Student learning independence to improve communication and collaboration skills in view of gender

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Abstract

This research aims to determine the differences and influence of independent learning on communication and collaboration skills. This research uses survey methods and a quantitative-descriptive approach. Data was obtained using a questionnaire with a Likert scale. The research subjects using random sampling techniques consisted of 33 female students and 82 female students in the Islamic religious education study program at UIN Datokarama Palu, Indonesia. The questionnaire contains 18 statements: 10 indicators of learning independence (LII), 3 indicators of communication skills (COM) and 5 indicators of collaboration skills (CLB). According to the results of data analysis using the Winsteps (Rasch model), male students have the best collaborative skills while female students are better at autonomous learning and the capacity to listen to information is the COM that is hardest to obtain. After applying one-way analysis of variance (ANOVA), a statistical significance of sig<0.05 was found indicating that male and female students exhibited distinct skill sets in the post hoc Games-Howell type follow-up test. The results show that for male and female students, learning independence is more dominant than communication and collaboration skills. The distinction lies in the fact that female students prefer communication skills while male students prefer collaboration skills. Further results obtained through the general linear model (GLM) test show that independent learning has an effect on communication skills (96.8%) and collaboration skills (93%). Finally, it can be stated that there is a positive relationship between learning independence and communication and collaboration skills.

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Contribution of this paper to the literature
Training and implementing educational patterns that train students in independent learning need to be carried out. This activity can create students who have adequate communication and collaboration skills. This research shows a relationship between independent learning and these skills in students.

1. Introduction

The primary basis for developing a person's personality and environmental adaptation is education (Bahtiar & Bahtiar, 2023; Pradana, Mahfud, Hermawan, & Susanti, 2020). Learning independence is a critical component of the educational process for students. The creation of people capable of competing on a worldwide scale in this globalization era requires independent study (Abidah et al., 2020; Arista & Kuswanto, 2018; Lo & Hew, 2020). The capacity of a student to plan and direct their own learning without entirely depending on their instructor is known as learning independence (Makarova & Makarova, 2018; Mazenod et al., 2019). The ability to take responsibility for their education and accomplish good learning outcomes will be possessed by students who become independent (Murtaqiatusholihat, Ali, Hernawan, & Dewi, 2023). Effective communication and teamwork are critical in the context of independent learning (Ratheeswari, 2018).

In the 21st century, students need to develop their collaboration, communication, critical thinking, and creative thinking (4C) skills. Students will be able to compete in the current world of technological advancements with these skills (Handajani & Pratiwi, 2018; Widiawati, Soetarno, & Sudiyanto, 2018). According to research by Kembara, Rozak, and Hadian (2019), students need to engage in a learning process that increases their 4C capacity. Additionally, this is consistent with research by Thornhill-Miller et al. (2023) showing that 4C abilities are critical for students to have in the twenty-first century. Researcher have presented many perspectives from important studies and they conclude that understanding the distinctions and connections among the 4C talents is necessary.

These skills are not only needed in the classroom but also in everyday life and facing the world of work. The researcher focused on communication and collaboration skills. Individuals can convey ideas clearly through good communication skills (Back, Fromme, & Meier, 2019; Rao, 2019). Proficiency in communication is also associated with the capacity to comprehend communications from others (Hargie, 2021; Simanjuntak, 2020) because communication skills are the process of conveying information, ideas and feelings with symbols, words, images and so on to help the recipient of the information respond (Vithayaporn, Yong, & Chai, 2021). As a result, students with communication skills need a language that is easy to understand, the ability to respect other people's opinions and the ability to explain logically. Broadly speaking, communication skills also include thinking rationally and showing respect for the other people in the conversation (Gunawan, Kosim, Ibrahim, Susilawati, & Syukur, 2021; Hartman-Caverly & Chisholm, 2020). The importance of communication skills is indirectly illustrated in the view above. More specifically, it is also based on significant research from Fomunyam (2019) that good communication skills need to be trained and possessed by students to face global challenges or advances in the world of education today.

Collaboration skills enable individuals to work together with others. Sanyal and Hisam (2018) solve problems together and achieve common goals (Le, Janssen, & Wubbels, 2018; Tomasello, 2018). Collaboration in the learning process is where each other helps in completing tasks. This can create cooperation within the group and adaptation to the group (Erdoğan, 2019). Collaboration skills relate to students' ability to work together to achieve common goals. Practices and group projects are effective ways to teach collaboration abilities (Tang, Vezzani, & Eriksson, 2020). The impact is that students tend to be more independent in their learning by not relying on teachers or lecturers as a learning resource. The importance of this corresponds to the perspectives of Agussuryani, Sudarmin, Sumarni, Cahyono, and Ellianawati (2022) who contend that enhancing students' collaboration abilities is a continuous learning process that necessitates data on students' abilities as an indicator of whether or not they are changing. According to Androutsos and Brinia (2019) and Tan's (2021) perspectives and studies, cooperation skills are essential for students to be able to produce original works, innovate goods or find solutions to problems that already exist.

The conditions above are not the same or shared by all students. The most basic cause is the difference in learning patterns or learning independence possessed by each individual. As a result, it will affect communication and collaboration skills. According to Alshare and Sewailem's (2018) research, one prerequisite is having strong communication abilities but lacking teamwork. It is also possible to analyse this in relation to learning independence. In other conditions, there can also be differences in learning independence, communication skills and collaboration (Stehle & Peters-Burton, 2019; Supena, Darmuki, & Hariyadi, 2021). According to study findings, students' communication abilities differ when participating in learning and discussion activities. As a result, there are students who are able to be active in discussion activities (collaboration) but are not able to communicate well or vice versa (Rohid & Rusmawati, 2019). This difference can be influenced by several factors, including the student's gender, the parent's education level and the parent's occupation. Gender has a role in shaping students' learning patterns and social interactions (Kalender, Marshman, Schunn, Nokes-Malach, & Singh, 2019; Lindsey, 2020). The role of higher education can also influence the way students learn and assess information to practice their communication skills (Erdener & Knoeppel, 2018). Students with adequate technology have the opportunity to develop collaboration skills through social interaction in the surrounding environment (Bonal & González, 2020; Romero, López-Romero, Domínguez-Álvarez, Villar, & Gómez-Fraguela, 2020).

The issues raised above highlight the need for in-depth study on the relationship between students' acquisition of independence and their capacity for cooperation and communication (Dowell, Lin, Godfrey, & Brooks, 2020; Mutohhari, Sutiman, Nurtanto, Kholifah, & Samsudin, 2021). These relationships are reviewed by considering factors such as student gender (Tzu-Ling, 2019). This research will provide a better understanding of how learning independence, communication skills and collaboration skills relate to and influence each other. It is hoped that the results of this research can provide valuable input in developing educational programs that

support increasing student learning independence especially in the context of developing communication and collaboration skills. An additional aim is that it might serve as a resource for parents, teachers and schools (Prabawati, Riyanto, Hariyati, Indrasetianingsih, & Ladiqi, 2023) in assisting and enhancing the skills of their students.

