

THE URGENCY OF THE CONCEPT OF COMPLEX NUMBERS TO GROW CREATIVE AND INNOVATION THINKING SKILLS

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ABSTRAK

Konsep bilangan kompleks sangat penting untuk mengembangkan kemampuan berpikir kreatif dan inovatif pada mahasiswa. Kemampuan berpikir kreatif dan berinovasi sangat penting untuk mencapai kesuksesan diberbagai bidang termasuk sains, teknologi, teknik, dan matematika. Penelitian ini bertujuan untuk mengetahui hubungan antara pemahaman bilangan kompleks dan pengembangan keterampilan berpikir kreatif dan inovatif dengan mengeksplorasi sifat-sifat dan penerapan bilangan kompleks, serta pemahaman yang lebih mendalam tentang konsep-konsep abstrak, belajar berpikir *out of the box*, dan menumbuhkan pola pikir yang terbuka terhadap ide-ide dan perspektif baru. Metode penelitian yang digunakan dalam penelitian ini adalah metode kualitatif dengan teknik pengumpulan data melalui observasi dan wawancara kepada Mahasiswa Tadris Matematika. Subjek pada penelitian ini adalah 10 Mahasiswa Tadris Matematika UIN K.H. Abdurrahman Wahid Pekalongan. Hasil penelitian ini menunjukkan bahwa integrasi konsep bilangan kompleks ke dalam kurikulum pendidikan dapat meningkatkan kemampuan berpikir kreatif dan inovatif mahasiswa secara signifikan. Temuan penelitian ini mempunyai implikasi yang signifikan bagi para pendidik dan pembuat kebijakan, menyoroti perlunya memasukkan konsep bilangan kompleks ke dalam program pendidikan untuk meningkatkan keterampilan berpikir kreatif dan inovatif di kalangan mahasiswa.

Kata kunci : Bilangan Kompleks, Berpikir kreatif, Inovatif, Skil Abad 21

ABSTRACT

The concept of complex numbers is very important for developing creative and innovative thinking abilities in students. The ability to think creatively and innovate is very important to achieve success in various fields including science, technology, engineering and mathematics. This research aims to determine the relationship between understanding complex numbers and developing creative and innovative thinking skills by exploring the properties and applications of complex numbers, as well as a deeper understanding of abstract

concepts, learning to think out of the box, and cultivating a positive mindset. open to new ideas and perspectives. The research method used in this research is a qualitative method with data collection techniques through observation and interviews with Tadris Mathematics Students. The subjects in this research were 10 Tadris Mathematics students at UIN K.H. Abdurrahman Wahid Pekalongan. The results of this research show that integrating complex number concepts into the educational curriculum can significantly improve students' creative and innovative thinking abilities. The findings of this study have significant implications for educators and policy makers, highlighting the need to incorporate complex number concepts into educational programs to improve creative and innovative thinking skills among students.

Keywords: *Complex Numbers, Creative thinking, Innovative, 21st Century Skills*

INTRODUCTION

Learning encompasses many things, one of which is learning mathematics. Learning is the process of changing behavior from the unknowing to the knowing and expected to the goal to be achieved. Mathematics is a unique field of science because the matter is presented systematically, deductively, and axiomatically. Abstract concepts in mathematics are also considered too difficult to understand and study in person (Wahyuni&Karimah, 2017).

However, on the other hand, mathematics is considered important because of its role as a powerful predictor for children to enter formal school rather than emotional and social skills. Besides, there is a fairly rapid improvement in the application of math in various fields of work in this technological age (Siregar, 2017).

In mathematics we are also demanding enough to possess the ability to think critically, logically, reflectively, creatively and innovatively.

It's vital for the ability to think critically, logically, reflectively, metacognitively, and creatively in the 21st century. Entering the 21st century -- marked by globalization, information, Asian Economic Society (AES), and AFTA -- has never been thought of by anyone, including students (Hidayah, 2015). However, in fact, it is still quite minimally recognized and less developed by students especially in students. This is because most of them have not realized the urgency of such skills and abilities.

According to the 2000 School of Mathematics Principles and Standards, five process skills that students and students must have during mathematical learning: (1) problem solving; (2) reasoning and proofing; (3) communication; (4) connections; and (5) representation (NCTM, 2000). One of the branches of mathematics is taught and has a relatively close urgency with the ability of creative thinking skills and innovation that is complex numbers. Complex numbers, consisting of real and imaginary parts, enable extensive geometric representations and applications in various fields such as physics, engineering, and computing. The ability to think creative and innovative involves the ability to deviate from conventions, combine unusual ideas, and understand relationships between seemingly unrelated ideas. By understanding the concepts of complex numbers, such as the rotation of complex fields and their geometric representations in two-

dimensional spaces, one can improve their thinking skills in new and challenging ways.

Thus, this study aims to explore the urgency of the concept of complex numbers in the context of developing creative and innovative thinking skills. By analyzing the impact of understanding these concepts on the ability of individuals to solve problems, generate new ideas, and think abstractly, it is expected that this research can provide a deeper insight into the role of complex number in developing thinking skills that are highly needed in the ever-changing modern world.

