DOI: https://doi.org/10.15625/2615-8957/22210109

Mathematical gifted education in East Asia and the West: A comparative review and case study of Vietnam

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ABSTRACT: *This paper aims to sketch a comparative review of the education of mathematical talents between Eastern and Western countries. In this study, East Asia refers to countries such as China, Hong Kong, Japan, Korea, Taiwan, Singapore, and Vietnam, and the "West" refers to North American countries and Europe. Student achievement is determined by a variety of different factors and international comparative studies would seek to identify similarities and differences in educational policies and practices, unraveling the variables underlying the different practices. Within the scope of this text, the variables construed to be related to talent development include the traditional perception of mathematical giftedness, the identification regime, gifted curriculum and teacher capacity. The strengths and weaknesses of each of the systems will be discussed in light of educational perspectives regarding mathematical talent education. The second half of the text examines a specific case of Vietnam, a country with impressive achievements in international Math competitions. Discussion will focus on Vietnam's mathematical successes and contributions in local and international contexts, as well as the future fostering of brilliant children in mathematics.*

KEYWORDS:

➔ Received 20/10/2021 ➔ Revised manuscript received 10/02/2022 ➔ Published 30/03/2022.

1. Introduction

East Asian students are often known by their outperformance in international mathematics competitions and investigations in mathematical abilities, compared to their Western counterparts. For example, in the 2019 Trends in International Mathematics and Science Study (TIMSS), Singapore has successfully topped the ranking charts for both Maths and Science in both age groups TIMSS (2019). East Asian countries also continue to dominate all the top positions with impressive results from Taiwan, South Korea, Japan and Hongkong (TIMSS, 2019). In the International Mathematics Olympiad, East Asian countries have dominated top 10 in the ranking table most of the time throughout the history of the competition (IMO, 2020). These statistics seem to prove that the superiority of East Asian students is consistent over time.

This paper aims to sketch a comparative review of the education of mathematical talents between Eastern and Western countries. In this study, East Asia refers to countries such as China, Hong Kong, Japan, Korea, Taiwan, Singapore, and Vietnam and the "West" refers to North American countries and Europe. Student achievement is determined by a variety of different factors and international comparative studies would seek to identify similarities and differences in educational policies and practices, unraveling the variables underlying the different practices. Within the scope of this text, the variables construed to be related to talent development include the traditional perception of mathematical giftedness, the identification regime, gifted curriculum and teacher capacity. The strengths and weaknesses of each of the systems will be discussed in light of educational perspectives regarding mathematic talent education.

The second half of the text examines a specific case of Vietnam, a country with impressive achievements in international Math competitions. Discussion will focus on Vietnam's

mathematical successes and contributions in local and international contexts, as well as the future fostering of brilliant children in mathematics. The review of Vietnam's mathematical achievement reveals that the country's math training at the school level has reached its international peak. This could be taken as a point to confirm the timely and innovative direction and effective investment in developing gifted schools and special/gifted classes and promoting mathematically talented school-age learners in Vietnam. However, the outstanding achievements of Vietnamese students in mathematics remain a mystery to many researchers around the world. Some evaluation and analysis of PISA data have not clarified the key factors affecting Vietnam's highly achieved results. There are unknown factors that need to be internally considered in Vietnam, from schools, programs, teaching staff to national policies and especially those that support the promotion of mathematical talents.

2. The origin and development of giftedness concept

2.1. The history and perception of mathematical giftedness in the East

Most of the Oriental nations' cultures are Confucian rooted in nature. According to Chan (2007), the writings of Confucius classify people's intellectual abilities as extraordinary (上), mediocre (中) and low (下). Confucius also highly valued the effect of education and diligence to become smart (Chan, 2007), while disregarding the significance of creative thinking abilities, in favor of obedience and harmony.

In Hong Kong, the surge of mathematical gifted education started in 1990, when the Ministry of Education founded a commission to investigate the possibility for gifted education in the region. This initiative recommended the establishment of school-based programs to cultivate the development of mathematically talented students based on exploration of the definition of mathematical giftedness and their learning needs (Poon, 1998). According to the Education Bureau of Hong Kong's multi-faceted definition of giftedness, gifted individuals should be determined by a combined measure of natural abilities and competencies (Phillipson, Phillipson, & Eyre, 2011). Hong Kong's gifted education policies are among the most inclusive in East Asia, providing highly attenuated levels of provision of gifted services which aim to serve students at all levels, not limited to those identified as gifted, with certain level of gifted education.

