



Received : 02 April 2022

Revised : 26 April 2023

Accepted : 28 April 2023

Publish : 30 April 2023

Page : 44 - 51

Effects of Implementing Innovative Character Integrated Chemical Bond Modules to Improve Learning Outcomes and Character

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Abstract: So far, students' textbooks have merely filled them with concepts that must be memorized, rather than inviting them to think as a process of creating their knowledge and experience to locate the concepts that they must grasp for themselves. As a result, the purpose of this research is to investigate the impact of unique chemical bond modules linked with established characteristics on student learning outcomes and character. This study included 20 chemical education students as participants. This study includes data analysis, the creation of novel teaching materials, validation by professional lecturers, and deployment to assess student learning results. There is an influence on the learning outcomes of students who are taught using the Innovative Chemical Association book which integrates character with students who are taught using used textbooks, according to the data from the hypothesis test results obtained a significance of $0.002 < 0.005$ then the Integrated Innovative Chemical Association Character Book can develop student character values with an average 85.53% in very good category.

Keywords: module; chemical bonding; character; learning outcomes.

INTRODUCTION

Education is one component of life that has always been prioritized in terms of promoting the dignity of individuals, communities, and nations. Achievement of educational goals may be accomplished through enhancing education quality, which can be demonstrated in the form of student learning results and changes in behavior toward students in formal education (Yanti et al., 2020). During the teaching and learning process, instructors frequently miss changes in student behavior (Arifin et al., 2019).

Education, particularly for students, shapes human character. Character education in schools must include all components, including the education component itself, such as curriculum content, learning and assessment processes, relationship quality, subject handling or management, school management, implementation of curricular activities or activities, infrastructure empowerment, financing, and work ethic for all residents and the school environment (Pratiwi et al., 2019).

Although chemistry is a result of natural knowledge in the form of facts, hypotheses, principles, and laws derived from scientific labor processes, it is regarded one of the most challenging topics (Yanti, 2021). Because the chemistry is abstract, students frequently struggle to grasp it (A. D. B. Simangunsong & Pane, 2021). These challenges might result in students having a poor comprehension of many chemical topics. Students solely utilize commercial texts during the learning process. So far, students' textbooks have just filled them with concepts that must be memorized, rather than inviting them to think as a process of developing their knowledge and experience to identify concepts that must be comprehended by themselves, as well as their significance and relevance to life (A. D. Simangunsong, 2020).

Using the instructional material module is one way to help students overcome their obstacles (Wartika et al., 2021). Modules are learning tools or tools in which materials, procedures, and evaluation are developed in a systematic and planned manner to meet the desired competency goals. Modules are properly and explicitly constructed depending on each student's understanding pace, encouraging students to learn according to their capacities (Zakaria et al., 2020). Some of the requirements for developing modules as learning resources include their accessibility to students, their capacity to help students study independently, and their facilitation of complete and up-to-date teaching materials (Winoto & Prasetyo, 2020). A good module should be attractively packed according to the subject area and include suitable graphics, illustrations, examples of queries or contextual scenarios to enhance teaching (Rupa & Sumbi, 2021).

The usage of modules in learning has been shown to improve student progress. According to the findings of a study, the percentage increase in student learning outcomes in the experimental class in the high group was greater than the control class (67.42% > 51.72%), and the percentage increase in student learning outcomes in the

experimental class in the low group was greater than the control class (67.91% > 60.81%). Wijaya and Vidiyanti (2020) also conducted study on the use of modules in learning. The findings revealed that there were disparities in learning outcomes between students who used the chemical learning module and those who did not.

Learning innovation is required specifically to create new learning that can deliver improved learning outcomes, boost the efficiency and efficacy of learning, and lead to renewal. Learning innovation to improve student learning accomplishment in chemistry courses is critical since it is related to enhancing the quality of graduates in filling chemistry-related employment. Internalizing character values in chemistry learning and incorporating them in the teaching materials to be utilized can be one of the learning innovation efforts.

LITERATURE REVIEW

Achievement of educational goals can be accomplished through enhancing education quality, which can be demonstrated in the success of formal education in the form of student learning outcomes and changes in behavior toward students (Yanti et al., 2020). During the teaching and learning process, instructors frequently miss changes in student behavior (Arifin et al., 2019). Character education in schools must include all components, including the education component, such as curriculum content, learning and assessment processes, relationship quality, subject handling or management, school management, implementation of curricular activities or activities, infrastructure empowerment, financing, and work ethic. all citizens, as well as the school atmosphere (Pratiwi et al., 2019). Because chemistry is a result of natural knowledge in the form of facts, hypotheses, principles, and laws derived from scientific work processes, it is one of the most challenging topics (Yanti, 2021).

