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ORIGINAL

Analysis of habits of mind through online learning in prospective biology teacher

Enálisis de los hábitos mentales a través del aprendizaje en línea en futuros profesores de biología

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ABSTRACT

The paradigma shift from face-to-face learning to online learning post-COVID-19 pandemic has had a significant impact on students' learning behaviors, especially their thinking habits. This study aims to analyze the formation of mind habits among prospective biology teachers after four years of involvement in online learning. A total of 301 biology education students (49 males, 252 females) from a university in West Java, Indonesia, participated in this descriptive quantitative study. Data were collected using a validated mind habits questionnaire consisting of 21 items based on 16 indicators and analyzed using percentage categorization. The findings revealed that 60 % of students exhibited very strong habits of mind, and 38 % had strong levels, indicating a generally high adaptation to an online learning environment. The highest score indicators include responding with amazement and awe, metacognition, empathy, and openness to continuous learning. On the contrary, the lowest are creativity, imagination, and innovation. No significant differences were found between the sexes or across the academic year. In conclusion, online learning contributes positively to the development of mind habits in prospective biology teachers. It is recommended that higher education institutions continue to design online and hybrid learning that supports reflective and adaptive thinking, while incorporating more creative and innovative components to enhance students' holistic development.

Keywords: Online Learning; Habits of Mind; Prospective Biology Teacher.

RESUMEN

El cambio de paradigma del aprendizaje presencial al aprendizaje en línea después de la pandemia de COVID-19 ha tenido un impacto significativo en los comportamientos de aprendizaje de los estudiantes, especialmente en sus hábitos de pensamiento. Este estudio tiene como objetivo analizar la formación de hábitos mentales entre los futuros profesores de biología después de cuatro años de participación en el aprendizaje en línea. Un total de 301 estudiantes de educación en biología (49 hombres, 252 mujeres) de una universidad de Java Occidental, Indonesia, participaron en este estudio cuantitativo descriptivo. Los datos se recogieron mediante un cuestionario validado de hábitos mentales que constaba de 21 ítems basados en 16 indicadores y se analizaron mediante categorización porcentual. Los hallazgos revelaron que el 60 % de los estudiantes exhibían hábitos mentales muy fuertes y el 38 % tenían niveles altos, lo que indica una adaptación generalmente alta a un entorno de aprendizaje en línea. Los indicadores de puntuación más alta incluyen responder con asombro y asombro, metacognición, empatía y apertura al aprendizaje continuo. Por el contrario, los más bajos son la creatividad, la imaginación y la innovación. No se encontraron diferencias

significativas entre los sexos ni a lo largo del curso académico. En conclusión, el aprendizaje en línea contribuye positivamente al desarrollo de hábitos mentales en los futuros profesores de biología. Se recomienda que las instituciones de educación superior continúen diseñando un aprendizaje en línea e híbrido que apoye el pensamiento reflexivo y adaptativo, al tiempo que incorpora componentes más creativos e innovadores para mejorar el desarrollo holístico de los estudiantes.

Palabras clave: Aprendizaje en Línea; Hábitos Mentales; Futuro Profesor de Biología.

INTRODUCTION

The challenges faced by students in the 21st century are not only the tight competition in finding work, but also facing various dichotomies and contradictions due to the rapid development of technology. Another challenge that is also unpredictable is the condition of nature and uncertain situations, for example, the attack of a disease such as a pandemic, resulting in a paradigm shift in the learning system to online learning and virtual activities, which opens up different prospects, challenges, and perspectives.[1]

Several changes in the learning system after the pandemic, namely the shift from offline to online learning, have been going on for approximately five years, may change several learning habits, as well as affect thinking habits. This is due to the change in the teaching and learning system from normal or offline learning to online learning.[2] It is possible that there are several habits that are formed stronger because they are trained continuously.[3]

The thinking skills possessed by students will not be adequately fulfilled if the positive character of students is not built, one of which is habits of mind. According to Carter et al.[4] students need to have the ability to solve complex problems, if students have good habits of mind then they will behave intelligently in facing every problem.

