Comparative Study of Curriculum In Amt (*Advanced Mathematical Thinking*) Learning Models In Indonesia And Australia

Ayu Aristika*

Pendidikan Matematika, FTK, Universitas Islam An Nur Lampung, Lampung, Indonesia
*Corresponding Author:ayuaristika@students.unnes.ac.id

Abstrak. Penyesuaian kurikulum memang sangat penting dalam proses pendidikan di suatu bangsa agar menciptakan pembelajaran yang efektif. Indonesia memiliki kurikulum merdeka yang memang masih terus dikembangkan tak terlepas dalam pembelajran matematika yang masih banyak problem dalam proses pembelajrannya. Begitupun Australia dengan kurikulum Reframing Mathematical Futures II (RMFII) dan ACARA yang masih fokus dalam pengembangan nalar siswa terhadap pemahaman matematika dan sains. Tujuan utama dalam analisis isi adalah untuk mencapai konsep dan hubungan yang dapat menjelaskan data yang terkumpul agar hasil dari analisis deskriptif dan konten, persamaan dan perbedaan antara kurikulum kedua negara dapat terungkap. Studi komparatif dengan pendekatan kualitatif dilakukan agar persamaan dan perbedaannya menjadi eksplisit. Alat pengumpulan data utama adalah kurikulum dan buku teks matematika kedua negara, sehingga analisis dokumen merupakan teknik metodologis yang digunakan dalam penelitian ini. Hasil belajar matematika ditentukan banyak faktor, baik dari dalam diri siswa ataupun dari luar siswa. Faktor dari dalam siswa, diantaranya; bakat, motivasi, sikap, tingkat kecerdasan. Sedangkan faktor dari luar, diantaranya; kurikulum, metode dan strategi, assesment, sumber belajar, lingkungan, dan performa guru. medote pembelajaran di Australia sangat di dukung oleh tenaga pengajar dan juga peran negara dalam pengembangan. Itu yang membuat pembelajaran disana sangat efektif dalam proses pemahaman tingkat lanjut.

Kata kunci: Studi Komparatif, AMT (*Advanced Mathematical Thinking*), Kurikulum, Penalaran Matematika

Abstract. Curriculum adjustment is indeed very important in the educational process in a nation in order to create effective learning. Indonesia has an independent curriculum which is still being developed, inseparable from mathematics learning, which still has many problems in the learning process. Likewise Australia with the curriculumReframing Mathematical Futures II (RMFII) and ACARA which are still focused on developing students' reasoning towards understanding mathematics and science.The main objective in content analysis is to arrive at concepts and relationships that can explain the collected data so that as a result of the descriptive and content analysis, similarities and differences between the curricula of the two countries can be revealed. A comparative study with a qualitative approach was carried out so that the similarities and differences become explicit. The main data collection tools were the two countries' mathematics curricula and textbooks, so document analysis was the methodological technique used in this research. Mathematics learning outcomes are determined by many factors, both from within the student and from outside the student. Factors from within students, including; talent, motivation, attitude, level of intelligence. While external factors, including; curriculum, methods and strategies, assessment, learning resources, environment, and teacher performance.learning methods in Australia are very much supported by teaching staff and also the role of the state in development. That's what makes learning there very effective in the process of advanced understanding.

Key words: Comparative Studies AMT (*Advanced Mathematical Thinking*), Curriculum, *Mathematic Reasoning*

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INTRODUCTION

Learning mathematics is one of the urgent means to develop students' academic abilities. The development of academic ability is one of the things to be realized through the educational process. Developing or honing these academic abilities, among others, through upgrading skills. Through these skills students are invited to understand meaning, think logically, understand negative examples, think deductively, think inductively, think systematically and consistently, draw conclusions, determine methods and make reasons, and determine strategies (Siregar et al., 2021). Talking about efforts to educate the nation's life, cannot be separated from education. Mathematics education that must be passed to realize the life of an intelligent nation. The intellectual life of the nation can only be achieved by and through the implementation of good education.

