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THE RELATIONSHIP BETWEEN EMOTIONAL INTELLIGENCE AND MATHEMATICAL COMPETENCY AMONG SECONDARY SCHOOL STUDENTS

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Abstract

Anxiety towards mathematics among secondary school students have been reported. Anxiety creates strong negative emotions and can hinder a person's cognitive, learning and academic performance. Fear of mathematics came early in the educational process and if this is not handled properly, it will negatively affect the students to adulthood. In learning mathematics, emotional intelligence (EI) impacts on how a person deals with emotions, mathematics and the general self-regulations strategies that the person adopts. A study was carried out to access secondary students' EI and their mathematical competency (MC). The EI was tested using an EI questionnaire for adolescents (IKEM-R/MEQI) consisting of 7 domains, while the MC was tested using selected questions from PISA (Programme for International Student Assessment) 2012 released items. Analysis shows that EI predict significantly students MC, but with low correlational value. Most of the respondents have moderate level of EI in all 7 domains whereby self awareness and self-regulation are the two domains with lowest scores. On the other hand, most of the students' MC are poor. This particular research shows that EI is not a good predictor of MC which contradicts other reports. However it is suggested that the data collection can be improved by examining students' EI while they are engaging in activities that call for MCs rather than doing it before or after the tasks.

Keywords: Emotional Intelligence (EI), emotion, Mathematical Competency (MC), PISA (Programme for International Student Assessment), anxiety

Abstrak

Kegelisahan terhadap matematika di kalangan siswa kelas menengah telah dilaporkan. Kegelisahan menyebabkan emosi negatif yang tinggi dan boleh mempengaruhi prestasi akademik, perkembangan kognitif, dan pembelajaran seseorang. Perasaan takut terhadap matematika timbul lebih awal dalam proses pendidikan dan jika hal ini tidak ditangani dengan baik, hal itu akan berdampak negatif kepada siswa sampai dewasa. Dalam pembelajaran matematika, kecerdasan emosional (EI) berdampak pada cara seseorang berhubungan dengan emosi, matematika dan strategi umum regulasi diri yang digunakan. Sebuah penelitian dilakukan untuk mengakses EI dan kompetensi matematika (MC)siswa menengah. EI diuji menggunakan kuesioner EI untuk remaja (IKEM-R/MEQI) yang terdiri dari 7 domain, sedangkan MC diuji menggunakan masalah yang dipilih dari item dirilis PISA (Program Penilaian Siswa Internasional) 2012. Analisis menunjukkan bahwa EI memprediksi secara signifikan siswa MC, tapi dengan nilai korelasional yang rendah. Sebagian besar responden memiliki tingkat moderat EI di semua 7 domain dimana kesadaran diri dan regulasi diri adalah dua domain dengan skor terendah. Di sisi lain, sebagian besar MC siswa adalah rendah. Penelitian khusus ini menunjukkan bahwa EI bukan prediktor yang baik untuk MC yang mana bertentangan dengan laporan lain. Namun disarankan bahwa pengumpulan data dapat ditingkatkan dengan memeriksa EI siswa sementara mereka terlibat dalam kegiatan yang membutuhkan MC ketimbang melakukannya sebelum atau setelah tugas.

Kata kunci: Kecerdasan Emosional (EI), emosi, kompetensi matematika (MC), PISA (Program Penilaian Siswa Internasional), kecemasan

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Within school and society as a whole, one aspect that has been overlooked is emotion. In mathematics, they are assessed on how well they can solve mathematical problems, the ability to

understand mathematical literacy, mathematical competencies, and so forth. However, what has been defined as EI is usually not assessed among students. In Malaysian National Educational Philosophy (2000), there are explicit and implicit goals that highlighted the importance and the crucial aspect of EI alongside other aspects of life such as intellectual intelligence and spiritual intelligence.

