23 (4), 2022, 1348-1357

Jurnal Pendidikan MIPA

e-ISSN: 2550-1313 | p-ISSN: 2087-9849

http://jurnal.fkip.unila.ac.id/index.php/jpmipa/

Effectiveness of Guided Discovery-Based Worksheets to Improve Learning Outcomes in Acid-Base Concept

Marla Ma'firah*, Rahadian Zainul

Department of Chemistry, Universitas Negeri Padang, Indonesia

Abstract: This research was conducted to develop students' worksheets based on guided discovery learning on acid-base materials. This student worksheet will be the basic content for developing a content learning system to improve the learning outcomes of 11th grade high school students in the pandemic era. Research and Development (R&D) using the ADDIE model is the research method used. Based on the research that has been carried out, the validity as measured by the Aiken's V formula is 0.85 which indicates that the developed students' worksheets are valid. The value of practicality of teachers and students was obtained by 84% and 88% which indicated the very practical category. Then, the N-Gain value obtained is 54.68% which indicates that worksheet is effective in improving student learning outcomes. So it can be concluded that this student worksheet is valid, practical, and effective to be used as a basic content in developing a content learning system based on guided discovery learning on acid and base.

Keywords: students' worksheets, guided discovery, acid-base.

Abstrak: *Penelitian ini dilakukan untuk mengembangkan lembar kerja siswa (LKS) berbasis pembelajaran penemuan terbimbing pada materi asam basa. LKS ini akan menjadi konten dasar untuk mengembangkan sistem pembelajaran konten untuk meningkatkan hasil belajar siswa kelas 11 SMA di era pandemi. Penelitian dan Pengembangan (R&D) dengan menggunakan model ADDIE merupakan metode penelitian yang digunakan. Berdasarkan penelitian yang telah dilakukan, validitas yang diukur dengan rumus Aiken's V adalah 0,85 yang menunjukkan bahwa LKS yang dikembangkan valid. Nilai kepraktisan guru dan siswa diperoleh sebesar 84% dan 88% yang menunjukkan kategori sangat praktis. Kemudian nilai N-Gain yang diperoleh sebesar 54,68% yang menunjukkan bahwa LKS efektif dalam meningkatkan hasil belajar siswa. Sehingga dapat disimpulkan bahwa LKS ini valid, praktis, dan efektif untuk digunakan sebagai materi dasar dalam mengembangkan sistem pembelajaran konten berbasis pembelajaran penemuan terbimbing pada asam basa.*

Kata kunci: *lembar kerja siswa, penemuan terbimbing, asam-basa.*

▪ INTRODUCTION

Chemistry is a field of science that is often said to be difficult. Most students when they first get acquainted with chemistry have the assumption that chemistry is a subject that only revolves around doing practical work in the laboratory. This can be said to be true because basically chemistry is an experimental science in which almost all of the material is the result of research in the laboratory. When compared with other sciences, chemistry is a little more difficult with special vocabulary and abstract concepts (Chang & Overby, 2011)

Acid-base solution material is one of the 11th grade high school chemicals in the even semester listed in the syllabus with basic competence 3.10, namely explaining the concepts of acids and bases as well as their strength and equilibrium in solution, and

Marla Ma'firah
*Email: marlamafirah96@gmail.com

DOI: http://dx.doi.org/10.23960/jpmipa/v23i4.pp1347-1357
Received: 14 September 2022
Accepted: 25 October 2022
Published: 07 November 2022

basic competence 4.10, namely Analyzing the pH change route of several indicators extracted from natural materials through experiments (Yerimadesi, Bayharti, et al., 2019) This material discusses the concepts of acids and bases according to experts experts, how the development of acid-base theory, classification of acid-base substances, and determination of the pH of a solution with indicators and calculations. Students' worksheets are one of the means to assist and facilitate teaching and learning activities so that an effective interaction will be formed between students and educators, so as to increase student activities in improving learning achievement.

