

Development of A Chemistry E-Module Based on Project Based Learning Using the Flipbook Application to Improve Learning Outcomes and Train Collaboration on Acid Base Material

Nadila Cempaka Hany*, Dewi Syafriani

Medan State University

*Corresponding Author: nadilacempakah@gmail.com

Abstract: This research aims to: (1) determine the validity of PjBL-based e-modules, (2) determine the practicality of PjBL-based e-modules, (3) determine the effectiveness of PjBL-based e-modules, and (4) determine whether there is a significant correlation between collaboration and learning outcomes. This research was conducted at SMA Negeri 1 Stabat with the sample studied being class Data analysis techniques were carried out by: e-module feasibility test according to BSNP, collaboration skills test, and correlation test between collaboration skills and learning outcomes. The results obtained in this research are: (1) The PjBL-based E-module is said to be "valid" after being validated by 1 chemistry lecturer with an average material assessment of 89% and an average media assessment of 95% which can be categorized as "very worthy"; (2) PjBL-based e-modules are said to be "practical" after receiving chemistry teacher responses with an average percentage of 97% which can be categorized as "very feasible" and student responses with an average rating of 87%; (3) The PjBL-based e-module is said to be "effective" with a posttest score of 82.17 which has increased from 47.33. So the N-Gain score was obtained at 0.66 (65.72%) which is in the medium criteria; (4) There is a positive and significant correlation between collaboration skills and student learning outcomes where r_{count} is 0.593 and r_{table} is 0.361

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Introduction

The very rapid development of information technology in the 21st century has had a very significant impact on the world of education (Simanjuntak, 2019). The 21st century is marked by the rapid development of science and technology so that science and technology are one of the important foundations in nation development (Kemendikbud, 2016). With the development of technology, the world of education is required to innovate and make optimal use of technology. Global demands also encourage the world of education to always adapt to developments in technology and communication to improve the quality of education, especially the application of technology in the learning process (Ashari et al., 2023). Therefore, the quality of education must be improved. Schools as educational institutions are required to train creative thinking skills, critical thinking and problem solving, communication and collaboration or what is usually called the 4Cs (Septikasari, R., 2018).

One of the 4C skills is collaboration. Collaboration skills are the ability to be able to develop good relationships with other people or friends, especially in learning activities by respecting each other so that a good learning atmosphere is created.(Aldian & Wahyudiati, 2023). Based on observations at SMA Negeri 1 Stabat, collaboration skills are still less than optimal. This can be seen from some students being less active and not involved in group discussions. Lack of level of cooperation, responsibility for tasks, respect and respect for friends' opinions during discussions and presentations makes learning less effective(Nuzalifa, 2021). For this reason, students are required to have collaboration skills. Based on the results of observations at SMA Negeri 1 Stabat during chemistry lessons, it can be seen that there is no discussion process in class because the material is only explained by the teacher in front of the class. This means that the teacher has not trained collaboration skills in the class and learning is still focused on the cognitive domain.

To train collaboration skills, this can be done in the classroom learning process. Classroom learning should train students to have collaboration skills in addition to achieving learning outcomes. To get learning outcomes and collaboration skills, learning should be carried out using the right learning model and media. However, it turns out that from the results of an interview with one of the chemistry teachers at SMA Negeri 1 Stabat, his teaching method was dominantly the lecture method, which means learning was teacher-centred and the media used was limited, namely only textbooks. Teachers never use e-modules because textbooks are the main source of learning provided by the government and loaned to each student. With this assistance from the government, teachers are more focused on exploring the contents of the textbooks that will be taught to students, because of this teachers do not create e-modules and only use textbooks.

Based on the results of an interview with one of the chemistry teachers at SMAN 1 Stabat, it is known that the students' learning outcomes in the acid-base material are less than satisfactory, this can be indicated by the cognitive score obtained which is less than the KKM (78), this happens because the students do not have an understanding beginning of chemistry. From the results of interviews with several students, they said that they actually liked chemistry lessons but only certain material was easy to understand, and they didn't understand the acid-base material themselves because the learning resource used was a textbook while the contents of the textbook were incomplete regarding acid material. base.

One learning model that can be used to improve collaboration skills and learning outcomes in acid-base material is the Project Based Learning model. PjBL is a model that uses projects as the core of the learning to be carried out. The PjBL learning model is a learning model that involves students in problem solving activities and provides opportunities for students to work autonomously to construct their own learning and ultimately produce student work products of realistic value.(Sunita et al., 2019). The PjBL model requires students to learn and produce work, therefore this model can increase student motivation to learn, increase student skills in problem solving and increase student cooperation in group work(Saputro & Rayahu, 2020).

