Inventive Thinking as a Life and Career Skill: a Survey in State Islamic University Students

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Abstract. Inventive thinking is a critical skill for generating useful innovations and supporting life and career competencies in the 21st century. This study aims to discover students' inventive thinking skills across faculties and study programs at a state Islamic university in Central Java. Employing a survey method, the study involved a population of 500 seventh-semester students from five faculties with various study programs. Random sampling was used to select the participants. Data were collected using a validated questionnaire consisting of 49 valid statements, with an Alpha Cronbach reliability value of 0.907. The results indicate that the inventive thinking skills of students at the university are in the high category, with an average score of 174.86. However, there is potential for further improvement to elevate these skills to the very high category, enabling students to better meet the demands of life and career challenges in the 21st century.

Keywords: Inventive Thinking Skills, Live and Career Skills, Student University. First Section

1 Introduction

Today, technology is developing very quickly, as evidenced by its widespread use in nearly every job and activity. This rapid development of technology and science in this era of globalization requires the readiness of a nation to face it so as not to be left behind [1]. A nation must be able to compete and adapt to become a superior nation [2]. The life of the future will require someone who can adapt to the complexities and challenges of diverse times [3,4]. Consequently, students are encouraged to develop the skills needed for the 21st century.

The 21st-century skills are supported by attitudes, ethics, values, skills, as well as a set of knowledge [5]. These skills include accessing, analyzing, and synthesizing information, generating creative innovations, demonstrating effective communication, and exhibiting strong collaboration abilities [6]. Innovation involves generating and implementing new ideas to solve problems and improve ways of working. Creativity is at the heart of this process, as it involves producing new and useful ideas in various contexts, while innovation focuses on their application.

To support creativity and innovation, individuals need the ability to solve problems in novel ways, create new technologies, and develop new applications of existing ones.

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21st-century learning emphasizes three main domains: 1) the ability to innovate and learn, 2) life and career skills, and 3) media and technology skills [7,8]. Competitiveness in life and the job market can be addressed by developing a 21st-century framework that includes 1) inventive thinking, 2) digital literacy skills, 3) high productivity, and 4) effective communication [9,10]. Among these, inventive thinking stands out as a critical skill for the 21st century.

Inventive thinking skills emphasize techniques to solve problems effectively and creatively so that there are discoveries that are useful for society [10]. This skill is essential for 21st-century education [11]. Inventive thinking is thinking that invents or produces something new as a result of human creativity [10]. Inventive thinking skills mean skills in solving new problems creatively and effectively [12]. The six core elements of inventive thinking are: 1) complexity and adaptability, 2) self-direction, 3) creativity, 4) curiosity, 5) risk-taking courage, and 6) higher-order thinking and reasoning [13]. These elements include the ability to adapt to change, set and achieve goals independently, maintain curiosity for lifelong learning, produce original ideas, take calculated risks, and apply higher-order thinking for problem-solving in diverse contexts.

The first element is adaptability, which is the ability to adapt or flexibility to change [14]. Adaptability is sometimes called flexibility, which is the ability to modify attitudes, behaviors, or thoughts to adjust to unpredictable circumstances [15]. Complexity is the ability to handle various problems/tasks/conditions, in other words being able to deal with complex things [7]. The second component is self-direction, which refers to the capacity of students to establish learning objectives, organize the attainment of these objectives, autonomously manage their time and energy, and autonomously evaluate the caliber of their education and each output that comes from their experiences and education. The third element is curiosity. The desire of students to learn something is important in lifelong learning.

Fourth, creativity is the realization of something entirely new and unique, both culturally and personally (original only for individuals). This suggests that the student can create something novel or unique that has cultural or personal significance. Risk-taking is the readiness of students to consider difficulties or problems, to share ideas or views with others, and to accept criticism. Risk-taking is the ability or willingness to venture outside of one's comfort zone, make mistakes, and find innovative solutions to obstacles to further one's development and success. Reasoning and higher-order thinking refers to the process of cognitive analysis, comparison, inference, interpretation, synthesis, and evaluation that is implemented in various academic fields or problem-solving fields. The problem in question is a contextual problem of life or a problem given to students specifically.

Amidst the rapid development of technology and the complexities of the global job market, inventive thinking skills are indispensable. These abilities not only enable individuals to innovate but also contribute significantly to national competitiveness. In Indonesia, particularly at state Islamic universities, the integration of Islamic values with modern innovation and technology presents unique challenges and opportunities. However, research investigating the inventive thinking skills of students in these institutions, especially in Central Java, remains scarce. This gap hinders a comprehensive understanding of students' readiness to face the challenges of life and job competition in the 21st century.

Therefore, the purpose of this study is to explore the student's inventive thinking skills across various faculties and study programs at a state Islamic university in Central Java. By identifying students' levels of inventive thinking, this research seeks to inform higher education policies aimed at improving learning strategies and preparing students for the demands of the 21st century.

2 Method

The research method used in this study was the survey method. This method was used to obtain or search for data on information in a fairly large population but using relatively smaller sample data. This study was carried out in one of Central Java's Islamic state universities. Students enrolled in semester seven at one of Central Java's Islamic state universities made up the study's population. Five hundred students from one of the Islamic state institutions in Central Java, which has five faculties and offers a variety of study programs, made up the study's sample. Sample random sampling was the sampling method used in this investigation. Each study program and faculty has the following number of research samples.

