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Implementation of Independent Curriculum on Chemistry Learning Outcomes Phase E at Senior High School

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Abstract: This research is motivated by the Mid-Semester Summative Assessment (STS) value of chemistry phase E at State Senior High School 2 Sungai Limau of 62.60, and the correlation analysis of the implementation of the Independent Curriculum on the learning outcomes of chemistry phase E at State Senior High School 2 Sungai Limau has not been carried out. This study aims to analyze the correlation between the implementation of the Independent Curriculum and the learning outcomes of chemistry phase E at State Senior High School 2 Sungai Limau. This research is a descriptive correlational study with a mixed-method research design of the concurrent triangulation type. The research instruments used were teacher interviews, teacher teaching module reviews, teacher questionnaires, student questionnaires, and End-of-Semester Summative Assessment (SAS) documents. Data were analyzed using the Spearman Rho correlation test. The correlation coefficient value (r) obtained from the data processing results was 0.339 (positive), and the sig. value was 0.021 < 0.05, so it was in the low category. The determination coefficient value was 11.5%. Meanwhile, the other 88.5% is influenced by other variables not discussed in this study. This means that the implementation of the Independent Curriculum at State Senior High School 2 Sungai Limau has a low and significant positive correlation/relationship with the results of learning chemistry phase E. If the Independent Curriculum is implemented properly, then the results of learning chemistry can increase. The chemistry teaching modules made by teachers have begun to apply the principle of Understanding by Design (UbD). However, the chemistry teaching modules must be completed, especially in the assessment section.

Keywords: Chemistry Learning Outcomes; Concurrent Triangulation; Correlation; Independent Curriculum.

Introduction

Education is useful as a forum for individuals to develop critical and creative thinking skills for survival in society. Education is useful for realising interests, talents and aspirations [1]. By taking advantage of this opportunity, students can take advantage of it in everyday life.

The curriculum guides teachers to conduct education with a directed and systematic learning process. The curriculum is a learning plan, teaching materials and learning experiences that have been prepared. The curriculum is the basis for educators implementing the learning stages [2]. Of course, the curriculum is adjusted to government regulations regarding this matter.

The implementation of the Merdeka Curriculum is expected to have an impact on improving student learning outcomes in chemistry. Currently, Indonesia uses the Independent Curriculum as a refinement of the previous curriculum. With this curriculum, education in Indonesia is experiencing a transformation. This curriculum is certainly based on the 1945 Constitution, paragraph three, to educate the nation's life. There are five principles that form the basis of the state called Pancasila. The objectives of the independent curriculum are stated in the Regulation of the Minister of Education, Culture, Research, and Technology of the Republic of Indonesia Number 12 of 2024, namely to make learning effective and meaningful to optimize faith in God, high character, foster and develop the creativity, feelings, and intentions of students to become Pancasila students throughout their lives [3]. This curriculum provides flexibility for schools in designing learning that is more contextual and appropriate to the needs of students so that it can move forward and with direction.

Curriculum implementation is a design that has been maximally designed so that the curriculum can be implemented [4]. Curriculum implementation to improve the quality of education must align with the current situation so that students' potential is optimal. For this reason, aspects such as educational objectives, content, processes and learning assessment, and supporting resources must be carefully considered [5]. In the implementation of the Merdeka Curriculum, there is an understanding of new views and developments regarding the Pancasila Student Profile (PPP) curriculum structure, Learning Achievements (CP), the number of learning hours determined per year, project-based learning, and collaborative assessments [6]. Implementation of the Independent Curriculum is the implementation of the curriculum after careful design, which is guided by the values of Pancasila so that independent learning can be realized and is based on state principles. Implementing the Independent Curriculum through Strengthening the Pancasila Student Profile focuses on character growth and living as an individual through school culture, intracurricular, extracurricular and co-curricular learning called project learning [7].

