



Reflecting from Chinese Mathematics Education to Improve Indonesian Mathematics Education: A Literature Review

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Abstract. Currently, the country that excels in mathematics is China based on PISA results. This caused researchers to be moved to find out more about the Chinese mathematics curriculum. The purpose of this study is to compare the Chinese mathematics education curriculum with the Indonesian mathematics education curriculum which focuses on implementing the teaching and learning process. The method used in this study is a systematic literature review conducted using PRISMA. Data from 17 articles and 4 documents taken from Google Scholar and the Chinese and Indonesian Ministry of Education websites in 2013 - 2023 are collected, filtered, and then synthesized to form an article. The results of the literature review show that the process standards and learning models used in China are the same as in Indonesia. The differences are in the use of STEM, the emphasis on persistence in learning mathematics, and the focus on developing mathematical literacy in China. The good things that can be adapted from Chinese teachers are training students to broaden their way of thinking, developing students' ability to solve problems, providing mathematical knowledge for students' future needs, guiding students to self-study, and instilling persistence in doing anything. Other Suggestions are to instil in every teacher to become a lifelong learner by being wise in teaching, exchanging information between teachers, and always being adaptive to change.

Keywords: Chinese Curriculum, Indonesian Curriculum, Mathematics.

1 Introduction

Mathematics is needed to shape humans into problem solvers and train critical thinking [1]. The level of mathematical ability of most students in a country can be seen from the results of PISA (Programme for International Student Assessment) and TIMSS (Trends in International Mathematics and Science Study). PISA and TIMSS are the tests in an international scope that evaluate reading, math, and science skills, for PISA, while TIMSS only evaluates math and science abilities. Policymakers and the public are usually more interested in ranking countries according to PISA and TIMSS study scores. For some people, TIMSS and PISA have become “Educational Olympiads” [2].

PISA 2018 shows China, with the highest literacy scores in reading, math, and science in the world with a math literacy ability of 555, math 591, and science 590

[3]. This is in contrast to Indonesia, which has a reading literacy score of 371, math 379, and science 396, making Indonesia one of the bottom ten groups [3]. For TIMSS 2019, China came second with a math score of 602 and a science of 574 [4]. In 2019, Indonesia did not participate in TIMSS.

The teaching of mathematics in China has attracted worldwide attention due to the outstanding achievements of Chinese students (Kan in Wu et al [5]). The world has a big question, “how is the Chinese mathematics learning system that makes them superior among countries in the world?”, “what can be adapted from learning Chinese mathematics?” This made researchers interested in learning more about the mathematics curriculum in China, especially in terms of teaching and learning when compared to the mathematics curriculum in Indonesia. Until now, research on comparative Chinese and Indonesian curricula is still about analyzing Chinese and Indonesian math books [6], mathematical literacy [7], the Chinese education system [8], and Chinese and Indonesian vocational education curricula [9]. Research is needed on the comparison of Chinese and Indonesian curricula in terms of teaching and learning processes. The purpose of this study is to compare the Chinese mathematics education curriculum with the Indonesian mathematics education curriculum which focuses on implementing the teaching and learning process. It is hoped that with comparative articles between the Chinese and Indonesian mathematics curricula, Indonesia can reflect and adapt the good points of the Chinese mathematics curriculum to improve Indonesian students' mathematical abilities, especially in terms of mathematical literacy on the PISA.

2 Method

Article searches were conducted by one researcher. Researcher uses systematic literature review method with PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) which steps include inclusive and exclusive criteria, electronic database, selection articles, collecting articles, and filter data [10]. This research aims to presents a comparative review of Chinese and Indonesian education curricula, especially in mathematics learning process. Search for Mathematics education curriculum documents in China and Indonesia was obtained from the Ministry of Education website. To search articles, researcher use Google Scholar. For Chinese education, uses the keywords “Chinese mathematics education” or “Chinese education”. For Indonesian education articles uses the keywords “Merdeka curriculum” or “Merdeka curriculum in mathematics”. For articles discussing the comparison of Chinese education and Indonesia, using the keywords “Chinese and Indonesian education” or “Chinese and Indonesian curriculum”. 166 articles were obtained from those keywords. The criteria of inclusion and exclusion to reduce the articles in Table 1.