Students' worksheets are a type of learning media that is intended to help students learn in a directed manner. The existence of students' worksheets has a considerable influence on the teaching and learning process so that the preparation of students' worksheets must meet various requirements such as didactic, construction, and technical requirements. understudy worksheets are one of the learning resources that can be developed by masters as facilitators in learning activities (Sri Utami, Ruja, & Utaya, 2016). The prepared students' worksheets can be designed and developed according to the conditions and situations of the learning activities that will be faced. Students' worksheets are also a learning medium because they can be used together with learning resources. Using students' worksheets as a process assessment instrument can assist the master in assessing the work process and student work results, such as the results of group discussions, experimental activities, evaluations, and independent exercises.

The function of students' worksheets is used as a reference to guide the implementation of learning activities and also as a tool to assess the learning process. Process assessment can be interpreted as an assessment of the ongoing learning process, which emphasizes student activity and creativity in acquiring knowledge, skills, values, and attitudes to achieve a goal. Using students' worksheets as a process assessment instrument can assist the master in assessing the work process and student work results, such as the results of group discussions, experimental activities, evaluations, and independent exercises. The results of the assessment of this process can prove that students are able to understand concepts and construct knowledge more deeply. Scientific discovery learning is an action-based learning method that emphasizes experimentation and hypothesis testing (Aini, Majid, & Majid, 2018). Guided learning can be defined as a type of learning in which students construct their own knowledge by experimenting with domains, and infer rules from the results of these experiments. (Bamiro, 2015) Guided Discovery Learning is based on the assumption that education is a process, not a set of facts (Yerimadesi, Kiram , et al., 2019).

Learning occurs when students build an understanding of newly discovered information by relating it to previous knowledge in an organized and systematic manner. The basic idea of revelation learning is that students can design their own experiments in space and infer the rules of space itself, thereby truly building their knowledge. Because of this constructive activity, it is assumed that they will understand space at a higher level than when the required information is only presented by the master or expository learning environment (Ardianto & Rubini, 2016). In Guided discovery learning, students learn by exploring and interacting with their environment. However, the findings should not be random, but systematic. In practical application, students are allowed to formulate their own learning objectives. They should be given resources to help them create and build knowledge. Students are required to have some

initial knowledge and skills to formulate a valid and useful guest. Students are often frustrated by the lack of information provided by the teacher. This requires a lot of practice on the part of students in framing guests, hypothesizing, and theorizing and it does not happen in all situations (Atiyah, Miarsyah, & Sigit, 2020).

In a pandemic condition, the implementation of distance learning is also an obstacle for students and teachers in achieving learning goals because there are no interesting media or teaching materials that can be used online (Daniel, 2020). So, after being developed, this Student Worksheet will be used as basic content in developing learning system content as a learning innovation during the pandemic and after the pandemic (Sriadhi et al., 2020).

▪ METHOD

The method in this study is Research & Development (R&D) with the ADDIE model. (Shelton & Saltsman, 2011) The population in this study were students of class XI MIPA SMA N 14 Padang, while the sample selected was 40 students of class XI MIPA 2. The sample was selected using purposive sampling technique (Barratt, Ferris, & Lenton, 2015). In addition, the research subjects also consisted of 3 chemistry education lecturers at Padang State University and 3 chemistry teachers from SMA N 14 Padang.

The study was conducted for 6 months. This research was conducted according to the research model in ADDIE. This ADDIE model is used for the development of media, teaching materials, learning models, and learning strategies (Molenda, 2003). The research procedure includes 5 stages, namely analysis, design, development, implementation, and evaluation. The first stage is analysis, at this stage there are 3 analyzes, namely needs analysis, curriculum analysis and student character analysis. This analysis was obtained from observations made by filling out questionnaires by teachers and students. Needs analysis was conducted to determine the needs of teachers and students in learning. Curriculum analysis is carried out so that the material to be presented is in accordance with the learning objectives. While character analysis is carried out to determine the character and ability of students in learning, using the internet, computers, and interest in the material to be delivered.