Student learning outcomes can determine whether or not the objectives of the Independent Curriculum are

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achieved. The extent to which students have mastered the subject matter after being taught by the teacher can be measured by their learning outcomes [8]. These learning outcomes are used as a guideline for further remedial and enrichment treatment. In phase E (class X) at the high school level, learning challenges, especially in chemistry subjects, which require conceptual understanding and critical thinking skills.

The Contextual Teaching and Learning (CTL) model on learning outcomes in colloid system material has significant differences [9]. The Think Talk and Write learning model significantly affects learning outcomes in global warming material [10]. The Probing Prompting Learning Model in class XI chemical bonding material improves student learning outcomes [11]. Likewise, research on schools in West Sumatra showed that: 1) Differentiated learning, learning readiness and learning styles had significant differences [12]; 2) There is a positive influence of the LSLC-based GDL model on the equilibrium shift factor material [13]; and 3) The use of Guided Inquiry-based LKPD on basic chemical law material has a positive effect on improving student learning outcomes [14].

However, problems were seen in State Senior High School 2 Sungai Limau; the importance of learning outcomes was not in line with the quality of actual learning outcomes. This was found based on direct observations made in the chemistry subject phase E in July 2022 during the Educational Field Practice (PLK) activities. Based on observations, it is known that the Merdeka Curriculum began to be implemented in July-December 2022 for phase E only, while other levels are continuing learning with the 2013 Curriculum.

The comprehensive Independent Curriculum is used in State Senior High School 2 Sungai Limau from July to December 2024 for phase E, early phase F, and advanced phase F. One indicator of implementing the Independent Curriculum is student participation during chemistry learning. In State Senior High School 2 Sungai Limau, chemistry learning uses this Independent Curriculum, teachers are seen to have tried to manage learning as well as possible, such as giving examples by linking chemistry material to everyday life and/or examples of questions regarding chemistry material that require calculations. However, some students do not understand, so only certain students follow the learning according to the teacher's instructions. Meanwhile, other students are not active enough for chemistry learning activities.

One of the domains to see students' learning outcomes is the cognitive domain. Learning outcomes play a role in achieving student understanding in learning through tests, which measure the domain that is more dominant for students [15]. The cognitive domain is the most important domain. The cognitive domain is a domain that includes mental activity in the brain [16].

Chemistry learning outcomes are achieved after carrying out chemistry learning activities [17]. In the Independent Curriculum, student learning outcomes are measured by assessments. Assessment is a means of assessing students' progress process and learning outcomes. Assessment is useful in determining students' basic abilities and initial situation [6].

There are three domains of Bloom's Taxonomy learning outcomes, namely: cognitive, affective and psychomotor. There are six cognitive domains in Bloom's Taxonomy: remembering, understanding, applying/applying, analyzing, evaluating, and creating/creating. The dimension of knowledge is divided into four types of knowledge, namely: 1) factual knowledge is knowledge about simple things that individuals must know in order to be knowledgeable and solve problems; 2) conceptual knowledge is knowledge related to simple things in a larger structure so that they are equally useful; 3) procedural knowledge is knowledge about how to do something, research methods, and conditions for using skills, algorithms, techniques and steps; and 4) metacognitive knowledge, namely knowledge about cognition, both general and specific. The cognitive process dimension consists of level one (remember) to level six (evaluate). Dimensions of cognitive processes include: 1) level of remembering, individuals can receive appropriate knowledge from long-term memory; 2) level of understanding, individuals begin to interpret structured messages, verbal, written and graphic communications; 3) application level, individuals can carry out procedures when problems arise; 4) level of analysis (analyze), individuals can conclude the material and determine the relationship of the material to each other and/or everything; 5) evaluation level, individuals can assess based on criteria and standards; 6) level of creation, the individual can combine elements to become a related whole; rearrange to form a new pattern [18]. This research examines student learning outcomes in the cognitive domain. Where the cognitive dimension process is at the analytical level, the knowledge dimension is factual and conceptual knowledge.