The emergence of mathematical gifted education in Taiwan began after a group of elementary school leaders initiated novel approaches to raise the quality of education of their best students. In 1962, the "Fourth Conference on Education" in Taiwan insisted that gifted education should be created on the principle that gifted students have to be taught according to their aptitude level. Gifted students, including mathematically able ones, were identified using an intelligence quotient test where score of 130 or higher is the benchmark for giftedness (Ibata-Arens, 2012). The definition of giftedness has been extended over time in Taiwan to include those with excellent potential and outstanding in different domains: general intelligence, academic character, art, creative ability, leadership skills and other specialties.

In Korea, gifted education was developed later than other East Asian countries with the first introduction of specialized education by the Ministry of Education, including Mathematical specialization, began in 1983 (Ibata-Arens, 2012). Gifted students were identified using two common criteria that are 'multiple-step evaluation processes' and mathematical creativity or advanced mathematical thinking capability' (Park, 2004). Entrance to high schools for the gifted is often based on performance in mathematical placement tests and/or mathematical Olympiad performance, as well as interview results.

The significance to initiate a gifted education program in Singapore was raised by the Minister of State for Education in 1981 (Neihart & Teo, 2013). According to the country's policy for the "Gifted Education Program", students in the top ten percent of the Singapore national examination are eligible to sit an additional test for admission to gifted programs (Unit, 1994). In addition, the Gifted Education branch of

the Ministry of Education specifies a child to be extraordinarily gifted in consideration of 4 dimensions: a psychological report, achievement and aptitude/above-level test scores, samples of the child's work, and teachers' recommendations. Academically gifted children are admitted into the Gifted Education Program, beginning at Primary 4 (Neihart & Teo, 2013).

In the case of Japan, there is virtually no official system for gifted education as well as no gifted institutions. It was not until 2002 that the Japan Science and Technology Agency launched the Super Science High School program in response to declining student scores and interest in math and science. Under this program, high schools are given extra funding for the promotion of math and science education and also to foster links with universities, including faculty-student mentoring programs (Ibata-Arens, 2012). However, the country still lacked a formal identification program at the time. Some private schools emerged to be more selective due to their high rates of graduates entering elite universities and considered "gifted schools". Admission into these institutions is based on students' aptitude and also interviews with parents.

In general, East Asian countries have a long history of provisions for gifted children. Identification of mathematical talents is largely based on the screening for general giftedness and outstanding performance in advanced Mathematics papers. The perception of ability and talent development are strongly attached with traditional Confucian perspectives in which environmental factors, particularly diligence and intensive tuition, are the dominant in the cultivation of talents. Early identification is not emphasized and hard work is much encouraged at home and at school.

2.2. The development of research on mathematical giftedness definition in Western countries

Compared to East Asian countries, the notion of mathematical giftedness has been much more researched and specified in the Western context. Various dimensions and complexities of the notion have been raised by Western scientists. According to the American Mathematician Krutetskii (1976), mathematical giftedness is the combination of mathematical abilities allowing successful performance in mathematical activity. The term "ability" here refers to a personal trait that helps an individual undertake a specific task promptly and with high quality/accuracy. According to his research, mathematically gifted students tend to interpret the surroundings using mathematical concepts, given their ability for rapid and broad generalization of mathematical relations and operations, and flexibility of mental processes.

Later predominant philosophical notions about mathematical giftedness tend to include domain specific abilities on the one hand, such as: mathematical sensibility, exceptional memory, rapid content mastery and structuring, atypical problem solution, preference for abstraction, interest and enjoyment of mathematics, success in identifying patterns and relationships, lengthy concentration span, generalizing and reversion of mathematical processes; and domain general capabilities on the other, including intellectual curiosity, willingness of exertion, joy and interest in problem solving, perseverance and frustration tolerance, ability to engage in independent self-directed activities, and affinity for challenging tasks (Mihaela Singer, Jensen Sheffield, Freiman, & Brandl, 2016).