Previous research states that the PjBL model can increase students' activeness in solving acid-base material problems, increase collaboration by working with students in working on projects during practicum, citing information obtained from trusted books and literature.(Siburian et al., 2021). Other research states that the application of the STEAM-integrated PjBL model to acid-base material shows that students have developed critical and creative thinking, problem-solving abilities, collaboration and argumentation and responsibility skills.(Annisa et al., 2018).

Schools provide textbooks as a learning resource. Package books are the main source for teachers to convey material in class, especially in the field of chemistry studies. The reality that occurs in the field is that the books used in the learning process are books from the government which are lent to each student, and teachers never use e-modules as a learning resource.

Learning media must also support the learning process, one of the media that can be used is e-modules. E-modules are a substitute for printed modules as learning or information resources (Romayanti et al., 2020). Implementing e-modules can encourage active students and facilitate them in learning. The difference between printed modules and e-modules is in their physical form, while the constituent components remain the same.

Previous research stated that there was an increase in learning outcomes based on the N-gain, namely 0.78, which can be classified as high when implementing PjBL-based e-modules (Siregar, 2020). Other research also stated that there was an increase in learning outcomes after testing the effectiveness of the PjBL-based e-module on the topic of acids and bases, namely by carrying out the N-gain test and obtained a result of 0.76 in the high category. (Nurhayati, 2023).

But above all, from the results of the analysis carried out by researchers regarding the existing PjBL e-module there are still several shortcomings, namely the writing is not neat, there is no attractiveness such as pictures that support the material and only black and white writing, the learning objectives are not in accordance with ABCD principles, basic competencies and competency achievement indicators are not made in tabular form, there are no videos in the module, and also the activities that students must carry out still seem to be doing practicums rather than making projects, namely by proving the pH value with universal indicators.

Research Method

The research carried out is included in development research, which refers to the development of Research and Development (R&D) with the ADDIE research model which consists of 5 research stages, namely Analysis, Design, Development, Implementation, and Evaluation. This research produces a product in the form of a PjBL based e-module using the flipbook application to access class XI Acid and Base material.

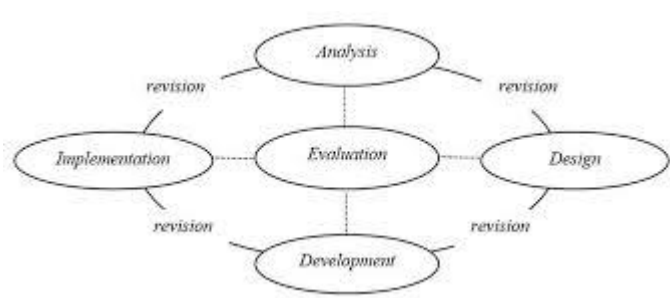


Figure 1. ADDIE procedure

This research was conducted at SMA N 1 Stabat which is located at Jl. Proclamation No. 3 Kwala Bingai, Stabat District, Langkat Regency, North Sumatra 20811. This research was conducted in the even semester of the 2023/2024 academic year starting from January 8 to February 2 2024.

The subjects in this research are validators. There is 1 validator in this research, namely the material expert validator and the overall media expert validator. Meanwhile, the object of this research is the e-module that will be developed. The e-module that becomes the development product will be validated by material expert validators and media expert validators. Apart from that, the practicality of the e-module will also be seen by asking for responses from 1 chemistry teacher and 33 students, and the effectiveness of the e-module will also be seen from the results of the students' pretest and posttest. This was done to see the feasibility of the e-module that has been developed.

The instruments used in this research were questionnaires, interview sheets, observation sheets, test questions, and validation sheets. Data processing in this research was carried out using descriptive analysis, including feasibility analysis and data analysis of learning outcomes and collaboration skills.

The data collection method in this research is to use a validation questionnaire to determine the validity of the e-module from material experts and media experts, as well as to determine the practicality of the e-module by asking for the responses of 1 chemistry teacher and the responses of 33 students. Test questions are used to see improvements in student learning outcomes. And use observation sheets to collect information regarding the implementation of the PjBL learning model and students' collaboration skills.

The research procedure includes 5 stages including: 1) Analysis, at this stage the researcher analyzes needs such as gap analysis, analysis of student characteristics, source analysis, syllabus analysis, KD, KI and reference analysis 2) Design, at the stage The researcher compiled a task list, analyzed the content and created an e-module design. 3) Development, at this stage the researcher starts creating the e-module then validates it with media and material expert validators and then revises the e-module. 4) Implementation, e-module teaching materials that have been validated can then be used in learning activities with a sample of 1 class, then provide pretest questions. 5) Evaluation At this stage the researcher tests the students' achievement of understanding regarding acid-base material after using the e-module by giving a post-test.

