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# Validation of ExPRession Learning Model-based E-Worksheet Assisted with Heyzine to Construct Computational Thinking Skill

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**Abstract**

This study aims to determine the validity of the e-worksheet based on the Expression Learning model to construct students' computational skills in direct current electric circuit material. This research was development research using Design, Development, and Research (DDR) which consisted of the analysis, design, development, and evaluation stages and used the mixed method to analyze the data. The instrument used to determine the validity of the developed e-worksheet product was an e-worksheet validation sheet. The e-worksheet validation sheet consisted of product and constructs design validity sheets which were validated by five experts who judged that the developed e-worksheet is very valid, with an average score for the construct validation test of 91.5% and an average score for design test validation of 89%. The research findings showed that ExPRession learning model-based e-worksheet assisted with Heyzine to construct computational thinking skill in direct current electric circuits material is very valid. This study provides evidence that applying the ExPRession learning model to the e-worksheet can construct students' computational thinking skills as one of the skills needed in the 21st century by teaching students the use of Microsoft Excel.

**Keywords:** Computational Thinking Skills; E-worksheet; ExPRession Learning Model; Heyzine

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## INTRODUCTION

The world has now entered the era of industrial revolution 4.0, which is characterized by the rapid development of Information and Communication Technology (ICT) that has had a significant impact on the lives of people (Hartini et al., 2017; Yunanto et al., 2018). In the 21st century, technological advances and developments in the field of education present theoretical constructions and realistic perspectives for the development and improvement of teachers' and students' knowledge (cognitive), skills (psychomotor), and attitudes (affective) (Leon-abao et al., 2015; Misbah et al., 2018). The implementation of the 2013 curriculum serves as a guide for the implementation of learning activities in schools that seek

to develop students' 21st-century competencies (Andrian & Rusman,2019; Redhana, 2019).

Learning & innovation skills-4C (critical thinking & problem solving, communication, collaboration, creativity), life & career skills, and information, media & technology skills are 21st century competencies. Information, media and technology skills, also known as digital literacy skills, are one of the six skills comprising information literacy, media literacy, and ICT literacy that students need to thrive in the digitally and globally interconnected world of the twenty-first century (Kivunja, 2015; Partnership, 2019). Present-day education incorporates digital literacy, one of which is computational thinking skill (Nelson et al., 2015).

Computational thinking skills are one of the skills required in the 21st century to assist students solve complex problems (Burke and Lia, 2015). Computational thinking skills are also defined as mental activities that are necessary in the current era due to the rapid and complex growth of Information Communication and Technology (ICT) (Ansori, 2020; Good, 2017). Computational thinking skill is broadly defined as the mental activity of abstracting a problem and formulating a solution that can be automated; therefore, it has the potential to be applied to various disciplines other than computer science and to significantly improve students' problem-solving skills and abilities as they learn start thinking in new ways (Yadav et al., 2014).

Computational thinking in education has the potential to significantly improve students' problem-solving skills; however, the literature on the implementation of computational thinking in curriculum settings is relatively sparse (Maharani, 2020: 65-67). Studies on computational thinking are still categorized as being insufficient; therefore, an introduction to computational thinking is necessary for students in the learning process (Ansori, 2020). The government, through the Minister of Education and Culture (Kemendikbud), Nadiem Anwar Makarim, is planning to add two new competencies to the learning system for Indonesian children, namely computational thinking and compassion, according to the Head of the Curriculum and Learning Center of the Ministry of Education and Culture, Awalludin Tjalla (Budiansyah, 2020).

Computational thinking is closely related to problem solving. This refers to mathematical thinking, particularly on direct current electric circuit material that requires understanding, reasoning, and proof. However, learning this material on schools more emphasizes problem solving, especially in the calculation section, lacks concept explanations and students' thinking processes evaluation. During discussions, students construct experiments infrequently and have not made connections between learning about conceptual and natural phenomena and their everyday applications (Rusilowati, 2012; Safrina et al., 2019). Several examples of physical phenomena in direct current electric circuits require abstract thought in terms of investigating physical objects to the order of the movement of electron currents, electric charges, and electromotive forces (emf) that cannot be observed directly (Noftiana et al., 2019).

This issue can be resolved with the aid of written instructional materials that include worksheets for more effective learning (Lee, 2014). E-worksheet refers to a type of worksheet that can be incorporated into electronic instructional materials (Haryanto et al., 2020; Lestari et al., 2021). E-worksheets can be used to overcome problems caused by the current Covid-19 pandemic, which

forces students to study from home online and transforms traditional learning into distance learning or online learning. Teachers can utilize e-worksheets through desktop computers, notebooks, smartphones, and mobile phones to assist the problem-solving process and to assure the effectiveness of learning activities (Ghozian et al., 2021; Haqsari, 2014; Kaymakci, 2012).