Western researchers have also come to differentiate between school giftedness and creative productive giftedness. The former is understood as the mastery of standardized tests and knowledge acquiring while the later implies the ability to create new output or processes (Mihaela Singer et al., 2016). The European scientist Brandl (2011) also highlighted that a "good student" might only refer to a high achiever who is not actually gifted and more concerned on satisfying teachers and parents. That means mathematical giftedness does not ensure high achievement in the subject and good results in mathematics are not always equivalent to being mathematically gifted (Brandl, 2011; Brandl & Barthel, 2012).

Grounded theoretical bases have resulted in well-structured models for the identification of mathematical giftedness in Western countries,

depending on the educational ideologies to which the country subscribes.

In the United States, Julian Stanley developed the Study of Mathematically Precocious Youth (SMPY) at John Hopkins University (Brody & Stanley, 2005). Under this program, students are screened by their performance in the mathematics part of the Scholastic Aptitude Test (SAT-M), which comprises 60 multiple choice problems to be solved in one hour. Since the SAT is used for college admission consideration, high scorers are interpreted as those who would successfully perform in school and college mathematics (Brody & Stanley, 2005). However, creativity is not recognized as a key component in the SMPY model, despite its great predictive validity in the domain specific identification (Subotnik, Robinson, Callahan, & Gubbins). Due to its lack of affective criteria, the model cannot afford to identify highly motivated, creative students or those with other mathematical abilities that are not covered in aptitude tests.

In Western Germany, the Hamburger model of giftedness was introduced in 1983, aiming to screen for mathematically gifted youths to provide them with an out-of-school enrichment program. The selection process takes two phases, of which of the first test is similar to SAT-M by SMPY and the second test is the Hamburger test for mathematical giftedness (HTMB). HTMB consists of seven open-ended problems to be solved in two hours. The problems revolve around six activities: "(1) Organizing materials", "(2) Recognizing patterns or rules", "(3) Changing the representation of the problem and recognizing patterns and rules in this new area", "(4) Comprehending and working with highly complex structures", "(5) Reversing and inverting processes", and "(6) Finding (constructing) related problems" (Mihaela Singer et al., 2016).

In an attempt to identify signs of mathematically gifted students through their engagement in mathematical activities, Irish scientists Vilkomir and O'Donoghue (2009) proposed the model of mathematically promising students to identify and educate mathematically able students in general classroom settings. Students are presented with a series of specially designed problems which are meant to activate the manifestation of some abilities. Teachers are expected to evaluate the level of mathematical ability of each student by observing them as they work on the problems, using a matrix of observables for multiple level of each mathematical ability (Vilkomir & O'Donoghue, 2009). According to this model, giftedness is most closely associated with the ability to generalize, and the abilities of flexibility and reversibility of mental processes.

In Sweden, the framework for creative and imitative reasoning was developed by Lithner (2008) and can be used to identify creative reasoning by students. While imitative reason is featured as the recalling of an answer or a solution algorithm, creative reasoning refers to the requirements of mathematically well founded and innovative reasoning (Lithner, 2008). The framework has been used to identify gifted students in the Swedish upper secondary school.

Overall, it can be seen that while the notion of mathematical giftedness in the Western world has been much researched and developed to consist of multiple dimensions and complexities, perception of giftedness in the field of Mathematics in East Asian countries is rather one-dimensional and largely associated with school and examination achievement. As a result, identification of gifted students in East Asia is more exam and content-based whereas in Western countries, other factors such as mathematical creativeness and motivation are given more attention.

3. The learning and teaching style for mathematically gifted students

Gifted education in East Asian countries are always associated with high achievements in examinations and competitions, especially university entrance exam and international Olympiads. The mathematical pathway is not an exception.

In the case of Japan, private middle schools design special curriculum to prepare students entry to high school and subsequently elite universities. The pressure is particularly large for high school students and curricula often revolve around university entrance test preparation (Ibata-Arens, 2012). There is a minimum amount of the

curricula dedicated to the development of thinking skills such as mathematical creativeness, which makes Japan struggle to develop a comprehensive national policy for the education of mathematically gifted students (Matsumoto, 2007).

In Korea, education of mathematically gifted students also used to be exam oriented where grade acceleration was more focused rather than same grade enrichment until the 1990s (Ibata-Arens, 2012). Since 2002, gifted education for mathematics in the country is implemented in three forms: gifted high schools, gifted education centers (for primary and middle school students) as an out-of-school program offered by universities and school boards, and gifted classes as an enrichment program in regular schools. As of 2008, over 3000 students signed up for weekend and summer enrichment courses operated by universities (Ibata-Arens, 2012).