After screening based on inclusion and exclusion criteria, The final references obtained for analysis are nine Chinese articles about mathematics education [5], [8],[11]–[17], one Chinese document about mathematics education [18], three Indonesian documents about curriculum especially in mathematics [19]–[21], five articles about Merdeka Curriculum [22]–[26], and three articles about comparison of Indonesian and Chinese curricula [6], [7], [9]. The 22 references found were analyzed

more deeply for each reference to determine the educational differences between China and Indonesia in the learning process.

Table 1. Inclusive and exclusive criteria.

Criteria	Inclusion	Exclusion
Timeline	Between 2013 - 2023	Less than 2013
Language	English	Non-English
Access	Open	Close
Title	Chinese mathematics education curriculum and Merdeka Curriculum in mathematics	No mentioned

3 Results and Discussion

3.1 Objectives, Focus, and Character Education in Chinese Mathematics Education Curriculum

For the Chinese curriculum, the goals are 1) the quality of the workforce is further improved, 2) strengthening and increasing national competitiveness, 3) changing the views of other countries from a ‘big country because of population’ to a ‘superpower’ using progress education [11]. The mathematics curriculum itself can be taken from one of the Chinese state mathematics curriculum documents [18]. The objectives of the Hong Kong Mathematics Education curriculum are that students have: (a) the ability to think critically and inventively, conceptualize, reason, and ask questions mathematically, and formulate, apply, and solve problems using mathematics in real life (b) the ability to communicate mathematically; (c) the ability to manipulate numbers, symbols, and other mathematical objects; (d) the ability to understand numbers and symbols; and (e) the ability to use mathematics to formulate and solve problems in everyday life in the context of mathematics and other disciplines [18].

In addition to formulating curriculum objectives, China also focuses on the implementation of learning on (a) STEM education; (b) the use of e-learning; (c) integrating language into mathematics (strengthening mathematical literacy); (d) developing general skills and positive values and attitudes in an integrative manner through various mathematics learning activities [18]. General skills written on Chinese curriculum documents are collaboration skills, communication skills, creativity, critical thinking skills, information technology skills, Mathematics skills, problem-solving skills, independent learning skills, and self-management skills. Minimum competency based on Hu et al and Lv & Cao [12], [13] are competence in terms of knowledge and abilities, thinking mathematically, solving problems, and regulating emotions and attitudes.

In addition to general knowledge and skills, the development of positive values and attitudes is also important in mathematics education, they are perseverance, respect for others, responsibility, national identity, commitment, integrity, and concern for others. For elementary and junior high school students, character education begins with practicing personal behavior and life skills. This is in line with the research of

Sulistyo & Dwidayanti [7] which states that China prioritizes character education as the basis for society.

Even though China is number one in terms of cognitive literacy, math, and science, there is a surprising finding that Chinese students do not excel in terms of affective outcomes. Students in general do not really like math. They don't attach much importance to it, and their confidence in their abilities is very low. Chinese teachers are so focused on student achievement, especially performance in general examinations that they ignore students' attitudes toward learning mathematics [14]. Future success is the main emphasis of standard learning strategies and student learning [27].

3.2 Mathematical Literacy as Main Focus in Chinese Curriculum

The Chinese Ministry of Education has divided mathematics content into 4 sections, they are “Number and Algebra”, “Application in life”, “Statistics and Probability”, and “Space and Shape”. At first glance, this division is the same as the distribution of content in PISA mathematical literacy. The focus is on developing students' understanding of numbers, understanding of symbols, spatial concepts, statistical concepts, and the application of awareness and reasoning abilities. In the numbers and algebra section, the concept of negative numbers, calculator applications, and strengthening the role of estimation are added. The Ministry of Education has reduced the emphasis on using the abacus, complicated operations and using simple numbers [5]. The Ministry of Education also proposes the use of critical thinking skills, investigation, and collaboration in learning, experiments, and challenging activities [5]. Research shows that teaching efficiency depends on two factors. One of them is the time students spend in full, active learning. Apart from that are learning outcomes, such as scores, self-perceptions about efficiency, cognitive structure, and competence in learning mathematics [5].

3.3 Efforts of Teachers in Enhancing the Mathematical Abilities of Chinese Students

Chinese mathematics teachers generally agree that the teaching and learning of mathematics should broaden students' ways of thinking, develop students' skills in handling and solving problems, and provide mathematical knowledge that applies to students' future needs [15]. According to Wang [15], Chinese teachers used the discovery learning model to instruct students in discovering mathematical facts on their own. In addition, Chinese teachers are starting to use a model they refer to as “flexible teaching” and “different-level teaching” in which content is differentiated according to students' abilities. This is in accordance with the Chinese Ministry of Education which reveals that teachers must recognize individual differences resulting from culture, learning environment, family background, and different thinking styles [16].