2. Literature Review

2.1. Learning Independence

Students generally carry out a series of activities based on their wishes. It could also be that the activity or events have previously been planned or scheduled. This leads to a definition of learning independence that is dominant in the form of learning activities (Perry, VandeKamp, Mercer, & Nordby, 2002; Zaharah, Windarti, & Galia, 2020). Independent learning is a series of learning activities carried out on the basis of prior planning (Hariyadi, Misnawati, & Yusrizal, 2023; Sugianto, Suryandari, & Age, 2020). Learning independence can also be defined as students' efforts to understand material, do assignments or solve problems independently both inside and outside of class hours (Fisher & Frey, 2021; Hockings, Thomas, Ottaway, & Jones, 2018).

Another view regarding learning independence is students' preparation about study schedules and taking responsible action to solve problems (Susilo & Pancarani, 2020). Independent learning is carried out by students who have time discipline and learning motivation (Hendikawati, Zahid, & Arifudin, 2019). The researcher comes to the conclusion that learning independence is a condition of students who are motivated to learn independently through forward planning based on the definitions given above.

Several indicators of learning independence such as those by Bahtiar, Maimun, and Ibrahim (2023) include self-confidence, discipline, motivation, initiative and responsibility. Another indicator is from Diana, Wirawati, and Rosalia (2020) which consists of 6 indicators. 1) Independence from other people, 2) having self-confidence, 3) having disciplined behavior, 4) having self-confidence, 4) having a sense of responsibility, 5) taking the initiative, and 5) self-control. Meanwhile, according to Sugandi (2013), there are 9 indicators. 1) Learning initiative, 2) diagnosing needs, 3) determining learning targets, 4) controlling or monitoring and organizing, 5) viewing difficulties as challenges, 6) looking for learning resources, 7) implementing learning strategies, 8) self-evaluation, and 9) having a self-concept.

2.2. Communication Skills

Communication is an important aspect of all forms of activity. Communication is an important aspect that supports the success and achievement of educational goals (Jamaludin & Mohammad, 2023; Lukitoyo & Wirianti, 2020). Communication is a way that individuals use to convey and exchange messages or information. Good communication will of course result in the maximum, clear and most understandable delivery of information (Fatorachian & Kazemi, 2021; Wogalter, 2018). As a result, students need to have good communication skills and support their learning activities (Hyland-Wood, Gardner, Leask, & Ecker, 2021; Sari, 2018).

The capacity of a student to communicate with another person is known as their communication skills. More complex communication skills are activities in expressing thoughts, hearts or emotions in verbal, written or action form (Nurcholis & Hidayatullah, 2019). There are several indicators of communication skills such as those from Bahtiar et al. (2023) which consist of speaking skills, listening skills and non-verbal communication skills. Additional indicators include language use, material completeness, content order and delivery methods that are systematic and organized Makiyah, Mahmudah, Sulistyaningsih, and Susanti (2021).

2.3. Collaboration Skills

The advancement of education may result in innovations in modern technology. The innovation product is the result of a combination of several branches of science. The incorporation process is a portrayal of collaboration skills (Partono, Wardhani, Setyowati, Tsalitsa, & Putri, 2021). Various types of problems and innovations can be resolved through collaboration (Gray & Purdy, 2018; Tan, 2021). This means that in order to promote the advancement of the times, students must be able to collaborate with others. Collaboration skills are the ability of students to work in teams and combine ideas to solve problems (Daga, 2022). Another definition is the skills of individuals who are able to work together and fix each other when creating a product (Septikasari & Frasandy, 2018; Zubaidah, 2018). Collaboration skills are essential for students to develop their social dimensions due to the nature of humans as social creatures (Blau, Shamir-Inbal, & Avdiel, 2020; Yuliansyah & Ayu, 2021). In the field of education, collaboration skills are synonymous with cooperation activities, discussions, practicums and project-based learning. There are several indicators of collaborative skills. According to, Fitriyani, Jalmo, and Yolida (2019), collaboration skills include cooperation, responsibility, compromise, communication and flexibility. Other indicators of Dewi, Putri, Anfira, and Prayitno (2020) namely positive interdependence, face-to-face interaction, accountability and responsibilities and communication skills. Finally, Bahtiar et al. (2023) consist of work productivity, participation and contribution, taking responsibility for completing work, participating with respect in discussion or debate and always compromising with the team in solving problems.

2.4. Gender

Gender is defined as a grouping of sex or biological characteristics of individuals. Gender is also defined as a social and cultural grouping of individuals (Dalimoenthe, 2021; Davies, 2018). In general, in each class, there are male and female students. As a result, it is possible to review differences in abilities or skills possessed. According to the following view, this gender difference is the basis for differences in skills or abilities possessed by students (Davita & Pujiastuti, 2020; Febriani, Tawil, & Sari, 2021; Shubina & Kulakli, 2019). Several studies have found that male and female students tend to have differences in aspects such as accuracy, collaboration, responsibility, innovativeness and creativity, independence, communication, problem solving and thinking (Bedir, 2019; Izzati, Bachri, Sahid, & Indriani, 2019).

3. Methodology

3.1. Investigation Tools

This research was conducted at the Islamic religious education study program, UIN Datokarama Palu, Indonesia. Sampling was done using random sampling techniques with a total research sample of 115 consisting of 33 male students and 82 female students. This research uses survey methods and a quantitative-descriptive approach. The selection of the research approach and method is due to the purpose of the research which is to know the relationship between several variables. Another reason is to test the hypothesis in order to achieve previous research objectives. Data was obtained through questionnaires on learning independence, communication skills and collaboration skills which were filled out by students who were taking the aqidah akhlak course. The research aims to determine whether there is an increase in communication and collaboration skills due to independent learning based on gender. Another review is to find out whether there are differences in the level of learning independence, communication skills and collaboration skills based on gender. Some of these reviews serve as research objectives. Modified learning independence indicators from research (Bahtiar & Bahtiar, 2023) are shown in Table 1.

Table 1. Indicators of learning independence.

Learning independence indicator (LII)	Description	Item number
Self-confident (LII-1)	1. Believe in your abilities. 2. Able to solve the problem yourself.	1, 2
Discipline (LII-2)	1. Study according to the set time. 2. Prepare all learning materials neatly.	3, 4
Motivation (LII-3)	1. Learn on your own. 2. Do your best to prepare for the exam.	5, 6
Initiative (LII-4)	1. Have their learning pattern. Looking for other alternatives to solve the problem.	7, 8
Responsibility (LII-5)	1. Plan your learning activities. 2. Submit assigned assignments on time.	9, 10
Total		10

For communication skills and collaboration skills, use references from Bahtiar et al. (2023) as shown in Tables 2 and 3.

Table 2. Communication skills indicators.