The Faculty of Adab and Language (FAB) consists of the Arabic Language and Literature Study Program with a sample of 19 people, the Arabic Language and Literature Study Program with a sample of 19 people, the English Language Education Study Program with a sample of 30 people, the English Literature Study Program with a sample of 31 people, and the Indonesian Language Study Program with a sample of 34 people. The Faculty of Islamic Economics and Business (FEBI) consists of the Sharia Accounting Program with a sample of 38 people, the Sharia Business Management Study Program with a sample of 25 people, and the Sharia Banking Study Program with a sample of 11 people.

The Faculty of Tarbiyah Sciences (FIT) consists of the Islamic Religious Education Study Program with a sample of 31 people, the Arabic Language Education Study Program with a sample of 29 people, the Madrasah Ibtidaiyah Teacher Education Study Program with a sample of 36 people, and the Early Childhood Islamic Education Study Program with a sample of 31 people. The Faculty of Sharia (FASYA) consists of the Sharia Economic Law Study Program with a sample of 4 people, the Islamic Family Law Study Program with a sample of 15 people, the Islamic Criminal Law Study Program with a sample of 9 people, and the Zakat and Waqf Management Study Program with a sample of 16 people.

The Faculty of Ushuluddin and Da'wah (FUD) consists of the Aqidah and Islamic Philosophy Study Program with a sample of 27 people, the Islamic Counseling Guidance Study Program with a sample of 26 people, the Qur'an and Tafsir Study Program with a sample of 11 people, the Islamic Communication and Broadcasting Study Program with a sample of 45 people, the Da'wah Management Study Program with a sample of 19 people, Islamic Psychology Study Program with a sample of 21 people, Sufism and Psychotherapy Study Program with a sample of 15 people.

The questionnaire was about the method of data collecting employed in this investigation. Data on the students' inventive thinking skills at one of the Islamic state universities in Central Java was gathered using the questionnaire. The questionnaire uses a

Likert scale with 5 alternative answers. Content and empirical validation were carried out on the inventive thinking skills questionnaire and produced 49 valid statements. The results of the reliability test of the inventive thinking skills questionnaire obtained an Alpha Cronbach value of 0.907. The value is more than 0.70 so it meets the requirements that the inventive thinking skills questionnaire is reliable or trustworthy. The criteria for the measurement results used are classification based on the ideal average and ideal deviation standard shown in the Table 1 below.

Table 1. Inventive Thinking Skills Category

Inventive Thinking Skills's Score	Category
$196 \leq X$	Very High
$163{,}33 \leq X < 196$	High
$130{,}67 \leq X < 163{,}33$	Moderate
$98 \leq X < 130{,}67$	Low
$X < 98$	Very Low

3 Results and Discussion

The average inventive thinking skills of students of Islamic state universities in Central Java based on faculty can be seen in the Fig.1 below.

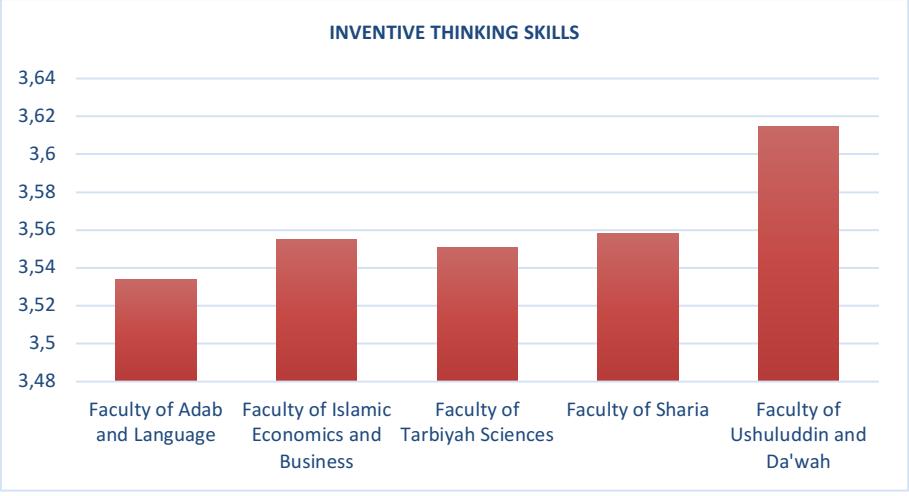

Fig. 1. Inventive Thinking Ability of Each Faculty

Based on the graph above, information was obtained that the average inventive thinking skills of students of the FUD were the highest among other faculties, namely 3.61. With an average difference of 0.05 from the FUD, the FASYA and FEBI have an average score of 3.56. With an average difference of 0.06 from the FUD, the FIT has an average

score of 3.55. With an average difference of 0.08 from the FUD, the FAB's score is 3.53 on average. It was found that the average difference in inventive thinking skills of the FUD with other faculties was not very different, which ranged from 0.05-0.08.