The domain of learning outcomes in the Independent Curriculum can be measured using assessments. Assessment includes diagnostic assessment, formative assessment, and summative assessment. Diagnostic or initial assessments include 1) cognitive aspects to see students' initial abilities and 2) non-cognitive aspects regarding family support, motivation, self, learning styles and students' social-emotional abilities. Formative assessment to see the extent to which students have achieved learning objectives. Summative assessment to see students' overall achievement of learning goals [19]. The assessment in this research is a summative assessment useful in viewing reports on chemistry learning results in phase E at State Senior High School 2 Sungai Limau.

The Independent Curriculum measures the cognitive learning outcomes domain using assessments. Assessments are divided into three, namely diagnostic assessments (assessments before learning), formative assessments (assessments during learning), and summative assessments (assessments after learning). Summative assessments report learning outcomes like the Mid-Semester Summative Assessment (STS). Based on the value data collection carried out on Friday, November 22, 2024, at State Senior High School 2 Sungai Limau, the average Mid-Semester Summative Assessment (STS) for chemistry phase E period July-December 2024 on 222 students was 62.60. State Senior High School 2 Sungai Limau has implemented the Independent Curriculum, but how it correlates with student learning outcomes needs to be studied. The purpose of this study is to analyze the correlation of the implementation of the Independent Curriculum on the results of learning chemistry phase E at State Senior High School 2 Sungai Limau. The implementation of the

Merdeka Curriculum in question can only be seen from the chemistry teacher teaching module at stage E with the principle of Understanding by Design (UbD). Meanwhile, the learning outcomes are only reviewed based on cognitive domain assessments. Conducting a correlation test between the implementation of the Merdeka Curriculum and the results of stage E chemistry learning at State Senior High School 2 Sungai Limau should be useful for chemistry teachers as input in improving the learning process. It is hoped that it can improve the results of stage E chemistry learning regarding the provision and completeness of the teaching module content.

Research Methods

This study is a descriptive correlational study with a concurrent triangulation type *mix method* research design. This study is useful in analyzing the correlation between the implementation of the Independent Curriculum on the results of learning chemistry phase E at State Senior High School 2 Sungai Limau. Qualitative data was analyzed based on the data obtained and concluded descriptively using concurrent triangulation. Qualitative data is interpreted by objectively assessing the researcher [20]. This research uses quantitative data as the main data and qualitative data as supporting data. Interpret mixed data between qualitative and quantitative data by combining the data into one or comparing them [21], where both data are taken simultaneously. Quantitative data was carried out by distributing questionnaires to phase E 2 and E 4 students at State Senior High School 2 Sungai Limau, a chemistry teacher at State Senior High School 1 Sungai Geringging, and 2 chemistry teachers at State Senior High School 2 Sungai Limau. Student and teacher questionnaires were measured and interpreted using a Likert scale. Quantitative data was also taken from the Final Semester Summative assessment documents for phases E 2 and E 4 of State Senior High School 2 Sungai Limau. The data were tested for correlation using the Spearman Rho test with the help of Minitab 19. Meanwhile, qualitative data was collected by interviewing and examining the three teacher teaching modules, and conclusions were drawn.

Before deploying the instrument, the following tests are required.

Instrument Testing

Testing of the student questionnaire instrument is needed to analyze whether respondents can understand the questionnaire statements. Trial respondents were not obtained from the same sample or research respondents. However, it is still taken based on the same population as the research population [22]. The respondents for testing the instrument in this research were phase E 2 students at State Senior High School 1 Sungai Geringging, totalling 30 respondents, so the distribution of measurement values was close to normal. The reason for choosing State Senior High School 1 Sungai Geringging was because it used the Independent Curriculum, the same accreditation, and was located closest to State Senior High School 2 Sungai Limau.