The second stage is Design, at this stage a development design is made which will be a reference in the development of learning media. The structure of the student worksheet is designed in this phase. Next, the Development stage is carried out, the researcher makes a product which is then validated by material experts and media experts, then revised according to the validator's assessment. The implementation stage is the fourth stage of the ADDIE model, namely the trial stage in order to obtain student and teacher responses in the use of products that have been developed. The last stage is evaluation, at this stage an evaluation of whether the resulting product is appropriate and suitable for use in learning (Nadiyah & Faaizah, 2015)

Validity sheets, practicality sheets, and evaluation of learning outcomes are some of the instruments used in research. The validity sheets evaluated by experts, three chemistry education lecturers, and three chemistry teachers, were instruments used to determine the validity of students' worksheets. There are several aspects to this validation sheet, including content feasibility, construction feasibility, linguistic component, and graphic component. The Likert scale, which uses a range of 1-4 to indicate different levels of validity, serves as the basis for evaluating the validity of this

student worksheet. (Joshi, Kale, Chandel, & Pal, 2015). The practicality questionnaire is an instrument used to measure practicality.40 students and three chemistry teachers completed this survey.THere are some aspects of this questionnaire, including usefulness, efficiency, and ease of use. Fill out the questionnaire using a Likert scale of one to four. The effectiveness instrument used is a quasi-experimental (Cook, 2014), with a post-test group pre-test design (Tesch, 2016). Multiple choice questions will be used to collect data in the form of scores to determine changes in student learning outcomes before and after participation in learning (Masak, 2014).

The assessment given by the validator of each statement was analyzed using Aiken's V formula. The formula proposed by Aiken is as follows: (Aiken, 1985)

$$V = \frac{\sum s}{n\,(c\text{-}1)}$$

which: $S = r\text{-}lo$, lo = the lowest validation score, c = the higher validation score, R = the given score by validators, N = number of validators.

The level of validity of students' worksheets based on guided discovery learning will be seen after being converted to the validity category according to the Aiken's V scale. If the Aiken's V score obtained is less than 0.8, then the development is declared invalid. Meanwhile, if the Aiken's V value obtained is large or equal to 0.8 then the development is declared valid. The practicality questionnaire that has been filled out by teachers and students after the practicality test process is then analyzed. The results of the questionnaire were analyzed by dividing the score obtained by the maximum score then multiplied by 100%. Practical values from teachers and students are classified into several categories. For a value range of 81 – 100 will be categorized as very practical. Then 61 - 80 in the practical category, 41 - -60 in the less practical category, 21 - 40 in the impractical category and 0-20 in the very impractical category (Amanda Putra, Rahim, & Azis Nabawi, 2018).

For the analysis of effectiveness data, the value of N-Gain is used. After obtaining student scores from the test, the normalized gain value is calculated using the N-gain formula. According to (Hake, 1998), the N-Gain value obtained can be categorized into 3 categories, namely if the N-Gain value is large or equal to 0.7 then it is included in the high category, if the N-Gain value is between 0.3 to 0, 7, then it is categorized in the middle category. While the N-Gain which is smaller than 0.3, is categorized in the low category.

▪ RESULT AND DISSCUSSION

Based on the objectives and research procedures that have been carried out, a student worksheet entitled acid-base based on guided discovery learning is produced for students of class XI SMA/MA. This student worksheet based on guided discovery learning has been validated by 3 lecturers of chemistry education at Padang State University and 3 teachers of chemistry subjects and a practical test has been carried out at SMA N 14 Padang. This study was designed using the ADDIE model.