Most of the students at Islamic state universities in Central Java are in the high and medium categories. The frequency of inventive thinking skills of students at Islamic state universities in Central Java can be seen in the Table 2 below.

Table 2. Percentage of Inventive Thinking Skills of students of Islamic state universities in Central Java

Faculty	VH	H	M	L	VL
FAB	7,89%	66,67%	24,56%	0,88%	0%
FEBI	14,86%	54,05%	31,08%	0%	0%
FIT	10,24%	55,12%	34,65%	0%	0%
FASYA	6,82%	56,82%	36,36%	0%	0%
FUD	11,59%	67,07%	20,73%	0,61%	0%

The average inventive thinking skills of students of the FAB based on the study program can be seen in the Fig.2 below.

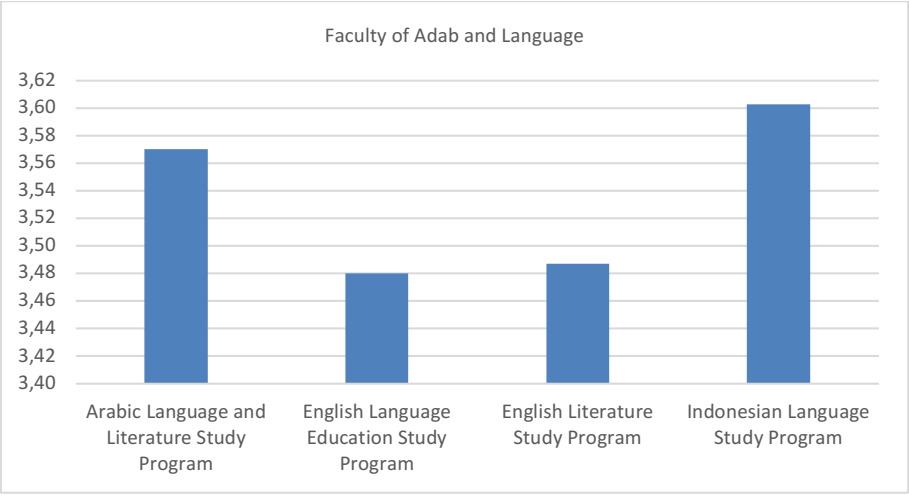

Fig. 2. FAB Students' Inventive Thinking Skills

Based on the graph above, information was obtained that the average inventive thinking skills of Tadris Indonesian students were the highest among other study programs in the FAB, which was 3.60. With an average difference of 0.03 from Tadris Indonesian, the Arabic Language and Literature score is 3.57 on average. With an average difference of 0.11 from the Tadris Indonesian, the English Literature score is 3.49 on average. The English Language Education has an average score of 3.48 with an average difference of 0.12 from the Tadris Indonesian. It was obtained that the average difference in

inventive thinking skills between the Tadris Indonesian and other study programs was not much different, which ranged from 0.03-0.12.

The average inventive thinking skills of students of the FEBI by study program can be seen in the Fig. 3 below.

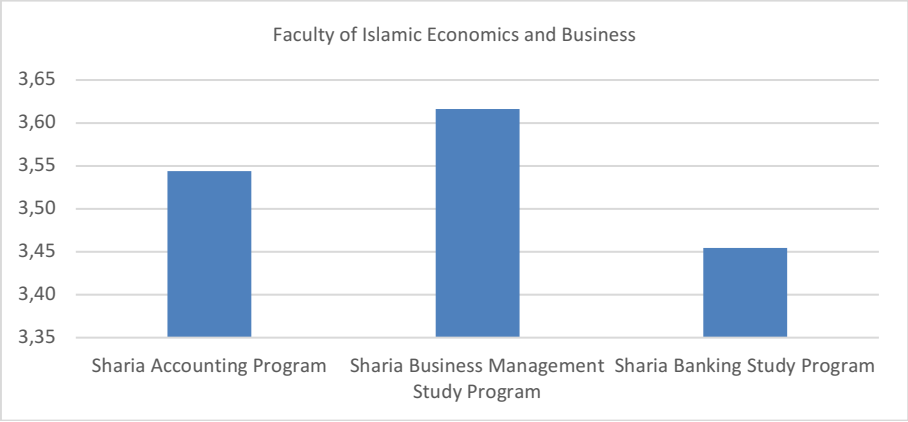

Fig. 3. FEBI Students' Inventive Thinking Skills

Based on the graph above, information was obtained that the average inventive thinking skills of Sharia Business Management students were the highest among other study programs in the FEBI, which was 3.62. The average score for the Sharia Accounting is 3.54, and the average difference between it and the Sharia Business Management study program is 0.08. The average score for Sharia Banking is 3.45, and the average difference between Sharia Business Management and Sharia Banking is 0.17. It was obtained that the average difference in inventive thinking skills between the Sharia Business Management and other study programs was not very different, ranging from 0.08-0.17.

The average inventive thinking skills of students of the FIT based on the study program can be seen in the Fig.4 below.