Test the validity of the instrument

The instrument validity test was conducted to analyze whether the research instrument was an appropriate measuring tool [20]. This test uses Pairwise Pearson Correlations assisted by Minitab 19 Software. It is said to be valid if the significance value is < 0.05, meaning H_0 is rejected and Ha is accepted. Whether the statement item is valid or not can also be seen from the rcount and rtable. If $r_{count} > r_{table}$, it means it is valid. Based on $r_{count} = 2.04523$, the r_{table} in this questionnaire is 0.38. Of the 20 statement items in the validity test, there were 16 valid statement items (statement items: 2, 4, 6, 7, 8, 9, 11, 12, 13, 14, 15, 16, 17, 18, 19, and 20) and 4 invalid statement items (statement items: 1, 3, 5, and 10). Where, r_{table}: 0.38 (if $r_{count} > r_{table}$, it means valid). r_{count} on statement item 1: 0.003, statement item 3: 0.200, statement item 5: 0.276, and statement item 10: 0.137 ($r_{count} < r_{table}$, meaning invalid). Meanwhile, the rest is valid because of $r_{count} > r_{table}$.

Instrument Reliability Test

Instrument reliability testing is carried out to analyze whether research instruments used frequently to measure the same subject will obtain the same results [20]. This test uses Cronbach's Alpha, assisted by Minitab 19 software. It is reliable if Cronbach's Alpha value is > 0.7 (reference value). Based on the reliability test, a Cronbach's Alpha value of 0.81 was obtained, which means it is reliable because it is greater than 0.7.

Test Prerequisites

The prerequisite tests are the normality test and linearity test. The normality test was performed using Kolmogorov Smirnov, assisted by Minitab 19 software.

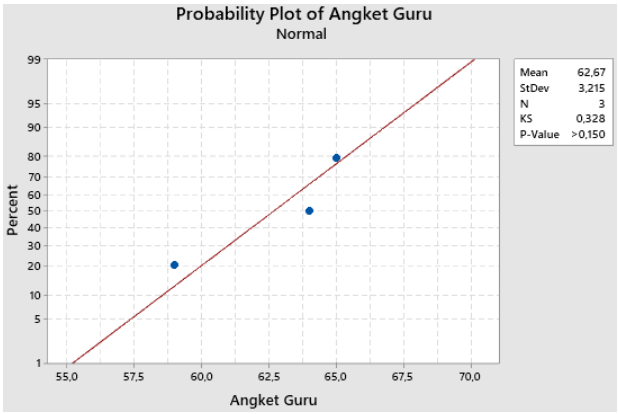

Figure 1. Teacher Questionnaire Normality Test

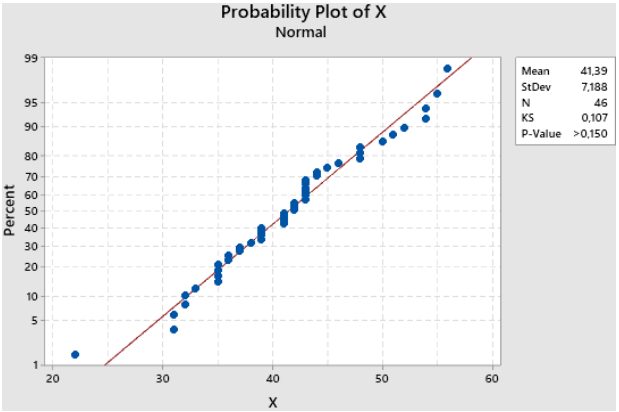

Figure 2. Student Questionnaire Normality Test

In Figures 1 and 2, the p-values of teacher and student questionnaires (variable X) are both > 0.150. This means that the data is normally distributed. Meanwhile, in Figure 3, the p-value (variable Y) is < 0.010. This means that the data is not normally distributed [23]. Because the data for one of the variables is not normal, a correlation test cannot be carried out using Pearson's Product Moment Coefficient. However, it was replaced by using Spearman Rho [24]. The linearity test also cannot be carried out because the data is not normally distributed.

