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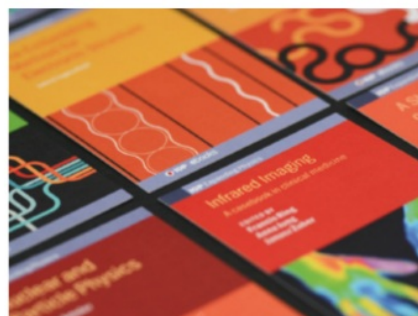
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The development of chemistry learning devices based blended learning model to promote students' critical thinking skills

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Abstract. The research aims to produce a valid, practical and effective chemistry learning devices based on a blended learning model to improve student critical thinking skills. The 4D development model was applied in this study. Testing of learning devices and tests of critical thinking skills are carried out on the tenth-grade students at high schools in the city of Mataram, West Nusa Tenggara, Indonesia. The one group pretest-posttest design was applied as a research design. The results showed that the validity of the developed chemical learning devices based on the blended learning model had an average value of syllabus, lesson plan, teaching materials, and critical thinking instruments were 82%, 86%, 72% and 70%, respectively. The practicality of the learning devices is tested through a blended learning processes. The chemistry learning devices have a practical criteria with a scoring percentage of 78%. Furthermore, the chemistry learning devices are effective in promoting critical thinking skills. The improvement of students' critical thinking can be seen from the increasing of their score from 55.3 to 82.2. In conclusion, the developed chemistry learning devices based on the blended learning model are valid, practical and effective criteria, and its applicable to promote students' critical thinking skills.

1. Introduction

Educational challenges of the 21st century are how to develop thinking skills of learners [1]. Among those skills are the skills to use information and communication technology and to train thinking skills [2]. The skills that learners need to be trained in order to meet the 21st century challenges is the ability to think critically [3]. Critical thinking skills is a process of thinking to decide and draw conclusions that can be accounted for by the relevant data includes the analysis, hypothesis, explain, argue and develop ideas [4,5]. The critical thinking skills direct the students to solve problems, investigate the evidence and assumptions from the concept being faces [6]. With critical thinking skills, students try to understand the situation, analyze the strengths and weaknesses of an object and then develop different points of view about the subject [7].

The importance of critical thinking skills training is the fact not yet in line with the learning conditions in schools at this time. The observations at the high schools in the Mataram city West Nusa Tenggara Indonesia showed that the efforts to promote critical thinking skills of students in chemistry learning has not been fully carried out by the teacher. In addition, the learning devices such as syllabus, lesson plans, teaching materials are not equipped with tools to train critical thinking skills.



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Furthermore, the schools has been supported by e-learning media, which should able to overcome the difficulties learners in understanding the chemical concept, but not optimally utilized as learning support, especially on chemistry learning proceses [8,9,10].

Based on the description and the above facts, this research focus on developing chemistry learning devices based blended learning models to promote the student critical thinking skills. The blended learning model is designed in which the students learn mostly through online content. The model combines face to face learning with online learning. This online content is supported by tools to control time, place, manner and learning speed [11]. Here, online learning means a process where learning material content delivered via internet access [12].

13 Methods

The 4D model development stages define, design, develop and disseminate was applied in this study [13, 14]. The development of learning devices focuses in syllabus, lesson plans, teaching materials, and instruments critical thinking skills, as well as testing the effectiveness of those devices to promote critical thinking skills. The developed critical thinking skills instruments refer to six indicators: questioning, argument analysis, decide a course of action, inducing and consider the results of induction, defining the term and consider the definitions and observing and considering the results of observations [15,16,17].

Validation of the learning devices carried by three validators. The validation are calculated using the following formula:

$$\text{Validity Percentage} = \frac{\text{Validator Total Score}}{\text{Maximum Score}} \times 100\% \quad (1)$$

Learning devices are feasible to use if they meet the eligibility criteria in Table 1 [18]:

Table 1. Validity Percentage

Percentage of Assessment Results (%)	Validity Level
80 – 100	Best Valid
66 – 79	Valid
56 – 65	Enough
40 – 55	Less
30 – 39	Invalid

The testing phase of learning and testing the effectiveness of the devices in class X MIA performed on one of the secondary schools in Mataram, West Nusa Tenggara-Indonesia, with a design using one group pretest-posttest design [19]. Effectiveness data analysis critical thinking abilities of learners were tested by administering tests about critical thinking essays as much as six questions to give an answer argument. The provision of these tests was conducted at the beginning of learning (pretest) and at the end of the study (post-test), which aims to determine the differences in the critical thinking skills of students after using learning tools developed. The results of the analysis of the calculation of the critical thinking skills of students were then divided into four categories [20], as presented in Table 2.

Table 2. Critical thinking skills assessment categories

Scale of Obtaining	Categories
> 81.25 - ≤100	very critical
> 62.50 - ≤ 81, 25	critical
> 43.75 - ≤ 62.50	less critical
≤ 25.00 - ≤ 43.75	very less critical

3. Results and Discussion

This development study focuses on the development of learning devices based blended learning model such as syllabus, lesson plans, teaching materials and instruments of critical thinking skill. Learning devices eligibility test data obtained from the questionnaires by three experts. The results of the validity test is depicted in Table 3.