The results of preliminary research conducted through semi-structured interviews and the distribution of questionnaires in several high schools in Lampung and Bogor showed that one of the physics materials, namely direct current electric circuits, is typically taught using the Project Based Learning model in conjunction with lecture, discussion, and other teaching methods. The availability of e-worksheets in schools created by teachers and publishers and distributed to students via Google Classroom is less effective. In general, the activities and activities contained in the e-worksheet consist of creating problem representations, locating problems based on made predictions, formulating problems, testing hypotheses, engaging in group discussions, and drawing conclusions. Teachers generally do not cover phenomena associated with the components of direct current electric circuits. Teachers have introduced computational thinking skills to students as part of the learning process, but these skills are limited to simple calculations and graphing. Since students have not been trained to think abstractly and use heuristic reasoning by integrating ideas, data, and logic to find solutions, they have difficulty using the correct formula for every problem in the problem set, particularly when discussing Kirchhoff's law and the electrical resistance circuit.

This development research is inspired by previous studies such as the research conducted by Fakhriyah et al. (2017) which described the validation results of the development of scientific literacy-based instructional materials in developing computational thinking skills, the research by Khasyyatillah and Osman (2019) which developed modules utilizing the ADDIE model to promote computational thinking, the research by Muliyati et al. (2020) which developed worksheets utilizing the Problem-Based Learning model to train computational thinking skills, and the research by Fakhriyah et al. (2019) which developed scientific literacy-based instructional materials to improve computational thinking skills. Based on the explanations of these experts, it can be concluded that instructional materials developed through diverse learning models, such as ADDIE and Problem-Based Learning (PBL), were able to promote, train, and enhance computational thinking skills.

This study differs from previous research in which the previous research have not utilized e-worksheet using the ExPRession learning model, which includes activities to demonstrate phenomena (ill-structured problems), find problems based on predictions, translate problems into various forms of representation, formulate problems, and test hypotheses, conduct discussions, evaluate, and solve problems (well-structured problems) using useful description abilities, physics acceptance, and specific applications of physics, mathematical procedures, and logical progressions to construct students' computational thinking skills on the topic of direct current electric circuits. E-worksheet in learning developed with the aid of Heyzine contains many features including page effects, background, links, images, video, audio, and the web that make the e-worksheet more attractive. In addition, it becomes more effective because it can be easily accessed online using a smartphone or laptop. Since studies on computational thinking are still considered to be

limited, the researchers conducted research entitled validation of ExPRession learning model-based e-worksheet assisted with Heyzine to construct computational thinking skill. This study aims to determine the validity of the e-worksheet based on the Expression Learning model to construct students' computational skills in direct current electric circuit material.

## METHOD

This development research adapted Design and Development Research (DDR) from the development design by Richey and Klein (2007). DDR consists of four phases: the analysis phase, the design phase, the development phase, and the evaluation phase. The purpose of the analysis phase is to determine the need for e-worksheets by identifying problems through semi-structured interviews and disseminating needs analysis questionnaires to a number of schools in Lampung and Bogor. The research population comprised physics teachers and XII MIPA high school students from one public high school in Bogor and nine public high schools in Lampung. The research samples who completed the needs analysis questionnaire were physics teachers and XII MIPA high school students. The physics teachers at Bogor Senior High Schools and Lampung High Schools filled out the questionnaire for teacher analysis. Meanwhile, the students from seven public high schools in Bogor and Lampung filled out questionnaires for student analysis.

The identified problems are then compared to the government's plan for the demands of the 21st century, which involves adding computational thinking skills to the learning systems of Indonesian children so that they can solve problems using computational thinking skills. The analysis phase entailed collecting data pertaining to e-worksheet, the ExPRession learning model, direct current electric circuit material, and computational thinking by conducting literature studies by perusing books, journals, and online articles.

The design phase is the phase in which the researchers designed the product concept that will be developed. The design phase was conducted to aid the researchers in creating e-worksheets by locating and collecting references for making e-worksheets, designing e-worksheets, and continuing with the creation of instruments in the form of questionnaires for validity tests, readability tests, student response tests, and teachers' perception tests as well as for assessing computational thinking abilities. The development phase was based on the researchers' e-worksheet product design. Then, the researcher conducted a readability test, response test, perception test, and computational thinking assessment to determine the product's feasibility, readability, students' responses after utilizing e-worksheet, and teachers' perceptions of the e-worksheet usage in learning. The evaluation phase was carried out to determine the success of the e-worksheet product developed after small-group testing. The evaluation phase was comprised of formative and summative evaluations conducted to enhance the produced prototype. Formative evaluation was conducted to determine product quality based on expert-validity tests, while summative evaluation was conducted to examine students' comprehension of e-worksheet usage through small-group testing.

