the best solution based on certain criteria.
	Step 6: Acceptance Finding	Prospective teachers prepare a solution implementation plan and present it in front of the class.
After Class	Self-Learning	Independent learning outside the classroom after learning through the Learning Management System (SPADA Unram) with the help of learning videos.

In addition, at this stage, the researcher also determines the design of the problems that will be solved by students during the learning process in the classroom. By referring to the main characteristics of the CPS learning model, namely the learning process based on contextual problem-solving activities or complex problems. Examples of real events that are complex in nature that are raised in learning and stated in student worksheets are as follows.

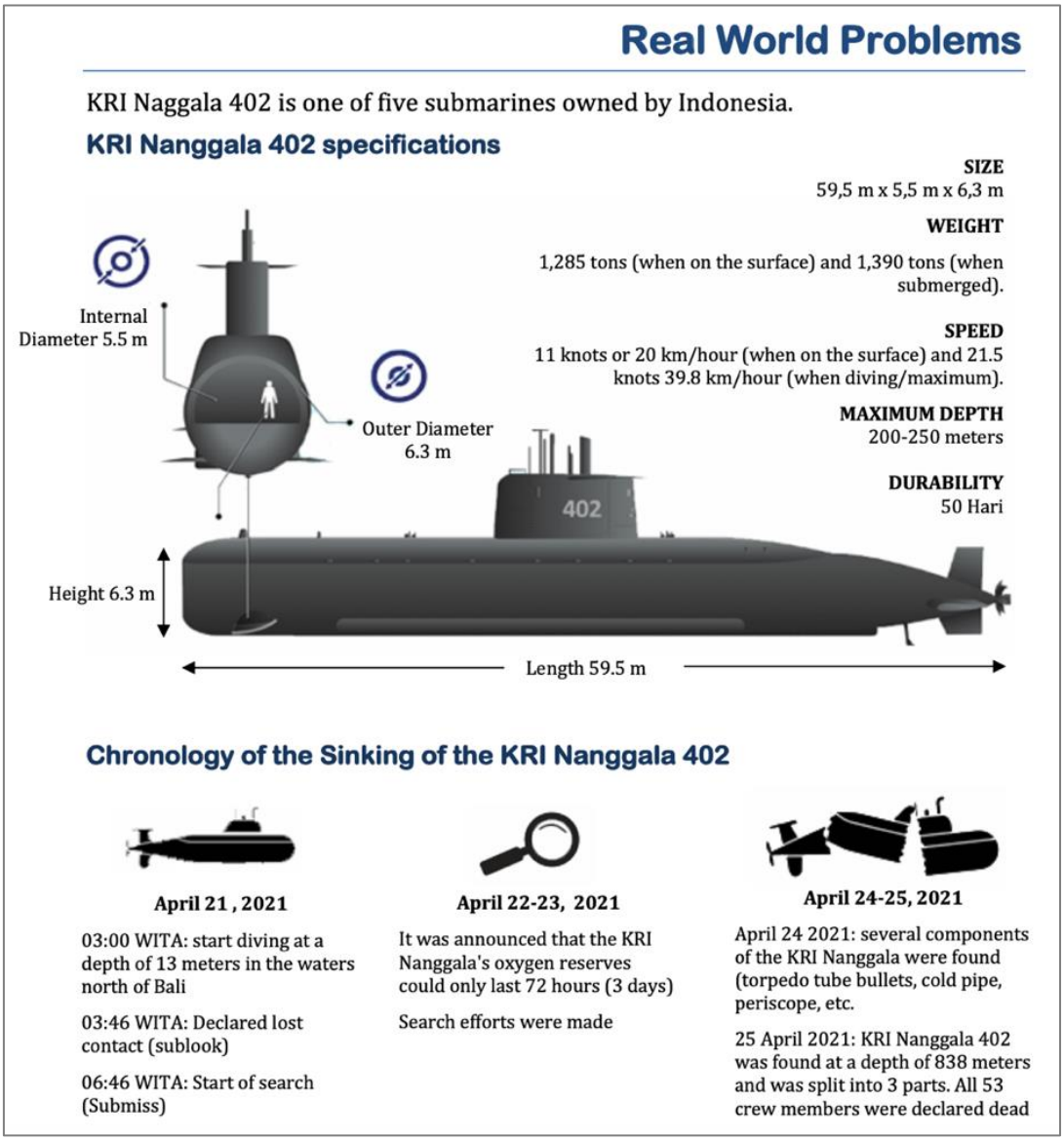

Figure 3. Form of real-life incident-based problems in H-CPS

At this stage, the researcher also began to design a critical thinking skills test instrument. The critical thinking skills test instrument developed in this study was a descriptive test. The test instrument was developed based on 5 (five) indicators of critical thinking skills according to Ennis, (1985).

Table 3. Description of questions in the Critical Thinking Skills Test Instrument (KBK)

Aspek KBK	Deskripsi soal
Elementary Clarification	Given an argument related to the concept of hydrostatic pressure. Students can analyze the truth of an argument and are able to provide a relevant basic explanation.
Basic Suport	Given a phenomenon or data, students can analyze the phenomenon or data to determine the variables they want to know.

Inference	Given open-ended problems in the form of real events, students are able to make decisions on the given problems.
Advanced Clarification	Given open-ended problems in the form of real events, students are able to analyze phenomena and are able to provide relevant explanations.
Strategies and Tactics	Given problems related to the concept of hydrostatic pressure, students are able to determine an action to solve the given problems.

Develop