Table 3. The validation results of the learning devices

Model learning devices blended learning	Percentage (%)	Validity Level
Syllabus	82.0	Best valid
Lesson plan	86.0	Best valid
Teaching materials	72.0	valid
Instrument critical thinking	70.0	valid
Average	77.5	valid

Table 3 shows the results of the validation test of the chemistry learning devices based blended learning model. The average percentage of the feasibility of the syllabus 82% with the criteria of best valid. The produced syllabus meet the criteria in the aspect of clarity, language and learning steps contained in the syllabus developed referring to the syntactic model of blended learning and indicators of critical thinking skills of learners. The average percentage of feasibility lesson plan 86% with the criteria of best valid. Learning activities in the lesson plan, for both at the stage of online and face-to-face are loaded with competency indicators and learning objectives for directing learners to be able to train their critical think skills. The average percentage of the teaching materials validity is 72% in valid criteria. The average validity percentage of critical thinking skill instruments is 70% with valid criteria after they had revision based on suggestions and feedback from the validators. The valid product then further undergo testing in the learning processes [21].

Practicality level of the chemistry learning devices based blended learning models has a percentage of 78% with practical criteria. The steps of the blended learning model applied by the teacher in learning chemistry are carried out well so that the level of practicality of the learning device can be measured properly. Learning devices are categorized as practical if their components can be implemented well by the teacher in classroom learning [22].

The effectiveness test of the developed devices is carried out by giving initial tests. This test aims to determine the students' initial critical thinking skills. Furthermore, students participate in learning with the chemistry learning devices using a blended learning model. At the end of the learning process, students are given a final test to find out the improvement in their critical thinking skills. Test data shows the differences in the results of the initial test and the final test after the application of learning tools by the teacher. Comparison of the results of the pretest and post test students' critical thinking skills is depicted in Figure 1.

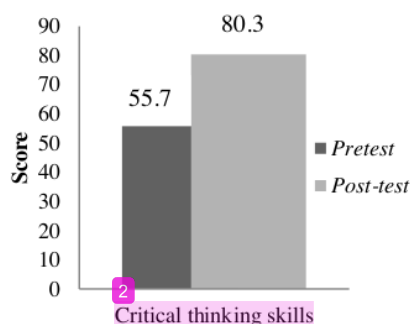


Figure 1. The effectiveness of critical thinking skills test results

Figure 1 shows that the difference in the results of the pretest and post-test of the critical thinking skills of learners. The developed chemistry learning devices based blended learning models have a significant effect on promoting the student critical thinking skills. The difference in the test scores of students' critical thinking skills before implementation and after implementation chemistry learning tool using the blended learning models can be seen in Figure 1. Students' critical thinking skills after implementing chemistry learning devices based on blended learning models have increased so that it can be concluded that the blended learning model is able to promote students' critical thinking skills. This finding is in accordance with previous research where blended learning is an effective learning strategy so students get concepts more easily. If students understand concepts well, the ability to think critically can develop [23,24]. Other finding shows that computer based learning such as virtual laboratory enhance students' conceptual understanding creativity, and science process skills [25]. Good science process skills will be able to develop critical thinking skills [26]. Furthermore, learning with e-learning also enhance student creativity and provide meaningful feedback for student work. The e-learning has been able to enhance creative thinking in aspects of fluency, originality, flexibility, and elaboration [27,28].

4. Conclusion

The developed chemistry learning devices based blended learning model are categorized valid, practical and effective in promoting students' critical thinking skills. The results showed that the average percentage of the validity of learning devices was 77.5% with valid criteria. The average percentage of practicality of chemical learning devices is 78% with practical criteria. The effectiveness of the chemistry learning devices is characterized as very critical based on the posttest critical thinking skill results, with initially 55.3 to 82.2 after the implementation of the devices