At this stage of needs analysis, information is collected on the obstacles and problems in the chemistry learning process in schools. Based on the information obtained from the results of questionnaires distributed to students and several schools in 3 Padang City public high schools, namely SMA N 1 Padang, SMA N 13 Padang, and

SMA N 14 Padang, it is necessary to develop students' worksheets based on guided discovery learning to support (Hamid, Lee, Taha, Rahim, & Syarif, 2021)

Curriculum analysis aims to formulate indicators and learning objectives that are in accordance with the competencies expected in accordance with the 2013 curriculum. The 2013 curriculum aims to improve spiritual attitudes, increase knowledge and improve students' skills . Learning objectives in accordance with the 2013 curriculum must make students who are able to be active in learning and can find and understand the concepts of the material being taught so that the guided discovery learning model needs to be applied to support the learning process.

The student worksheet design was developed according to the following syntax guided discovery learning. The first stage is the stage of motivation and problem presentation. This stage is a stage that aims so that students can observe the problems given related to acid-base material, then students can understand the problems raised. This stage is displayed in the form of pictures and brief descriptions as well as problems in the form of questions related to the picture. An example of the motivational stage and problem presentation is shown in Figure 1. (Atiyah et al., 2020)


Motivasi dan Penyampaian Masalah *(Motivation and Problem Presentation)*

Tabel 1. Contoh Asam dan Basa

Asam Lambung (HCl)	Obat Maagh ($Mg(OH)_2$)
Asam Cuka (CH_3COOH)	Sabun (KOH)

Pada lambung manusia terdapat cairan HCl yang membantu proses pencernaan, cairan ini sering disebut sebagai asam lambung. Lalu, ada asam cuka yang digunakan sehari-hari. Mengapa kedua cairan diatas disebut sebagai asam ? Bagaimana sifat larutan tersebut?

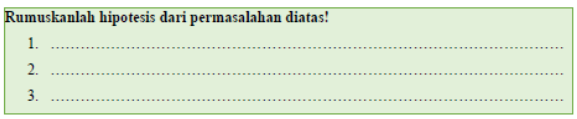
Ketika seseorang mengalami sakit maagh, maka diberikan obat yang dapat menetralkan asam dalam lambung yaitu basa, salah satunya obat yang mengandung $Mg(OH)_2$. Lalu, untuk membersihkan tubuh saat mandi digunakan sabun yang salah satu kandungannya adalah KOH yang merupakan basa. Mengapa kedua zat tersebut disebut basa? Bagaimana sifat zat tersebut?

Penyampaian Masalah

1. Mengapa HCl dan CH_3COOH disebut sebagai asam?
2. Mengapa $Mg(OH)_2$ dan KOH disebut sebagai basa?
3. Bagaimana konsep asam basa menurut teori Arrhenius?

Figure 1. Motivation and problems statements

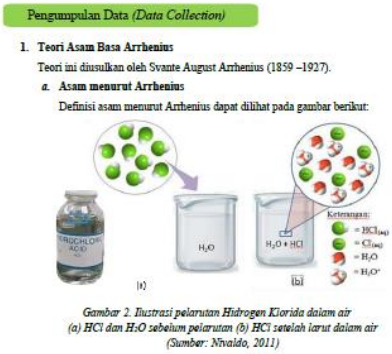
After the motivation and problem presentation stage, then proceed to the hypothesis. At this stage, students propose hypotheses from the problems that have been stated previously. An example of the hypothesis stage can be seen in Figure 2.


Rumuskanlah hipotesis dari permasalahan diatas!

1. .....
2. .....
3. .....

Figure 2. Hypothesis

Next is the data processing stage. At this stage, students can analyze and collect information in various ways and sources, such as pictures, books, and videos. An example of the stages of data collection can be seen in Figure 3.



Gambar 2. Ilustrasi pelarutan Hidrogen Klorida dalam air (a) HCl dan H_2O sebelum pelarutan (b) HCl setelah larut dalam air (Sumber: Nivaldo, 2011)

Figure 3. Data collection

At the data processing stage, students answered the questions given with the aim of solving problems and finding concepts from the material being studied. Then proceed with the verification stage. At this stage, students prove the truth of the hypothesis that has been stated previously. Examples of data and verification can be seen in Figure 4. In the last stage, students formulate conclusions that have been obtained during learning. The closing view is shown in Figure 5.