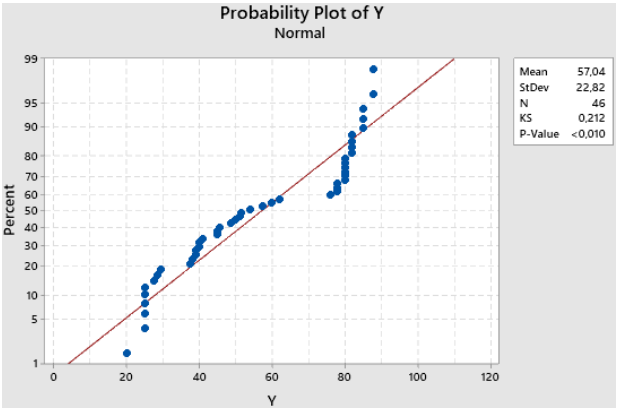

Figure 3. Normality Test of Final Semester Summative Assessment Phases E 2 and E 4

Results and Discussion

This research was conducted at State Senior High School 1 Sungai Geringging and State Senior High School 2 Sungai Limau. At State Senior High School 1 Sungai Geringging, teacher interviews, a review of phase E chemistry teacher teaching modules, and a distribution of teacher questionnaires were conducted. While at State Senior High School 2 Sungai Limau, teacher interviews, a review of phase E chemistry teacher teaching modules, and distribution of teacher and student questionnaires were conducted for phases E 2 and E 4. Interviews and review of teacher teaching modules were conducted with 3 chemistry teachers: 1 chemistry teacher at State Senior High School 1 Sungai Geringging, and 2 chemistry teachers at State Senior High School 2 Sungai Limau.

Chemistry teaching modules that the Independent Curriculum guides must, of course, include general information, core components, and complete appendices [25]. Based on an interview with a chemistry teacher at State Senior High School 1 Sungai Geringging, it was found that the Independent Curriculum guided the chemistry teaching module that the teacher created. However, the chemistry teaching module did not contain non-cognitive diagnostic assessments, a glossary, or a bibliography. Based on an interview with 2 chemistry teachers at State Senior High School 2 Sungai Limau, it was found that the Independent Curriculum guided the chemistry teaching module that the teacher created. However, the chemistry teaching module of one of the chemistry teachers did not yet contain non-cognitive diagnostic and summative assessments. Meanwhile, other chemistry teacher chemistry teaching modules do not yet contain summative assessments, LKPD, reading materials for teachers and students, glossaries, and bibliographies.

This study focuses on chemistry teaching modules with the principle of Understanding by Design. The achievement of teaching modules with this principle is seen from the learning objectives, assessments, learning activities, and applying the principle of Understanding by Design (UbD) [19]. This is in line with the Implementation of the Independent Curriculum stages. This study is guided by the advanced stage [25]. The results of chemistry learning that are not optimal occurred at MAN 2 Kota Bima. This is due to the lack of information about the Independent Curriculum, so the stages and implementation are less effective [26]. The implementation of the Independent Curriculum needs to be socialized to educators, students, educational staff, and partners on an ongoing basis [27].

The chemistry teacher teaching module at State Senior High School 1 Sungai Geringging reviewed the chemistry teaching module on Electrons in Atoms (Atomic Shell Configuration). The basic competency determines. Where there are 3 learning objectives, namely: 1) being able to determine the maximum number of atomic shells and electrons in an atom, 2) being able to determine the filling or distribution of electrons based on electron configuration rules, and 3) being able to determine the number of outermost electrons in an atom's shell (valence electrons). The assessment and learning objectives are interrelated because there are questions that are in line with the learning objectives. This teaching module uses a scientific approach with the Problem-Based Learning learning model. The learning media used are modules, textbooks, and the periodic table of elements. The learning steps are in accordance with the learning objectives and assessment because each step focuses on achieving the learning objectives. The learning steps include preliminary activities (introduction, apperception, motivation, and providing references), core activities (problem orientation, organizing, investigating individuals/groups, developing and presenting work results, and analyzing and evaluating the problem-solving process), and closing activities.