Habits of mind in the learning dimension consist of critical thinking, creative thinking, and self-regulation,[5] while according to Costa & Kallick[6] there are 16 characters of thinking habits, the 16 characters are intelligent thinking characters that must be possessed by students, namely: persistent, managing impulsivity, striving for accuracy, thinking and communicating clearly and precisely, collecting data through all senses, questioning and asking problems, thinking about thinking (metacognition), listening with understanding and empathy, thinking flexibly, creating, imagining, innovating, finding humor, responding with wonder and awe, applying past knowledge to new situations, taking responsible risks, thinking interdependently, and remaining open to continuous learning. Habits of mind are an intellectual and practical learning approach.[7] Learning activities are very important for the formation of habits of mind, because habits of mind can be formed through learning processes and activities.[8]

Habits of mind are abilities that a person must have in order to be considered intelligent,[9] this is important as a sign of readiness and preparation for learning activities in higher education. Several indicators of habits of mind are useful both during and after lectures, so they are absolutely necessary for every student. Some of these habits are creativity, openness, curiosity, perseverance, flexibility, sense of responsibility, and metacognition.[7,10]

One example of an unexpected situation that occurs in students is the COVID-19 pandemic experienced during the learning process, allowing the formation of students' habits of mind. During the pandemic, students experienced many difficulties and changes in learning strategies, encouraging students to make various efforts to survive the difficulties, this also encourages the formation of habits of mind, especially the character of persistence or not giving up easily. Online learning and its influence on student character growth will continue to develop and various studies are needed to continue to reveal this.[11] When students get assignments that require references from the internet, a continuous learning character can be formed, when students have to present the results of their assignments, the character of asking and raising problems can be trained. Students' intelligent thinking habits are formed mainly because of pressure and exams during learning. Moore et al.[12] stated that several problems experienced by students and also activities carried out during learning can support the formation of a habit of mind.

Thinking habits can help students survive in an era of global competition and a lot of pressure. Some characters of thinking habits such as never giving up, continuing to learn, finding humor and others, are closely related to students' learning abilities, for example, research from Moore et al.[12] where the problems given in mathematics problems provide a way for students to form intelligent thinking characters, while according to Gloria et al.[13] thinking habits are formed through formative assessments during learning activities. Thinking habits are important things that students have in overcoming problems during learning activities. The importance of thinking habits because thinking habits can be a predictor for Higher Order Thinking Skills (HOTS) which include critical thinking and creative thinking. Someone who has an intelligent thinking character will encourage the formation of critical thinking skills because in general critical thinking will be formed when someone is faced with various problems[14] and how he is able to try to solve the problem without giving up.

Students who have strong thinking habits will find it easy to solve problems at the HOTS level because they have a strong desire to solve problems.[15]

The importance of habits of mind encourages teachers and lecturers to try to improve ways to form optimal habits of mind. This is because habits of mind are influenced by the learning process and learning activities, one example of which is virtual practical learning that can affect students' attitudes.[16] Habits of mind can be trained through providing feedback.[17,18,19] Learning activities that can train habits of mind are learning that trains mental and concentration and avoids behavior that causes anxiety while learning.[20] Habits of Mind can be improved through practical activities[21] can be improved through an inductive approach[22] and can be improved by using formative assessments.[13,23]

Habits of Mind are related to critical thinking skills and mathematical thinking skills.[3,22] In the concept of habits of mind, critical thinking is needed for learning through writing activities about an experience with various purposes. This is because the writing process involves the process of interpretation, synthesis, and response.[24]

Given the importance of habits of mind possessed by students in the 21st century, especially in challenging times, for example the COVID-19 pandemic, it is also very important to know how habits of mind are formed. Information regarding habits of mind is still lacking, especially regarding the formation of habits of mind during the pandemic and how students' habits of mind are after the pandemic ends. Therefore, the purpose of this study is to determine the formation of habits of mind after online learning and what are the indicators of habits of mind that are formed through the application of online learning to prospective biology teacher students.

METHOD

Research Samples

The method used is descriptive quantitative, where habits of mind are interpreted based on data analysis from survey results. The number of participants was 301 people consisting of 49 male and 252 female. Participants are biology education students at one of the higher institutions in West Java, Indonesia.