Among numerous comparative studies mathematics teaching for gifted students between the East and the West, Leung (2001) remained one of the most comprehensive description of East Asian mathematic gifted education compared to the Western world. According to his study, product (content) based rather than process based and whole class teaching instead of individualized learning in East Asia make the biggest difference between the two systems. Specifically, teaching style for mathematically gifted students in China, as well as other Oriental countries, is heavily dependent on teacher's explanation and mostly transmission of knowledge content in nature. On the other hand, mathematically gifted classes in the United States seem to be more learner centered, inviting more input from students and allowing space for self-exploration and interpretation of mathematical problems and concepts. Even though acceleration and grade skipping are allowed in the Western systems, most mathematically gifted programs in these countries are enrichment courses that aim to promote recreational mathematics and challenge students in a fun way. Compared to East Asian countries, mathematically gifted education systems in the West offer students more opportunities to participate in different competitions that seek to promote various mathematical areas of expertise as well as entice more students to pursue mathematics intensive studies and careers (Mihaela Singer et al., 2016).

4. Teacher education and development

In East Asian countries, pre-service and in-service education for mathematics teachers mostly focus on problem solving skills and techniques. Teachers of gifted students in mathematics are hardly offered specialized training on dealing with mathematically gifted students (Blömeke, Suhl, & Döhrmann, 2013; Leung, Park, Shimizu, & Xu, 2015). While gifted adolescents should benefit from a flexible and input-rich environment to self-direct their study, many teachers are unaware of these learning needs and core concept of gifted education, hence focus only on practicing exam techniques (Tran, 2020; Vu, 2011). Students are not stimulated to develop thinking skills as well as encouraged to actively and independently lead their study due to the heavy focus on exam preparation.

Singapore makes an exception on the seriousness and investment of Government on the professional development of teachers for the gifted. Every teacher who will be in charge of gifted learners is always given prior training (Laili, Vibraena, Junaidi, & Dewantoro, 2020). This course aims to familiarise teachers with material for affective education on how to instil values and build the quality of a gifted child. Besides, they are also trained to develop curricula that cater individual needs, teaching techniques and fit along well with customized supervision. Teachers of gifted schools also meet with representatives from the Ministry of Education to monitor the implementation of the program against the curriculum process design. Beyond that, there are conferences annually in which teachers and educators are encouraged to review gifted educational curricula and also design new curricula in the following academic year (Laili et al., 2020). Teachers are enabled to sign up for courses or workshops concerning the management of gifted education. There are also learning opportunities that often invite Ministry officials along with gifted educational consultants from abroad (Hong, 2007).

In reality, in addition to strengthening their mathematical content knowledge, teachers of mathematically gifted students should receive regular training on recognition of students with mathematical potential, pedagogical techniques to challenge students' thinking, selection and development of materials that allow students to create ideas, generalize and connect various mathematical concepts, at the very least (Sheffield, 1995). For example, in the United States, the project Mentoring Mathematical Minds (M3) focused on developing conceptual understanding in mathematics, involves teachers to explore how to implement teaching strategies to promote deeper reasoning, problem solving and problem posing, and verbal and written mathematical communication (Gavin et al., 2007). They also receive individualized assistance from expert visits to school every week. As clearly significant progress is made by students, teachers also confirm the increase in not only mathematical content knowledge but also understanding of their students and improvement in their teaching skills (Gavin et al., 2007).

In another example discussed by Chamberlin and Chamberlin (2010), American pre-service teachers without prior training in gifted teaching took part in a mathematics teaching methods course. They were assigned tasks that require the selection of suitable materials and implementation of teaching in a real classroom context. Teachers' post training reflections confirmed the widening view of mathematically gifted teaching, understanding of the importance to align instruction with students' readiness and interests an awareness of student-centered approaches (Chamberlin & Chamberlin, 2010). Results from studies like these emphasize the significance of teachers having real life experience of handling challenging tasks and offer constructive and useful feedback to students.