The chemistry teacher teaching module at State Senior High School 2 Sungai Limau was reviewed on the chemistry teaching module on (The Nature and Role of Chemistry) and (The Periodic Table of Elements). Based on the Nature and Role of Chemistry module, the basic competencies can be seen to explain and identify. The learning objectives are to explain the role of chemistry in everyday life and its relationship with other sciences, as well as to identify various products containing chemicals in everyday life. The assessment and learning objectives are

interrelated because there are questions that are in line with the learning objectives. This teaching module uses a scientific approach (observing, trying, asking, associating, and communicating) with the Guided Discovery Learning learning model. The learning media used are modules, textbooks, and chemistry PPT. The learning steps are in accordance with the learning objectives and assessment because each step focuses on achieving the learning objectives. steps include preliminary activities (orientation, apperception, motivation, and reference provision), core activities (stimulus, problem identification, data collection, data processing, proof, and conclusions), and closing activities.

Based on the Periodic System of Elements module, it can be seen that the basic competencies are explaining and analyzing. The learning objectives are to correctly explain the development of the periodic system of elements and analyze the relationship between electron configuration and the position of elements in the periodic table. The assessment and learning objectives are interrelated because there are questions in accordance with the learning objectives. The teaching module uses a scientific approach (observing, trying, associating, asking, communicating) and a Problem Learning model. While the learning media uses modules, textbooks, chemistry PPTs, and a periodic table of elements. The learning steps are in accordance with the learning objectives and assessments because each step focuses on achieving the learning objectives. The learning steps include preliminary activities (orientation, apperception, motivation, and providing references), core activities (overview, brainstorming, systematization, problem description, evaluation, knowledge gathering, reporting, and evaluation of the problem-solving process), and closing activities.

The third chemistry teaching module of the teacher was made before the learning activities took place so that it led to the achievement of learning objectives. An assessment is a tool to measure learning achievement and the learning steps that have been prepared. Thus, it is concluded that the third teacher's teaching module has begun to apply the principle of Understanding by Design (UbD) [19]. However, there is a need for complete teaching modules, especially in the assessment section (diagnostic: cognitive and non-cognitive, formative, and summative) [25].

The teacher and student questionnaires used a Likert scale with the summated rating method. This questionnaire has 4 categories of questionnaire responses to avoid subjects' tendency to choose Neutral (N) responses in the middle category. This questionnaire only consists of positive statements because negative statements allow respondents to misunderstand in responding to the questionnaire. The 4 categories of questionnaire responses are strongly agree (SS), agree (S), disagree (TS), and strongly disagree (STS). Where SS is worth 4, S is worth 3, TS is worth 2, and STS is worth 1.

End of Semester Summative Assessment (SAS) Chemistry Phase Data, at State Senior High School 2 Sungai Limau, odd semester, 2024/2025 academic year. In phase E 2, which consisted of 22 students, none completed (100% did not complete and 0% completed). In phase E 4, which consisted of 24 students, 19 students completed (79.17%) and 5 students did not complete (16.67%).

Table 1. Interpretation of Teacher and Student Questionnaires

Questionnaire	Questionnaire Percentage	Questionnaire Interpretation
Teacher	87.03%	Almost all phase E chemistry learning with the Merdeka Curriculum is implemented by teachers at State Senior High School 1 Sungai Geringging and State Senior High School 2 Sungai Limau
Learners	64.67%	Most of the phase E chemistry learning with the Independent Curriculum is implemented by students at State Senior High School 2 Sungai Limau