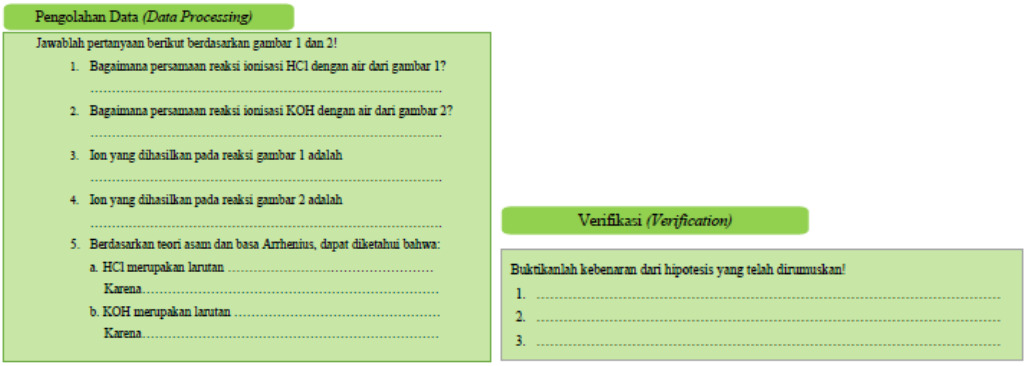


Figure 4. Data processing and verification

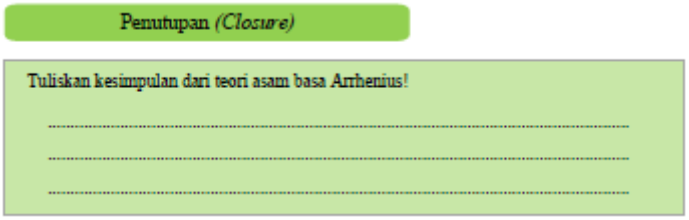


Figure 5. Conclusion

After the design stage, the research continues to the development stage. This development stage consists of a validation process. The validity test was conducted by 3 chemistry education lecturers at Padang State University and 3 chemistry subject teachers at SMA N 14 Padang. The selection of 6 validators is in accordance with the opinion of WHO which states that to test the validation of an instrument a minimum of 3 assessors is required. Thus (Sugiyono, 2014), the more validity values obtained, the more realistic. The purpose of the validity test is to test the level of validity of students' worksheets based on guided discovery blended learning that has been developed. Students' worksheets validity is a test of the validity of the student worksheet display, material content, language, and syntax used in developing students' worksheets. While the validity of the media or e-learning is a test of the validity of the e-learning display, ease of use, and audio-visual aspects of the use of e-learning. Each component has several question items that will be assessed by the validator.

Tabel 4. The validity results of worksheet

Criteria	Average score (k)	Category
Content Eligibility	0.87	Valid
Construction Eligibility	0.83	Valid
Linguistics Component	0.85	Valid
Graphic Components	0.86	Valid
Middle	0.85	Valid

Aiken's V for aspects content eligibility is 0.87 with a valid category. The content feasibility aspect shows the suitability of the material with core competencies, basic competencies, and learning objectives. This shows that the students' worksheets made are in accordance with the related basic competencies. The validity of this content feasibility aspect shows that the development of this student worksheet is in accordance with the existing curriculum.