5. Gifted education in Vietnam

Alongside with the advancements of the Vietnamese Mathematical Community, Vietnam's Mathematics has been positioned between 35-40 in the world and ranked first in ASEAN (by the number of international publications) (Hanh & Thu, 2020). This is a very impressive achievement, in the context that many countries around the world, and even in Southeast Asia such as Indonesia, Malaysia, Singapore and Thailand, have invested huge funding in basic science and the entire system of research and training entities. In addition to the number of scientific publications, the successful carrying out of major international conferences of Vietnam Institute for Advanced Studies in Mathematics, Mathematics departments of two Vietnamese universities being included in the QS rankings, the Institute of Mathematics (VAST) has many achievements in research with the establishment of an international training and research centre recognized and patronaged by UNESCO all contribute to proving the position of Vietnamese Mathematics in recent years (Hanh & Thu, 2020). One of the contributing factors to the country's achievements is Mathematics education, particularly education for the gifted at pre-university level. Throughout the history of 45 years of IMO participation, Vietnam has almost always satyed in top 10 countries in the International Mathematical Olympiad results ranking (Table 1). Various factors that facilitate as well as challenges facing Vietnam's gifted math education will be examined and discussed in this section.

Table 1. Vietnam's achievements in International Mathematical Olympiad 2012 -2021

Year	Gold medal	Silver medal	Bronze medal	Rank
2021	1	2	3	14
2020	2	1	2	17
2019	2	4	0	7
2018	1	2	3	20
2017	4	1	1	3
2016	1	4	1	11
2015	2	3	1	5
2014	3	2	1	10
2013	3	3	0	7
2012	1	3	2	9

5.1. The secret of success

Vietnamese culture

Scholarship is one of the traditional values that make up the soul and identity of the Vietnamese people (Nguyen, 2013) and the fondness for learning has a durable foundation steadfast in every Vietnamese family (Thang, 2006). Investing in children's education is always the top priority of Vietnamese parents, in which families with stronger financial backgrounds often spend greater investment on their offspring's education (Dang & Rogers, 2016). Vietnamese parents often think that "if you study well, you must be good at math", so investing in mathematics is the choice of most students' parents. Interestingly, Vietnamese parents are more likely to invest in mathematics education for female children more than boys (Work, 2018). In addition, with deeply founded connections from history and strong support in education and training programs for potential intelligent teams, Vietnam's education has been significantly influenced by the education of the Soviet Union, which focused heavily on math and sciences (biology, physics, and chemistry) for students (VNIES, 2021).

Policy

The foundation of gifted schools in 1965, according to the Decision No. 14/CP signed by the Prime Minister, which aimed to develop high-quality human resources for the country's future development, was considered an important turning point in the history of the Vietnam's government. Investment in gifted schools showed the foresight of the country's leaders and a high expectation of a team of students who graduated from specialized schools even during the war period. This is considered a huge effort by the Vietnamese government, especially when other countries only showed interest in gifted/specialized education at later stages. For instance, China did not pay attention to specialised education until the early 2000s when the first gifted schools were established (Yang, 2004). Another example is Singapore where gifted education was officially launched in 1984 (Neihart & Tan, 2015), or non-official specialised education in the current education system in Japan (Cho & Lee, 2015).

The Minister of Education and Training issued Decision No. 1483/QD-TTg approving the National Program for the Development of Mathematics until 2020 (Government Office, 2010b) with the goal of improving mathematical education nationwide from 2010 to 2020. Specifically, following this national mathematical project, training for math teachers teaching gifted students at high school levels has been held by the Vietnam Institute for Advanced Study in Mathematics (VIASM, 2019). Teachers' benefits are also given much attention since those teaching gifted students receive 70% higher than the salary of teaching staff working in regular schools. In addition, all provinces have specific regulations on policies to attract teachers to gifted schools, ensuring the quantity requirements and high professional standards; increase investment in funding for professional training and development, ICT skills and foreign languages for teachers and administrators of gifted schools (MOET, 2022).

Gifted high school students enjoy a variety of priority policies both during and after graduation. The encouragement might focus on winning medals or prizes in national and international competitions, contests, and Olympiads. One of the most encouraging policies for Vietnamese students is that if they obtain national or international math Olympiad medals, they will be admitted directly to one of these faculties, including faculty of natural sciences, engineering and economics at top universities in Vietnam (MOET, 2018). Interestingly, students graduated from Vietnamese gifted/specialized high schools with high GPA could be admitted directly into the Bachelor programs at a number of foreign institutes or universities (Leversha, 2017). Students who win mathematics awards at either national or international levels also receive scholarships.