Table 1. Total population and sample of respondents

No.	Year of Study	Number of Respondents
1.	Student 1st year / 2nd semester	31 people
2.	Student 2nd year/ 4th semester	135 people
3.	Student 3rd year / 6th semester	135 people

Research Variables

This study uses one main variable, namely Habits of Mind (HoM). This variable is an indicator of student thinking intelligence that reflects productive and positive thinking habits in dealing with problems during learning, especially in the context of online learning. According to Costa and Kallick Habits of Mind is the tendency to respond to dilemmas or problems with a reflective, responsible, and results-oriented way of thinking.

Research Instruments

The instrument used in this study is the Habits of Mind questionnaire which has been developed based on the theory of Costa and Kallick. The questionnaire consists of 21 question items representing the 16 indicators of Habits of Mind. Each item is graded using a Likert scale of 1–10, where a score of 1 indicates the lowest frequency and a score of 10 indicates the highest frequency in displaying a particular behavior.the structure of the instrument based on components and indicators:

Table 2. Structure of the instrument based on components and indicators

Component	Indicator	Number of Question Items
Reflecting	Listening with empathy	2
	Metacognition	2
	Ask questions and ask questions	1
	Collect data through all senses	1
Attending	Gigih (persisting)	1
	Managing impulses	2
	Striving to be accurate	2
	Think and communicate appropriately	1
Generating	Think flexibly	1

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	Create, imagine, innovate	2
	Respond with admiration	2
	Finding humor	2
Projecting	Applying past knowledge	1
	Take responsible risks	1
	Think interdependently	1
	Open to continuous learning	1
	Total	21

Data Collection Techniques

The data was collected by distributing an online questionnaire to students of the Biology Education Study Program at one of the universities in West Java. The number of respondents was 301 students, consisting of 49 males and 252 females, who came from semesters 2, 4, and 6.

Data Analysis Techniques

The data was analyzed descriptively quantitatively. The total score of each respondent is calculated, then converted into a percentage with the formula:

Final Score = (Score Obtained / Maximum Score) × 100

The categories of score interpretation are as follows:- 0–20: Very Low- 21–40: Low- 41–60: Medium- 61–80: Strong- 81–100: Very Strong

RESULTS

Based on the results of the study in the form of tracing the thinking habits of students who have attended online lectures and practices, data on thinking habits were obtained which were then analyzed based on differences in gender and differences in lecture levels.

The results of tracing the habits of mind of 301 students who attended lectures at the biology education department during the pandemic generally obtained results as shown in figure 1.