An indicator of communication skills	Item number
Speaking ability (COM-1)	11
Listening ability (COM-2)	12
Non-verbal communication ability (COM-3)	13
Total	3

Table 3. Collaboration skills indicators.

An indicator of collaboration skills	Item number
Work productively with others (CLB-1).	14
Participate and contribute actively (CLB-2).	15
Take joint responsibility to complete the work (CLB-3).	16
Participate respectfully in discussions, debates and disagreements (CLB-4).	17
Always compromise with the team to solve problems (CLB-5).	18
Total	5

3.2. Data Collection

Referring to the indicators above will produce a questionnaire containing 18 statements. This statement is assessed by scoring a Likert scale (4, 3, 2, and 1) for each item.

3.3. Data Analyses

The total score was then analyzed using Microsoft Excel, Winsteps (Rasch Model) and SPSS version 24 with a general linear model test to determine the effect of independent learning on communication and collaboration skills. A one-way analysis of variance (ANOVA) test is used to determine differences in learning independence, communication skills and collaboration skills in terms of gender. ANOVA is a type of statistical test to find out whether the means of two or more groups are significantly different or not.

4. Results

4.1. Data on Learning Independence in Terms of Gender

A total of 115 samples were analyzed for questionnaire data containing 10 questions about learning independence. This statement is the result of a description of 5 indicators of learning independence. The results of the data analysis and the average score for each indicator are shown in Figure 1.
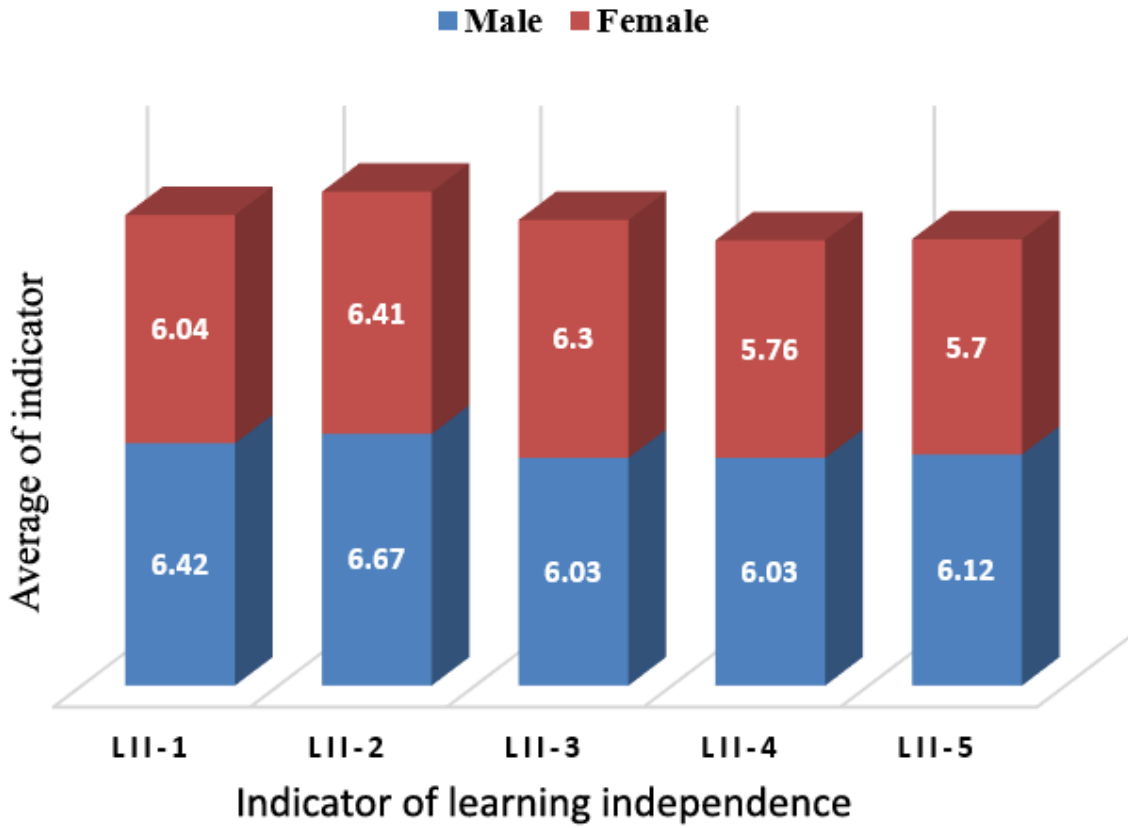
Figure 1. Learning independence data based on gender.

Male students' abilities to prepare all study materials and study within the allotted time are included in the LII-2 indication (discipline) which prevails for both female and male students as seen in Figure 1. More specifically, it is known which of the 115 samples has the highest learning independence. Additionally, Figure 2 displays the top 10 independent learning tasks that students find most challenging.
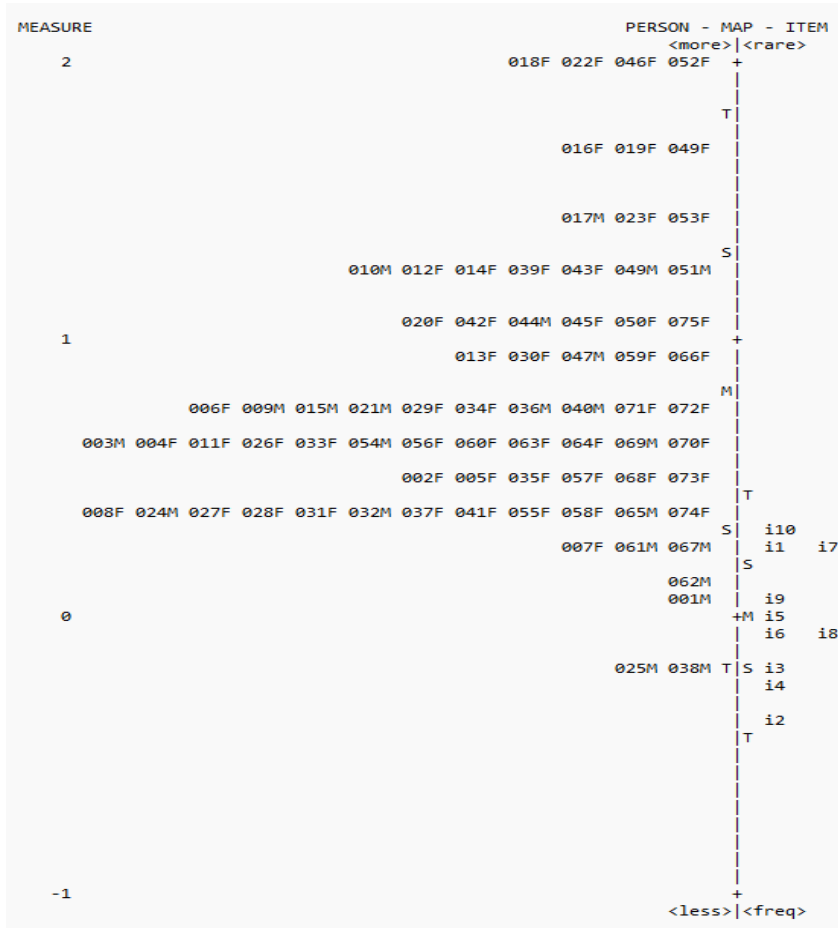
Figure 2. Wright learning independence map based on indicators and gender.