The development stage is the main stage of this research. At this stage, the researcher began to compile learning devices consisting of H-CPS learning designs, student worksheets, learning videos, and critical thinking skills test instruments based on previously created designs. The Learning Devices and Test Instruments that had been developed were then validated by 3 experts (lecturers). Based on the validation results, it was found that the learning devices and all questions were declared valid with slight improvements such as improvements in terms of writing and grammar. The validated learning devices and Test Instruments were then revised according to the validator's suggestions. The results of the validation of the learning devices by 3 (three) experts are shown in the following Table 4.

Table 4. H-CPS Strategy Validation Results

No	Assessment Aspects	Score
1.	Learning activities in the H-CPS strategy are in accordance with the availability of teaching hours at the University.	4,00
2.	The stages and learning activities in the H-CPS strategy show a logical sequence.	4,00
3.	The stages in the H-CPS strategy are in accordance with the curriculum at the University.	3,33
4.	The H-CPS strategy has the potential to be easily implemented by lecturers.	4,00
5.	The H-CPS strategy has the potential to provide meaningful learning experiences for students.	4,00
6.	The H-CPS strategy has the potential to make learning in the classroom more effective and enjoyable.	4,00
7.	Activities in the H-CPS Strategy have the potential to support the achievement of learning objectives.	4,00
8.	Activities in the H-CPS Strategy are oriented toward improving high-level thinking skills (analyzing, evaluating, and creating).	4,00
9.	Activities in the H-CPS Strategy are oriented toward improving 21st-century skills, especially critical thinking skills.	4,00
10.	Activities in the H-CPS Strategy are oriented toward facilitating students with different characteristics (differentiated learning).	3,33
Average		**3,87**

The data in Table 4 above shows that the average score of the 3 validator assessments of the H-CPS learning model is 3.87. This average score shows that the H-CPS strategy that has been developed is in the very valid category. The validation data for the learning device in the form of a student worksheet can be seen in Table 5 below.