The validity of the construction feasibility aspect based on table 5 produces a V Aiken value of 0.83 with a valid category. This shows that the construction of the developed students' worksheets has been well and systematically arranged according to the components of the students' worksheets. The preparation of this student worksheet is referred to in accordance with the preparation guidelines from the Ministry of Education and Culture. There is a systematic compatibility of the preparation of these components with the guided discovery learning model and has a relationship with the material being studied. (Matanluk, Mohammad, Kiflee, & Imbug, 2013). The validity of the linguistic aspect is an assessment related to the use of language in displaying material in students' worksheets. The V Aiken value obtained for the linguistic aspect is 0.85 with a valid category. The question shows that the students' worksheets that have been made have used Indonesian which is in accordance with the improved spelling. In addition, the delivery of language in students' worksheets is easy for students to understand and does not use confusing terms. The last aspect that is assessed from the student worksheet is the graphic aspect. This aspect examines the details of the appearance of the student worksheet such as layout, symbols, animations, illustrations, and how they are positioned in the student worksheet. the graphic aspect obtained a V Aiken value of 0.86 with a valid category. The score indicates that the graphic aspect in

the student worksheet is appropriate and proportional. Symbols and animations can be seen clearly with appropriate colors and fonts and do not make students bored reading them.

The overall value of the validity of the student worksheet is in the valid category. In the following, there are still some aspects that require revision according to suggestions from several validators. The results of the data analysis of the validity of students' worksheets by 6 validators are shown in table 3 which shows that of the 4 aspects assessed to determine the feasibility of students' worksheets, the V Aiken value is obtained which indicates that the average of these aspects is considered valid, which is 0.85.

After the development stage, the research continued to the implementation stage. At this stage the practicality test and effectiveness test are carried out. The implementation of the practicality test involved 3 teachers and 40 students who took part in chemistry lessons. Each teacher and student was given a questionnaire containing a review of students' worksheets used in learning. Then the data obtained from the questionnaire was analyzed to get the percentage of practicality of students' worksheets. The results of the practical analysis of teachers and students are shown in table 5 and table 6.

Table 5. practicality assessment by teachers

Criteria	Practicality (%)	Category
Ease of use	84	Very practical
Time Efficiency	83	Very practical
Benefit	86	Very practical
Middle	84	Very practical

Table 6. practicality assessment by students

Criteria	Practicality (%)	Category
Ease of use	86	Very practical
Time Efficiency	89	Very practical
Benefit	88	Very practical
Middle	88	Very practical

The teacher practicality score of 84% was achieved by showing that the category was very practical, as shown in the table above. In contrast, students received a score of 88% for practicality, placing them in the very practical category as well. A product is considered practical if it has been developed with a practicality value greater than 61 percent. Therefore, the developed students' worksheets can be categorized as practical based on the findings of the practicality analysis for teachers and students (Hajar & Fauzan, 2020).

The results for the practicality of teachers and students are presented in the very practical category. This shows that the high level of practicality of the students' worksheets produced has a positive effect on the ease with which students and teachers use this learning media. Students and teachers alike benefit from using students' worksheets, which can also reduce study time by making learning more efficient.