According to Figure 2, the samples with the highest levels of learning independence are those with the numbers 018F, 022F, 046F and 052F. All samples are female students. Meanwhile, the samples with the lowest level of learning independence were samples 025M and 038M (male students). This shows that female students are superior at independent learning. It is also evident from Figure 2 that item number 10 (i10) has the most challenging indicator for students to study on their own. This item is about responsibility in terms of taking attendance or signing on time. According to the theory, it will be challenging for students to go back to browsing and attend class on time (Fisher & Frey, 2021). This is also supported by research by Büchele (2021) that shows that attendance at lectures is no longer important for students due to technological developments and being able to access learning materials and resources independently. Meanwhile, the easiest indicator for

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students to carry out independent learning is item number 2 (i2). This item is about self-confidence in terms of being able to solve one's own problems because the educational curriculum makes students easily solve their own problems (Ismail & Imawan, 2022).

4.2. Communication Skills Data in Terms of Gender

Communication skills are an individual's ability to convey messages to other people to inform and change overall attitudes, behavior and opinions both directly and indirectly. As a result, each individual has different skills (Coffelt, Grauman, & Smith, 2019). The research used 3 indicators of communication skills. The differences in communication skills for each indicator are shown in Figure 3.
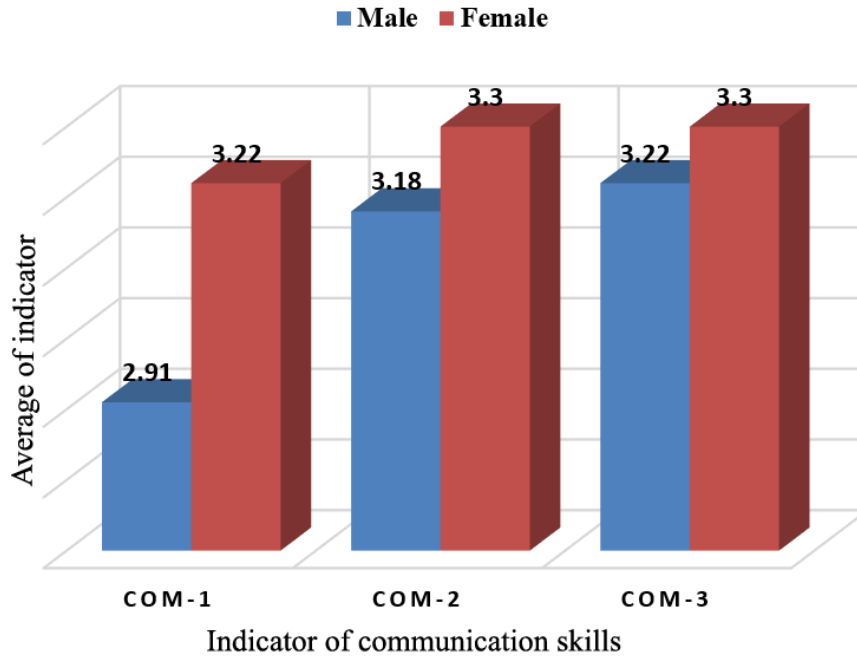
Figure 3. Communication skills data based on gender.

Figure 3 illustrates the dominance of male and female students in the COM-3 (non-verbal communication) indicator. Figure 2's condition shows that female students dominate in each indicator. This is also supported by Hakim, Daulay and Listari (2021). Female students show more critical thinking skills and are able to evaluate information in a wider range of ways. Erdiana, Bahri, and Akhmal's (2019) research also supports the idea that female students performed better on average than male students in speaking abilities or information delivery, with female students scoring an average of 68.5 out of 63.3. Furthermore, it is recognised that several indications of communication abilities are relatively easy or difficult for students to complete based on the questionnaire items. The results are shown in Figure 4.

Figure 4. Scores and difficulty levels of communication skills items.

Referring to Figure 4, item number 12 (i12) is an indicator of communication skills that is most difficult for students to achieve. However, for this item, there are students who are able to get the maximum score and there are also students who get the lowest score. Item number 12 is about the ability to listen to information. Accord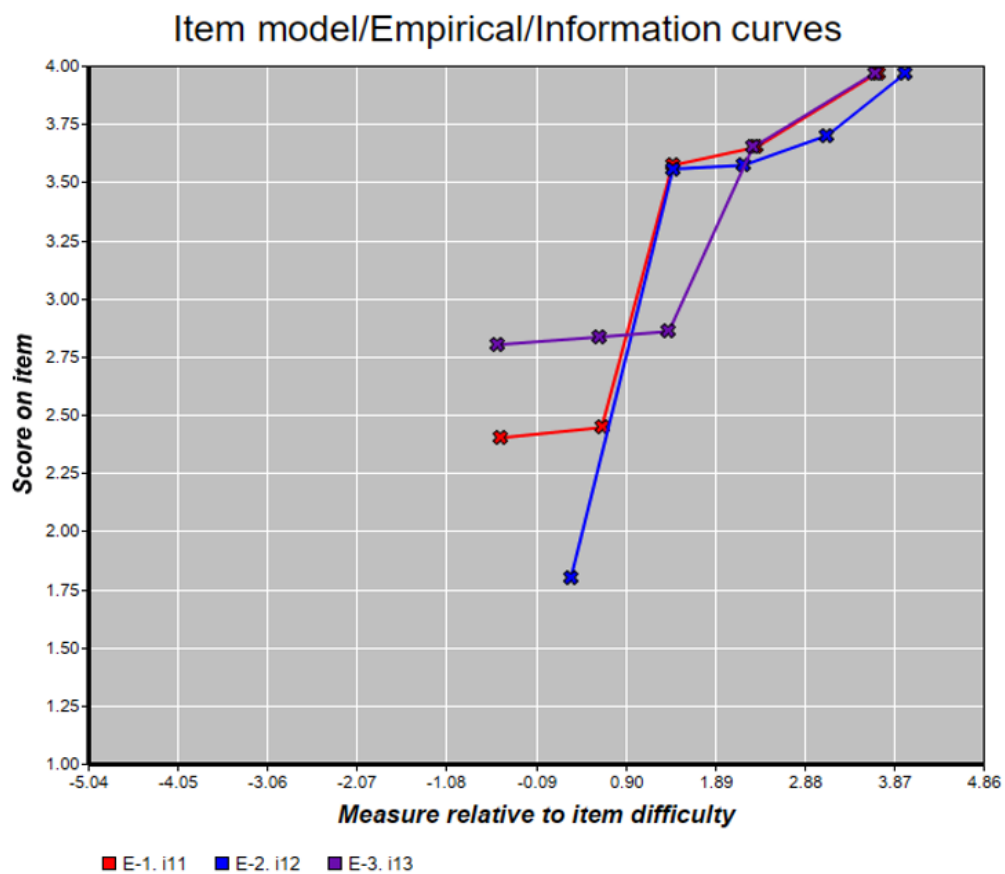ing to research results, it is stated that students feel strange and have difficulty focusing on listening to information due to the amount they are studying and the orders given (Rahmat, 2023). Meanwhile, items 11 and 13 are at the same level of difficulty and are relatively easy for students to do. These items are about speaking skills and non-verbal communication. Various languages make it difficult for people to communicate verbally which enables students to reinforce their speech with non-verbal communication. As a result, the level of speaking and non-verbal communication skills can be aligned (Franchini et al., 2018).