Some students may have disciplinary problems when their EI fail to develop in tandem with the development of cognitive intelligence. Badrulzaman Baharom (2006) claimed that low emotional intelligence in adolescents is a factor that caused increasing number of deviant behavior such as fighting, bullying, drug abuse, sexual harassment, threatening and truancy.

Wu *et al*. (2013) in their study found that adolescents who encountered mathematical difficulties tended to have social problems including the above mentioned deviant behavior. In an earlier study, Shaiful *et al.,* (2009) report that adolescents who face mathematical difficulties were associated with deviant behaviors, which is defined as a cultural norm recognized as a type of behavior that violates the law. This behavior (deviant) commonly occurs among adolescents at secondary school level. Thus, this study examined whether there is a relationship between EI and MC. It is hypothesized that emotional intelligence is positively related with mathematical competencies.

Emotional Intelligence

EI is a relatively new concept of intelligence that is gaining attention from researchers and psychologists. The term EQ (*emotional quotient*) is sometimes used interchangeably with EI (*emotional intelligen*ce). EI accounts for social intelligence that was first introduced by Thorndike in 1920. Interest in the modern world of EI begins by early writings of Mayer and Salovey in 1990. They were the first group to study from a psychological perspective using a systematic method. In part, EI has gained popularity because it is thought to be intelligence that anyone can have (Goleman, 1995). Since Goleman published his book entitled “The emotional intelligence”, many researchers began to show an interest in research in this new field. Researchers try to understand how EI can join forces with intellectual intelligence and common sense to determine the success of a human being in their life.

Similar developments can be seen in Malaysia when Noriah *et al*. (2000) reported her preliminary study, and demonstrated that EI has a positive relationship with one's cognitive ability and competency in completing a task. Subsequently, many researchers in Malaysia study this concept from various angles using a variety of subjects. For instant Noriah *et al.* (2004) has adopted the model of EI by Goleman (1998) and developed an instrument to measure EI among Malaysians. The instrument included the elements of spirituality and maturity which were not considered by Goleman.

The study on the influence of EI toward mathematics competency has not been widely investigated. However previous studies focus more on the relationship of EI and academic achievement in mathematics. In general, studies on influence of EI towards learning mathematics are mainly carried out in Western countries. In Malaysia, studies within this scope are still having little progress and therefore not much have been understood.

To gather information for the success of this study, *Inventori Kecerdasan Emosi Malaysia* (IKEM) or Malaysian Emotional Quotient Inventory (MEQI) questionnaires have been used for data collection. This EI instrument was developed by a group of researchers from Universiti Kebangsaan Malaysia (Noriah *et al*. 2003), and the instrument gathered by the researcher has been authorized by Prof. Datuk Dr. Noriah Bte Mohd Ishak (Patent No. PI20070304). The items in the instruments were adapted by addressing the emotions towards doing or learning mathematics rather than the general emotions. In conclusion, this study measures the 7 elements of emotional intelligence which is self-awareness, self-regulation, motivation, empathy, social skills, spirituality, and maturity.

Mathematical Competency

Competence has been used to speak about what students are accounted for mathematically and what is valued in classroom discourse (Cobb, Gresalfi & Hodge, 2009). Niss (2003) presents a more condense version as below:

> "To possess a competence (to be competent) in some domain of personal, professional or social life is to master (to a fair degree, modulo the conditions and circumstances) essential aspects of life in that domain" (pp. 120).

Dealing with a problem in PISA involves mathematical thoughts and actions. In activating the knowledge base (consist of concept, knowledge and skills), there are seven Fundamental Mathematical Capabilities for mathematical actions. These seven capabilities are derived from the mathematical competencies framework which were based on work done by Niss and his Danish colleagues (Niss, 2003; Niss & Jensen, 2002; Niss & Hojgaard, 2011) who previously identified eight capabilities referred to as 'competencies' by Niss for engineering undergraduates.

