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The Validity of Multiple Representations-Based Blended Learning Program to Stimulate Complex Problem Solving and Reduce Learning Loss

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Abstract: This research aims to describe the validity of multiple representations-based blended learning programs to stimulate complex problem-solving and reduce student learning loss. The products developed for validation are in the form of syllabi, Lesson Plans, Electronic Student Worksheets (e-Worksheet), and e-Handouts. This type of research includes Research and Development (R&D) using the ADDIE development design which consists of five steps, namely analysis, design, development, implementation, and evaluation. This research is limited to the development stage. The analysis phase is the problem analysis step. The design stage is designing product development. The development stage, namely product development, is carried out by product validation by an expert validator using a validity test sheet instrument in the form of a questionnaire. Validation scores are accumulated to obtain validity values. The results of the investigation based on expert validation prove that the learning program developed is in the category of very high validity. This shows that this learning program is worth experimenting with in teaching and learning activities to find out the practicality and effectiveness of the product in stimulating complex problem-solving and reducing learning loss.

Keywords: Blended Learning; Complex Problem Solving; Learning Loss; Multiple Representations; Validity of Learning Program.

Introduction

The 21st century is a transitional era that confronts the world with an environment with complex problems to solve (Fischer et al., 2012; Schefer-Wenzl & Miladinovic, 2019). One of the skills considered relevant to the needs of the world of work and personal life in the 21st century is Complex Problem Solving (CPS) (Binkley et al., 2012; Funke et al., 2018). This skill is seen as crucial to be able to deal with problems whose root causes are unknown in a dynamic environment (Graesser et al., 2018; Greiff et al., 2013). Teaching CPS in the learning process is an important point that needs attention. However, research on this matter is still rare. Several studies on CPS have focused more on assessment, exploration, and planning (Bhagat & Spector, 2017; Dörner & Funke, 2017; Eichmann et al., 2019, 2020).

Furthermore, school closures due to the Covid-19 pandemic seem to have had quite a serious impact. The findings of the World Bank (Yarrow et al., 2020) state that Indonesian students have lost 0.9 years or around 10 months of learning at school due to the co-19 pandemic since early 2020. The findings of the learning loss phenomenon that has occurred are also supported by the results of a survey of teachers where teachers saw indications of learning loss from missed assignments to dropping test scores (Chen et al., 2021). Several studies offer solutions to overcome learning loss with the gamification method. However, the use of this gamification method is mostly applied to learning in elementary schools (Purniasih et al., 2020; Putrama & Suyasa, 2020; Qodr, 2020; Tangkui & Keong, 2020) and students with special needs (Fachresya, 2020; Pradnyana et al., 2020). No research specifically discusses the application of this method in learning physics in secondary schools. The use of Multiple Representations (MRs) in Blended learning programs has the potential to increase CPS and reduce learning loss. Research on learning with MRs has shown that students' performance will increase when they can interact with

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appropriate representations (Fatmaryanti & Nugraha, 2019; Lucas & Lewis, 2019; Munfaridah et al., 2021). Likewise, carefully designed blended learning activities have the potential to improve higher education, especially in post-pandemic scenarios (Jones & Sharma, 2020), where activities include face-to-face interactions in class, online content, assignments, announcements, synchronous conversations, asynchronous forum discussions, as well as online chat (Calderón et al., 2021).

The results of a survey of 13 teachers and 25 students from several schools in 4 provinces in Indonesia which include Lampung Province, DI Yogyakarta, Central Java, and West Java, show that physics learning is carried out in schools quite varied, not only lectures but teachers also encourage students to conduct discussions, experiments, demonstrations, and practicum. However, CPS skills have not been fully trained in learning. This is known from the fact that all CPS indicators have not been included in learning activities, teaching materials, and worksheets used by teachers and students. This was caused by the limited time for online and offline learning during the pandemic and the large amount of material that had to be completed. So learning is only focused on solving calculation questions and choosing the main material to be conveyed regardless of the CPS skills obtained. The LKPD used by the teacher is still limited to summarizing material, practicing questions and completing practicum activities in general and has not been intended to specifically train CPS.