Because chemical content is abstract, students frequently struggle to understand it

(A. D. B. Simangunsong & Pane, 2021). So far, textbooks have merely filled students with concepts that must be memorized, rather than inviting students to think as a process of developing their knowledge and experience to identify concepts that must be grasped by themselves, as well as their meaning and relevance to life (A. D. Simangunsong, 2020). Using the instructional material module is one way to help students overcome their obstacles (Wartika et al., 2021). Modules are properly and explicitly constructed depending on each student's understanding pace, encouraging students to learn according to their capacities (Zakaria et al., 2020). Some of the requirements for developing a module as a learning resource include student accessibility, the capacity to assist students learn independently, and the provision of complete and up-to-date teaching resources (Winoto & Prasetyo, 2020).

A good module should be attractively packed according to the subject area and include suitable graphics, illustrations, examples of queries or contextual scenarios to enhance teaching (Rupa & Sumbi, 2021). The usage of modules in learning has been shown to improve student progress (Situmorang, 2013). Furthermore, research on the use of modules in learning has been conducted by (Wijaya & Vidianti, 2020).

METHODS

This study's population consisted of all HKBP Nommensen Pematangsiantar University students. This study's sample consists of Chemistry Education Students. Purposive sampling was utilized in this investigation to choose samples. Purposive sampling is sampling that is carried out solely on the researcher's assumption that the desired elements already exist in the members of the sample taken. The steps taken in the research are referred to as the research procedure. Figure 1 depicts the research procedure. The stages of the research procedure can be explained as follows:

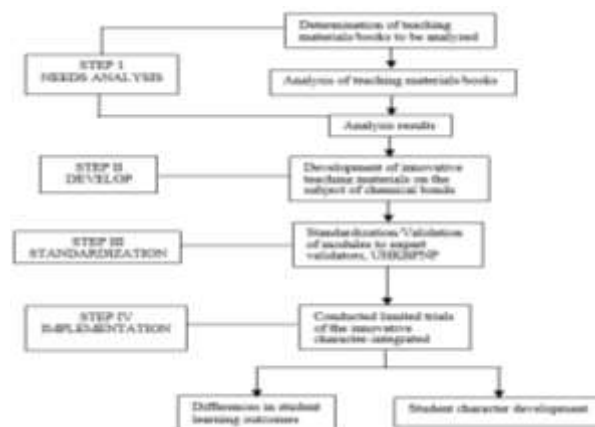


Figure 1. Procedure

(1) Chemistry Module Conformance Test Sheets (2) Character Observation Sheets were used to collect data for this study. (3) Test Questions on Learning Outcomes.

The learning outcomes test data was evaluated to see whether there were disparities in student learning results. A data precursor test, namely the data normality and homogeneity test, was performed prior to evaluating the hypothesis.

- The normality test was used to determine whether the research data was normally distributed. This refers to whether the data distribution is normal in the population. The Kolmogorov-Smirnov technique was used to test data normality using SPSS 17.0 for Windows. If Assymp.sig (2-tailed) > 0.05, the data is said to be normally distributed.
- The homogeneity test is used to examine whether the data distribution in a population is homogeneous. Homogeneity testing was performed using the Levene's Test technique in SPSS 17.0 for Windows, with the probability value or Sig value greater than 0.05 indicating that the research data has a homogenous variant or comes from a homogeneous (same) population.
- The hypothesis is tested using learning outcomes data that passed the initial analysis test. Hypothesis testing is used to assess if a hypothesis is accepted or rejected. The two-party Independent Sample T-test in SPSS 17.0 for Windows was used to test the hypothesis. If the Sig.

(2-tailed) ($\alpha=0.05$), the hypothesis is accepted.

- d. The normalized gain formula (N-Gain) can be used to calculate the increase in learning outcomes.

Value and Classification of N-Gain Normalization to Determine High and Low Achievement of Student Learning Outcomes in Table 1.

Table 1. Normalized N-Gain Values and Classification

The average (N-gain)	Classification
$0.7 \leq N\text{-gain}$	High
$0.30 \leq N\text{-gain} < 0.70$	Medium
$N\text{-gain} < 0.30$	Low

RESULT AND DISCUSSION

Before beginning the investigation, the researcher performed a preliminary examination of chemistry textbooks on chemical bonding materials published by publishers A, B, and C (Stage I examination). In accordance with the amended BSNP standards, textbooks were analyzed to evaluate their eligibility level in terms of content feasibility, language feasibility, and presentation feasibility. Figure 2 depicts the findings of the chemistry textbook analysis.