Table 5. Student Worksheet Validation Results

No	Assessment Aspects	Score
1.	Clarity of Student Worksheet Identity.	4,00
2.	Clarity of Student Worksheet Instructions.	4,00
3.	Suitability of Problem Form with H-CPS Strategy Characteristics (Contextual Problems).	3,33
4.	Problems are presented using easy-to-understand language.	4,00
5.	Systematics or sequences of activities/activities in the student worksheet are arranged in a structured and systematic manner in the H-CPS strategy.	3,33
6.	Suitability of activities/activities in the student worksheet with the stages of the H-CPS strategy.	3,33
7.	Clarity of instructions, statements, and questions in the student worksheet.	3,67
8.	Clarity of illustrations and images in the student worksheet.	3,67
9.	Level of relevance of activities in the student worksheet with learning objectives.	4,00
10.	Level of relevance of questions in the student worksheet with learning objectives.	3,67

No	Assessment Aspects	Score
11.	Use of clear and easy-to-understand language.	4,00
12.	Activities in the student worksheet are oriented toward improving students' high-level thinking skills (analyzing, evaluating, and creating)	3,67
13.	Activities in the student worksheet model are oriented towards improving 21st-century skills, especially critical thinking skills.	3,67
	Average	**3,72**

The data in Table 5 above shows that the average score of the 3 (three) validator assessments of the student worksheet is 3.72. This average score shows that the student worksheet that has been developed is in the very valid category with a few improvements, namely simplifying the level of complexity of the problems used on the grounds that the quality of students due to the Covid pandemic has decreased slightly. The validation results of the Critical Thinking Skills Test Instrument can be seen in Table 6 below.

Table 6. Validation results of the Critical Thinking Skills Test Instrument

No	Assessment Aspects	Score
1.	Clarity of question identity.	4,00
2.	Clarity of instructions for completing questions.	4,00
3.	Suitability of question items with indicators of Critical Thinking Skills.	3,67
4.	Suitability of question items with teaching materials.	4,00
5.	Suitability of the number of questions with the allocation of time for completion.	4,00
6.	The sentences used are easy to understand.	4,00
7.	The sentences used are clear and do not give rise to multiple interpretations.	4,00
8.	Questions are composed using standard and correct language according to EYD (Enhanced Indonesian Spelling System).	4,00
	Average	**3,96**

The data in Table 6 above shows that the average score of the 3 (three) validators of the critical thinking skills test instrument is 3.96. This average score shows that the scientific literacy test instrument that has been developed is in the very valid category with slight improvements by correcting writing errors. The data from the validation results of the interactive learning video can be seen in Table 7 below.

Table 7. Results of Interactive Learning Video Validation

No	Assessment Aspects	Score
1.	The suitability of the media type with the learning objectives.	4,00
2.	The suitability of the content/material with the learning objectives.	3,33
3.	The accuracy of the content/lesson material.	3,67
4.	The suitability of the example questions with the learning objectives.	3,67
5.	The material is presented clearly and in a structured manner.	3,67
6.	The learning videos are interactive and support learning.	3,00
7.	The use of visual media (graphics, animations, or images) that enrich the material.	4,00
8.	Clarity of audio (sound) and visuals (text, graphics, animations, or images).	3,67
9.	No material violates copyright or other rules.	4,00
10.	The sentences used are clear and do not give rise to multiple interpretations.	3,67
11.	The questions are written using standard and correct language according to EYD (Enhanced Indonesian Spelling System).	3,67
12.	The material is ethical and respects diversity.	4,00
13.	No content demeans or discriminates against certain groups.	4,00
	Average	**3,72**

The data in Table 7 above shows that the average score of the 3 (three) validator assessments of the interactive learning video is 3.72. This average score shows that the learning video being developed is in the very valid category with a few improvements, namely showing sample questions, correcting the misconception of mass with the weight of an object, and extending the duration or pauses in

parts that are considered important and need time to digest the information in the video.

CONCLUSION

The study aims to develop learning tools that include a hybrid learning design of H-CPS strategy, student worksheets, learning videos, and creative thinking skills test instruments. The results of the study show that the learning tools and test instruments developed are very valid and have high reliability. Thus, it can be concluded that the learning tools and test instruments that have been developed are worthy of being continued to the limited trial stage, wider trial, and dissemination. In this study, the material used was limited to static fluid material. Therefore, it is recommended for further researchers to develop learning tools and critical thinking skills test instruments on other physics materials. In addition, the researcher suggests that these learning tools and test instruments be continued to the limited trial stage and wider trial so that the products resulting from this study can be disseminated and used in Higher Education.

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