4.3. Collaboration Skills Data in Terms of Gender

Collaboration skills are the main key in the learning process to understand or discover knowledge. Its application is used to solve science problems in discussion activities. Collaboration skills are also important to achieve the best results when solving complex problems (Graesser et al., 2018). This research uses 5 indicators of collaboration skills, each containing 1 statement. The results of the questionnaire data analysis showed a comparison of collaboration skills for each indicator as shown in Figure 5.
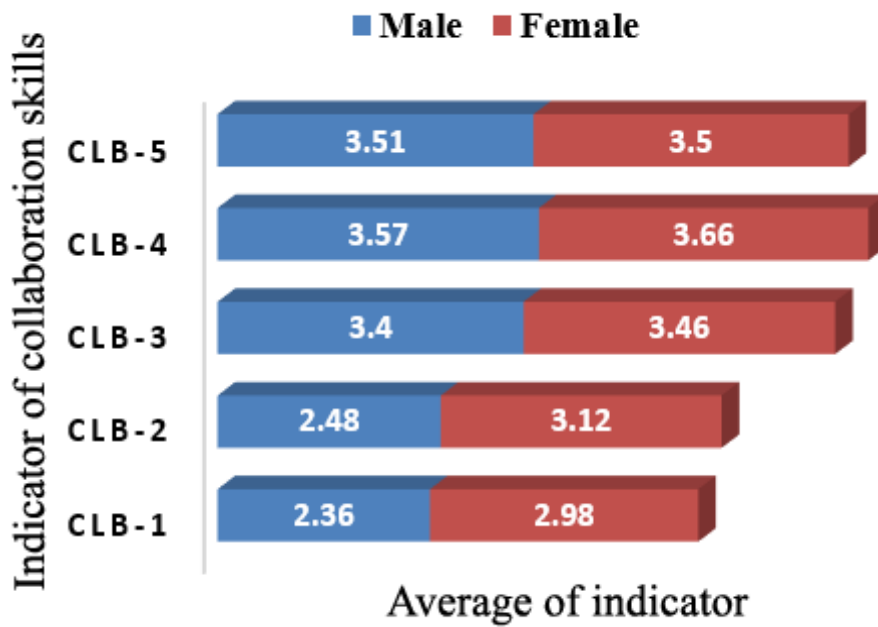
Figure 5. Collaboration skills data based on gender.

Figure 5 shows that male students and female students are equally dominant in the collaboration skills indicator (CLB-4) which is about participating in discussions, debates or disagreements in learning activities. The CLB-4 indicator shows that female students are superior. This condition is in accordance with the statement (Malik & Ubaidillah, 2021) that in learning activities or discussions, female students tend to prefer to put forward solutions to solve problems. It will be possible to gather information by closely examining the five collaboration skills questionnaire items as shown in Figure 6.
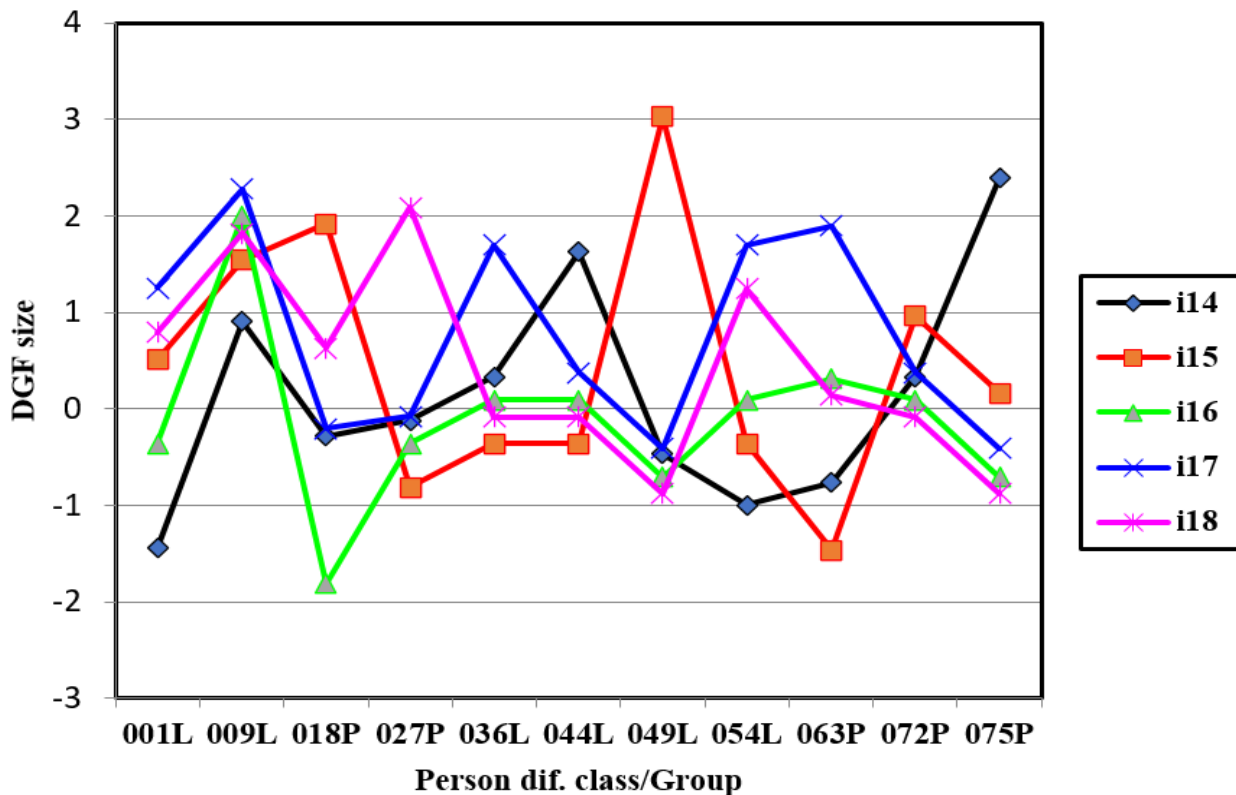
Figure 6. Distribution of collaboration skills item scores.