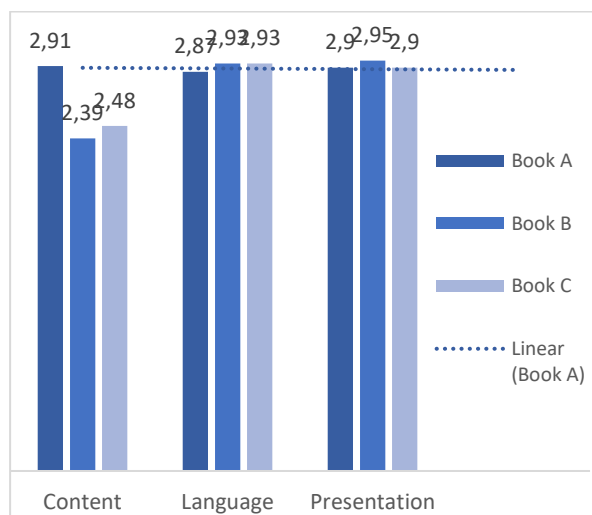


Figure 2. Graph of Analysis Results of Chemistry Textbooks A, B, and C

Following an examination of the textbooks of publishers A, B, and C, the development (Phase II, Development) of

novel chemical bond modules integrated with the characters was undertaken. In the construction of the produced chemical bond module, deficiencies based on the findings of an analysis of chemical textbooks on the subject of chemical bonds are utilized as a reference.

The designed Character Integrated Innovative Chemical Bonds Module was validated using a modified National Education Standards Agency (BSNP) eligibility standard. As shown in Figure 3, the produced module is evaluated based on three BSNP eligibility standards: content eligibility, language eligibility, and presentation eligibility.

The following stage is the implementation stage, which is used to determine how much the use of the chemical bond innovation module, which is integrated with character values, has a beneficial impact on learning outcomes as well as the growth and development of student character. A small-scale trial was carried out at the University of HKBP Nommensen Pematangsiantar.

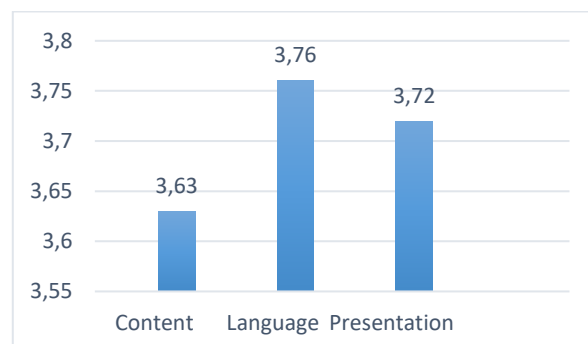


Figure 3. Graph of Feasibility Analysis Results of Character Integrated Chemical Bond Module

This study included two classes: one experimental class taught with a new chemical bonding module combined with PBL characters and models, and one control class taught with a chemistry textbook used at HKBP Nommensen University and the PBL model.

Prior to receiving differing therapy, the two samples were given a pretest or pretest to determine the students' starting ability. The

pretest contained a total of 25 questions. Table 2 shows the outcomes of the students' pretests in the experimental and control classrooms.

Table 2. Pretest Data of Experimental and Control Class Students

Class	Mean	Standard deviation	Highest score	Lowest score
Experiment	24.69	7.06	40	12
Control	25.00	7.85	40	12

Table 3 summarizes the average posttest scores for the experimental and control classes based on the data acquired from the research outcomes.

Table 3. Posttest Data of Experimental and Control Class Students

Class	Mean	Standard deviation	Highest score	Lowest score
Experiment	80.89	5.58	92	72
Control	77.00	4.52	88	72

The normalized gain (N-gain) can be calculated using the results of the pretest and posttest to determine the level of students' understanding of chemical bonding. Table 4 provides a summary of the experimental and control class N-gain data.

Table 4. Normalized Gain Data

Class	Mean	Standard deviation	Highest score	Lowest score
Experiment	0.75	0.07	0.89	0.53
Control	0.69	0.05	0.80	0.61

Normality testing is used to determine whether data is regularly distributed. The Kolmogorov-Smirnov test was used to determine data normality. If the probability or sig value is greater than 0.05, the data is considered normal. Table 5 displays the normality test results for experimental and control student data.

Table 5. Data Normality Test Results for Experiment Class and Control Class

Class	Data	Sig	α	Description
Experiment	Pretest	0.368	0.05	Normally distributed
	Posttest	0.224	0.05	Normally distributed
	N-gain	0.915	0.05	Normally distributed
Control	Pretest	0.150	0.05	Normally distributed
	Posttest	0.117	0.05	Normally distributed
	N-gain	0.291	0.05	Normally distributed

The data homogeneity test was performed utilizing SPSS 17.0 and the Levene's Test technique. The pretest, posttest, and gain data from the two sample groups were homogeneously tested. If sig. >0.05, the data is considered homogeneous. Table 6 shows the results of the homogeneity test.

