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Research Article

Analysis of critical thinking ability based on student gender through the implementation of independent curriculum in chemistry learning

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Keywords

Critical thinking
Chemistry
Curriculum
Gender

Abstract

The implementation of the independent curriculum in high schools after the Covid-19 pandemic has become a challenge for teachers and education implementers because the demands of 21st century education must fulfill the 4C skills, one of which is critical thinking for male and female students. This research is a descriptive quantitative research, with a one group control posttest only research design, to analyze students' critical thinking skills in chemistry learning with an independent curriculum when viewed from gender differences. The population in this study is students senior high school in Jakarta, and the samples used in this study were 58 students consisting of 34 male students and 22 female students who were taken by random technique. Instrument test in this study was multiple choice questions consisting of 15 questions, which consisted of 3 sections according to Bloom's taxonomy, namely questions number 1-5 on C4, numbers 6-10 on C5 and numbers 11-15 on C6. The test instrument used is valid through the revision results according to the expert validator's input. The instruments used to obtain information regarding critical thinking skills were analyzed descriptively and the average male score was 56.67 (N=34), while for female it was 57.27 (N=22). Based on these data, the difference in critical thinking ability when viewed from gender differences is only 0.60 on a scale of 100 (Sig. <0.05). Furthermore, further test results show that there are differences in the critical thinking abilities of male and female students when learning chemistry in the independent curriculum.

Introduction

The Learning competencies in the 21st century through character strengthening must be improved through critical thinking, creative, able to communicate, and collaborate. This is in accordance with the demands of education in Indonesia based on Pancasila education and the 1945 Constitution prioritizing characters that include 4C competencies, namely Critical Thinking and Problem Solving, Creativity, Communication Skills, and Ability to Work Collaboratively which are indispensable in facing global challenges (Purba and Sibarani, 2017; Erdoğan, 2019; Mulyasa, 2021). The four competencies have different achievement indicators (Purnami, 2021; Tahmidaten, 2021).

The achievement indicator for the 4C competencies, namely critical thinking (Romero, 2015; Dinira, 2019; Suyitno, 2020) starts from formulating the main problem, uncovering facts to solve problems, choosing logical, relevant and accurate arguments, detecting bias from different points of view and determining the consequences of a statement. The achievement of critical thinking indicators in chemistry learning will be developed which will emphasize the characteristics of learning based on cognitive science (Ahmadi and Besançon, 2017; Ariffin et al. 2020). In addition to the principles of cognitive science, chemistry learning in high school is oriented to generic science skills (Mashami and Khaeruman, 2020; Islamiyah et al. 2022).

Achieving cognitive abilities and generic science skills in chemistry learning during the Covid-19 pandemic requires distance learning using online learning media (Nuriansyah, 2020). Many online learning media, both

free and paid or subscribed, can be used by teachers, such as free google meet (Laeli, 2021; Nyoto, 2021), zoom which is paid (Haqien and Rahman, 2020; Purba et al. 2021). By using the online learning media, the pandemic condition is not a reason to improve students' critical thinking skills.

There are four indicators of critical thinking skills used in research (Lailasari et al. 2018), namely determining assumptions about the problem, understanding the meaning of words, drawing logical conclusions and evaluating based on facts. Based on a study of several research results, determining assumptions is always involved as an indicator of critical thinking (Kurniastuti et al. 2018; Maharani, 2021; Siahaan et al. 2021; Rohmania et al. 2022). Indicators determine assumptions play an important role in critical thinking (Ferdyan and Arsih, 2021; Hidayati et al. 2021) in addition to other indicators, because they give students space to understand concepts from events that arise in their environment.

When viewed in terms of individual factors, gender also affects the ability to assume, which is an indicator of critical thinking skills. Intrapersonal intelligence of male students develops more slowly than female students because men are a bit late in the development of linguistic abilities (Herliani, 2013). Based on the results of research (Wardani et al. 2018) the critical thinking ability of female students is better than male students.

The critical thinking ability of female and male students in chemistry learning is an important thing to be studied to improve the quality of graduates equally. Chemistry learning before and even after the covid-19 pandemic demands equal education in various schools and educational units (Prastiwi and Rahmadanik, 2022). This is in line with the results of research (Hegarty, 2018) which shows that male students are more dominant in visualization and female students are more dominant in orientation which leads to the ability to assume as an indicator of critical thinking ability.

This critical thinking ability is also a demand for the independent curriculum, as a substitute for the 2013 curriculum. The independent curriculum in chemistry learning currently implements an innovation process model through reducing Basic Competence specifically in chemistry subjects so that teachers and students can focus more on essential competencies for continuing learning at the next level (Kurniati et al. 2022). Chemistry learning material in the independent curriculum for class X starts from green chemistry, global warming, nomenclature of compounds, atomic structure, configuration and so on. Some of the chemistry material in class X is new material and some of it is the same material as the 2013 curriculum (Rahmawati et al. 2022). This shows that in the independent curriculum, students are directed to be able to think critically in understanding material which is generally applied chemical material (Petterson et al. 2020).