The seven Fundamental Mathematical Capabilities (or MC) used in PISA 2012 framework are Communication, Mathematising, Representation, Reasoning and Argument, Devising strategies for solving problems, Using symbolic, formal and technical language and operations, and Using mathematical tools. In this study, the MC test questions were selected from OECD (2013) released item on PISA 2012 questions.

This study determined the relationship between MC and EI of secondary school students. Measuring the dimensions of EI: self-awareness, self-regulation, motivation, empathy and social skills, spirituality, and maturity is important to see how these dimensions may influence the mathematical competencies among adolescents. Specifically the objectives for the study are:

1. To identify the EI of Form 4 Secondary school students
2. To identify the MCs of Form 4 Secondary school students
3. To determine the relationship between EI and MC of Form 4 Secondary school students

METHOD

A descriptive research design was used based on adoption of survey methods that review a population with sample selection selected from a population to find occurrence, distribution, and

relationship between social and psychological variables. Here the quantitative approach was used to see the influence of EI of form 4 students on their MCs. The survey was carried out in four secondary schools in Johor Bahru district. Data were collected from two instruments, namely EI questionnaire and students' written solutions on a set of mathematics questions. Table 1 display the distribution of the 53 items for each EI element studied in this research. The elements for social skills have the most items, numbering 15 compared to only 3 items for the element of spirituality and maturity.

Table 1. Distribution of Items for each element in IKEM (R) EI Inventory

EI ELEMENT	TOTAL ITEM
1. Self-Awareness	8
2. Self-Regulation	10
3. Motivation	7
4. Empathy	7
5. Social Skills	15
6. Spirituality	3
7. Maturity	3
TOTAL	**53**

Table 2 listed the PISA 2012 released items domain in the mathematical literacy that can be analyzed in terms of three interrelated aspects which are *mathematical process, content, and context* as a main assessment. The first question from the set of 7 questions involves the process of formulating, related to the content area on space and shapes with personal context. Further the PISA items were analyzed in terms of MCs as portrayed in Table 3.

Table 2. Analysis of PISA items in terms of *mathematical process, content, and context*

Question No.	Question	Process	Content area	Context
1	Apartment Purchase	Formulate	Space and shape	Personal
2	Oil Spill	Employ	Space and shape	Scientific
3(i)	Climbing Mount Fuji	Formulate	Quantity	Societal
3(ii)	Climbing Mount Fuji	Formulate	Change and relationship	Societal
3(iii)	Climbing Mount Fuji	Employ	Quantity	Societal
4(i)	Memory Stick	Interpret	Quantity	Personal

Table 3 displays the rating of MCs for Question 1 with respect to the six domains of competencies. The 7th domain, using tools does not appear in the table since this domain is non

applicable for Question 1. Devising strategies for problem solving was rated highest compare to representation which is the lowest.

Table 3. MCs rating by PISA Development Team

Question	MC domain	Rating
1	communication	1.2 (moderate)
	mathematising	1(moderate)
	representation	0(very low)
	Reasoning and argument	1 (relatively low)
	Devising strategies for solving problem	2 (relatively high)
	Using symbolic. Formal and technical language and operations	1.8 (moderately high)

The total number of form four students who are about 16 year olds from the selected four schools was 747 pupils. Based on a population of 800 people, the sample size can be taken for research as recommended by Krejcie and Morgan (1970) is 260 respondents. But the researchers choose a sample of 272 respondents (the total number of an acceptable finding out of 300) for this study because the larger the sample size would reduce sampling errors (whether the sample is not selected or does not have the characteristics of the population). From the total, 58.1 percent is made up of male and the rest is made up of 41.9 per cent among female students. Out of a total of 272 students, the majority was Malay students by 62.5 percent as the largest data contributor in this study, followed by students from Chinese ethnic by 28.3 per cent, the Indian ethnic student by 8.1 percent, and other ethnic groups of 1.1 percent.

RESULTS AND DISCUSSION

The data analysis will be discussed in accordance with the flow of research objectives: Analysis on EI; Analysis on MC and Analysis on the relationship between MC and EI.