Table 6. Data Homogeneity Test Results for Experiment Class and Control Class

Data	Sig	α	Description
Pretest	0.429	0.05	Homogeneous
Posttest	0.287	0.05	Homogeneous
N-gain	0.130	0.05	Homogeneous

Following the completion of the preliminary tests, namely the normality and data homogeneity tests, the data were produced with a normal and homogeneous distribution, allowing a hypothesis test to be performed using the SPSS 17.0 for Windows application. Table 7 shows the outcomes of hypothesis testing.

Table 7. Hypothesis Test Results

Posttest Score	Sig	α	t_{count}	t_{table}
Equal variances assumed	0.002	0.05	3.247	2.00

Measurement of student character Chemical bonding learning progresses using observation sheets. Three observers who made direct observations made observations. At each of the three meetings, student character observations were conducted. Religious, inquisitive, critical, and cooperative traits are observed.

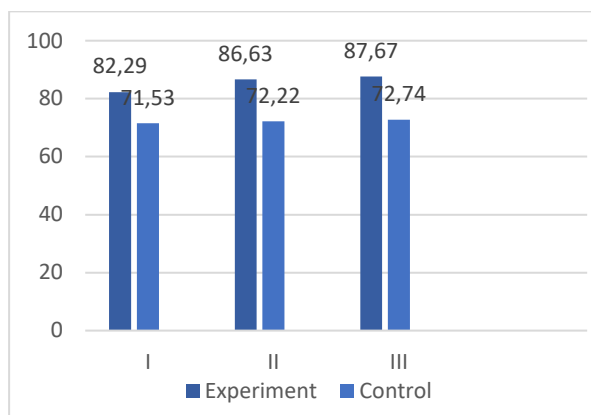


Figure 4. Graph of Average Character Values of Experimental and Control Class Students at Each Meeting

DISCUSSION

The purpose of this research is to establish the level of viability of innovative chemical bond modules that are integrated with BSNP features.

1. Analysis of Chemistry Books on Chemical Bonds Material.

Based on the modified BSNP, the average score of 1) publisher A is 2.89, indicating that it is quite valid and feasible to use; 2) issuer B is 2.76, indicating that it is quite valid and feasible to use; and 3) issue C is 2.77, indicating that it is quite valid and feasible to use. However, there are several textbook portions that need be added.

Aspects of character integration in the content, improving students' views on chemical bonding material, utilizing language appropriate to student development, and language that is less communicative and plain need to be improved in book A. Things that need to be updated in book B include updating the material, including student character values into the material, expanding students' views on chemical bonding material, and utilizing less communicative and dialogic language. The accuracy of the information, the updating of the material, the integration of student personalities, the elaboration of material that might spark student curiosity, the development of student insights, and less dialogical language are all aspects that need to be improved and added to book C.

2. Development of an Innovative Chemical Bond Module Integrated with Character Values

In the construction of the produced chemical bond module, deficiencies based on the findings of an analysis of chemical textbooks on the subject of chemical bonds are utilized as a reference. The designed Character Integrated Innovative Chemical Bonds Module was validated using a modified National Education Standards Agency (BSNP) eligibility standard. The generated module is evaluated using three BSNP eligibility standards: content feasibility, language eligibility, and presentation feasibility.

3. Test Results of Students' Understanding of Innovative Chemical Bond Modules Integrated with Character Values

A small-scale trial was carried out at the University of HKBP Nommensen Pematangsiantar. This study included two classes: an experimental class taught using an innovative module of internalized character chemical bonding and the PBL paradigm, and a control class taught using a school-based chemistry textbook and the PBL approach. After performing the preliminary tests, namely the normality and data homogeneity tests, and obtaining data with a normal and homogeneous distribution, the hypothesis test can be performed using the SPSS 17.0 for Windows application.

It is possible to conclude that there are disparities in student learning results when employing the chemical bond innovation module, which integrates character values with the campus's books.

4. The Effect of Using an Innovative Character-Integrated Chemical Bond Module on the Growth and Development of Student Character.

Observation sheets are used to assess student character growth and improvement in chemical bonding learning. Three observers who made direct observations made observations. At each of the three meetings,

student character observations were conducted. Religious, inquisitive, critical, and cooperative traits are observed.

This demonstrates that by using the novel chemical bond module that is interwoven with character, students can embed the module's character ideals in everyday life.

CONCLUSION

The conclusion of this study is that the level of feasibility of Chemical Bonds textbooks from publishers A, B, and C on the subject of chemical bonds is feasible to use and does not require revision, but there are still deficiencies in each book, so it needs to be developed. The integrated character chemical bond innovation module received an average of 3.70 from the lecturer, indicating that it is legitimate and does not require modification before being utilized in chemistry learning. Students who are taught utilizing the chemical bond innovation module, which is interwoven with character, have different learning outcomes than students who are taught using campus textbooks. The Character Integrated Innovative Chemical Bonds Module produced can help students develop character values, with an average of 85.53% rating it as very good.

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