Data analysis in this research uses qualitative descriptive analysis which describes the results of product development in the form of PjBL-based e-module teaching materials. The data collected can be grouped into two, namely quantitative data in the form of numbers and qualitative data in the form of words. Qualitative data will be analyzed logically, while quantitative data will be analyzed using average calculations. Data on learning outcomes will be analyzed using the N-Gain test, data on e-module feasibility and collaboration skills will be analyzed using averaging techniques, data on collaboration skills and learning outcomes will be analyzed with a correlation test using the product moment formula which previously will be analyzed using a data homogeneity test and regression linearity test.

Result and Discussion

The main result of this research is a chemical e-module product based on PjBL. This research was carried out at SMA Negeri 1 Stabat which is located at Jl. Proclamation No. 3 Kwala Bingai, Stabat District, Langkat Regency, North Sumatra 20811 involving 1 class which was given treatment by learning using a PjBL based e-module which had been developed on Acid and Base material in the even semester of the 2023/2024 academic year. This PjBL-based chemistry e-module was developed using the ADDIE model which consists of 5 stages, namely analysis, design, development, implementation and evaluation.

➤ **Validity test**

The results of e-module validation by material experts and media experts show good results. The validator assesses the suitability of the e-module for use as research material by assessing several aspects, namely suitability of the curriculum, accuracy of the material, clarity of evaluation, accuracy of presentation of the material and conformity with writing rules. The results of the material and media expert validator assessment can be seen in Figure 1 and Figure 2.



Figure 3. graph of media expert assessments

E-module is said to be valid if it reaches the criteria of feasible and very feasible. Based on the calculation results of the scores given by the validator for the material assessment aspect, an average percentage of 89% was obtained, which can be said to be "very feasible". For the media assessment aspect, an average percentage of 95% was obtained, which can be said to be "very appropriate."

➤ **Practicality Test**

Meanwhile, the results of the practicality assessment based on teacher and student responses also showed good results. After providing assessments and suggestions, the researcher revised several suggestions from the teacher such as writing errors, decorative composition and material content. The following graph results from the assessment of teacher responses and student responses can be seen in Figure 3 and Figure 4.



Figure 4. Teacher response assessment graph

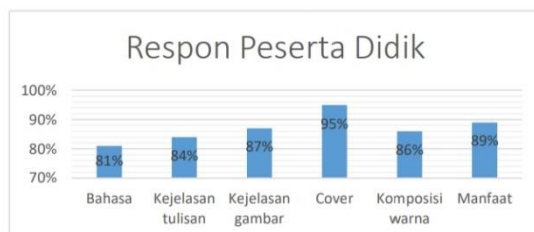


Figure 4. Graph of student response assessment

E-module is said to be practical if it reaches the criteria of feasible and very feasible. Based on the results of the calculation of the grades given, the average percentage was 97% and could be said to be "very feasible" and based on the students' responses, the average percentage was 87% which was included in the "very feasible" criteria.

➤ **Effectiveness Test**

After carrying out the treatment and giving pretest and posttest questions, N-Gain score data was obtained with an average pretest score of 47.33 and an average posttest score of 82.17. From these results it can be seen that the N-Gain score obtained was 65.72 which can be categorized as Quite Effective.

This is in line with Siregar's research, 2020, which stated that there was an increase in learning outcomes based on the N-gain, namely 0.78, which can be classified as high when implementing PjBL-based e-modules. Nurhayati's research, 2023, also stated that there was an increase in learning outcomes after testing the effectiveness of the PjBL-based e-module on the acid-base topic, namely by carrying out an N-gain test and obtained a result of 0.76 in the high category.