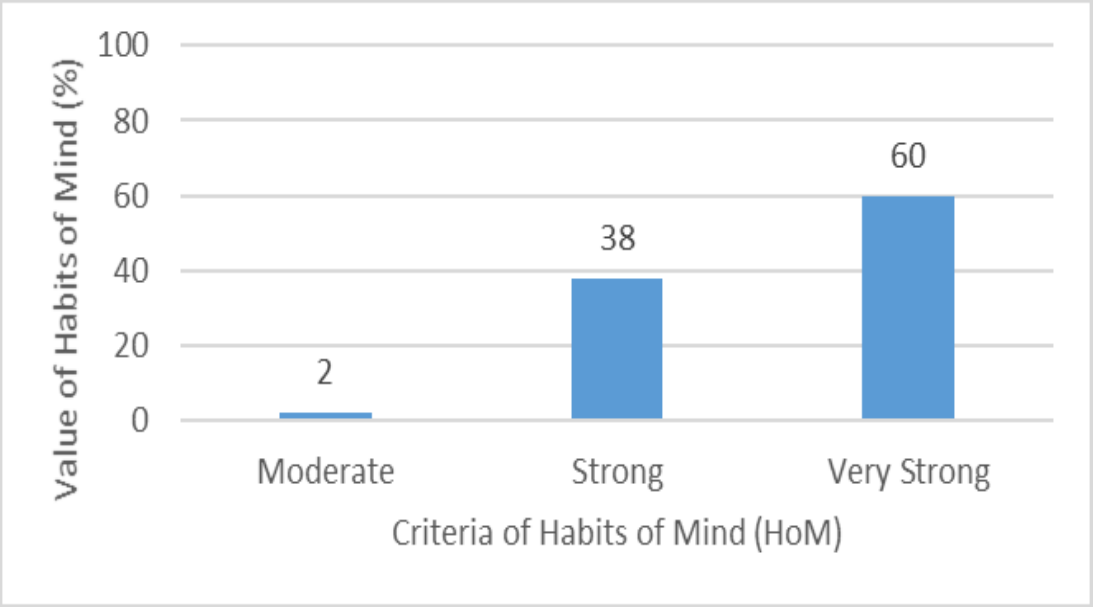

Figure 1. Habits of Mind of Students after the online lectures and practices

Habits of mind of students who are included in the very strong criteria are 60 % of the entire sample. Students who have a habit of mind value which is included in the moderate criteria are only 2 %. From figure 1 it can be seen that in general students have a satisfying habit of mind score because most of them have strong and very strong habits of mind (38 % and 60 %)

The result of the next data analysis is to analyze the value of students' habits of mind based on the habits of mind component, namely the components of contemplating, doing, creating and projecting. Figure 2 is data that displays the average value of habits of mind based on the 4 components of habits of mind.

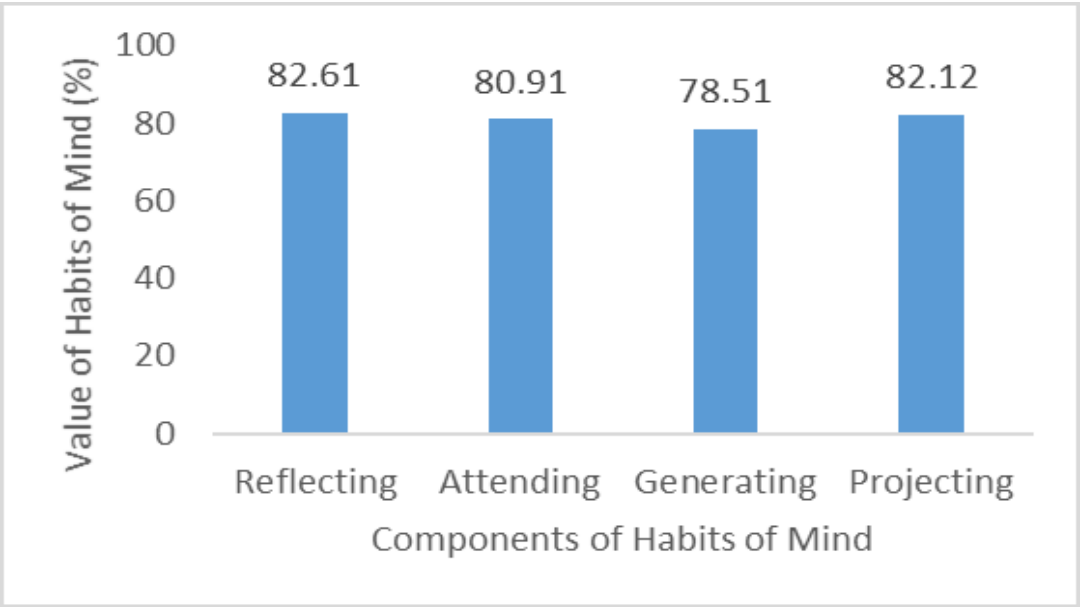

Figure 2. The average value of students' habits of mind in each component

The average of the four components of student habits of mind is not too much different, the highest average value of habits of mind is found in the pondering component (82,61) which is included in the very strong value criteria, while the lowest score is in the creating component (78,51) included in the strong criteria. If you look at the difference between the highest value and the lowest is 4,1. For the contemplating component, even though it has the highest average value but not much different from the average projected component value (82,12), it means that the difference is only around 0,49.

The habits of mind indicator consists of 16 indicators which are divided into four components. The graph of the values of habits of mind based on indicators can be seen in figure 3.