Indicator item number 15 (i15) which is the collaboration skill with the highest score in the male student sample (049L) is based on Figure 6. The item is always compromising with the team to solve problems. Meanwhile, those with the lowest collaboration skills are female students (018P), namely in item number 16 (i16). The item is about taking shared responsibility for getting the job done. Both of these factors support the claim that male students outperform female students in group problem solving because they are more compassionate and have a stronger sense of responsibility (Graesser et al., 2018; Risopoulos-Pichler, Daghofer, & Steiner, 2020).

4.4. Comparison of Learning Independence, Communication Skills and Collaboration Skills in Terms of Gender Factors

The percentage levels of learning independence, communication skills and collaboration abilities were determined based on each indication which was derived from the questionnaire responses. The results of the analysis are shown in Figure 7.
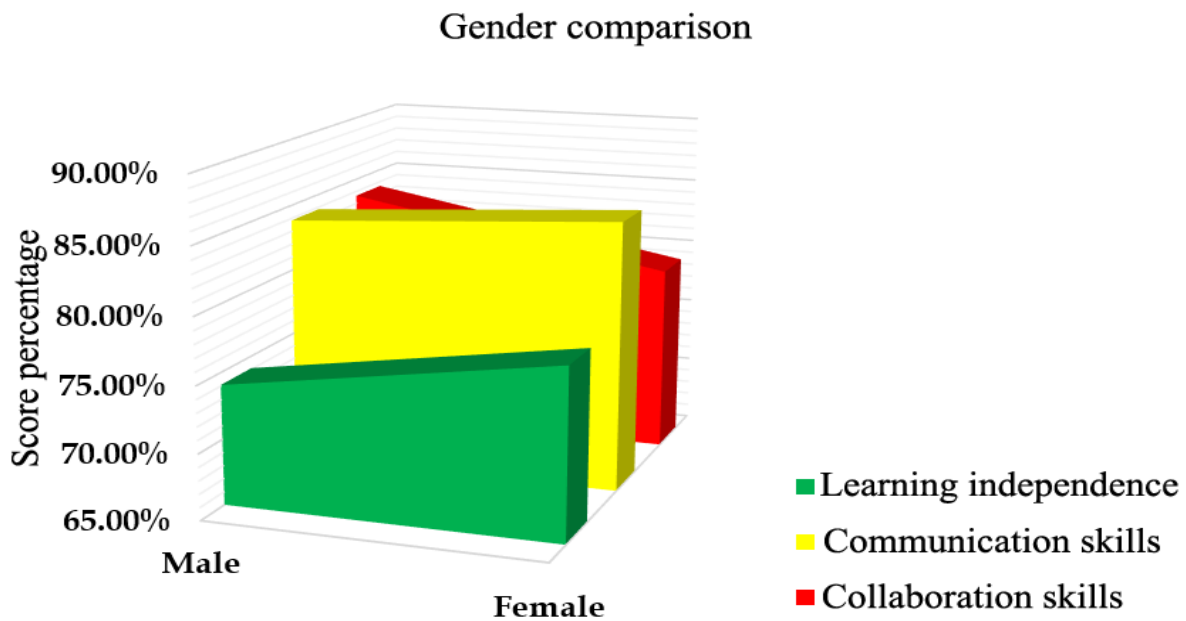

Figure 7. Comparison of learning independence, communication skills, and collaboration skills in terms of gender factors.

Female students excel in independent learning and communication skills according to Figure 7. Female students can achieve higher learning outcomes than male students because they are more numerous, persistent and committed. Female students have better self-management skills than male students (Yu, 2021). Meanwhile, male students excel at collaboration skills. Figure 4 further demonstrates that learning independence will lead to an increase in collaboration and communication abilities.

4.5. Statistical Analysis to Determine the Influence or Relationship between Learning Independence on Communication Skills and Collaboration Skills in Terms of Gender

In this analysis, Table 4 displays the results of the General Linear Model (GLM) test.

Table 4. GLM test results between learning independence and communication skills.

Multivariate test[a]		Value	F	Partial eta squared
Effect		**Value**	**F**	**Partial eta squared**
Research variable	Pillai's trace	0.968	953.299[b]	0.968
	Wilks' Lambda	0.032	953.299[b]	0.968
	Hotteling's trace	30.263	953.299[b]	0.968

Note: a: Learning independence, b: Communication skills.

Learning independence (a) influences communication skills (b) by 96.8% as shown by the partial eta squared value referring to Table 4. The influence given is positive so it can be concluded that the higher the value of learning independence, the higher or better the communication skills will be.

Table 5. GLM test results between learning independence and communication skills in terms of gender.

Tests of between-subjects effects				
Source	**Dependent variable**	**Mean square**	**F**	**Partial eta squared**
Corrected model	Male student	6322.970	933.462	0.936
	Female student	7297.515	1318.196	0.954

According to Table 5, a student's learning freedom affects their communication skills by 93.6% for male students. Meanwhile, the level of learning independence among female students has a 95.4% impact on their communication skills.

Learning independence(a) influences collaboration skills(b) by 93% as shown by the partial eta squared value referring to Table 6. The influence given is positive so it can be concluded that the higher the value of learning independence, the higher or better the collaboration skills will be. According to Al-Samarraie and Saeed (2018) independent learning makes a positive contribution to communication skills in terms of expressing opinions in discussion activities.

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Table 6. GLM test results between learning independence and collaboration skills.

Multivariate test[a]				
Effect		**Value**	**F**	**Partial eta squared**
Research variable	Pillai's trace	0.930	417.252[b]	0.930
	Wilks' lambda	0.070	417.252[b]	0.930
	Hotteling's trace	13.246	417.252[b]	0.930

Note: a: learning independence, b: communication skills.

Table 7. GLM test results between learning independence and collaboration skills in terms of gender.

Tests of between-subjects effects				
Source	**Dependent variable**	**Mean square**	**F**	**Partial eta squared**
Corrected model	Male student	2749.636	354.662	0.847
	Female student	4418.182	611.641	0.905

Table 7 indicates that the level of learning independence among male students has an 84.7% impact on their ability to collaborate. Meanwhile, for female students, their learning independence influences collaboration skills by 90.5%.

4.6. Statistical Analysis to Determine Differences in Learning Independence, Communication Skills and Collaboration Skills in Terms of Gender

The one-way ANOVA test was used to determine differences in learning independence, communication skills, and collaboration skills in terms of gender factors.

Table 8. ANOVA test results for learning independence, communication skills, and collaboration skills in terms of gender.

ANOVA						
		Sum of squares	**df**	**Mean square**	**F**	**Sig.**
Male student	Between groups	6537.293	2	3268.646	544.717	0.000
	Within groups	576.061	96	6.001	–	–
	Total	7113.354	98	–		
Female student	Between groups	19183.569	2	9591.785	1686.231	0.000
	Within groups	1382.256	243	5.688	–	–
	Total	20565.825	245	–		

Table 8 indicates that there are disparities in learning freedom, communication abilities and collaborative skills between male and female students. This is proven by the sig value of <0.05.