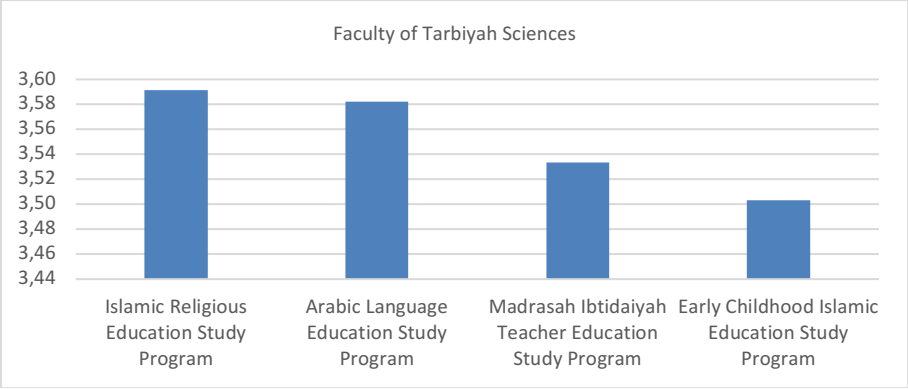

Fig. 4. FIT Students' Inventive Thinking Skills

Based on the graph above, information was obtained that the average inventive thinking skills of Islamic Religious Education students were the highest among other study programs in the FIT, which was 3.59. The average score for Arabic Language Education is 3.58, and the average difference between it and Islamic Religious Education is 0.01. The average difference between Islamic Religious Education and Madrasah Ibtidaiyah Teacher Education is 0.06, and the average score of Madrasah Ibtidaiyah Teacher Education is 3.53. The difference average score for Islamic Religious Education and Early Childhood Islamic Education is 0.09, whereas the average score for Early Childhood Islamic Education is 3.50. It was obtained that the average difference in inventive thinking skills between the Islamic Religious Education and other study programs was not much different, which ranged from 0.01-0.09.

The average inventive thinking skills of FASYA students by study program can be seen in the Fig.5 below.

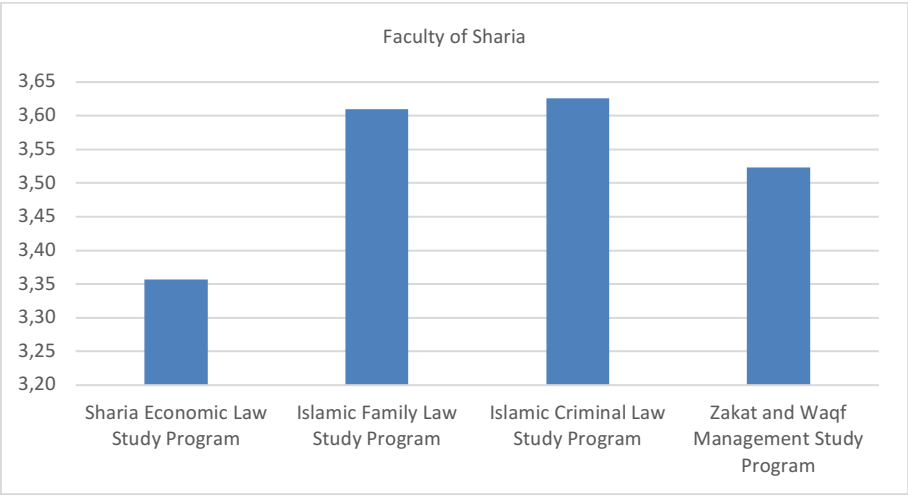

Fig. 5. Fasya's Students Inventive Thinking Skills

Based on the graph above, information was obtained that the average inventive thinking skills between Islamic Criminal Law students were the highest among other study programs in FASYA, which was 3.63. The Islamic Family Law study program has an average score of 3.61 with an average difference of 0.02 from the Islamic Criminal Law. The average score for the Zakat and Waqf Management is 3.52, with an average difference of 0.11 from the Islamic Criminal Law. With an average score of 3.36, the Sharia Economic Law differs from the Islamic Criminal Law by 0.27 on average. It was found that the average difference in inventive thinking skills of the Islamic Criminal Law and other study programs was not much different, ranging from 0.02-0.27.

The average inventive thinking skills of students of FUD based on the study program can be seen in Fig. 6 below.

