THE ROLE OF SCIENTIFIC THINKING TOOLS
IN SCIENCE DEVELOPMENT

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Abstract: This article discusses the role of scientific thinking tools in developing science. Over time, science has also expanded. The development of science must be connected to the human ability to think scientifically. Tools are needed to carry out scientific thinking activities: language, logic, mathematics, and statistics. Mastering good scientific thinking tools should also support good scientific thinking skills. One step towards mastery is knowing the role of each means of thinking in Scientific thinking. This article was developed using qualitative methods to review related literature. The results obtained are presented as a description that directly discusses the role of scientific thinking tools in developing science.

Keywords: thinking, scientific, language, logic

A. INTRODUCTION
Every human being requires cognitive activities in their daily lives to remain aware of their surroundings and to survive an existence based on truth, which is the objective of nature's creation. A cognitive activity is a process that produces knowledge by following a particular way of thinking, ultimately making knowledge. Furthermore, explained that thinking is an activity to find correct understanding. However, there are times when the truth can be subjective and different for each person because the thinking activities involved in obtaining the fact in question are also various.

A scientific thinking process is essential to gaining true knowledge that many people can accept. Salam defines scientific thinking as a human process or activity

that seeks to acquire or obtain knowledge. Scientific thought is a sequence of procedures that lead to conclusions that become new knowledge³.

To get true knowledge, scientific thought processes should be followed by proof, which includes induction and deduction activities. Induction is a type of reasoning that draws general conclusions from statements and specific case situations. Deduction, on the other hand, is a style of thinking that develops precise conclusions from broad statements or case studies⁴. As a result, scientific inquiry tries to reveal previously unknown the facts and ideas.

To carry out cognitive activities, scientific thinking tools can be used. Scientific thinking tools make it possible for scientific approaches to apply scientific techniques to seek the truth⁵. In other words, this approach can be used to generate human knowledge based on truth. As a result, the tools of scientific thought are critical for scientists to gain new knowledge and truths for humanity⁶. For a scientific activity to go smoothly, it must go through the stages of scientific thinking. As a result, learning the skills of scientific thinking is required for a scientist to defend the discoveries made⁷.

The four areas that comprise scientific thinking are language, logic, mathematics, and statistics⁸. Scientists employ a variety of scientific thinking methods to find and explore phenomena that exist in the universe when acquiring and developing existing knowledge. These four ways of thinking constitute an essential foundation for the development of information that people learn. A comprehensive understanding will be achieved by a thought process and systematic approach by applying all thinking in synergy by using these four means of scientific thought.

The aim of studying the means of scientific thinking is to enable us to carry out scientific research properly; as previously discussed, the means of scientific thinking are tools for carrying out scientific activities in various steps that must be taken. These tools consist of language, logic, mathematics, and statistics⁹ which help a scientist to carry out good, thorough, orderly, and continuous scientific activities¹⁰, so that the results of discoveries can be obtained accountable.

New knowledge obtained from scientific thinking will produce scientific knowledge as well. Scientific knowledge is all kinds of knowledge obtained through an empirical, systematic, objective, analytical, and verification philosophical

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thinking process to find a truth through scientific methods. In this case, scientific thinking will be advantageous as a tool for various sciences to develop their knowledge material based on scientific methods.

Therefore, to gain scientific knowledge, the author concludes that it is essential to study scientific facilities in more depth to make it easier for scientists to carry out scientific activities that produce new scientific knowledge. By utilizing scientific thinking tools, scientists will achieve the desired goals because they are carried out with good scientific research whose results can be helpful in everyday human life.

B. PROBLEM
This article aims to answer several questions related to the use of scientific thinking tools in science development. The problem studied in the discussion is the function of each foundation of scientific thinking (language, logic, mathematics, and statistics) in scientific activities to obtain new scientific knowledge. Next, the author analyzed the extent to which scientific tools are helpful for the development of science.

C. METHOD
To answer the problems raised regarding scientific thinking, the writers use a qualitative descriptive research method with data collection techniques in the form of literature studies. To collect relevant information related to the problem of scientific thinking, the writers limit the study activities only to library research. According to Yusuf, the qualitative method explores, and understands a general phenomenon through interviews, observations, literature studies, and others. Meanwhile, descriptive is the presentation of data obtained in the form of definitions and contextual explanations of the data obtained.

In relation to the procedure of the study, the writers read and reviewed literary sources in the form of books and scientific journals regarding the topics discussed, namely, means of scientific thinking (language, logic, mathematics, and statistics). Data was obtained by conducting a literary study to collect the required information. Next, the data was classified, described systematically, and presented as a description.

D. DISCUSSION
1. Language as a Means of Scientific Thinking
Language is an element that combines with other elements in a cultural network. Language allows humans to explore and convey knowledge that exists in nature. In line with cultural developments in society, language also experiences development. This is needed to produce more accessible and more straightforward communication for fellow humans so that the ideas and intentions conveyed will be received clearly by the listener. At the same time, language is also a means of expressing the values of thought, culture, and people’s lives.