The problem that is often faced by students is the ability to represent AMT (Advanced Mathematical Thinking) when learning mathematics. In Indonesia, mathematics is a subject that is less attractive to most students because it is complicated and difficult to understand. It is inseparable from that in

neighboring countries, namely Australia, they also experience problems similar to Indonesia in the problem of understanding advanced mathematics in learning studies. (Hutajulu & Minarti, 2017) explains that most students still have difficulty using various mathematical representations to explain mathematical ideas and solve mathematical problems. The next problem is abstraction which is a fundamental process in mathematical form. Then abstraction and representation are two things that complement each other and that is sometimes still not perfect in the learning process.

The Australian Curriculum Mathematics (ACM) found several problems that had not been reflected in mathematics learning at schools there, namely consisting of four forms of proficiency, namely, conceptual understanding, procedural fluency, mathematical problem solving, and mathematical reasoning. Program for International Student Assessment (PISA) results for 2012 and 2015 show a significant decline in the level of mathematical literacy among 15-year-olds in Australia since 2003 (Sullivan et al., 2018).This is consistent with the Middle Years Numeracy Research Project (MYNRP), which found that many students in Grades 5 to 9 had considerable difficulty interpreting problem situations, applying what they knew to solve unfamiliar situations, explaining their thinking, and communicate mathematically (Parjayanti & Wardhono, 2013).

(Miller & Larkin, 2017) A broader problem is the fact that curriculum content descriptors are generally stated in a form that allows observation and measurement with little/no indication of their relative importance or how they connect to the 'big idea' in mathematics necessary to ensure students make progress. This situation definitely emphasizes skills over concepts and deemphasizes problem-solving processes and mathematical reasoning. Learning mathematics requires proof because mathematics is a science that uses axiomatic deductive reasoning so that proof has a significant position in mathematics.

The Third International Mathematics and Science Study (TIMSS) is the most comprehensive international comparative study in mathematics and science that has ever been conducted. TIMSS was actually carried out in 1994-1995 and was again carried out (repetition) in 1998-1999 so it was called TIMSS Repeat, abbreviated as TIMSS-R. TIMSS and TIMSS-R are organized by the International Association for the Evaluation of Educational Achievement (IEA), based in Amsterdam, the Netherlands. This institution is an independent international organization that cooperates with government agencies in 36 participating countries. (Herman, 2003) They concluded that it was constructed based on the curriculum framework developed by the committee team and taking into account input from mathematicians and science experts, measurement and evaluation experts, and from the coordinators of the organizers of each participating country. Based on the agreement, a curriculum framework was obtained to measure students' abilities in mathematics (Prastyo, 2020).

Table 1. Tiga Dimensi Kerangka Kurikulum TIMSS

Mathematics	Science
Content	
Numbers	Earth sciences
Measurement	Life sciences
Geometry	Physical sciences
Proportionality	Science, technology, and mathematics
Functions, relations, and equations	History of science and technology
Data representation, probability, and statistics	Environmental issues
	Nature of science
Elementary analysis	Science and other disciplines
Validation and structure	
Performance Expectations	
Knowing	Understanding
Using routine procedures	Theorizing, analyzing, and solving problems
Investigating and problem solving	Using tools, routine procedures
Mathematical reasoning	Investigating the natural world
Communicating	Communicating
Perspectives	
Attitudes	Attitudes
Careers	Careers
Participation	Participation
Increasing interest	Increasing interest
Habits of mind	Safety
	Habits of mind

Out of 38 countries, 35 of them have a national curriculum as a reference for education. The three countries that do not have a national curriculum are Australia, Canada and the United States. Except for Belgium, all countries use test and assessment systems to support curriculum implementation, curriculum development, and the needs of policy makers. This comparative study is designed to provide necessary information for curriculum developers, and researchers to understand in depth about the achievements and education systems that exist between countries. The types of information collected include the education system, curriculum, teacher and school characteristics, and learning practices.

METHOD

Because the data obtained in this study is comparing advanced mathematics curricula between Indonesia and Australia, comparative studies with qualitative approaches are carried out so that the similarities and differences become

explicit. This study looked for evidence to compare the two countries in terms of education systems and advanced mathematics curricula from a deeper perspective. The main data collection tools are the mathematics curricula and textbooks of both countries, so document analysis is a methodological technique used in this study.

The data in this study were obtained using descriptive analysis methods and content analysis. The main goal in content analysis is to reach concepts and relationships that can explain the collected data. Data summarized and interpreted in descriptive analysis undergoes a deeper process in the analysis. The stages of content analysis are data coding, theme search, organizing and defining data according to code, and interpretation of findings, so that the results of descriptive and content analysis, similarities and differences between the curricula of the two countries can be revealed.