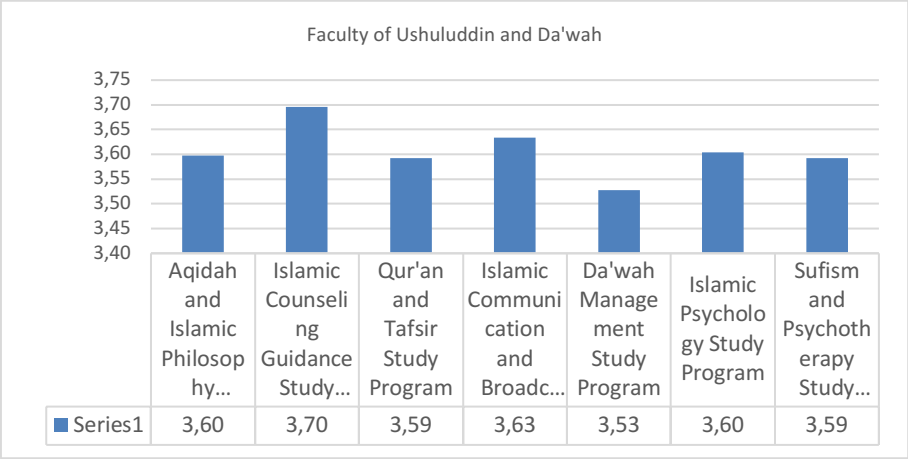

Fig. 6. Inventive Thinking Skills of the FUD's Students

Based on the graph above, information was obtained that the average inventive thinking skills of Islamic Counseling Guidance students were the highest among other study programs in FUD, which was 3.70. The Islamic Communication and Broadcasting study program has an average score of 3.63 with an average difference of 0.07 from the Islamic Counseling Guidance study program. The Islamic Psychology and Aqidah and Islamic Philosophy study programs have an average score of 3.60 with an average difference of 0.10 from the Islamic Counseling Guidance study program. The Qur'an and Tafsir and Sufism and Psychotherapy study programs have an average score of 3.59 with an average difference of 0.11 from the Islamic Counseling Guidance study program. It was obtained that the average difference in inventive thinking skills between the Islamic Counseling Guidance Study Program and other study programs was not much different, which ranged from 0.07-0.11.

The average inventive thinking skills of UIN Raden Mas Said students for each indicator can be seen in the Fig.7 below.

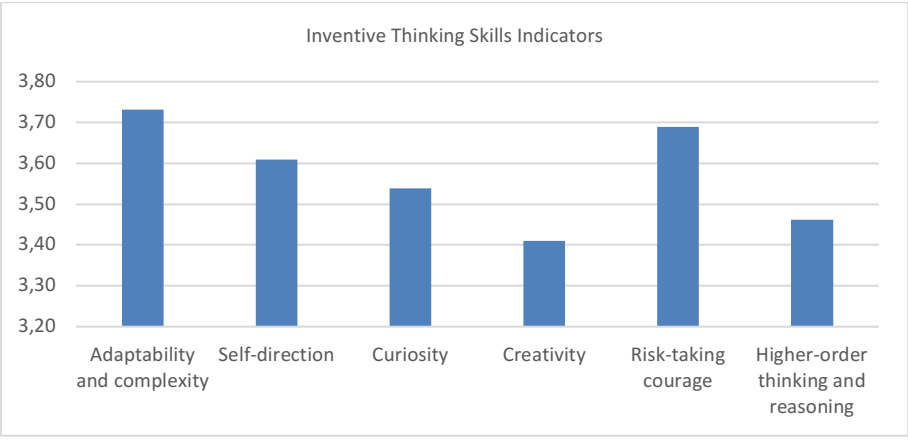

Fig. 7. Inventive Thinking Skills of Every Indicator

Based on the graph above, information was obtained that students at Islamic state universities in Central Java had the highest average score on adaptability and complexity indicators, namely 3.73. The average score for the risk-taking daring indicator is 3.69, with an average difference of 0.04 from the indicators for complexity and adaptability. The average score for the self-directed ability indicator is 3.61, with an average difference of 0.12 from the indicators of complexity and adaptability. The curiosity indicator has an average value of 3.54 with an average difference of 0.19 from the adaptability and complexity indicators. The average score of the high-level thinking and reasoning indicators was 3.46, with an average difference of 0.27 from the indicators of complexity and adaptability. The creativity indicator has an average value of 3.41 with an average difference of 0.32 from the adaptability and complexity indicators.

The average inventive thinking skills for adaptability and complexity indicators in students of each faculty can be seen in the Fig.8 below.

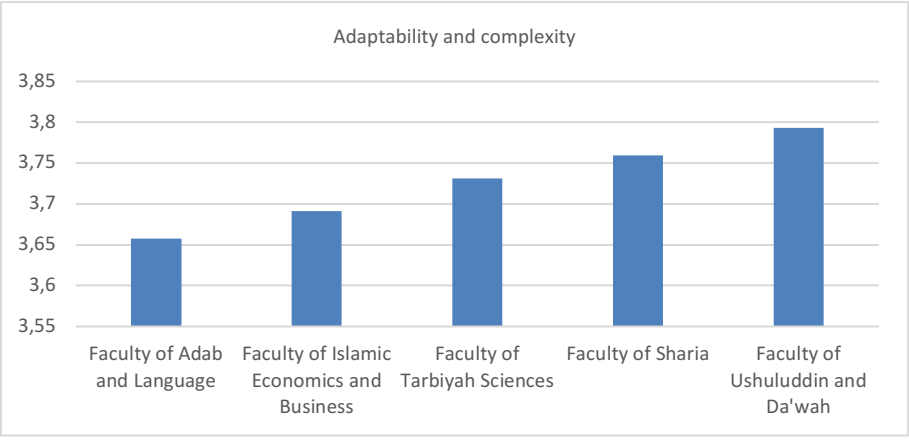

Fig. 8. Adaptability and Complexity of Students in Each Faculty

Based on the graph above, information was obtained that in the indicators of adaptability and complexity, the average inventive thinking skills of students of FUD were the highest among other faculties, namely 3.79. With an average difference of 0.03 from the FUD, FASYA has an average score of 3.76. With an average difference of 0.06 from FUD, FIT has an average score of 3.73. FEBI has an average score of 3.69 with an average difference of 0.10 from FUD. With an average difference of 0.13 from FUD, FAB has an average score of 3.66. It was found that the average difference in inventive thinking skills in the indicators of adaptability and complexity of FUD with other faculties was not much different, ranging from 0.03-0.13.