After the covid 19 pandemic, the learning system returned offline with a new curriculum, namely the independent general curriculum. This requires students to be able to adapt at the same time with the learning system and the latest curriculum. Some students may not be affected by changes in the curriculum as well as the learning system as is the case in several countries (Owusu-Fordjour et al. 2020; Omodan and Ige, 2021), but it is possible that many students will have difficulties (Aliyyah et al. 2020), both male and female students.

To improve students' critical thinking skills without distinguishing their gender, the teacher must be able to analyze the differences in students' abilities. Thus, this study was conducted with the aim of analyzing students' critical thinking skills in chemistry learning Through the Implementation of Independent Curriculum in Chemistry Subject.

Method

This research is a descriptive quantitative namely an objective research approach that uses numbers, starting from data collection, interpretation of the data as well as the appearance and results (Arikunto 2006). The population in this study is high school students in East Jakarta. With random sampling technique, the sample in this study involved 56 high school students in Jakarta. The variables in this study include independent variables and dependent variables and control variables. The independent variable in this study is gender, the dependent variable is critical thinking ability and the control variable is chemistry learning (Duli, 2019).

Data on students' critical thinking skills in chemistry learning focused on the sub-subject of Equalizing Redox Reactions Through the Implementation of Independent Curriculum in Chemistry Subject based on gender differences were obtained using 15 multiple-choice questions and choices A, B, C, D and E presented with difficulty level C4-C6. The grid of test instruments in this study is presented in Table 1.

Table 1. Grid of test instruments

	Question Items Based on Difficulty Level		
Redox Equivalent	C4	C5	C6
	1, 2, 3, 4, 5	6, 7, 8, 9, 10	11, 12, 13, 14, 15

The test instrument that will be used is tested for validity (Yusuf, 2018) to get an instrument that is suitable for use in this study. Valid test instruments were used in this research to be processed and analyzed, involving

expert validators who are competent in the field of evaluation of chemistry learning. The data obtained were presented in the form of histograms, to facilitate descriptive data analysis.

The data from this study will be tabulated in tables and histograms then analyzed descriptively to find out the overall mean of the data and the mean in the male and female groups and then analyzed with 2x3 MANOVA using the help of SPSS 24 (Darma, 2021) with a significance level of 5% which is analyzed using SPSS 24. Furthermore, the results of data analysis are analyzed descriptively based on ability indicators. critical thinking by adjusting to the test instrument, namely the questions used in this study. The minimum to maximum value scale for the critical thinking skills of both male and female students is a scale of 0-100 with 34 male and 22 female students respectively. This maximum score serves as a benchmark for the preparation of each student's score for further analysis.

Results and Discussion

Description of data

Data collection in this study was carried out using a valid question instrument as many as 15 statement items that had been reported according to the validator's expert input. Valid test instruments were used in this study to obtain information related to students' critical thinking skills in terms of gender differences, male and female. The above data is interpreted in the score table which is converted into a score with a scale of 100, based on data analysis based on gender, the average value for males is 56.67 and for females it is 57.27 on a scale of 100, as presented in Table 2.

Table 2. Data description

Gender	N	Skor	Nilai	Deviation Standart	Sig
Male	34	1.926	56.67		
Female	22	1.260	57.27	0.43	0.00
	Average		56.97		

Analysis of data

Breaking down research data based on gender (Male and Female) and difficulty level of questions (C4, C5 and C6), data obtained from the results of this study are tabulated in tabular form and simplified in the form of a histogram as presented in Fig. 1.