Analysis on EI

A total of 53 items were presented to the respondents to determine the type of EI possessed among them. Table 4 present the mean score for each type of the 7 elements in EI from the responses of 272 respondents. The items were measured using 5 points Likert scale. Of the total, the analysis shows that as many as 2 types of EI elements were categorized at high level, namely self-motivation and empathy. The other five elements which are self-awareness, self-regulation, social skills, spirituality and maturity were all at moderate level.

Table 4. Analysis on EI in terms of element, mean and level

EI element	Mean	Level
Self-awareness	3.31	Moderate
Self-regulation	3.47	Moderate
Self-Motivation	3.72	High
Empathy	3.72	High
Social Skills	3.5	Moderate
Spirituality	3.59	Moderate
Maturity	3.62	Moderate

Analysis on Mathematical Competency

Findings gathered on MC's test were obtained to find out whether students have the seven domains of MCs highlighted by OECD PISA assessment. The total score for each competency as shown in Table 5 is 1904 which is obtained by multiplying the number of respondents (272) and the number of problems (7). A respondent will gain one point for a particular domain if her solution for that question is acceptable. Therefore from the table it can be understood for the domain communication, the score is 1527 meaning that there are 1527 acceptable respondents' solutions related to communications from the 7 questions. Consequently, it can be concluded that for communication domain, almost all students have this domain in the MC test. For mathematising domain, overall, many students do not have this competency, but those who do only have this competency in their written solution for Question 3 (i) and 3 (iii). It has also been detected that students are lacking in Representation, and Reasoning and argument. Similarly in Devising strategies, solving problems, and Using symbolic, formal and technical language and operations domain, almost all of the students lack these competencies in all questions. The respondents also did not display much in Using mathematical tools in their written solutions except for Question 3 (i) and 3 (iii). For overall result, descriptive analysis of the seven domains of mathematical competence is shown in Table 5 below.

Table 5. Descriptive analysis on MCs

MATHEMATICAL COMPETENCIES	SCORE (OUT OF 1904: 7x272)	PERCENTAGE (%)	LEVEL	RANK
Communication	1527	80.2%	Excellent	1
Mathematising	810	42.5%	Poor	4
Representation	896	47.1%	Poor	2
Reasoning and Argument	727	38.2%	Poor	5
Devising Strategy	438	23.0%	Very Poor	6
Using Symbolic, Formal and Technical Tools	424	22.3%	Very Poor	7
Using Mathematical Tools	855	44.9%	Poor	3
Average percentage		**42.6% (POOR)**		

Analysis on relationship between EI and MC

Table 6 shows that the linear regression suggest that EI predict significantly students' competencies (r^2 =0.028, F=7.652, p=0.006<0.05). Moreover, there are four domain of EI that can significantly predict students' MCs. The four domains mentioned are *self-motivation* (r^2 =0.043, F=12.086, p=0.001<0.05); *empathy* (r^2 =0.027, F=7.544, p=0.006<0.05); *social skills* (r^2 =0.033, F=9.099, p=0.003<0.05) and *maturity* (r^2 =0.017, F=4.774, p=0.030<0.05). This result implies that EI and the four domains of EI predict positively students' MC. However, it should be noted that the regression coefficient (r^2 value) is low.

Table 6: Analysis on Relationship between EI and MC

No.	Regression Path	R Square	F	Sig.
1	Self-Awareness →MC	0.007	1.876	0.172
2	Self-Regulation →MC	0.006	1.604	0.206
3	Self-Motivation →MC	0.043	12.086	0.001*
4	Empathy →MC	0.027	7.544	0.006*
5	Social Skills →MC	0.033	9.099	0.003*
6	Spirituality →MC	0.001	0.301	0.584
7	Maturity →MC	0.017	4.774	0.030*
8	Emotional Intelligent→MC	0.028	7.651	0.006