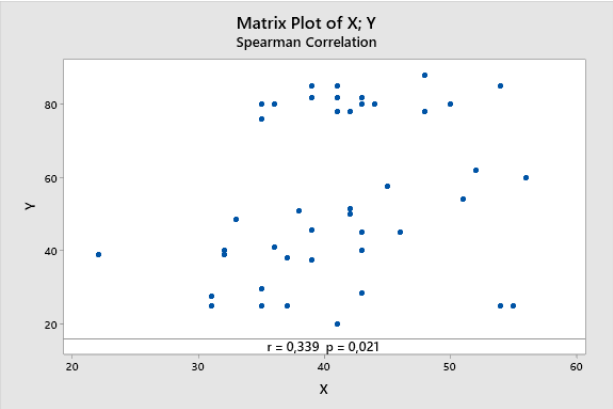

Figure 4. *Spearman Rho* X and Y test

The correlation results of implementing the Independent Curriculum on chemistry learning outcomes were 0.339 (positive value). Meanwhile, with a p-value of 0.021, then the implementation of the Independent Curriculum is significantly related to the chemistry learning outcomes of phase E at State Senior High School 2 Sungai Limau. Therefore, r > 0, then the relationship is positive (directly proportional). This means that the higher the implementation of the Independent Curriculum, the higher the chemistry learning outcomes of students. The relationship between the Independent Curriculum (X) implementation and chemistry learning outcomes (Y) can be seen from the r value. Based on Guilford's Empirical Rule, the correlation is low because $0.20 \leq r\ 0.40$.

The magnitude of the influence between the implementation variables of the Independent Curriculum on chemistry learning outcomes can be seen from the value of the coefficient of determination. Based on the calculation, the coefficient of determination of this study is 11.5%. This means that the Independent Curriculum (X) implementation variable slightly influences the chemistry learning outcome variable (Y) by 11.5%. The rest (100% - 11.5% = 88.5%) is influenced by other variables not discussed in this study. There is a relationship between student self-efficacy and chemistry learning outcomes in the Independent Curriculum

[15]. There is a strong relationship between the Independent Curriculum and student learning interests. Implementing the Independent Curriculum contributed 43% to students' interest in learning chemistry, and 57% was influenced by other variables [28]. There is a significant influence between implementing the Independent Learning Curriculum and the learning outcomes of the Islamic Religious Education and Character Education (PAIBP) class XI SMA N 2 Ungaran academic year 2022/2023 [29]. There is a positive and significant influence of the Independent Learning Curriculum on economic learning outcomes (correlation coefficient 0.160, t value 1.822, significance 0.035), as well as a positive and significant influence on learning motivation (correlation coefficient 0.382, t value 5.908, significance 0.000). Learning motivation was also proven to significantly affect economic learning outcomes (correlation coefficient 0.154, t value 2.242, significance 0.016). Furthermore, implementing the Independent Learning Curriculum indirectly influences economic learning outcomes by mediating learning motivation (correlation coefficient 0.152, t value 2.042, significance 0.022) [30].

The approach in the Independent Curriculum is determined from assessments, such as cognitive and non-cognitive assessments, formative assessments, and summative assessments, as well as conducive learning flexibility that contributes to student learning outcomes. Teachers need to implement the Independent Curriculum perfectly, such as providing and completing the content of chemistry teaching modules using the principles of Understanding by Design (UbD) to the teaching and learning process and evaluation. Teachers should also use related media, approaches, learning strategies, etc. to realize significant positive improvements in student learning outcomes. Of course, this cannot be separated from students' high desire and awareness to gain knowledge and values, as well as the important role of other educational stakeholders.

Conclusion

Based on the results of the study, it was concluded that there was a low and significant positive correlation between the implementation of the Independent Curriculum and chemistry learning outcomes. This can be proven from the r value = 0.339 (positive). At a significance level of 5%, the p-value is 0.021, so it is in the low category. This means that the implementation of the Independent Curriculum at State Senior High School 2 Sungai Limau is correlated/related to the chemistry learning outcomes of phase E. 11.5% of the implementation of the Independent Curriculum is influenced by the chemistry learning outcomes of phase E at State Senior High School 2 Sungai Limau and 88.5% is influenced by other variables not discussed in this study. If the Independent Curriculum is implemented properly, chemistry learning outcomes can improve. The chemistry teaching modules made by teachers have begun to apply the Understanding by Design (UbD) principle. However, the chemistry teaching modules need to be completed, especially in the assessment section.

Author's Contribution

Syafriffah Jaslin: Compiling research design, data analysis, and completion of scientific article writing. Prof. Dr. Yerimadesi: Providing constructive suggestions for the perfection of the writing.

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