Data on N-Gain score results based on the average pretest and posttest scores can be seen in table 1

Table 1. N-Gain Score Results Data

No.	Average	Mark	N-Gain	Category
1	Pretest	47.33	65.72	Effective enough
2	Posttest	82.17		

➤ **Test Collaboration Skills**

From the observation results, the percentage obtained at meeting 1 was 77%, then it increased at meeting 2 by 89% and experienced another increase at meeting 3 with a percentage of 100%. Thus the average percentage of the 3 meetings is 87%, this means there is an increase in collaboration skills during 3 meetings

This is in line with research by Siburian, et al, 2021 which states that the PjBL model can increase students' activeness in solving acid-base material problems, increase collaboration by working with students in working on projects during practicum, citing information obtained from trusted books and literature. Annisa, et al, 2018 also said that the application of the STEAM-integrated PjBL model in acid-base material shows that students have developed critical and creative thinking, problem-solving abilities, collaboration and argumentation and responsibility skills. For more clarity regarding the percentage of collaboration skills, see table 2

Table 2 Percentage of Collaboration Skills

No.	Activity	Average number of values	Percentage
1	Meeting 1	92.7	77%
2	Meeting 2	107.0	89%
3	Meeting 3	120.0	100%
Average			87%

➤ **Normality Test**

The normality test is carried out to determine whether the data is normally distributed or No. In this study, testing was carried out using the Mann Whitney test. Decision making data in the normality test, namely, if the value of the Mann statistic Whitney $<$ Mann Whitney critical value then there is a significant difference. The following Mann Whitney test table is shown in table 4.11. Calculations can be done see attachment 25.

Table 4. Normality Test Table

No.	Data	Nilai U	Nilai Var (U)	Zhitung	Ztabel
1	Collaboration	900	4574	6,653	1,96
2	Learning Outcomes	0			

Based on the table above, it can be seen that the Zcount value is equal to 6.653 and the Ztable value is 1.96. So it can be concluded that the data there is a significant difference because $Z_{count} > Z_{table}$.

➤ **Linearity Test**

The linearity test was carried out using analysis of variance. This linear test decision making data means that if $F_{count} > F_{table}$ then the data has a linear and significant relationship. The following linearity test table is shown in table 5

Table 5. Linearity Test Table

Diversity Source	Db	JK	KT	Fcount	Ftable (0.05)(1)(28)
Regression (R)	1	451.12	451.12	15,16	4.20
Remainder (S)	28	833.05	29.75		
Total	29	1284.1			

Based on the table above, it can be seen that the $F_{count} > F_{table}$ value is at a significance level of 5%, which means there is a linear and significant relationship between variable X and variable Y.

➤ **Correlation Test**

In this research there are 2 variables, namely learning outcomes (X) and collaboration skills (Y). The correlation results obtained between the two variables are 0.59366958. Correlation results data can be seen in table 5.

Table 5. Correlation Test Table

	<i>Collaboration</i>	<i>Learning outcomes</i>
Collaboration	1	
Learning outcomes	0.59366958	1

After being analyzed using the Product Moment formula, the posttest scores of 30 students and the average score of the students' collaboration skills from meetings 1-3 were analyzed for correlation and a calculated value of 0.593 was obtained. The results obtained are consulted to the product moment point price with $N = 36$ at a real significance level = 0.05, obtained $r_{table} = 0.329$. Because $r_{count} > r_{table}$ then H_0 is rejected. Thus, it can be concluded that there is a positive and significant correlation between collaboration skills and learning outcomes using PjBL-based chemistry e-modules on acid-base material. α

Conclusion

Based on the research that has been carried out, the following conclusions can be drawn: 1) E-module PjBL based on acid base material is said to be "valid" after being validated by 1 chemistry lecturer. For the material assessment aspect, an average of 89% was obtained, which can be categorized as "very adequate". Meanwhile, for the media assessment aspect, an average of 95% was obtained, which can be categorized as "very adequate". 2) E-module PjBL based on acid base material is said to be "practical" after receiving responses from one of the chemistry teachers at SMA Negeri 1 Stabat and 33 class can be categorized as "very feasible". Meanwhile, the results of student responses obtained an average of 87%, which can be categorized as "very feasible". 3) E-module PjBL based on acid base material was said to be "effective" after being taught to students, the average pretest score was 47.33 and the average posttest score increased to 82.17, thus obtaining an N-Gain score of 0.66 (65.72%) which can be categorized as "Fairly Effective" and is in the "medium" criteria. 4) There is a positive and significant correlation between collaboration skills and learning outcomes. The posttest scores of 30 students and the average score of students' collaboration skills from meetings 1-3 were analyzed for correlation and an r-calculation value of 0.593 was obtained. The results obtained are consulted to the product moment point price with $N = 30$ at a real significance level = 0.05, obtained $r_{table} = 0.361$. Because $r_{count} > r_{table}$ then H_0 is rejected. Thus, it can be concluded that there is a positive and significant correlation between collaboration skills and learning outcomes using PjBL-based chemistry e-modules on acid-base material. α

Recommendation

Researchers have several suggestions after conducting this research, including:

1. PjBL-based chemistry e-module teaching materials on acid-base material need to be refined again, to produce more useful and high-quality products.
2. It is necessary to develop PjBL-based chemistry e-module teaching materials on other materials that are tailored to students' needs and the conditions of each school so that learning activities can be effective and enjoyable.