In Wu, Zhou, and Wang [5], various models have been described by Chinese teachers in teaching. Elementary schoolteachers use “learn first, teach later” so that the way of teaching depends on student needs and characteristics. Middle schools use a five-step model, that are guiding students to learn independently through books,

demonstrations, practice, assessment, and feedback [5]. There is also a Dao Jiang Ping teaching model that focuses on what to learn, how to learn, and what the learning outcomes are [5]. A distinctive feature of Chinese mathematics lessons is that the teacher's explanation follows the sequence of "bridging, understanding, instructing, and evaluating," in which the teacher and students investigate mathematics together [17]. Every week there is time for math teachers to discuss teaching both between teachers in schools and between schools. Common topics for discussion are reflections on learning, problems encountered while teaching, sharing successful experiences, analyzing student mistakes, and making connections between content. In essence, teaching efficiency depends on two factors, that are the time spent by students in full and students actively learning [5].

3.4 Objectives, Focus, and Profile of Pancasila Students in the Indonesian Merdeka Curriculum

In each step, a clear goal is needed so that it is carried out properly. For the purposes of the mathematics curriculum itself in the Merdeka Curriculum based on decision letter [19], which to equip students to have the ability: 1. Mathematical connection, 2. Problem-solving, 3. Mathematical reasoning and proof, 4. Mathematical disposition, and 5. Mathematical communication.

In implementing learning, the strategy used in the Merdeka Curriculum is based on the Minister of Education and Culture Standards regarding Process Standards No. 16 of 2022 [20], which is carried out by:

1. using real-life problems;
2. encourage active participation of students;
3. optimizing the use of resources in the educational or community environment;
4. using information and communication technology tools.

In Process Standard No. 16 of 2022 [20], it is expected that learning will be implemented in: a) interactive, b) inspiring, c) fun, d) challenging, e) motivating students to actively participate, and f) providing sufficient space for initiative, creativity, independence following the talents, interests, and physical and psychological development of students. Teachers are also expected to provide exemplary, mentoring, and facilitation.

Not only the emphasis on the cognitive field but also the emphasis on students' attitudes in society. In the Merdeka Curriculum, there is a program "Profil Pelajar Pancasila (PPP)" or Pancasila student profile. The goal is to create Indonesian students as lifelong learners who are competent, have character, and behave according to Pancasila values [19]. In terms of content, activities, and implementation time, it is implemented flexibly. Technical matters regarding P5 have been explained in full in the book "Panduan Pengembangan Proyek Penguatan Profil Pelajar Pancasila" or Guide to Developing Projects for Strengthening Pancasila Student Profiles. The main characteristics of the Pancasila Student Profile are faith, fear of God Almighty, and have noble character, global diversity, mutual cooperation, independence, critical reasoning, and creativity [19].

3.5 Indonesian Mathematical Literacy

Learning material in mathematics at every level of education is packaged with the topics of Numbers, Algebra, Measurement, Geometry, Data Analysis and Opportunity, and Calculus (as an option for 11th grades and 12th grade). This is like China, which divides mathematical content such as PISA. In the Merdeka Curriculum, it is written that it is obligatory to foster literacy and numeracy competencies in students. In the Ministry of Education's document No. 5 of 2022 [19], it was stated that it was hoped that students could demonstrate numeracy skills when using logic, reasoning, facts, and mathematical tools from an early age. For elementary school, it is intended to solve problems related to the immediate environment and oneself. For junior high school, it is increased by adding the surrounding community. For senior high school, it is further enhanced for the global community.

Apart from writing it on the curriculum document, the government has made efforts to increase math literacy through the Minimum Competency Assessment (AKM). There are 4 contents in AKM, they are numbers, geometry, and measurement, data and uncertainty, and algebra. The content is like the PISA content, namely change and relationships, space and shape, numbers, uncertainty, and data. The context used is also like PISA, namely personal, socio-cultural, and scientific. Only in PISA is added occupation context. Because it has been written in the curriculum document and has also become a national assessment, the teacher is obliged to train students in mathematical literacy.