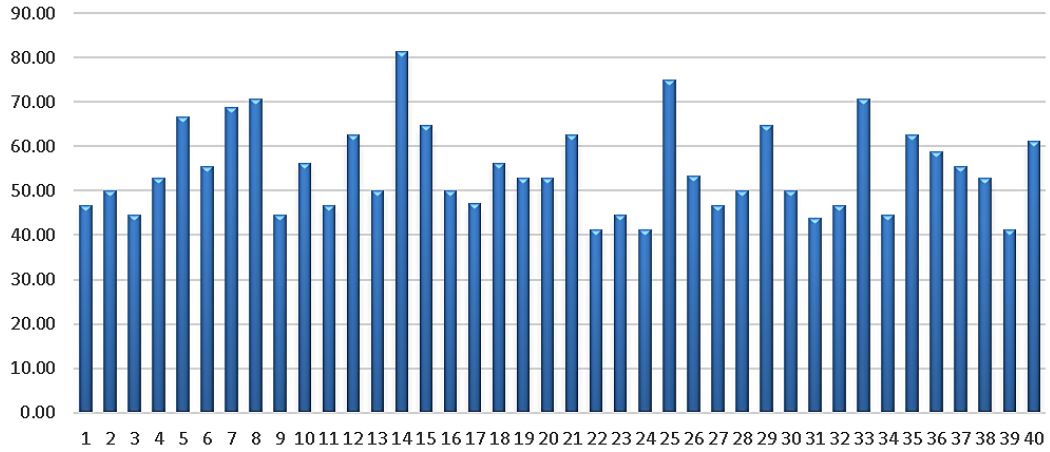


Figure 6. Average N-gain

After that, a quasi-research-based effectiveness test was conducted through the formation of pre-test and post-test groups. The formula for calculating the N-Gain percentage is used to assess the effectiveness of the previously created worksheets for students. Figure 6 shows the N-Gain graph of 40 students in class XI MIPA 2. The average N-Gain value of 54.68% is obtained from the N-Gain analysis, indicating that the developed students' worksheets are effective to a moderate level. Based on these findings, it appears that students' worksheets can improve learning outcomes. In this study, the use of students' worksheets can improve learning outcomes, which can be influenced by a number of factors, one of which is the use of good learning media (Istuningsih, Baedhowi, & Sangka, 2018).

Students' worksheets have been successfully developed in this study. The resulting students' worksheets are valid, practical, and effective in improving student learning outcomes so that this development can be said to be successful (Schachter, 2015). So that the students' worksheets that have been produced can be used as basic content in the development of content learning systems for further research.

▪ CONCLUSION

Based on the research that has been done, students' worksheets based on guided discovery learning on acid-base material with the stages of motivation and problem presentation, data collection, data processing, verification, closure have been successfully developed. The resulting students' worksheets have been analyzed so that they can be categorized as valid products according to the validation results from expert assessors. The practicality of this student worksheet is stated to be very practical. This student worksheet has also been effective in improving student learning outcomes. The students' worksheets that have been developed can be used directly or used as basic content in developing media or more innovative learning systems such as content learning systems. In the development of students' worksheets, there are still various shortcomings, especially in appearance. For this reason, it is hoped that further researchers can develop students' worksheets with a more attractive appearance.

▪ REFERENCES

Aiken, L. R. (1985). Three Coefficients for Analyzing the Reliability and Validity of Ratings. Educational and Psychological Measurement, 45(1), 131–142.

Aini, N., Majid, A., & Majid, N. A. (2018). Augmented Reality to Promote Guided Discovery Learning for STEM Learning. International Journal on Advanced Science Engineering Information Technology, 8(4–2), 1494–1500.

Amanda Putra, Z., Rahim, B., & Azis Nabawi, R. (2018). The Practicality of Learning Module Based on Jigsaw-Cooperative Learning Model in Media Education Course. Advances in Social Science, Education and Humanities Research (ASSEHR), 201, 48–52.

Ardianto, D., & Rubini, B. (2016). Comparison of students' scientific literacy in integrated science learning through model of guided discovery and problem based learning. Jurnal Pendidikan IPA Indonesia, 5(1), 31–37.

Atiyah, U., Miarsyah, M., & Sigit, D. V. (2020). The Effect of Using E-Learning Based Guided Discovery Learning Model Based on Self-Efficacy Towards Student Learning Outcomes In Biology Class in Reproductive System Subject in High School. International Journal for Educational and Vocational Studies, 2(9), 789–796.

Bamiro, A. O. (2015). Effects of guided discovery and think-pair-share strategies on secondary school students' achievement in chemistry. SAGE Open, 5(1).

Barratt, M. J., Ferris, J. A., & Lenton, S. (2015). Hidden Populations, Online Purposive Sampling, and External Validity: Taking off the Blindfold. Field Methods, 27(1), 3–21.

Chang, R., & Overby, J. (2011). General Chemistry: The Essential Concepts Sixth Edition (Sixth Edition). New York: McGraw-Hill.