5. References

- [1] Jufri W 2015 *Belajar dan Pembelajaran Sains Bandung* Pustaka Reka Cipta
- [2] Jiniarti B E, Harjono A and Makhrus M 2019 Pengembangan Perangkat Model Pembelajaran Berbasis Masalah Berbantuan Virtual Eksperimen Untuk Meningkatkan Penguasaan Konsep Peserta Didik Pada Materi Alat-Alat Optik *Jurnal Pijar Mipa* **14** 2 25-30
- [3] Andayani Y, Hadisaputra, S and Hasnawati H 2018 Analysis of the Level of Conceptual Understanding In *Journal of Physics Conference Series* **1095** 1 012045
- [4] Sulistyowami P A D, Prahani B K, Supardi Z A I and Jatmiko B 2019 The effectiveness of OR-IPA teaching model to improve students' critical thinking skills on senior high school physics subject. In *Journal of Physics: Conference Series* **1157** 3 032011) IOP Publishing
- [5] Cañas A J, Reiska, P and Möllits A 2017 Developing higher-order thinking skills with concept mapping: A case of pedagogic frailty *Knowledge Management and E-Learning* **9** 3 348
- [6] Zulkarnain Z, Andayani Y and Hadisaputra S 2019 Peningkatan Keterampilan Berpikir Kritis Peserta Didik Pada Pembelajaran Kimia Menggunakan Model Pembelajaran Preparing Dong Concluding *Jurnal Pijar Mipa* **14** 2 96-101
- [7] Mashami R A and Gunawan G 2018 The Influence of Sub-Microscopic Media Animation on Students' Critical Thinking Skills Based on Gender In *Journal of Physics: Conference Series* **1108** 1 012106
- [8] Treagust D, Nieswandt M, and Duit R 2000 Sources of students difficulties in learning Chemistry *Educación química* **11** 2 228-235
- [9] Hakim A, Liliarsari L, Kadarohman A and Syah Y M 2016 Improvement of student critical thinking skills with the natural product mini project laboratory learning. *Indonesian Journal of Chemistry* **16** 3 322-328
- [10] Ramandha M E P, Andayani Y and Hadisaputra S 2018 An analysis of critical thinking skills among students studying chemistry using guided inquiry models In *AIP Conference Proceedings* **2021** 1 080007
- [11] Kumar A 2017 E-learning and blended learning in orthodontic education. *APOS Trends in*

- Orthodontics **7** 4 188
- [12] Wichadeeq S 2017 A Development of the Blended Learning Model Using Edmodo for Maximizing Students' Oral Proficiency and Motivation *International Journal of Emerging Technologies in Learning* **12** 2
- [13] Sugiyono 2018 *Metode Penelitian Kuantitatif, Kualitatif R and D* Bandung Penerbit Alfabeta
- [14] Azmy M K, Purwoko A A and Hadisaputra S 2018 The Development Of Chemistry Teaching Materials In The Form Of Handouts Based (PBL) In Class XI IPA Madrasah Aliyah Kediri District *IOSR Journal of Research & Method in Education* **8** 3 71-73
- [15] Arifin I S Z and Baginda U 2018 The Application of Inquiry Learning to Train Critical Thinking Skills on Light Material of Primary School Students In *Journal of Physics Conference Series* **1108** 1 012128
- [16] RH Ennis 2011 *The Nature of Critical Thinking: An Outline of Critical Thinking Dispositions* Univ. Illinois 1–8
- [17] Facione PA 2011 Critical thinking: What it is and why it counts. *Insight assessment* **1** 1-23
- [18] Ernawati I 2017 Uji Kelayakan Media Pembelajaran Interaktif pada Mata Pelajaran Administrasi Server *Elinvo Electronics Informatics and Vocational Education* **2** 2 204-210
- [19] Sugiyono 2017 *Metode Penelitian Kuantitatif, Kualitatif R and D* Bandung Penerbit Alfabeta
- [20] Klimovienė G, Urbonienė J and Barzdžiukienė R 2006 Developing critical thinking through cooperative learning *Kalby studijos* **9** 77-84
- [21] Ningsih Y C, Purwoko A A and Hadisaputra S 2018 Development Of Learning-Based Pogil (Process Oriented Guided Inquiry Learning) To Improve Mastery Of Base Student Concept Of Acid Base Material In Senior High School *IOSR Journal of Research & Method in Education* 04-06
- [22] Yustiqvar M, Gunawan G and Hadisaputra S 2019 Analisis Penguasaan Konsep Siswa yang Belajar Kimia Menggunakan Multimedia Interaktif Berbasis Green Chemistry *Jurnal Pijar Mipa* **14** 3 135-140.
- [23] Jou M, Lin Y T and Wu D W 2016 Effect of a blended learning environment on student critical thinking and knowledge transformation *Interactive Learning Environments* **24** 6 1131-1147
- [24] Gunawan G, Harjono A, Kusdiatuti M, Nisyah, M and Herayanti L 2019 Increasing Students' Critical Thinking Skills in Physics Using A Guided Inquiry Model Combined With an Advanced Organizer *Journal of Advanced Research in Dynamical and Control Systems* **11** 7 313-320
- [25] Gunawan G, Suranti N M Y, Nisrina N, Herayanti L and Rahmatiah R 2018 The effect of virtual lab and gender toward students' creativity of physics in senior high school In *Journal of Physics Conference Series* **1108** 1 012043
- [26] Gunawan G, Harjono A, Susilawati S and Dewi S M 2019 Generative Learning Models Assisted by Virtual Laboratories to Improve Students' Creativity in Physics *Journal of Advanced Research in Dynamical and Control Systems* **11** 7 403-411
- [27] Gunawan G, Harjono A, Hermansyah H and Herayanti L 2019 Guided Inquiry Model Through Virtual Laboratory to Enhance Students' Science Process Skills on Heat Concept *Jurnal Cakrawala Pendidikan* **38** 2
- [28] Adawiyah R., Harjono A and Gunawan G and Hermansyah H 2019 Interactive E-Book Of Physics to Increase Students' Creative Thinking Skills on Rotational Dynamics Concept In *Journal of Physics: Conference Series* **1153** 1 012117.

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