Furthermore, eighteen out of 25 students admitted that the learning they received during the Covid-19 pandemic was not efficient and optimal. Several factors are the cause, such as: difficulty understanding the material, lack of direct explanation from the teacher, difficulty concentrating while studying, limited study time on a limited internet network. As many as 17 out of 25 students claimed to experience failure in learning and decreased academic progress (learning loss). In addition, most students have difficulty understanding direct current electricity material on almost all topics caused by a lack of literacy in understanding the material, a lack of visual representation, too many formulations in the material, and limited learning media at school. The difficulty of learning dynamic electricity is caused by low mastery of concepts, students' mathematical calculation skills, lack of ability to convert units (Wahyuni & Handhika, 2019), and lack of variety of media and learning methods (Nofitasari & Sihombing, 2017).

Therefore, in this case, a blended learning program based on multiple representations was developed with the hope that it could be used as a guide in stimulating students' CPS and learning loss, especially on the topic of direct current electricity. The developed learning program needs to be validated. Validation aims to assess the quality of the initial product that has been produced before being used during field trials. Product development needs validation to ensure its quality (Putra et al., 2018). Based on this, it is necessary to carry out validation test research on the results of device development with the aim of describing the validity of a multiple representations-based blended learning program so that it is feasible to implement in learning.

Method

This type of research includes Research and Development (R&D) using the ADDIE development design which consists of five steps, namely: (1) analysis, (2) design, (3) development, (4) implementation, and (5) evaluation (Branch, 2010). This research is limited to the development stage. The subjects of the investigation were class XII MIPA students at SMA Islam Plus At Tholibin Central Lampung for the academic year 2022/2023 consisting of 25 members. Product development in this research includes syllabus, Lesson Plans, Electronic Student Worksheets (e-Worksheet), and e-Handouts. Furthermore, the validity test is carried out on the product developed to obtain its validity value. The sample uses nonprobability sampling with a purposive sampling technique.

The validators in this study consisted of two lecturers from the University of Lampung and one education practitioner in Bandar Lampung. Data collection techniques were carried out using non-test techniques. The validator will carry out validation of the learning program developed by filling in a validity test sheet in the form of a questionnaire using a Likert scale. Data analysis techniques consist of descriptive data analysis, validation, and questionnaires. Descriptive data analysis was carried out by analyzing the data collected from the validation sheet. Analysis of the validation sheet data is carried out by processing the values obtained at the expert validation stage. The analysis of the results of expert validation includes validity from three perspectives, namely content, media, and design. The Learning Program is said to be valid if it obtains a minimum of 60.1%, while the calculation is as Table 1.

Table 1. Validation Criteria (Arikunto, 2019)

Percentage (%)	Criteria
0.00 - 20	Very low validity
20.1 – 40	Low validity
40.1 – 60	Moderate validity
60.1 – 80	High validity
80.1 - 100	Very high validity

Results and Discussion

Validation activities for blended learning programs based on multiple representations are carried out to

describe whether the learning programs that have been made are valid or not. Assessments and suggestions from the validator are then used as a basis for revising the learning program. The results of the recapitulation of material expert validation in the multiple representations-based blended learning programs are shown in Table 2 with an average score of 92.40% with a very high validity category. These results indicate that the quality of the material from the multiple representations-based blended learning programs that were developed was very good.

These results are inseparable from the development of the syllabus and lesson plans which consider the completeness of each of its components, including presenting learning materials that are following Basic Competence (KD), Competency Achievement Indicators (GPA), and learning objectives. RPP development has also fulfilled the principle of development, namely the competencies that are formulated are clean, intact, and comprehensive, and the achievements are clear, simple, and flexible in the sense that they can be carried out in learning activities and the formation of student competencies and the activities that are arranged and developed already support and are following the basic competencies that will be realized (Fahrurrozi & Mohzana, 2020). All components contained in the syllabus and lesson plans are part of the lesson plan which makes the teacher more focused on carrying out learning and can make implementation time more efficient (Andrian & Rusman, 2019; Marbun et al., 2022).

The learning process is designed to contain activities that maximize the use of representations, both internal and external representations. Learning activities are designed to encourage student activity and bring about two-way learning. Students are directed to find concepts and solve problems related to phenomena that are often encountered in real life so that it can motivate them to find various information to solve problems (Novitra, 2021).