RESULTS AND DISCUSSION

The driving school program is implemented through an independent curriculum where the curriculum applied to driving schools is a refinement of the 2013 curriculum, namely the independent curriculum by prioritizing student learning outcomes based on the Pancasila student profile (Javanisa et al., 2022). The curriculum was developed with the aim of improving the quality of education because the heart of an education is the curriculum. The independent curriculum creates active and creative learning. This program is not a substitute for an already running program, but to provide improvements to an already running system (Siregar et al., 2021).

The results of the evaluation of Indonesian school mathematics at the world level exacerbate the problem we are still suffering from, namely the low mathematics achievement of students. Information from various parts of the country announced that the Pure Ebtanas Score (NEM) for mathematics at each school level is generally at the bottom. To cure this suffering requires compact collaboration between various parties related to education, because it is not only the teacher's responsibility.

International studies that are consistent and followed by many countries are TIMMS, PIRLS (Program in International Reading Literacy Study) and PISA. The results of the study show that East Asian countries such as Japan, Singapore, Korea have often been ranked in the top 5 in recent years. Singapore has always been a top performing country in the TIMSS and PISA international studies. (Malikah et al., 2022) concluded that the curriculum, teachers, students and the learning environment greatly contributed to this performance.

Australia is one country that does not have a national curriculum. But in the education process Australia made Reframing Mathematical Futures II (RMFII) a three-year project funded by the Australian Government Department of Education and Training under the auspices of the Australian Mathematics and Science Partnership Program (AMSPP). The project is working with industry partners and practitioners in each State and Territory and the Australian Association of Mathematics Teachers (AAMT) to build sustainable evidence-based integrated teaching and learning resources to support the development of mathematical reasoning (Siemon et al., 2017).

- Development of evidence-based learning in algebraic, statistical, and spatial reasoning that can be used to inform teaching decisions and choices of mathematics learning activities and resources by teachers and students;
- A rich variety of validated assessment assignments and scoring rubrics that can be used to identify what students know and understand in relation to learning progress, inform starting points for teaching and demonstrate learning over time.
- Detailed teaching suggestions related to learning progression that define and consolidate learning at the identified levels and introduce and develop the ideas and strategies needed to advance learning to the next framework level;
- Indicative resources to support implementing targeted teaching approaches in mixed ability classes.

Australia also created the Mathematics curriculum (Australian Curriculum, Assessment and Reporting Authority [ACARA], 2016) has combined Numbers and Algebra in a single thread to allow for the two to be developed together. Developing numerical and algebraic reasoning together gives students the opportunity to pay attention to structures and robust schemes for thinking about number patterns and relationships. This implies that classroom practice needs to be adapted to build a stronger understanding of mathematics as a process of generalizing and formalizing, or as Kaput (1998)

puts it, 'algebrafying' a process. This transformation can be seen as classroom practice moving from one of following rules and memorizing to one of making sense.

CONCLUSION

Curriculum adjustment is indeed very important in the educational process in a nation in order to create effective learning. Indonesia has an independent curriculum which is still being developed, inseparable from mathematics learning, which still has many problems in the learning process. Likewise Australia with the Reframing Mathematical Futures II (RMFII) curriculum and ACARA which are still focused on developing students' reasoning towards understanding mathematics, but the learning methods there are very much supported by teaching staff and also the role of the state in development. That's what makes learning there very effective in the process of advanced understanding.

The international studies of PISA and TIMSS are a reference for analyzing the mathematical and scientific capacity of a country. The domination of East Asian countries in this event is interesting. Singapore by placing a curriculum framework that is oriented towards solving mathematical problems with its spiral approach was able to achieve high performance at the event with the support of teachers, students and the learning environment being the determining factors. Finland, which is recognized as having the best education system, continues to develop through Design-Based Research (DBR) so that Innovative School Community models. The Finnish education system, with its participatory and openness, is able to involve various parties collaboratively to improve student performance according to what they need. Reforms were also carried out in Australia with mathematical sciences and the United States with CCSSM (Common Core State Standards for Mathematics) (Abdussakir, 2017).

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