Cook, T. D. (2014). Quasi-experimental design. In S. C. Cooper (Ed.), Wiley Encyclopedia of Managemen (pp. 1–2). Jhon Wiley & Sons, Ltd.

Daniel, S. J. (2020). Education and the COVID-19 pandemic. Prospects, 49(1–2), 91–96.

Hajar, I., & Fauzan, A. (2020). Analysis of the Practicality of the PjBL Model for Biology Lectures. Advances in Social Science, Education and Humanities Research, 504, 152–157.

Hake, R. R. (1998). Interactive-engagement versus traditional methods: A six-thousand-student survey of mechanics test data for introductory physics courses. American Journal of Physics, 66(1), 64–74.

Hamid, S. N. M., Lee, T. T., Taha, H., Rahim, N. A., & Sharif, A. M. (2021). E-Content Module For Chemistry Massive Open Online Course (Mooc): Development And Students' Perceptions. Journal of Technology and Science Education, 11(1), 67–92.

Istuningsih, W., Baedhowi, B., & Sangka, K. B. (2018). The Effectiveness of Scientific Approach Using E-Module Based on Learning Cycle 7E to Improve Students' Learning Outcome. International Journal of Educational Research Review, 3(3), 75–85.

Joshi, A., Kale, S., Chandel, S., & Pal, D. (2015). Likert Scale: Explored and Explained. British Journal of Applied Science & Technology, 7(4), 396–403.

Matanluk, O., Mohammad, B., Kiflee, Dg. N. Ag., & Imbug, M. (2013). The Effectiveness of Using Teaching Module based on Radical Constructivism toward Students Learning Process. Procedia - Social and Behavioral Sciences, 90(2013), 607–615.

Molenda, M. (2003). In search of the elusive ADDIE model. Performance Improvement, 42(5), 34–36.

Nadiyah, R. S., & Faaizah, S. (2015). The Development of Online Project Based Collaborative Learning Using ADDIE Model. Procedia - Social and Behavioral Sciences, 195(2015), 1803–1812.

Schachter, R. E. (2015). An Analytic Study of the Professional Development Research in Early Childhood Education. Early Education and Development, 26(8), 1057–1085.

Shelton, K., & Saltsman, G. (2011). Instructional Design: Concepts, Methodologies, Tools and Applications. Hershey: IGI Global.

Sri Utami, W. S., Ruja, I. N., & Utaya, S. (2016). The Effectiveness of Geography Student Worksheet to Develop Learning Experiences for High School Students. Journal of Education and Learning, 5(3), 315–321.

Wahyuningtyas, N., Zainul, R., Adri, M., Wedi, A., Surahman, E., Aisyah, E. N., ... & Adnan, E. (2020, July). Development of moodle-based content learning system in MKDK student development subjects at LPTK in Indonesia. In Journal of Physics: Conference Series (Vol. 1594, No. 1, p. 012021). IOP Publishing.

Sugiyono, S. (2014). Metode Penelitian kuantitatif, kualitatif dan R & D [Quantitative, Qualitative and R & D Research Methods]. Bandung: Alfabeta.

Tesch, A. (2016). Implementing Pre-Post Test Designs in Higher Education Evaluations. New Directions for Evaluation, 2016(151), 85–96.

Yerimadesi, Y., Bayharti, B., Azizah, A., Lufri, L., Andromeda, A., & Guspatni, G. (2019, April). Effectiveness of acid-base modules based on guided discovery learning for increasing critical thinking skills and learning outcomes of senior high school student. In Journal of Physics: Conference Series (Vol. 1185, No. 1, p. 012151). IOP Publishing.

Yerimadesi, Y., Kiram, Y., Lufri, L., Festiyed, F., & Guspatni, G. (2019). Validity and practicality of guided discovery learning models for chemistry learning in senior high school. Journal of Physics: Conference Series, 1317(1), 1–8.