In terms of facilities, schools for gifted students are given higher priority than ordinary public schools, with higher number of classrooms, multi-purpose gyms, libraries, teacher conference rooms, public houses, boarding houses and cafeterias, swimming pools according to specified standards (Government Office, 2010a).

Overall, there is clear supporting policy and adequate capital devoted to gifted mathematical education in Vietnam. It is completely different from its neighbouring countries such as China (Zhang, 2017) and Japan (Sumida, 2013) where there are no formal policies supporting gifted education. This is considered a solid foundation to train better gifted talents, only if all requirements to implement this process are met.

Mathematics curriculum for the Gifted

At the national level, there is no fixed curriculum for the gifted math students. The specific curriculum for the specialized math classes is often compiled by math teachers at these gifted schools. However, Ministry of Education and Training releases the guidelines for schools for the gifted. The guideline on how to teach and learn specialised maths for gifted upper secondary schools, issued in Official Letter No. 10803, has been used up until now (MOET, 2006). Following the Vietnam Ministry of Education and Training (MOET)'s guideline, the mathematics curricular will be extended by 50%, in other words, the schools for the gifted provide 150% maths periods per week compared to regular schools (MOET, 2006). The model of devoting more time (8 - 12 periods per week) to mathematics learning in gifted schools was influenced by the gifted school system in Russia (Karp, 2010). Moreover, teachers at specialized schools have more rights and flexibility in building a curriculum that works best for their students. Furthermore, teachers can also design specific practice topics if needed. The learning outcome assessment of mathematics gifted students has also been instructed by the MOET. Currently, MOET is implementing the development of a new gifted education curriculum based on the 2018 national curriculum in general education.

Availability of Mathematics supportive learning journals

The presence of specialized maths journals, including the "Mathematics and Youth" since 1964 is considered an extremely useful learning source for students in general and gifted students in particular when studying maths. Mathematically gifted students regularly send solutions of solved mathematical problems to this journal. The "Childhood Math Magazine" journal targets lower secondary school students by providing interesting, less common, and difficult math problems and creative solutions, aiming to improve students' problem-solving skills. Compared to China or Japan whose first mathematical journals were established much later (the first mathematical journal in China was established in 1988) (Yang, 2004), Vietnam had already established a strong interest and an ideal scientific environment to motivate maths talents. However, it is worthy to note that journal reading is no longer attractive to school students. Nowadays, very few students subscribe to magazines that were once immensely popular in schools.

5.2. Challenges of current mathematics gifted education in Vietnam

An exam-based paradigm to identify talents

In Vietnam, entrance to gifted high schools takes place in two rounds. First, students are assessed by consideration of their profile, including academic performance and extracurricular activities during four years of lower secondary school (MOET, 2014). Shortlisted candidates after the first round will enter an examination of four subjects: General Mathematics, Vietnamese Language and Literature, Foreign Language and Specialised Mathematics. Since the examination is of fierce competitiveness, the vast majority of students have to take private lessons and revise harshly in order to win the race (Vu, 2011). The problem is paper questions of these exams are very much knowledge-based and require mostly rote learning (Tran, 2020). Because students can get through by merely practising as many papers as possible, admitted candidates are not necessarily truly talented with genuine interest in Mathematics (Nguyen, Hoang, & Nong, 2016). Therefore, besides only very few of those who are selected for the National Math Olympiad team, the vast majority of Math gifted students are not typically committed in pursuing Maths to further level of study. Even for those very top students with national and international awards, nurturing their passion for Mathematics learning might not be the primary objective of their teachers and schools (Phan Thao, 2020).

Absence of an engaging curriculum

Gifted Maths schools in Vietnam follow a separate Mathematics curriculum which is more advanced than the national curriculum. There is a Mathematics specialised textbook series for gifted students grades 6 to 12. However, the specialised curriculum as well as learning materials are mostly exam-centric and not engaging to students while core value of gifted education is to encourage students with special talents and passion for math learning, because those with high motivation often have more positive attitudes towards the subject (Singh, Granville, & Dika, 2002). Gifted students often get bored in the context of classrooms. A cause might be relating to (1) decreased motivation from the learning environment and (2) low level of interaction.