The results of the next validation are e-Worksheet and e-Handout as teaching materials. In terms of content, the results of the e-Worksheet and e-Handout validation obtained an average percentage score respectively, namely 88.09% and 91.10% with very high validity criteria. Content validity is viewed from the aspect of content feasibility and language feasibility, each of which is categorized as very good. This shows that in terms of content feasibility, the steps for presenting the MRs-based e-Worksheet and e-Handout are following the objectives to be achieved and according to the needs of students to study independently or in groups. Each step of the MRs-based e-Worksheet and e-Handout is designed by eliciting representational activities and facilitating the representational needs of students so that they can support the learning needs of different students.

Table 2. Results of Material Expert Test for Blended Learning Program based on Multiple Representations

Component	Percentage Validity (%)	Qualitative Statement
Syllabus	92.95	Very High Validity
Lesson Plan	97.47	Very High Validity
e- Worksheet	88.09	Very High Validity
e-Handouts	91.10	Very High Validity
Average	92.40	Very High Validity

The feasibility aspect of the contents of the e-Worksheet and e-Handout is also reviewed in terms of social systems, reaction principles, support systems, as well as instructional and accompaniment impacts. In a social system, the use of e-Worksheet and e-Handout allows interaction between students and other students as well as between students and teachers. This interaction can then build communication between them and the involvement of students in learning. In principle, the reaction allows the teacher to act as a facilitator and motivator in making strategies, giving directions and examples of solutions to solving problems, and giving reinforcement to students' opinions. The support system enables the use of media, both print and electronic, to seek information. In terms of instructional and accompaniment impacts can motivate students, and enable them to be active in learning, understand concepts, communicate orally, work together, and respect the opinions of others. In addition to the content feasibility aspect, e-Worksheet, and e-Handout content validation are also reviewed from the language feasibility aspect which shows that the language used is straightforward, communicative, dialogic, and interactive, following the level of development of students, presenting stages of learning that are coherent and coherent, and consistent in the use of terms, symbols, and icons.

Table 3. Media Test Results and Multiple Representations-based Blended Learning Program Designs

Component	Percentage Validity (%)	Qualitative Statement
e- Worksheet	91.39	Very High Validity
e-Handouts	95.65	Very High Validity
Average	93.52	Very High Validity

The validation of e-Worksheet and e-Handout is also reviewed in terms of media and design in the cover and content sections. The results of the validation of the media and the design of the blended learning program based on multiple representations can be seen in table 3 which shows an average acquisition of 93.52% validity with very high validity criteria. This shows that the quality of the media and design of the e-Worksheet and

the e-Handout blended learning program based on multiple representations which are developed as media and teaching materials is very good. In terms of design, the covers of the e-Worksheet and e-Handout have a center of view, a balance of composition and size of the layout elements, alignment of the cover design, alignment of the title color with the background, as well as a combination of fonts, each of which is very good. The illustrations presented in the e-Worksheet and e-Handout can describe the content/material, and have shapes, sizes, colors, and illustrated proportional objects under reality. Furthermore, the contents, the placement of the title, and layout elements are consistent, the print area and margins are proportional, the suitability of the shape, color, and size of the layout elements is good, has elements of page numbers, illustrations and descriptions of images, uses a combination of fonts, letters decorative, and a good variety of letters. This innovation was made to attract interest and motivate students in learning because the media presented is not only in the form of words or text, but consists of words or text, pictures, animations, and videos (Collins et al., 2002; Mayer, 2002). This is following the principle of MRs which can display various concepts using verbal methods, pictures, graphs, diagrams, tables, or mathematical equations simultaneously (Abdurrahman et al., 2019).

Overall, the results of validating the blended learning program based on multiple representations to stimulate complex problem-solving and reduce learning loss obtained a score of 92.96% with very high validity criteria. Therefore, a blended learning program based on multiple representations can be tested in the field to find out its practicality and effectiveness.

Conclusion

The validity of the multiple representations-based blended learning programs as a whole is included in the very high validity category. This criterion means that this learning program is feasible to be implemented in teaching and learning activities. Furthermore, the researcher suggests conducting research on the effectiveness and practicality of multiple representations-based blended learning programs in stimulating complex problem-solving and reducing students.

Author Contributions

The author's contribution in the field of education is the creation of a blended learning program based on multiple representations, aimed to enhancing the quality of physics education in Indonesia. The program is anticipated to be effective in improving teaching standards and valuable addition to the field.

Funding

The results indicate that a blended learning scheme grounded on various depictions is deemed valid, thereby enabling its application in physics educational endeavors.

Conflicts of Interest

No conflicts of interest.

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