The average inventive thinking skills for indicators of self-directed ability in students of each faculty can be seen in the Fig.9 below.

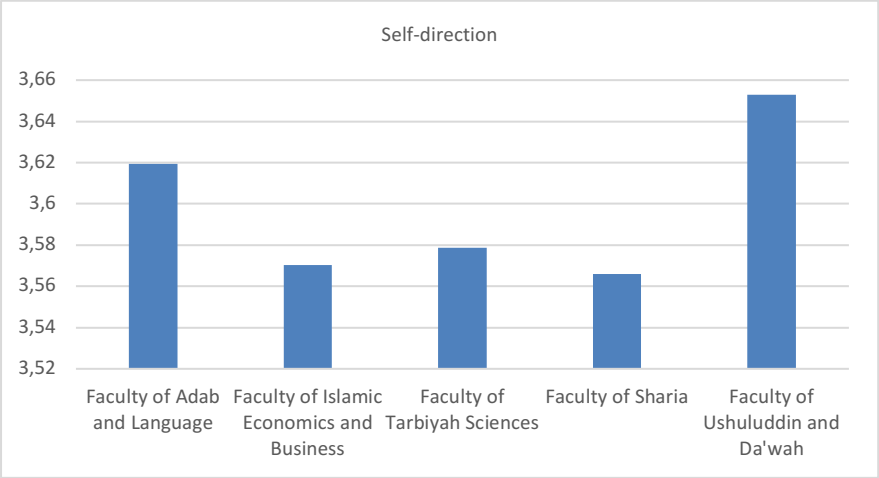

Fig. 9. Ability to Direct Students in Each Faculty

Based on the graph above, information was obtained that in the indicator of self-direction, the average inventive thinking skills of students of FUD were the highest among other faculties, namely 3.65. With an average difference of 0.03 from FUD, FAB has an average score of 3.62. With an average difference of 0.07 from FUD, FIT has an average score of 3.58. The average score for FEBI and FASYA is 3.57, and their average difference from FUD is 0.08. It was found that the average difference in thinking skills in the indicators of inventive self-direction ability of FUD with other faculties was not much different, ranging from 0.03-0.08.

The average inventive thinking skills for curiosity indicators in students of each faculty can be seen in the Fig.10 below.

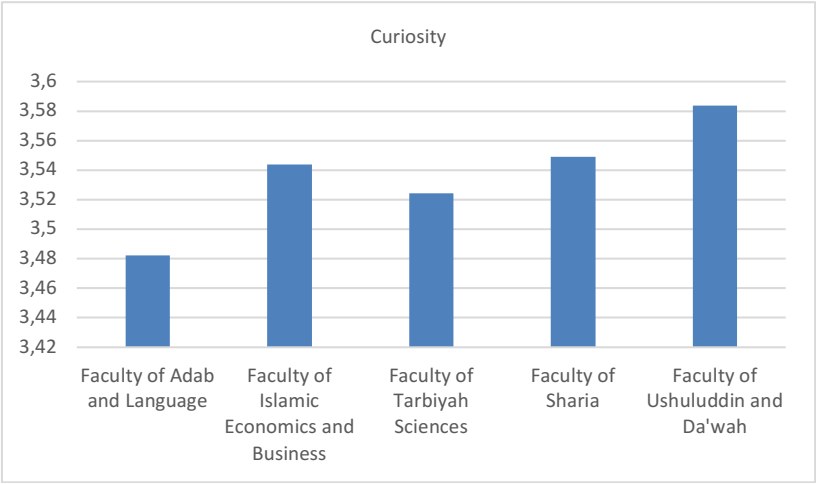

Fig. 10. Student Curiosity in Each Faculty

Based on the graph above, information was obtained that in the curiosity indicator, the average inventive thinking skills of students of FUD were the highest among other faculties, which was 3.58. With an average difference of 0.03 from FUD, FASYA has an average score of 3.55. With an average difference of 0.04 from FUD, FEBI has an average score of 3.54. With an average difference of 0.06 from FUD, FIT earns an average score of 3.52. With an average difference of 0.10 from FUD, FAB has an average score of 3.48. It was found that the average difference in inventive thinking skills in the indicators of adaptability and complexity of FUD with other faculties was not much different, ranging from 0.03-0.10.

The average inventive thinking skills for creativity indicators in students of each faculty can be seen in the Fig.11 below.