From the findings of previous studies, it is crucial to check and balance adolescent's EI in order to overcome the occurrences of social problems among teenagers that make up 20% of the total population in Malaysia. Besides, there are some teenagers who were found guilty of having engaged with social problems. Probably this phenomenon can be explained as this group of people in the society are lacking in skills to recognize and control emotions. Although this number is not considerably high, it may be sufficient enough to trigger further distress that could lead to social problems. In this paper, EI was measured through seven domains, namely (1) self -awareness, (2) self-regulation, (3) motivation, (4) empathy, and (5) social skills, (6) spirituality, and (7) maturity. The findings showed that EI of the form four students that were surveyed had an overall mean value of 3.62 percent which is categorized as moderate. However, it can be concluded that most adolescents (respondents) surveyed has a mean level of EI between medium and high. Only for the domain of self-awareness were found to be in the low range. On the other hand, other 6 domains which are self-awareness, self-regulation, motivation, empathy, social skills, spirituality and maturity are all at moderate level for the form four students. These findings are similar with findings of a study conducted by Noriah *et al.* (2004), where most of the adolescents surveyed have EI at a moderate level, and most of them need to regulate their emotions, and develop good social skills to interact with others. Consequently, these findings could be used to help the concerned parties to build and organize

special programs to help young people (not only those were studied) to improve their EI to a higher level, especially in the context and perspective of mathematics learning as well.

For MC analysis, only communication domain of the form four students can be considered excellent. Unfortunately the respondents were weak at the other six competencies which are representation, reasoning and argument, devising strategies for solving problems, and using symbolic, formal and technical language and operations. The overall results indicate that form four student's MC is poor (42.6 percent), which is less than 50 percent. PISA studies also found that Malaysian teenagers did not perform well on PISA items. It is typical that many Malaysians students do not like questions that have long sentences whereby they need to understand the information and instructions provided before they can proceed. When they are faced with a wordy mathematical problem, they get demotivated such that some of them automatically give up answering the question. Some students expressed their concerns that the PISA released questions are difficult to understand. Other than that, most students do not provide complete solutions although they had been told to do so. In handling PISA questions that are multiple choice questions, they took the easy way out by simply guessing the most suitable answers. In fact there are many students that provide solutions for the problems but they failed to provide justifications, explanations or arguments to support their answers, even though it has been instructed clearly in the questions. All these matters need to be addressed in improving the learning of mathematics, specifically on nurturing MCs. Richer exposure in learning mathematics should be provided to learners so that they experience the true nature of learning mathematics and problem solving.

The analysis of linear regression showed that EI predict significantly students competencies even though the correlation is low. Furthermore, four domain of EI predict positively student's mathematical competencies. The findings suggest that MC should be fostered by stimulating learning environment that can improve emotional stability of students, especially while they are doing mathematics. Many students hold the impression that mathematics is a subject that is difficult and tiring their minds, especially mathematics problems that demand intensive reading, thinking, analyzing, making inferences and manipulating symbols and variables. Their emotions while doing mathematics have to be properly balanced and controlled so that they can sustain their struggle in solving problems. Resilience in accomplishing intellectual intelligence should be trained among learners. Thus to be a successful learner, EI and EQ should both be developed and nurtured.

CONCLUSION

From this study and other several studies conducted by previous researchers, it can be generally concluded that the EI of adolescents in Malaysia are still at a moderate level, From a mathematical standpoint, the respondents viewed their feelings towards mathematics is at the moderate level. Since there is a positive relationship between EI and MC, parallel to the Malaysian educational philosophy that emphasize educating the young in both emotions and intelligence, reliable efforts should be taken

to improve the quality of EI and MC among school learners. The small correlational value between EI and MC should be a concern for interested researchers to call for improving the research methodology. Some research questions that we can further investigate could be: Is there a difference between measuring EI during and before respondents' engagement in mathematical tasks? What is the nature of MCs among students with low, moderate or high EI?

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