Students’ view of mathematics in general high school and vocational high school

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Abstract. Much of the current debate among researchers revolves around the differences on the view of mathematics in secondary schools. The present research is concerned with the issue of whether or not students’ view of mathematics in secondary schools in terms of the type of schools’ factors are different between general high schools (Sekolah Menengah Atas referred to as SMA) and vocational high schools (Sekolah Menengah Kejuruan referred to as SMK) or not in the Riau province - Indonesia. This research involved a total of 276 secondary school students, 131 students from SMA and 145 students from SMK. A survey design was employed to investigate the students’ view of mathematics among secondary school students using the questionnaire. The quantitative data was statistically analyzed using MANOVA. Findings of this study indicated that a one-way MANOVA analysis revealed a significant multivariate main effect for SMK and SMA. It was concluded that SMK had a more positive view than SMA. SMK had a higher effort, mastery of goal orientation and self-confidence. These findings imply that teacher should consider students’ view of mathematics to present the most suitable learning strategy which can be imposed for students in order to boost their mathematics achievement

1. Introduction

In Indonesia, one of the escalating issues in mathematics instructions is the effectiveness of mathematics teaching and learning process. The inability of teachers in supporting students to freely express mathematical thinking and lack of understanding mathematical thinking is a practice that exists in the context of mathematics teaching [1]. At the same time, majority of the students only learn how to pass the exam rather than learn a subject to build their mathematical understanding in order to find solutions of mathematical teaching [2]. A number of students faced some difficulties in mathematics education in particular in problem solving [3]. For example, the various factors that have been identified, as failure in the problem solving process, in which the students encountered are; the tasks are lengthy expression of a problem, not understanding the problem on the first reading [3] incorrect prior knowledge, time-consuming and unproductive struggle [4], and misaligned with the intent of the problem [5]. On the other hand, students who participate actively in the teaching and learning process will be determined by their positive views on the subject which eventually influence their achievement [6].
However, generally secondary students hold distinctive perceptions of competence, difficulty, and effort [7]. In particular, students in SMA tend to view lack of proficiency in mathematics as a challenge, and attribute success in mathematics to effort and perseverance, perceive difficulty in mathematics as an obstacle, and attribute failure to their own lack of inherited mathematical ability [6]. Similarly, the 10th grade students in SMA have the lower scores in beliefs about the significance of and competence in mathematics and beliefs about mathematics as a functional necessity of school life [8]. In another case, students in SMK have indicated the lower levels of agency beliefs in the effort and effort exertion, find much higher level of normative difficulty [7]. This is because they usually do not hold a robust mathematics background so they have lack of sufficient knowledge in mathematical lessons easily [9]. However, their mastery goals influence their preferences for the use of deep and surface information processing strategies [10].

In this study, we propose to extend existing view of mathematics literature by discussing view of mathematics between SMA and SMK. Only few literatures have been documented in secondary schools in terms of the types of schools [6]. On the other hand, there is insufficient research on secondary students about mathematics view and are still unclear differences of mathematics view among secondary schools. Therefore, this present research is concerned with the issue of students’ view of mathematics between SMA and SMK.

The purpose of this research is to investigate students’ view of mathematics between SMA and SMK. We hypothesise that there is no significant difference in the view of mathematics between SMA and SMK in Riau province Indonesia.

2. View of Mathematics

The term view of mathematics is used widely in mathematics education which refers to the systematic character of beliefs [11]. Initially, they have classified eight scales such as competence, effort, teacher quality, family encouragement, enjoyment of mathematics, difficulty of mathematics, and confidence into three dimensions namely feelings, beliefs, and motivation as the aspects of view of mathematics [12]. Researchers sometimes prefer to use a framework which consists of five dimensions [13] or three dimensions [14]. However, we applied the view of mathematics in current research which refers to three dimensions, the cognitive dimension (self-competence, self-confidence, difficulty of mathematics), the emotional dimension (enjoyment of mathematics) and the motivational dimension (mastery goal orientations and effort). Mastery goal orientation refers to the representation of the desire to construct competence and enhance knowledge through effortful learning [15]. The effort construct reflects to the intensity of the students’ motivation [14]. From an emotional aspect, the enjoyment of mathematics is as attitude [12] which is defined as affective response that entangles positive or negative feelings of moderate intensity and plausible stability [16]. Lastly in cognition, difficulty of mathematics is considered as a belief about mathematics, and the competence and success are beliefs about self [12]. Self-competence is an assessment of competency to successfully bring about desired results [17]. Burton (2004) considered confidence as a confluence of feelings relating to beliefs about the self, and about one’s efficacy to serve underneath a social setting [18].