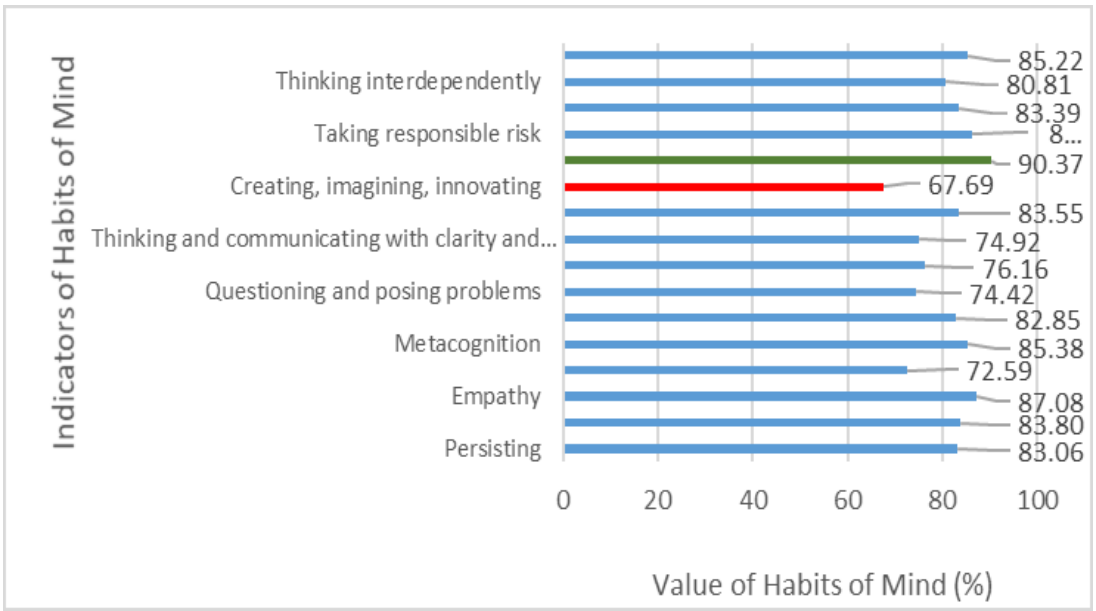

Figure 3. The average value of students' habits of mind for each indicator

The graph in figure 3 shows that the students' habit of mind scores per indicator range from 67,69, the lowest to 90,37, the highest. the highest score obtained from all respondents is the value on the indicator responding with admiration with a value of 90,37 included in the very strong criteria. While the lowest score on the creative, imaginative and innovative indicator, which is 67,69, is included in the strong criteria. Of the 16 indicators there are 11 indicators whose values are included in the very strong criteria group, meaning that the remaining 5 indicators have habits of mind values included in the strong criteria.

Students' habits of mind based on gender involved 49 male students and 252 female students. In general, the differences in the values of the habits of mind of male and female students can be seen in the following graph.

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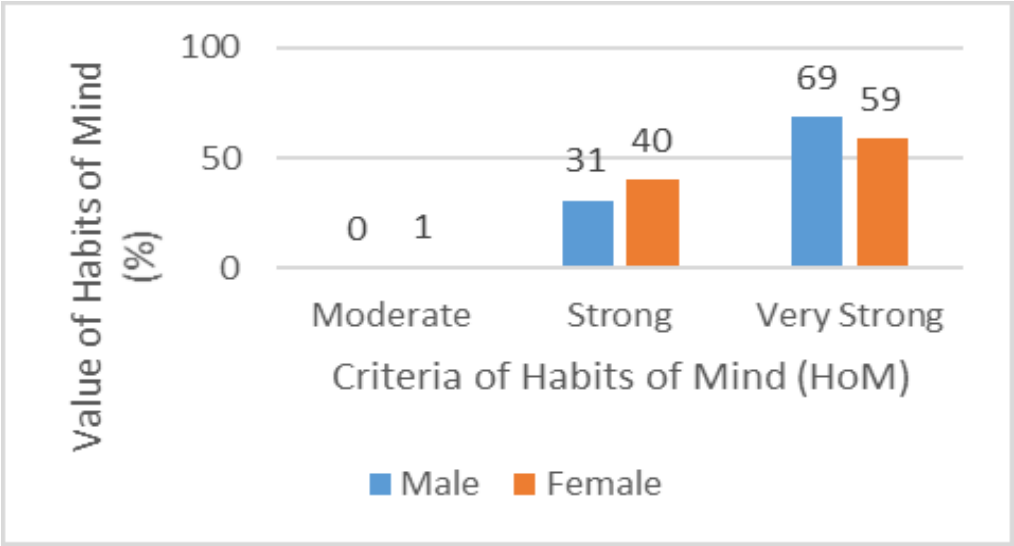

Figure 4. Categories of habits of mind based on gender differences

Figure 4 Regarding the habits of mind category based on gender differences, it shows that male and female students have an average group value of very strong habits of mind more than the strong category group.