In addition, mathematically gifted students spent more than 70% of the time in the classroom devoted to preparation for math exams (VNIES, 2021). Other cultural- based classes, experiential activities or out-of-school activities (arts, physical education) are taken lightly. The fact is that those gifted students often lack skills to handle life situations, and to communicate effectively. This also holds true for Mathematically gifted students. Consequently, many students are only good at Mathematics, and are not fully developed due to the unbalanced method of learning. They only know how to solve maths problems, but have less fun and practice life skills. Although many students show strength in their specialization, they lack dynamic and social understanding (VNIES, 2021). Until now, no solution has yet been proposed or analysed to deal with this unbalanced learning approaches. It is worthy to note that specialised/gifted education is positive for students' academic development, a wide range of researchers, however, argued that there might be negative impacts on students' self-concept (Rindermann & Heller, 2005). Moreover, continuous and rigorous learning activities to gain mathematical knowledge and solve problems have been shown to increase the learning pressure for the gifted students, and specialized students in the national team preparing for national or international exams who might have to deal with as twice stress as compared to usual.

Limited quantity and quality of learning resources

At selective classes in regular high schools, math teachers usually develop their own learning enriched materials, which are used along with standard materials to promote and encourage math learning for students. Resources that introduce students to a wide range of Mathematical topics are, however, particularly scarce in Vietnam. Mathematical learning is strictly limited in classroom environment without opportunities to connect and learn from different sources such as online platform, visiting teachers, exchange programs, etc. In addition, as mentioned above, over the past 10 years, the ignorance of gifted students to maths journals has increased, as evident by the number of submissions by mathematically gifted students. Math students nowadays in general have lost access to a science sharing playground. In 2017, the journal Pi was founded by the Vietnam Math Association which targets readers who have genuine interest and passion for Math. Even though the journal quality is carefully monitored, attracting a wide range of readers still remains its biggest challenge.

Teachers' profession

There is no special academic degree requirement for teachers of the gifted (MOET, 2018). Although, teaching in a gifted class in Vietnam does not require a special higher degree than teaching in a regular class, teachers must be carefully recruited by the specialised schools. In-service training for teachers in gifted schools is often conducted by MOET. However, the training is primarily aimed at advancing Mathematical knowledge of teachers instead of their pedagogical capacity in a gifted class. The most concerning issue regarding teaching methods is that many teachers are not aware of the typicality of the gifted and their learning needs and only focus on exam revision while this group of learners demand an input-rich environment to self-direct their study (Tran, 2020; Vu, 2011). Too much exam preparation takes away time and resources for students to develop thinking skills and actively take control over their study.

6. Conclusions

Comparative review of mathematical gifted education between Eastern and Western countries reveals that the superior performance of East Asian students in international mathematical studies and competitions seem to result from the typical teaching and learning mode in this region, which is heavily exam-based. This is perhaps due to the cultural effects of Confucianism, placing high values on scholarship and qualification.

Despite its recognized achievements in the field, education for the mathematically gifted in East Asian countries is in critical need of a sustainable roadmap, supported by extensive scientific research on gifted and mathematical education. There needs to develop official identification models which embrace various dimensions of the mathematical giftedness construct with more focus on mathematical creativity rather than school achievements. If mathematics education for the gifted in East Asian regimes can improve in the promotion of students' long-term motivation and interests as well as thinking abilities, then they will overcome any obstacles on the way to upskill the human resources and their capacity in mathematical studies.

The root goals of gifted mathematics schools focus on three aspects: (1) to create motivation for maths learning among school-aged children; (2) to find out the meaning of maths for children; (3) to educate them how to solve mathematical problems. Vietnam's current gifted mathematics schools seem to focus on the third goal only. In general, learning maths at Vietnamese gifted schools often inclined towards theory than practice. This explains a high number of mathematically talented students pursuing and becoming successful applied mathematicians or related fields. It is thus suggested that schools for the gifted should develop a more stimulating environment for students to develop their knowledge and skills comprehensively, and create opportunities for students to learn subjects based on career orientation. To optimise the potentials of gifted education, the gifted mathematical curriculum should be revised and further developed (Kim, 2016; Rotigel & Fello, 2004; VanTassel-Baska & Brown, 2007; Wolfle, 1986), along with long-term plans for capacity building of teachers in gifted schools.

Acknowledgement

This research was supported by the Project "Assessment of the significance and efficiency of the gifted high schools in Vietnam", sponsored by VinUniversity under the Contract 45/2021/HDDV/CECS/VUNI-VKHGD (Vins).

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