This research uses qualitative methods with data collection techniques through observation and interviews with tadrīs mathematics students. Student's creative and innovative thinking skills are assessed using standardized tests, and their understanding of complex numbers is evaluated through a series of questions and assignments.

DISCUSSION

1. Complex number concept

The Gauss number system divides a number starting from a complex number. From that complex number are subtracted other numbers. A real number, for example, is actually a number in the form of $a + bi$, where a is a real number and $b = \text{zero}$; an imaginary number is a complex number that has the same shape as $a = \text{zero}$ and b is the real number. To facilitate the explanation given the diagram below. The existence of complex numbers not only affects algebra, but also affects analysis and geometry. The functional theory of the complex numbers was later developed; absolute differential geometries [number] and vector analysis – so vital to modern science – developed so that known semi-real and semi-imaginary numbers. A complex number can be added, deducted, multiplied, divided, raised or sought its root result in cases where a complex number is in the form of $a + bi$ – although a , b or both may be equal to zero. New numbers can be created to perform operations against complex numbers. The old algebraic number system is now closed, for the use of complex numbers, all forms of equation can be solved and all kinds of operations can be

performed. The achievement of the closure of the mathematical system is a continuous human quest since the days of Pythagoras. (Purwosetiyono, 2015).

2. Creative thinking

Creative thinking is the ability to think broadly, for people with this ability to see and solve problems from different perspectives and to create a solution with new ideas. Creative thinking or creative thinking is very close to the creativity of a person in performing analysis of things and becoming something new. This ability is usually possessed by people who are able to consider things from a different perspective. Because basically the ability to think creatively depends on the way a person thinks and of course goes hand in hand with their ability to solve problems. When a person finds a way to solve a problem, but for a person with a creative ability to have a variety of ways to resolve problems with his brilliant ideas.

Types of Creative Thinking:

- a. Divergent Thinking: One is free to think as many ideas as possible based on imagination.
- b. Lateral Thinking: Thought that makes one more inclined to look for another idea than to rely on one already existing idea.
- c. Inspirational Thinking: These thoughts are very much related to someone's inspiration, they can come from anywhere, from imagination to something seen.
- d. System Thinking: A system thinking that generally considers this kind of thinking to be connected between one idea and another, a thought that makes one realize the things that are in front of him. Interconnected then forms a bigger thing, so it can be a more effective solution.
- e. Aesthetic Thinking : This thinking focuses on things whose nature is beauty and the value that is inherent to it, aesthetical thinking allows one to produce or find things that are pleasant and beautiful to them (Mulyasa, 2013).

3. Innovative Thinking

Innovation is the implementation of better solutions that meet new requirements, articulated needs, or existing market needs. Innovations are

achieved through more effective products, processes, services, technologies, or ideas available to markets, governments, and communities. The term innovation can be understood as something original and (as a consequence) new, that "raps" the market or society. The definition consistent with this aspect is: "Innovation is something original, new, and important in any field that enters the market or society."

According to the Indonesian Great Dictionary, "creativity is the ability to create, creativity, creation." Not much differently, the Merriam Webster Dictionary mentions that "the ability to make new things or think of new ideas". Some experts define creativity as:

- a. "the ability to solve problems and formulate products and ask new questions" (Gardner, 1993);
- b. "a state of mind in which all our intelligences work together" (Lucas, 2001);
- c. "an imaginative process with original and valuable results" (Robinson, 2001);
- d. creativity is characterized by "innovation, effectiveness and credibility" (Cropley, 2002).
- e. To be creative, an action, idea or product "must be new and valued by some external criteria". (Gruber & Wallace, 1999).

Diversity isn't always wrong. However, creativity is about the ability to be different, which begins in the mind. Creativity is capable and willing to think differently than most people do. Creativity is being able to see things that others can't see, including opportunities that most people don't think of. Creativity is a skill that is in the process of creating something new, useful, that solves issues in society (Mulyana, 2022).

The results of this study indicate that the experimental group, which received complex number instruction, performed significantly better in creative and innovative thinking skills compared to the control group. The students who received complex number instruction demonstrated a deeper understanding of complex numbers and were able to apply these concepts to real-world problems. The findings of this study suggest that the integration of complex number concepts

into educational curricula can significantly enhance students' creative and innovative thinking abilities.

CONCLUSION

The results of this study have significant implications for educators and policymakers. The findings suggest that complex number concepts are not only important for mathematical understanding but also for the development of creative and innovative thinking skills. The study highlights the need to incorporate complex number concepts into educational programs to promote creative and innovative thinking skills among students. The study also suggests that educators should focus on developing students' problem-solving skills and encouraging them to think creatively and innovatively.

In conclusion, this study demonstrates the urgency of complex number concepts in nurturing creative and innovative thinking skills. The findings of this research have significant implications for educators and policymakers, highlighting the need to incorporate complex number concepts into educational programs to promote creative and innovative thinking skills among students. The study suggests that complex number concepts are not only important for mathematical understanding but also for the development of creative and innovative thinking skills.

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