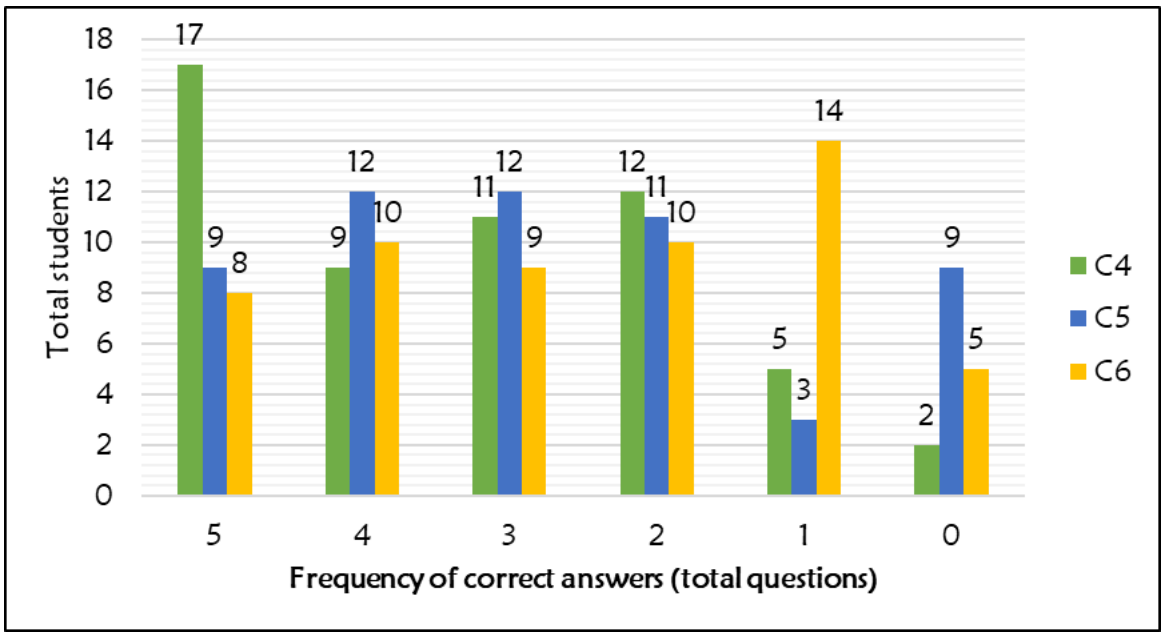

Figure 1. Tabulation of total students based on the frequency of questions at C4, C5 and C6.

Based on the histogram above, the total number of students who answered correctly (5 questions) on C4, namely questions number 1 to 5, is 17 students, on C5, namely questions number 6 to 10, there are 9 students, on C6, namely questions number 11 to 15, there are 8 students. And so on to see the total number of students who answered correctly as many as 4 questions, 3 questions, 2 questions, 1 question and 0 questions (nothing

is correct) on C4, C5 and C6 respectively on the histogram. In more detail, from 56 students consisting of 32 male students and 24 female students, obtained a frequency comparison of all correct answers until no one was correct at each level of difficulty of the questions, as shown in Table 3.

Table 3. Scores of questions at each level of difficulty of questions and student gender

Answer Frequency Correct (Question)	M (N=34)			F (N=22)		
	C4	C5	C6	C4	C5	C6
5	333.33	200.00	166.67	233.33	100.00	100.00
4	133.33	106.67	106.67	106.67	213.33	160.00
3	140.00	180.00	140.00	80.00	60.00	40.00
2	106.67	120.00	120.00	53.33	26.67	13.33
1	20.00	6.67	46.67	13.33	13.33	46.67
0	0.00	0.00	0.00	0.00	0.00	0.00
Total Score	733.33	613.33	580.00	486.67	413.33	360.00
The average score for each level of difficulty	21.57	18.04	17.06	22.12	18.79	16.36
Score Total Average by Gender		56.67			57.27	
Score Total Average	56.97					

Information: M: Male; F : Female; N : Total students

Based on the table above, it can be concluded that the total score for 56 students in this study was 56.97 in the low category because it was below the Minimum Mastery Criteria (75 scale 100). When grouped by gender, the total average score for males is 56.67 and for females is 57.27. The average score of female and male is not significantly different because the difference is only 0.60 on a scale of 100, with the higher is the average score of women (Cahyono, 2017; Wahyudiati, 2021; Gunawan et al. 2021). In the C5 and C6 category questions, if it is interpreted like the data in the C4 category questions, it can be concluded that the distribution of male and female students' critical thinking skills is different, but the difference is not significant.

This is because all the samples in this study were involved in the same tutoring (informal school), this is based on the results of research showing that informal teachers are effective in supporting the learning of academic teachers in schools (Van-Lankveld et al. 2016), Formal education contributes most primarily to shaping the psycho-cultural profile of the human personality and plays an important role in educational action, but it seems that recently it has become increasingly open. formal education towards non-formal and informal education which shows that students' needs for education still need support other than formal education (Melnic and Botez, 2014). Based on further interviews, the students who were sampled in this study stated that they were used to doing difficult exercises. The results of further analysis, namely the MANOVA test with the help of SPPS are presented in Table 4.

Table 4. Multivariant test results

	Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared
Intercep	.004	.062a	3.000	52.000	.979	.004
Gender	.004	.062b	3.000	52.000	.979	.004

Based on the data in Table 4 above, with sig. 0.979 indicates that there is no significant difference between male and female gender (Sig> 0.05), it can be seen that the difference in the values of the two is only 0.04. The results of this analysis mean that there are actually differences in critical thinking skills between male and female students but not significant because there is only a score difference of 0.004. This is in line with various studies showing insignificant differences in critical thinking skills between males and females (Mohammadi et al. 2012; Fuad et al. 2017; Nadiroh et al. 2019; Al-Mahrooqi and Denman, 2020). Critical thinking is another form of mental processing that should be distinguished but often combined (Elder and Paul, 1996).

Conclusion

The conclusion obtained in this study is students' critical thinking skills in chemistry learning through the implementation of independent curriculum in chemistry subject are differences between male and female students, the critical thinking skills of female students are higher than male students.

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