Based on the habits of mind tracing test that has been carried out, the differences in the values of each habit of mind component between male and female students can be seen in table 3.

Table 3. Habits of mind scores of students based on gender differences

	Value of Habits of Mind	
HoM components	**Male Student**	**Female Student**
Reflecting	81,25	82,87
Attending	80,68	80,95
Generating	81,31	77,96
Projecting	83,29	81,89

There is a difference between the percentage of habits of mind scores for male students and female students. The highest score for male students was obtained on the projecting indicator with a value of 83,29. Whereas for female students, the highest score was obtained for the contemplating component, with a score of 82,87. The indicator with the lowest score for male students was found in the working component with a value of 80,68 while for female students it was found in the creating component with a value of 77,96. There are differences in scores between components between male students and female students.

Differences in the values of habits of mind for each component of male and female students can be seen in figure 5.

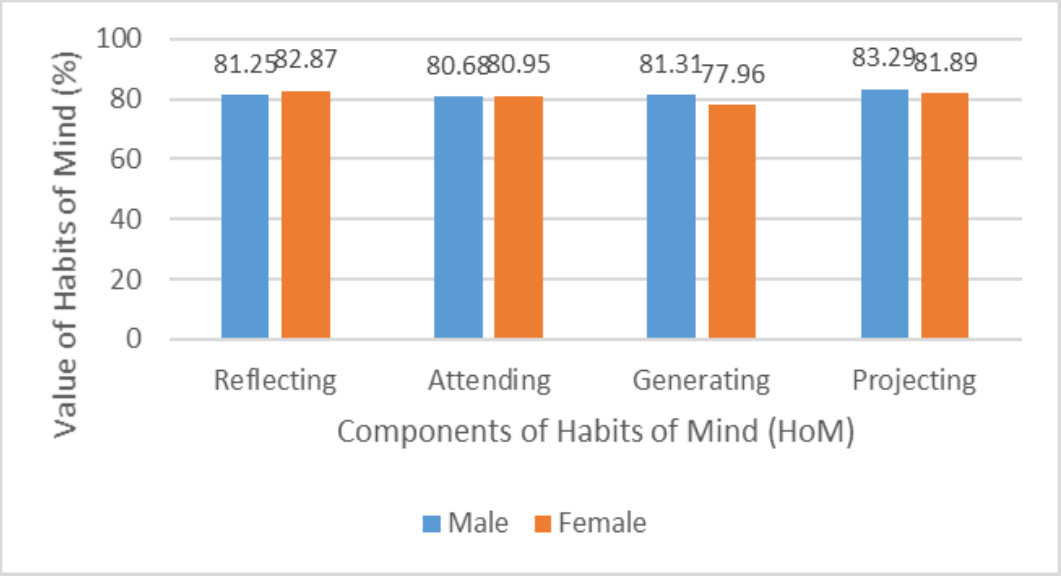

Figure 5. The value of the habits of mind of each component is based on gender differences

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In general, the values of the habits of mind of male and female students are relatively not much different for each component. In each component, the values of the habits of mind, both male and female, are included in the very strong value category (81-100), except for the values of habits of mind. for female students in the creating component is included in the strong category. The highest habits of mind value is in the habits of mind of male students for the projecting component (83,29) which is included in the very strong category.

To find out the value of habits of mind for each indicator for each gender, it can be seen in figure 6. namely the value of habits of mind of students based on gender differences in each indicator figure 6. Completely presents the values of the habits of mind of male and female students for 16 indicators. The indicator responding with admiration had the highest habits of mind score of 93 for male students and 89 for female students, while the lowest habits of mind score was for creative, imaginative and innovative indicators, namely 72,96 for male students and 66,67 in female students. However, in general there is no significant difference between all indicators.