References

- Aldian, H., & Wahyudiati, D. (2023). Analisis Pengaruh Bahan Ajar Kimia Berbasis IT Terhadap Keterampilan Kolaborasi dan Komunikasi Siswa. *Jurnal Paedagogy*, 10(1), 207.
- Annisa, R., Hsb, M. H. E., & Damris, M. (2018). Peningkatan Kemampuan Berpikir Kreatif Siswa dengan Menggunakan Model Project Based Learning Berbasis STEAM (Science, Technology, Engineering, Arts Dan Mathematic) pada Materi Asam dan Basa di SMAN 11 Kota Jambi. *Journal of the Indonesian Society of Integrated Chemistry*. 10(2), 42–46.
- Ashari, V. R., Fatirul, A. N., & Walujo, D. A. (2023). Pengembangan E-Modul Kimia Materi Asam Basa Berbasis Flip PDF Professional untuk Peserta Didik Kelas XI SMA Negeri 1 Menganti. *Jurnal Pendidikan Dan Pembelajaran*, 4(2), 1391–1398.
- Julia, I., Utami, L., Islam, U., Sultan, N., Kasim, S., Islam, U., Sultan, N., & Kasim, S. (2020). Desain Dan Uji Coba E-Modul Kimia Berbasis Problem Solving Pada Materi Larutan Penyangga Untuk Kelas XI SMA Semester II. *Journal of Research and Education Chemistry (JREC)*, 2(1), 1–11.
- Kemendikbud, 2016. Silabus Mata Pelajaran Sekolah Menengah Atas/ Madrasah Aliyah (Sma/Ma): Mata Pelajaran Kimia
- Lubis A., P., dan Iswendi (2020). Validitas Permainan Ular Tangga Kimia Sebagai Media Pembelajaran Pada Materi Asam Basa Kelas XI SMA / MA The Validity of Chemical Ladder Snake Game. *Edukimia* 3(1), 65-71
- Nurhayati, N. (2023). Pengembangan E-Modul Asam Basa Model Project Based Learning (PjBL) Terintegrasi Science, Technology, Engineering, Art, And Mathematics (STEAM) pada Peserta Didik SMKN 9 Bulukumba. *Chemistry Education Review, Pendidikan Kimia PPs UNM*, 6(2), 127–133.
- Nuzalifa, Y. U. (2021). Penerapan Model Pembelajaran Think Pair Share (Tps) Berbasis Lesson Study Sebagai Upaya Untuk Meningkatkan Keterampilan Kolaborasi Mahasiswa. *Jurnal Pendidikan Dan Pembelajaran Sains Indonesia (JPPSI)*, 4(1), 48–57.
- Romayanti, C., Sundaryono, A., & Handayani, D. (2020). Pengembangan E-Modul Kimia Berbasis Kemampuan Berpikir Kreatif Dengan Menggunakan Kvisoft Flipbook Maker. *Alotrop*, 4(1), 51–58.
- Saputro, O. A., & Rayahu, T. S. (2020). Perbedaan Pengaruh Penerapan Model Pembelajaran Project Based Learning (Pjbl) Dan Problem Based Learning (Pbl) Berbantuan Media Monopoli. *Jurnal Imiah Pendidikan dan Pembelajaran* 4(April), 185–193.
- Siburian, B. K., Rampe, M. J., & Lombok, J. Z. (2021). Penerapan Model Project Based Learning (PjBL) Pada Materi Asam Basa di Kelas XI IPA SMA Negeri 2 Tondano. *Oxygenius* 3(2), 76–80.
- Simanjuntak, M. (2019). Membangun Ketrampilan 4 C Siswa Dalam Menghadapi Revolusi Industri 4.0. *Prosiding Seminar Nasional Fakultas Ilmu Sosial Universitas Negeri Medan*, 3, 921–929.
- Sunita, N. W., Mahendra, E., & Lesdyantari, E. (2019). Pengaruh Model Pembelajaran Project Based Learning Terhadap Minat Belajar Dan Hasil Belajar Matematika Peserta Didik. *Widyadari*, 20(1), 127–145.
- Yuliani, F., & Herlina, L. (2015). Pengembangan Buku Saku Materi Pemanasan Global untuk SMP. *Unnes Journal of Biology Education*, 4(1), 104–110.