3.6 The Efforts of Mathematics Teachers in the Implementation of the Merdeka Curriculum

The existence of a Merdeka Curriculum makes teachers independent in determining the direction of their learning. In Permendikbud Number 22, the Strategic Plan of the Ministry of Education and Culture for 2020-2024, teachers are given the freedom to become learning facilitators, independent in using technology for learning, previously pedagogy, curriculum, content-controlled assessments have become competency and values based. In implementing the Merdeka Curriculum, one of the approaches used by teachers is Contextual Teaching and Learning (CTL) [22]. Apart from CTL, teachers use constructivism [23]. The distinctive feature of the Merdeka Curriculum is differentiated learning that is adapted to the conditions of students. Differentiated learning has an impact on improving the quality of learning, and student interest, learning is more effective, creative, and fun [24].

According to Anggreini and Priyoadmiko [25], the positive impact of a Merdeka Curriculum on mathematics is the flexibility that students have to gather as much knowledge as possible and maintain their learning skills. Improving students' mathematical abilities is a benefit of independent learning in mathematics.

3.7 Comparison of the Chinese Mathematics Curriculum with the Merdeka Curriculum

Table 2. Comparison of the Chinese curriculum with the Merdeka curriculum in mathematics

Chinese curriculum	Merdeka curriculum
Emphasis on cognitive and affective aspects	Emphasis on cognitive and affective aspects
Emphasis on STEM, e-learning, and mathematical literacy for each lesson	Does not emphasis on STEM, e-learning, and mathematical literacy for each lesson
Emphasis on persistence in learning mathematics	Does not emphasis on persistence in learning mathematics
Does not have a national assessment that leads to PISA	Have a national assessment that leads PISA (AKM)
Chinese teachers are always adaptive when there are new changes, always holding regular meetings once a week between teachers	Indonesian teachers are less adaptive to reform, instilling the ability to think critically, creatively, and persistently in any case

In the Chinese curriculum, there is a balanced emphasis on cognitive and affective aspects. In the Chinese mathematics curriculum, there is an emphasis on STEM, e-learning, and mathematical literacy for each lesson. From an affective perspective, it has been written what attitudes students must have to live in society. The same with Indonesia, the Merdeka Curriculum document has also emphasized cognitive aspects, and affective aspects, especially through “Projek Profil Penguatan Pelajar Pancasila.

Character education in Chinese students is so strong that it forms students who never give up in facing anything, for example in doing mathematics. Even though they don't like math because they prefer other fields, they still try to get high math scores. It is proven that there are students who have low motivation in mathematics, but have high scores in mathematics [14].

In terms of increasing mathematical literacy, China has made mathematics literacy the focus of learning mathematics which is taught from an early age. This is no different from Indonesia, which requires teachers to introduce mathematical literacy to students from an early age. However, China does not have a national assessment that leads to PISA like Indonesia which implements AKM.

For the teaching and learning process, the approaches and models used by China and Indonesia are almost the same. However, it is different in terms of teachers' efforts to improve mathematics learning. Chinese teachers are always adaptive when there are new changes, always holding regular meetings once a week between teachers, prioritizing the development of students' thinking, and persistence in solving problems. However, in Chinese learning, there is still a rote method in learning mathematics. It should no longer be used as a learning method. On the other hand, in the implementation of the Merdeka Curriculum, Indonesian teachers are less adaptive to reform, instilling the ability to think critically, creatively, and persistently in any case is not emphasized [26].

4 Conclusion

China emphasizes on the use of STEM, persistence in learning mathematics, and the main focus on developing mathematical literacy, so there is no doubt why China scored the highest on the PISA. In terms of the learning model used is also not much different from Indonesia. The good things that can be adapted from Chinese teachers are training students to broaden their way of thinking, developing students' skills in handling and solving problems, providing mathematical knowledge that applies to students' future needs, guiding students to learn independently so that they are accustomed to learning because of their intentions and instill persistence in doing anything. Another suggestion is to instill in every teacher to become a lifelong learner wisely by teaching according to student conditions, helping each other, and exchanging information between students, teachers, and always looking for the latest information in the world of Education. Chinese teachers' principle that teaching efficiency depends on the time spent by students fully, and students' active learning. It is hoped that Indonesia can reflect on China in implementing the curriculum by taking the good side. Suggestions for further research are to examine more deeply the comparison of instructional media used in China and Indonesia as a form of effort to improve students' mathematical abilities.

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