4.7. Further Test: One -Way ANOVA (Post Hoc)

The purpose of this test is to find out in detail the differences that occur between learning independence, communication skills and collaboration skills when viewed by gender. In addition, this test can be used to precisely evaluate the learning independence of teamwork and communication skills or vice versa. The test results are given in Table 9.

Table 9. Hasil uji post hoc ANOVA.

Multiple comparisons						
Dependent variable		**(I) Research variable**	**(J) Research variable**	**Mean difference (I-J)**	**Std. error**	**Sig**
Male student	Games-Howell	Learning independence	Communication skills	19.576	0.603	0.000
			Collaboration skills	12.909	0.603	0.000
		Communication skills	Leaning independence	-19.576	0.603	0.000
			Collaboration skills	-6.667	0.603	0.000
		Collaboration skills	Learning independence	-12.909	0.603	0.000
			Communication skills	6.667	0.603	0.000
Female student	Games-Howell	Learning independence	Communication skills	20.890	0.372	0.000
			Collaboration skills	15.305	0.372	0.000
		Communication skills	Leaning independence	-20.890	0.372	0.000
			Collaboration skills	-5.585	0.372	0.000
		Collaboration skills	Learning independence	-15.305	0.372	0.000
			Communication skills	5.585	0.372	0.000

The Games-Howell advanced test type was used because the data analyzed did not meet the homogeneity requirements. Each research variable influences each other both in terms of male students and female students as evidenced by the sig value <0.05 based on Table 2. More specifically, Table 2 shows that male and female students have better learning independence than communication and collaboration skills. Another situation is that collaboration skills are better than communication skills. Figures 8 and 9 provide more visual information.
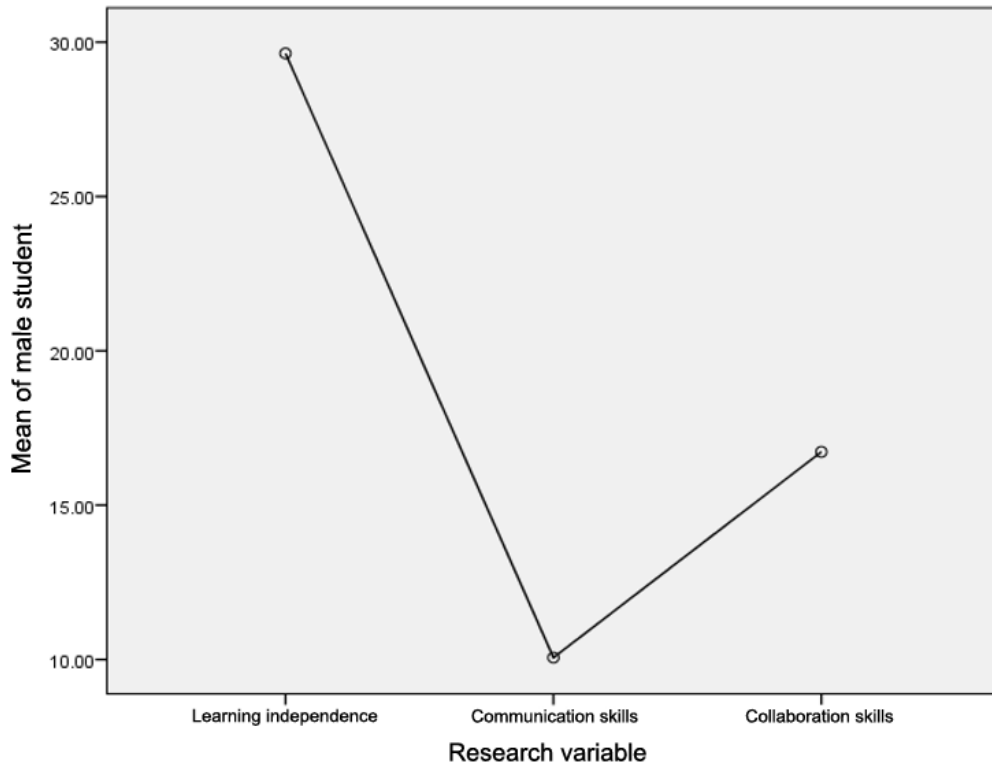
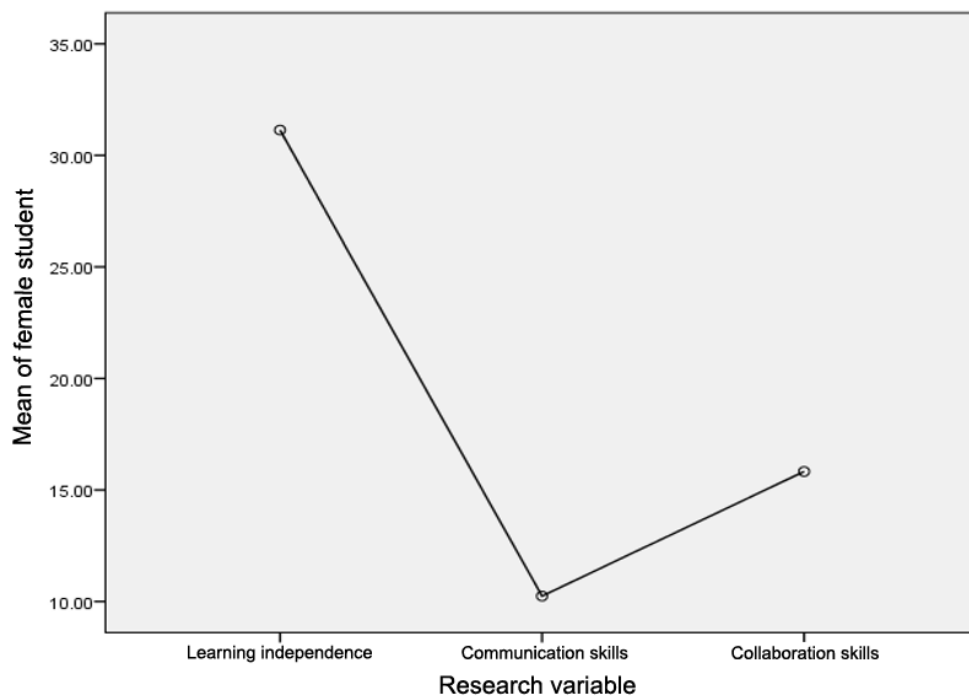**Figure 8.** Graph of research variables for male students.

Figure 9. Graph of research variables for male students.