References
Language is a communication tool that cannot be separated from everyday human life. This also includes human life in order to develop science. A scientist or philosopher relies heavily on language to convey his ideas to others.\(^{15}\)

Language allows us to process information clearly. Humans may utilize language to organize purposes, such as while carrying out scientific experiments. With the use of language, ideas and conceptions that are still abstract can be stored and strengthened in the human mind.\(^{16}\)

Based on several definitions of language mentioned above, it can be concluded that language is a communication tool that can be used in the process of scientific thinking to convey specific information to other people in verbal form in the form of sounds, symbols, or specific codes.

Language has an essential function in developing knowledge.\(^ {17}\) As a communication tool, language can transfer information in the form of ideas or concepts from the sender to the recipient. Therefore, good language mastery is necessary for a scientist to carry out scientific activities.\(^ {18}\) Scientific thinking activities are closely related to language because language can function as a means of conveying thoughts, feelings, and emotions. As for society, language is a means for societal change.\(^ {19}\) Society can establish communication between one individual and another. Furthermore, the exchange of information and understanding to other people can be carried out.\(^ {20}\)

As a means of scientific thinking, language has functions, structures, and vocabulary with its characteristics. Through language, discoveries can be explained to others. However, good language mastery must also be supported by mastery of other means of scientific thinking because language also has weaknesses. The use of appropriate language supports science development because collaborative thinking between scientists is complex.\(^ {21}\) Apart from that, another language weakness is that language can be interpreted differently, which is difficult to avoid in practice. Hence, misinterpretation of information often occurs between senders and recipients.\(^ {22}\) Seeing these shortcomings, language requires other means of scientific thinking so that the new knowledge produced can be published and understood by other people. However, language remains the primary means of scientific thinking, which significantly advances science.\(^ {23}\)

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2. Logic as a Means of Scientific Thinking

Logic is a means of systematic, valid, and accountable. With logic, humans can distinguish between right and wrong. We can group logic into natural and scientific logic. Natural logic is the instinct possessed by humans who think correctly and straight before being influenced by subjective desires and tendencies. Meanwhile, scientific logic refines and sharpens the mind and intellect.

Logic is also an important foundation of knowledge. Thinking without logic will only end in disaster. As a result, logic can lead humans to think logically by using the correct style of thinking, allowing the thought process to be systematic and the outcomes of the thoughts or concepts obtained to be accounted for.

There are two ways of drawing conclusions through logic: inductive and deductive. Inductive logic concludes specific examples to general conclusions, while deductive logic is the opposite, namely, concluding general rational things to specific cases. In this case, logic allows scientists to evaluate and analyze different ideas or opinions regarding a topic so that scientists can draw their conclusions based on the sources they analyze.

To conclude, logic helps scientists in various processes, from formulating hypotheses and designing effective models to draw conclusions carried out systematically with the help of logical reasoning. Therefore, scientists should get used to practicing thinking using logic to get valid and justifiable ideas. Apart from that, by getting used to thinking exercises, scientists can also evaluate where they made mistakes and return to a careful and straight-thinking process.

3. Mathematics as a Means of Scientific Thinking

Mathematics is a language in the form of symbols that convey the meaning of the statement. In science, mathematics is used to model and understand complex phenomena. Mathematics is a means of scientific thinking that can simplify thinking for problem-solving. Studying mathematics will sharpen human reasoning abilities, which helps the critical, logical, systematic thinking process.

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that they can solve problems, whether in the field of mathematics or problems in everyday life.\footnote{Sumarni, E., Adawiah, ER., Yurna, Y. (2023). Sarana Berpikir Ilmiah (Bahasa, Logika, Matematika, dan Statistika). Jurnal Pendidikan Berkaracter. 1(4), pp. 106-122. DOI: https://doi.org/10.51903/pendekar.v1i4.299}

Mathematics plays a role in many dimensions of human life. In everyday life, people can use mathematics to solve problems, such as in the buying and selling process, where mathematics can clarify the price, someone has to pay. The ease of mathematics in life is due to its clear structure in the form of consistent and accountable numbers.\footnote{Hermanto (2022). Sarana Berfikir Ilmiah dalam Pengetahuan. COMSERVA. 2(4). DOI: 10.36418/comserva.v2i4.240} Therefore, using mathematics to explain an idea may make the idea more accessible for others to understand.

As a means of scientific thinking, mathematics allows for orderly and careful analysis. Mastery of mathematics will help scientific activities in the various steps that must be taken. To complement existing deficiencies in language and sharpen mastery of logic, scientists can use mathematical tools. Symbols or symbols in mathematics have meanings that can obscure verbal language's subjective and emotional nature.\footnote{Firmansyah & Ali, M. (2021). Sarana Pengetahuan Ilmiah (Tinjauan Filosofis). Contemplate. 2(2).}

Mathematics uses more numerical than verbal language, which is helpful for quantitative measurements. In scientific activities, these quantitative characteristics are valid for solving problems precisely and carefully. Apart from that, quantitative characteristics of mathematics provide more detailed and precise information so that it is clearly understood by readers.\footnote{Firmansyah & Ali, M. (2021). Sarana Pengetahuan Ilmiah (Tinjauan Filosofis). Contemplate. 2(2).}