The instrument of this research was used to collect the data through interview guidelines and questionnaires (validity test, readability test, response test, and perception test). The method employed was a mixed method. A mixed method is a combination of qualitative and quantitative research techniques. Implementing the use of mixed methods in research was accomplished by

accumulating quantitative and qualitative data in stages (sequentially) or simultaneously (Creswell, 2003). This study employed validity test, practicality test, response test, and perception test as data analysis techniques.

Five experts in the disciplines of instructional media, materials, construct and design completed the questionnaire sheet regarding the validity of the e-worksheet product. The validity data were obtained from the material and construction expert test questionnaires, as well as the media and design expert test questionnaires that were filled out by the validators. Then, the validity was analyzed using percentage analysis (Sudjana, 2005). The percentage of validity data obtained was converted to criteria adapted from Arikunto (2011) as shown in Table 1.

Table 1 Product validity assessment score conversion

| Percentage | Criteria |
|---|---|
| 0,00% - 20% | Very low validity/ not good |
| 20,1% - 40% | Low validity/less good |
| 40,1% - 60% | Moderate validity/ good enough |
| 60,1% - 80% | High validity/good |
| 80,1% - 100% | Very high validity/ very good |

(Arikunto, 2011)

Based on Table 1, the researchers provided limitations that the e-worksheet product developed is categorized as valid for use in direct current electric circuit learning during the Covid-19 pandemic or face-to-face if the product meets the score that the researchers had determined, which is a minimum of 60% with the criteria for validity being moderate/sufficient.

## RESULT AND DISCUSSION

The results of the product validity test, which was conducted materially and structurally, as well as in media and design, as shown in Tables 2 and 3.

Table 2 Material and construct expert test results

| No. | AyD | SP | PK |
|---|---|---|---|
| 1 | Conformity of Content | 90% | Very high validity |
| 2 | Construction | 93% | Very high validity |
| Average | | 91,5% | Very high validity |

AyD : Assessed Aspect
SP : Examiner Score
PK : Qualitative Statement

The results of the material and construction expert test on the applicability of the material and construction received an average score of 91.5% with a very high validity category, indicating that the developed e-worksheet material is of very high quality.

Table 3 Media and design test results

| No. | AyD | SP | PK |
|---|---|---|---|
| 1 | Cover section | 88% | Very high validity |
| 2 | Contents section | 90% | Very high validity |
| Average | | 89% | Very high validity |

AyD : Assessed Aspect
SP : Examiner Score
PK : Qualitative Statement

The average score for the material and construction expert test on the cover's validity was 89%. This demonstrates the high quality of e-worksheet as an instructional material.

Based on Table 2 and 3 obtained an average percentage weight of 91.5% and 89% with very valid criteria. The validity of the material and construction in terms of the material's content and construction feasibility is categorized as exceptional. In terms of the applicability of the material's content and support systems, the feasibility of the material's content in e-worksheet validation is assessed. The constructability of e-worksheet validation is evaluated based on the simplicity of a sentence and the communication language employed. The

material content and construction of this e-worksheet meet the criteria for suitable instructional materials: accuracy in presenting theory, appropriate competence and scope of content, systematic organization, a student-centered orientation, and use of correct, comprehensible language (Sinaga, 2019; Wang et al., 2018).

The cover and content of the E-worksheet are validated based on a media feasibility and design aspect. The cover section of the e-worksheet includes the center of the view on the cover, the balance of the composition of the layout elements, the size of the layout elements, the harmony of the design, the harmony of colors, the combination of fonts, the illustrations presented, the proportion of shapes, sizes, and objects, as well as the color of the actual illustration objects. The e-worksheet's content section includes the application of layout elements, titles, print areas, and margins, information on figures and tables, a variety of typefaces, and pages. E-worksheets containing text, videos, and images serve as an innovation for teachers to pique students' interest in learning activities at schools (Collins, 2002; Mayer, 1999).

## CONCLUSION

E-worksheet based on Expression learning model assisted with Heyzine to construct computational thinking skill is declared valid with a very high validity value in terms of material and media based on product validation results and the judgment of experts. The validation analysis of the e-worksheet yielded an average score of 91.5% for the material and construction suitability aspect and an average score of 89.0% for the cover aspect, indicating that the e-worksheet can be administered to high school students.

This finding contributes to the practice of designing instructional materials that enhance students' computational thinking abilities in physics subject involving dynamic electrical materials. This study provides evidence that by implementing the ExPRession learning model to the e-worksheet, it is possible to develop students' computational thinking skills as one of the necessary skills for the 21st century by teaching students the use of Microsoft Excel.

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