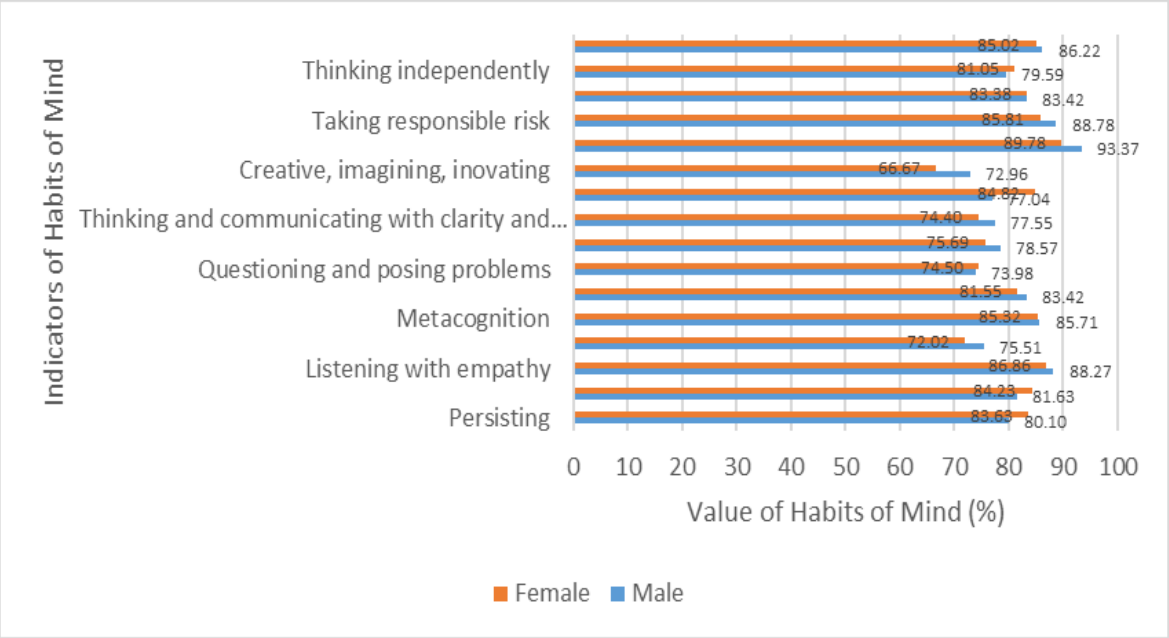

Figure 6. The value of students' habits of mind based on gender differences in each indikator

DISCUSSION

The thinking habits of prospective Biology teachers after online learning are known from the results of the study in general to have an average value that is included in the strong category (80,87). Overall, there are 60 % of biology education students who have very strong thinking habits. In contrast to Gloria, who found that before online learning, the average student thinking habits were included in the moderate criteria. This can explain that online learning does not affect intelligent thinking habits. High student thinking habit scores also show their resilience and readiness to change so that their interest in learning remains high even though they have to face uncertain situations.[26]

Online learning has the potential to provide good encouragement and motivation for students' habits of mind, students' efforts to survive even in abnormal circumstances make several indicators of habits of mind more optimally formed. Lecturers provide learning through online learning, both theoretical learning and practical learning. Lecturers give students more assignments. Assignments are given with the hope that they will encourage them to search for learning materials via the internet, books, and other media, this will form persistent habits of mind indicators, creative and innovative indicators, as well as seek information and continue learning. Research by Prihandhika et al.[27] found that online and hybrid learning pay more attention to affective abilities so that the formation of habits of mind after online learning is more optimal.

Online learning methods, for example, during a pandemic can encourage students to increasingly have 21st century abilities and skills, especially skills in utilizing high technology, this is also related to the habits of mind indicator, namely seeking high standards and accuracy. Adedoyin & Soykan[28] explain several factors that influence online learning activities, including technology factors and digital competence. Online learning provides more enthusiasm to students. With evidence from the results of this study, online learning still provides a maximum and clear way of learning. The results of this study also prove that online learning supports student independence in learning and seeking various information, in line with the research of Paechter & Maier[29] that students relatively choose online learning for skills in independent learning.