4. **Statistics as a Means of Scientific Thinking**

Statistics is a set of methods for gaining knowledge, which is done by managing and analyzing data so that scientific conclusions can be drawn.\footnote{Timotius, K. H. (2017). Pengantar Metodologi Penelitian: Pendekatan Manajemen Pengetahuan untuk Perkembangan Pengetahuan. Penerbit Andi.} Statistics is not just a collection of data; in a broader sense, statistics is a way of conducting investigations in the form of numbers. Furthermore, Sudjana explained that statistics is a science related to collecting, processing, analyzing, and drawing conclusions based on the data that has been collected.\footnote{Rijal, M., & Sere, I. (2017). Sarana Berfikir Ilmiah. BIOSEL (Biology Science and Education): Jurnal Penelitian Science dan Pendidikan, 6(2), pp. 176-185.}

Data obtained from accurate research and analysis methods is needed to make decisions in scientific activities. Therefore, statistics can be a solution to solve this problem. Statistics can produce data that reflects the actual situation. As part of scientific thinking, statistics help scientists generalize and draw conclusions from existing data distribution more accurately.\footnote{Firmansyah & Ali, M. (2021). Sarana Pengetahuan Ilmiah (Tinjauan Filosofis). Contemplate. 2(2).}

Scientific research in the form of a survey or experiment is able to produce accurate data if obtained using statistics. Statistics can carry out data assessment procedures relevant to the hypothesis that is trying to be proven after going through
scientific stages; the results can be defined simply through statistical testing but are factual\(^{38}\).

The role of statistics as a means of scientific thinking is that it can calculate accurate interpretations of data sets to minimize errors in interpreting data\(^ {39}\). Apart from that, in scientific research activities, statistics is also widely used to test the truth of a hypothesis and calculate the sample size to the stage of testing the validity and reliability of an instrument.

5. **Means of Scientific Thinking in the Development of Science**

Science is the result of human labor accomplished through scientific means. The role of scientific thinking tools in developing science is crucial in ensuring that the analysis carried out is organized, careful, and accurate\(^ {40}\). Furthermore, to carry out scientific activities searching for truth, that knowledge must be developed through various scientific activities.

Scientific thinking tools as many people use also act as a tool to convey new knowledge gained\(^ {41}\). Collaboration between language, logic, mathematics, and statistics is the key to carrying out scientific activities, both in the process and in conveying new knowledge. Scientific thinking tools can strengthen the validity and reliability of research results and expand our understanding of this complex world\(^ {42}\).

Scientific facilities are tools used to carry out scientific activities in various steps that must be taken. Scientists study the tools of scientific thinking in order to carry out accurate analysis so that new truths can be obtained that may be able to solve everyday problems\(^ {43}\). Therefore, the role of scientific thinking tools in everyday life is vital for developing science following current developments\(^ {44}\).

Furthermore, scientific thinking is a tool for the scientific method to obtain the truth. As human culture continues to develop, the results of scientific thinking obtained must also develop. It is necessary because human needs are also increasingly developing and being complex. Therefore, scientific thinking tools are needed to enable scientists to carry out scientific studies well, regularly, and carefully to obtain new truths\(^ {45}\).

The combination of scientific thinking tools in language, logic, mathematics, and statistics complements each other in scientific activities. The proper use of these

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\(^{45}\) (Fortune, 2017)
facilities, of course, impact the development of knowledge supported by thinking tools, which play an essential role in observation and experimental activities. Suitable scientific thinking activities require scientific thinking tools in language, logic, mathematics, and statistics. Understanding and mastery of these four tools of scientific thinking are essential for scientists to do accurate research, developing robust theories, and disseminating scientific knowledge effectively.

These four tools for scientific thinking complement each other according to needs in the field and expected goals. Language is a verbal communication tool used in scientific thinking activities; where logic has a role in carrying out reasonable reasoning. Mathematics has a vital role in providing accurate information, while statistics plays a role in processing and presenting data more orderly and systematically. Therefore, scientific thinking tools are essential in scientific activities to obtain good, careful, and accurate knowledge results.

E. CONCLUSION

In seeking new knowledge, scientists often use scientific thinking activities. Through scientific methods such as formulating problems, proposing hypotheses, reviewing literature, testing hypotheses, and drawing conclusions, these scientific thinking processes are carried out well supported by good mastery and application of scientific thinking tools in the form of mastery of language, logic, mathematics, and statistics.

Scientific thinking tools assist scientists in carrying out scientific activities through a series of processes. The means of scientific thinking in question are the mastery and application of language, logic, mathematics, and statistics. These four tools can ensure that the process has been carried out scientifically so that the results obtained can be accounted for.

These four tools of scientific thinking have their respective roles in scientific activities. Language is a verbal communication tool used in scientific thinking activities. Logic helps us understand and assess the truth of statements made in language. Mathematics is essential in providing accurate information in quantitative form, while statistics plays a role in processing and presenting data more accurate, well-order and systematic.

By the times science develops knowledge, these four means of scientific thinking synergize and complement each other so that the goals expected from the development of science can be achieved. Knowledge can continue to be utilized and developed by anyone, anytime and wherever they are.

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