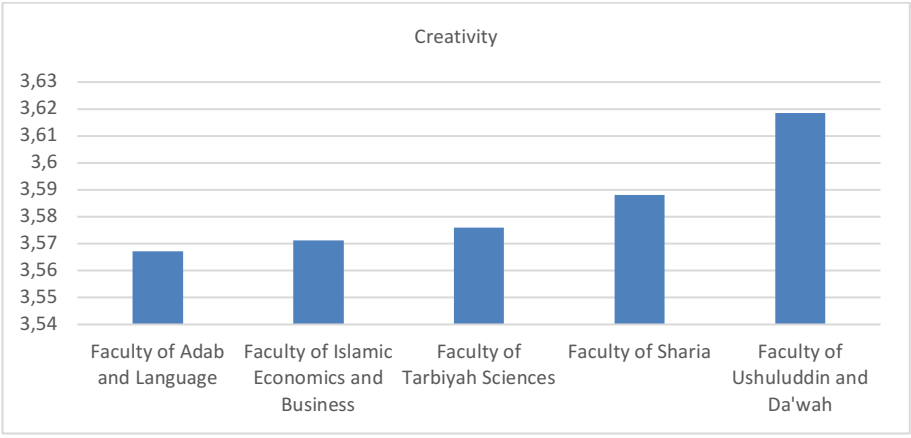

Fig. 11. Student Creativity in Each Faculty

Based on the graph above, information was obtained that in the creativity indicator, the average inventive thinking skills of students of FUD were the highest among other faculties, namely 3.62. With an average difference of 0.03 from FUD, FASYA has an average score of 3.59. With an average difference of 0.04 from FUD, FIT has an average score of 3.58. The average score for FEBI and FAB is 3.57, and their average difference from FUD is 0.05. It was found that the average difference in inventive thinking skills in the creativity indicators of FUD with other faculties was not much different, ranging from 0.03-0.05.

The average inventive thinking skills for risk-taking indicators in students of each faculty can be seen in the Fig.12 below.

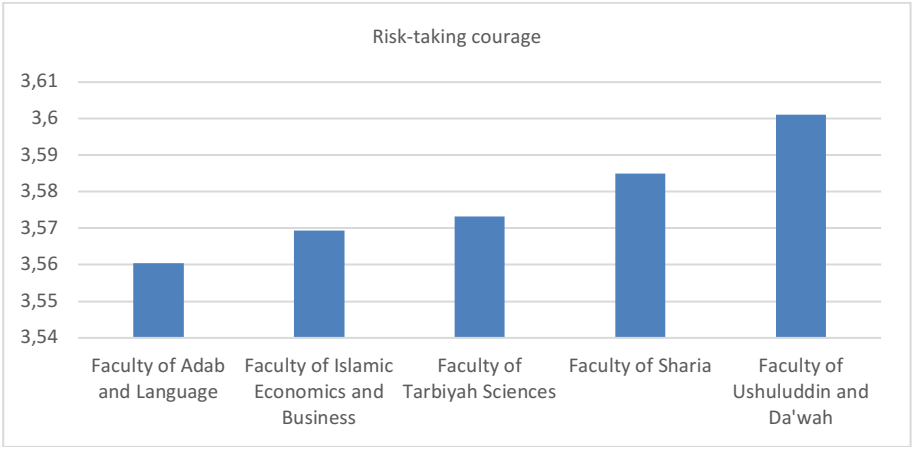

Fig. 12. The Courage to Take Student Risks in Every Faculty

Based on the graph above, information was obtained that in the indicator of risk-taking courage, the average inventive thinking skills of students of FUD were the highest among other faculties, namely 3.60. FASYA has an average score of 3.58 with an average difference of 0.02 from FUD. With an average difference of 0.03 from FUD, FEBI and FIT have an average score of 3.57. The average difference between FAB and FUD is 0.04 and the average score is 3.56. It was found that the average difference in inventive thinking skills in the indicators of adaptability and complexity of FUD with other faculties was not much different, ranging from 0.02-0.04.

The average inventive thinking skills for indicators of high-level thinking and reasoning in students of each faculty can be seen in the Fig.13 below.

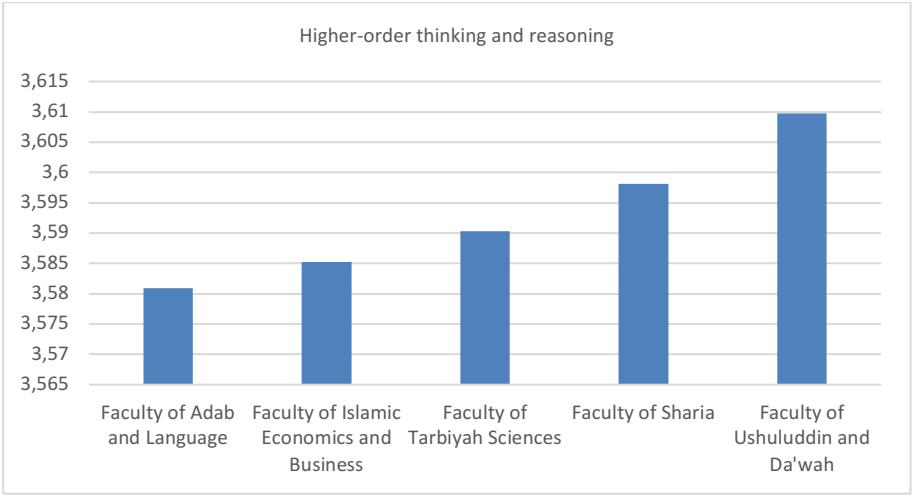

Fig. 13. Higher Level Thinking and Student Reasoning in Each Faculty

Based on the graph above, information was obtained that in the curiosity indicator, the average inventive thinking skills of students of FUD were the highest among other faculties, namely 3.61. With an average difference of 0.01 from FUD, FASYA has an average score of 3.60. The average score for FEBI and FIT is 3.59, and their average difference from FUD is 0.02. With an average difference of 0.03 from FUD, FAB has an average score of 3.58. It was found that the average difference in inventive thinking skills in the indicators of adaptability and complexity of FUD with other faculties was not much different, ranging from 0.01-0.03.