The implementation of online learning has motivated students to survive (persistent indicator), so that

their adaptive abilities have increased. High adaptive abilities are formed because of circumstances that force them to survive in uncertain situations, and the relatively long pandemic period, namely two years, is likely to encourage the formation of these adaptive abilities to be even higher. Adaptability is needed especially when considering the many uncertain and evolving circumstances.[30]

The implementation of online learning example during a pandemic, learning that continues well will have a good influence and factor on students' emotions and self-control. In this regard, preliminary observations before the data research show that biology education students continue to receive material related to their courses and continue to carry out practical practicums. online and independently, especially for practicum activities carried out at their respective residences and with simple practicum tools. According to Mega et al.[31] learning achievement is influenced by positive emotions. Positive emotions accelerate learning achievement in students as long as they are mediated by independent learning activities and the existence of learning motivation. Meanwhile Gloria et al.[13] found that student understanding can be improved through the application of a formative assessment which includes feedback, peer assessment, and self assessment. This proves that learning experiences affect the value of habits of mind. Supporting research is the research of Rikizaputra & Firda[20] which shows that the habit values of mind in 6th semester students are greater than students in 2nd and 4th semester, meaning that students who experience lectures have higher habits of mind values .

In this study, the results of an analysis of the habits of mind between men and women explain that after online learning, the habits of mind formed in both male and female students are relatively the same, both men and women have habits of mind which are classified as very strong values (81-100) for each component which includes reflecting, attending, generating, and projecting. The results of this study are in line with that of Gloria et al.[14] which was conducted three years before the covid pandemic (online learning), concluded that there was no significant difference between the habits of mind in Biology Education students, both male and female students.

In this study, male students had the highest scores on the projecting component (utilizing prior knowledge, taking risks, being able to work together in a team, and learning continuously). Female students had the highest scores on the reflecting component (emphatic listening, metacognition, asking and answering problems, taking data with all senses). In contrast to the results of Hidayati & Idris[32] the analysis of habits of mind that was carried out before the pandemic which had the highest habits of mind value was creative thinking, while critical thinking was in last place. Ariyati et al.[33] shows the highest presentation value of habits of mind is flexible thinking while the lowest is the category of thinking and communicating with clarity and accuracy.

The habit of mind scores after the pandemic were not affected by how long students studied figure 7. This is a graph that explains the habits of mind scores of students in 2nd, 4th, and 6th semester. The graph shows that the average student scores are relatively the same, which is included in the strong criteria. In general, biology education students during the pandemic both received online learning for both theoretical and practical learning. The assignments given by the lecturers are the same regarding materials related to biology, this causes what students experience to be relatively the same. Therefore, students' habits of mind are optimally formed through online learning and are not affected by how long they have been students. This is different from the findings of Alomyan[34] research that measures computer skills is in fact influenced by differences in the length of time students are in college. First year students have a lower level of computer skills compared to second, third and fourth year students. This means that there is a difference between the formation of thinking habits and the formation of thinking skills.

CONCLUSION

The results of the study show that online learning during the COVID-19 pandemic has positively contributed to the formation of *Habits of Mind* (HoM) in prospective biology teacher students. As many as 60 % of respondents have a very strong HoM category, and another 38 % are included in the strong category. The most prominent indicators are responding with admiration, metacognition, empathy, and openness to continuous learning. Meanwhile, the lowest indicators were creativity, imagination, and innovation. There was no significant difference between male and female students, as well as between semester levels. This shows that online learning is able to form positive and adaptive thinking habits equally. These findings are proof that online learning systems, if designed well, can strengthen students' thinking character, especially in facing the challenges of 21st century learning. Therefore, the development of an online curriculum that supports reflective and creative thinking is highly recommended for the education of prospective teachers in the future.

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DATA AVAILABILITY

Complete research data cannot be displayed and is only owned by researchers, this is because the data is confidential.

CONFLICTS OF INTEREST

This research does not contain any conflict of interest with anyone

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