5. Discussion

Technological developments in higher education currently require students to study independently. Polytechnics, institutes or universities are examples of higher education institutions that require higher education institutions management and services (Ogunode & Musa, 2020). Students' individual roles are guided by the same principles that support this management and service. Lecturers are not the only ones who acquire and form this role such as by assigning instructional materials (Peters, 2020; Wargadinata, Maimunah, Eva, & Rofiq, 2020). The process cannot only occur at school or on campus (Lau et al., 2018). As a result, individuals who have learned independence are able to practice the 21st-century skills that are needed today (Chalkiadaki, 2018; Chu, Reynolds, Tavares, Notari, & Lee, 2021). The skills in question include communication and collaboration skills (Shafie, Majid, & Ismail, 2019; Silber-Varod, Eshet-Alkalai, & Geri, 2019). This research aims to determine the relationship between independent learning and these skills in terms of gender with male students as the research sample.

The first thing that was found was that female students were around 4% superior in learning independence compared to male students, so it shows that there is a difference (Hodge, Wright, & Bennett, 2018). Specifically, based on the indicators, it was found that both male students and female students were equally dominant in the LII-2 indicator (discipline). These indicators are about learning skills according to the specified time (Susanty, 2020). This condition describes male and female students who are able to carry out learning or learning activities according to their lecture schedule or independent study schedule. The explanation of these indicators is also in terms of preparing all learning materials. This condition is that males and students are able to prepare all the tools or materials for learning needs before lecture activities begin (Ratheeswari, 2018). The study findings of Davita, Nindiasari, and Mutaqin (2020) corroborate the idea that male and female students differ in their levels of learning freedom. These differences are found in the indicators of choosing and determining learning strategies.

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The next finding is that female students excel by around 3% in communication skills. The results of this finding are slightly different from the research which states that male students excel in speaking skills but female students excel in comprehension and conveying information skills (Erdiana et al., 2019). The reason might be that female students are more calm and relaxed and enjoy gatherings and discussions more since they have dominant oestrogen and progesterone hormones. Enjoying gatherings or discussions here is not about the material or substance of the discussion but about enjoying gathering information for their use (Collins, McCutcheon, & Petroff, 2022). Female students are more skilled and superior when presenting the results. Moreover, the communication skills indicators revealed that there was a dominance of male and female students in the COM-3 (non-verbal communication) indication.

Meanwhile, male students excel by around 5% in collaboration skills. Furthermore, referring to the collaboration skills indicator obtained by male students and female students, both are dominant in the collaboration skills indicator (CLB-4). This indicator is about participating in discussions, debates or conflicts in learning activities. According to Osborne, Byrne, Massey, and Johnston (2018), students' cooperation skills will be evident when they make the most of their practice and discussion opportunities. Male students have the testosterone hormone which makes them more likely to like a challenge than female students. The challenge in question is like racing, competing with ideas and concepts. As a result, they like to carry out discussion activities or meetings (Sherrod, 2018). According to this theory, male students have the ability to solve problems easily.

According to Agaoglu and Demİr (2020), a cooperative collaborator will facilitate problem-solving. Another view is that individuals with high collaboration skills will have the ability to solve problems easily and well in group work (Bahtiar, Ibrahim, & Maimun, 2022). According to Sanyal and Hisam (2018), there are several supporting factors for collaboration or cooperation, namely analytical skills, mastery of correct concepts, leadership, forms of evaluation and appreciation for team performance. As a result, female students excel in independent learning and communication skills while male students excel in collaboration skills.

Additional results were obtained using a general linear model test with the assistance of SPSS 24 specifically focusing on the association between developing independence and communication and collaboration skills. It was found that Kurnia, Mulyani, Rohaeti, and Fitrianna's (2018) research indicated that gaining independence could impact communication abilities by 96.8%. Gender-specific analysis reveals that gaining independence affects communication abilities in male students by 93.6%. Meanwhile, for female students, their learning independence influences communication skills by 95.4%. The next review is independent learning of collaboration skills. It was found that learning independence influenced collaboration skills by 93% according to research by Hidayat, Yulianti, and Herpratiwi (2021). Based on gender, it shows that male students' learning independence influences collaboration skills by 84.7%. Meanwhile, for female students, their learning independence influences collaboration skills by 90.5%. The final finding was a one-way ANOVA test to determine the differences between learning independence, communication skills and collaboration skills in terms of gender. The test results show sig<0.05, thus stating that there are differences in learning independence, communication skills and collaboration skills between male students and female students. A more specific review of these differences using post hoc tests shows that male and female students have better learning independence (15%-21%) compared to communication and collaboration skills. Another condition is that collaboration skills are around 5%-7% better than communication skills. This is in accordance with data from the Organization for Economic Cooperation and Development (OECD) which is a global organization with the aim of fostering cooperation in realizing a strong and advanced economy between countries and its members. According to the OECD, Indonesia remains poor in scientific and numerical literacy. This statement contains conditions for skills in communicating, explaining, interpreting data or correctly presenting theories found after conducting experiments (Fuadi, Robbia, Jamaluddin, & Jufri, 2020). Renn believes that in order to solve issues and get past egocentric mindsets, there must be excellent communication during the teaching process (Renn, 2020).

6. Conclusion

This research concludes that the level of learning independence is superior for female students and the dominant indicator is discipline in learning. Similarly, female students excel in communication skills and the dominant indicator is non-verbal communication. On the other hand, female students' ability to collaborate is superior to that of male students and the dominant indicator is participating in discussion activities well. Furthermore, it was found that there were differences in learning independence, communication skills and collaboration abilities between male and female students. Another fact is that independent learning can at least influence communication skills (96.8%) and collaboration skills (93%). More specifically, looking at gender, the fact that learning independence in male students is able to influence communication skills (93.6%) and collaboration skills (84.7%). Meanwhile, female students were able to influence communication skills (95.4%) and collaboration skills (90.5%). In a nutshell, it can be indicated that the relationship between independent learning communication skills and collaboration skills is positive. A positive relationship defines the higher the level of learning independence, the higher the level of communication skills and collaboration skills.

7. Suggestions

This research only includes samples from one university, so it is possible that there are differences in learning independence, communication and collaboration skills among students at other universities. We suggest that future research can review more than one university. This enables the claim to be based on more objective research findings. Another point to consider is that variations in campus facilities, learning models and methodologies and college curricula may all have an impact on how successfully students acquire independence, teamwork and communication. We also suggest that it is necessary to train and implement learning models that are able to train students' learning independence. It is important for students in this era of modern technological development to have learning independence. Learning independence will allow students to be varied in finding learning resources, completing assignments or problems, finding innovations or even planning their learning targets for 1 semester. Other skills can be trained and emerge in students as a result of independent learning,

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namely communication and collaboration skills. Students who are able to look for, identify and acquire knowledge on their own will perform better and be more prepared to share their thoughts and opinions in class or during lectures. As a result of their ability to discover the latest innovations, students are able to easily be active in collaborative activities with team members when completing projects or assignments. In the end, this research needs to be followed up to create conditions for students who have the maximum levels of learning independence, communication and collaboration skills.

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