Students in Islamic state universities in central Java have high levels of creative thinking, which is a valuable life and career skill in the twenty-first century. The increasingly sophisticated use of technology in the classroom has an impact on this. According to this study, innovative talents were favorably connected with technological pedagogical knowledge, technological knowledge, and technological content knowledge [16]. Teachers must be better equipped to use technology creatively and innovatively to provide engaging, delightful learning experiences that can boost students' interest and motivation to keep studying in an era of increasingly complicated and advanced globalization.

Knowing students' inventive thinking skills is important for students themselves, it is also important for stakeholders, especially lecturers. The research provides workshops for teachers in developing learning plans to improve students' inventive thinking skills [17]. This indicates that teachers make an important contribution to students' inventive thinking skills. Teachers need to come up with ideas to improve students' inventive thinking skills. One of the things is the idea of learning through innovation education with design thinking. Li et al. (2024) understand more about how design thinking-driven innovation education can help people become more creative and inventive, and how student engagement is critical to this process. One example is the Islamic communication and broadcasting study program under the auspices of FUD, the majority of the learning is related to innovation with design thinking, this is in accordance with the results of the survey that inventive thinking skills are the highest in students of FUD.

Inventive thinking skills have been most often associated with technology and engineering. The main idea behind inventive activities is that the invention of Engineering, also known as Engineering creativity, allows the solution of complex and not easily solvable engineering problems, which results in "new means of production" and innovations that expand and enrich the field of Engineering [18]. But actually, inventive thinking skills are very important for all students because they are the capital to face the challenges of the 21st century, not only for engineering students. Research in the field of law shows political stake in the relationship between citizenship, patents, and inventive ability [19]. In addition to the field of law, there is also research on inventive thinking skills in the health field [20].

Most of the students of Islamic state universities in Central Java are in the high and medium category, but only a few are in the very high category. This is influenced by several things besides classroom learning. A child's tendency to create something is influenced by exposure to innovation in childhood, for example children from high-income families (1%) are ten times more likely to become inventors than children from families with below-average income [21]. This directly shows how important the envi-

ronment is. Children who grow up in environments or families with high levels of innovation are more likely to become inventors. This is reaffirmed by Bell et al. (2019) that children whose families move to areas with high levels of innovation when they are young have a greater chance of becoming inventors in the future, because exposure to environments that support creativity, access to better educational resources, and the presence of innovative role models can influence the development of their critical thinking skills and aspirations.

The environment from childhood and family background are not the only things that influence them. The inventive thinking skills of the students of Islamic state universities in Central Java can be improved again so that they can reach a very high category as a life and career skill in the 21st century. Students can be trained to use inventive thinking skills through courses with assignments or materials that demand student innovation. Successful initial findings are an important indicator of an inventor's inventive potential, even exceeding factors such as early education or early background [22]. Universities can create programs or condition the environment to spur the improvement of students' inventive thinking skills. Nesterenko & Terekhova (2017) mentioned that the educational environment can use the concept of "City of Discovery" as an innovative element of the educational environment that allows collaboration between teachers, students, parents, and psychologists to learn how to change objects and situations through complex research methodologies. The city of discovery includes "Training Room", "Amusement Park", "Discovery Laboratory", "Discovery Evaluation Center", and "Discovery Museum". This is just one idea, in essence universities should create a learning environment that promotes skill development to create and evaluate creative products. Inventive thinking skills are 21st century skills. Students after graduation will enter the world of work. If students who have entered the world of work have high inventive skills, it will create a high innovation area. Areas with high innovation capacity are more likely to achieve success in mastering service activities. Innovative areas are more likely to develop new and innovative services [24]. A culture of innovation can drive efficiency and effectiveness in service delivery.

4 Conclusion

Based on the results of the hypothesis test and discussion, the following conclusions were obtained. The inventive thinking skills of the students of Islamic state universities in Central Java as a life and career skill in the 21st century are in the high category with an average score of 174.86. This research is survey research conducted at one of Islamic state universities in Central Java on 7th semester students from 22 study programs spread across five faculties. This study aims to provide a comprehensive overview of inventive thinking skills, which are considered as one of the essential skills for life and career in the 21st century, by highlighting their relevance in facing global challenges and supporting innovation and creative problem solving. Based on the conclusion, the implications of the results of this study are as follows. The inventive thinking skills of the students of Islamic state universities in Central Java can be improved again so that they can reach a very high category as a life and career skill in the 21st century. This is because these two things are crucial aspects in preparing individuals to face the complex and dynamic challenges of the 21st century, including the demands of innovation,

problem solving, and adaptation to global change. For the next researcher, carry out similar research but on learning strategies that are able to improve inventive thinking skills.

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