Mastery goal orientations was correlated to enjoyment and self-confidence [14], and self-competence [19]. Students holding high degree of mastery goal orientation, typically looked themselves to be competent. In addition, self-competence, self-confidence and difficulty of mathematics revealed are more closely related [11]. Students with high self-competence and self-confidence to perform mathematics experienced less difficult in mathematics. Again, self-confidence was also connected richly to effort and emotion [14]. Therefore, it was concluded that students’ view toward mathematics is referred to this correlation of these constructs.

3. Methods

Survey method was employed to collect students’ information in the current research. Survey research designs are procedures in quantitative research in which it provides researchers the opportunity to administer a survey to a sample or to the entire population of people to describe the attitudes, opinions,
behaviors, or characteristics of the population [20]. The population of this study consists of SMA and SMK in rural school district in Riau Province Indonesia. Since the current research selects groups rather than individuals, cluster random sampling is suitable [21]. The researchers can select a specific number of schools and test all the students in those chosen schools by cluster sampling [22]. A total of 276 students, 131 of SMA and 145 of SMK, participated in the current research. A number of female participants were 101 while male participants were 175 with ages ranging from 15 to 18 years old. Moreover, students who are enrolled in SMK in the current research are specialized under the programmes of technology and engineering, and marine resources. Both schools completed the survey during school hours which was compulsory and voluntary. Participants from the secondary school also completed the questionnaire covering 25 items. The researcher gave 10 to 15 minutes to every individual to read and answer the questionnaire.

3.1. Data Collection
Method of the back translation is used in the current research toward the original questionnaire in order to confirm that the translation was precise. Before the items were piloted, researcher translated the questionnaire from English by the author then translated back into Indonesian language by bilingual language expert. The instrument of mathematics view was adopted from Tuohilampi et al., (2015) [14]. The respondents answered twenty five items about their views towards mathematics which was categorised into three dimensions; the cognitive dimension (self-competence, self-confidence, difficulty of mathematics - the latter is referred to as DoM), the emotional dimension (enjoyment of mathematics - referred to as EoM) and the motivational dimension (mastery goal orientations and effort – the former is referred to as MGO) on three Likert scale (1 = true, 2 = partially true, 3 = not true). The use of only three points seemed to be the easier instrument since the respondents were young students [29]. Five factors had high Cronbach’s alpha [1] which was self-competence + DoM (0.83), self-confidence (0.65), EoM (0.83), MGO (0.80), and effort (0.60).

3.2. Data Analysis
In accordance with the general purpose of this research, descriptive analysis such as mean and standard deviation, and inferential statistics such as one way multivariate analysis of variance (MANOVA) to determine differences are used for the data analyses. We used the statistical program SPSS 24.0 software for the data analysis. The significance level was taken as .05 for the statistical analyses.

4. Results and Discussion
4.1. Results
Bivariate correlations in the current research was conducted to determine the strength of the relationships among the factors. Table 1 reveals that almost all the correlations were considered very low. For example, correlation between self-competence and enjoyment of mathematics is 0.15. In addition, the highest correlation was assigned by correlation between mastery goal orientations and self-confidence ($r = 0.32$).

Descriptive analysis in the current research was conducted by reporting the means and standard deviations. As seen in Table 2, the average of students’ score in self-competence factor is 1.84, the average for effort is 1.72, for mastery goal orientations it is 1.32, for enjoyment of mathematics it is 1.87, the average for self-confidence is 1.76, and the average for difficulty of mathematics is 1.70.
Table 1. The correlations matrix between factors

| Factors | Competence | Effort | MGO  | EOM  | Confidence | Difficulty |
|---------|------------|--------|------|------|------------|------------|
| Competence | 1.00 |        |      |      |            |            |
| Effort  | 0.22 | 1.00   |      |      |            |            |
| MGO    | 0.31 | 0.27   | 1.00 |      |            |            |
| EOM    | 0.15 | 0.16   | 0.10 | 1.00 |            |            |
| Confidence | 0.17 | 0.28   | 0.32 | 0.10 | 1.00       |            |
| Difficulty | 0.13 | 0.17   | 0.17 | 0.31 | 0.03       | 1.00       |

Table 2. Descriptive statistics on the view of mathematics

| View of Mathematics | N  | Mean | Std. Deviation |
|---------------------|----|------|----------------|
| Competence          | 276| 1.84 | 0.45           |
| Effort              | 276| 1.72 | 0.30           |
| MGO                 | 276| 1.32 | 0.33           |
| EOM                 | 276| 1.87 | 0.29           |
| Confidence          | 276| 1.76 | 0.39           |
| Difficulty          | 276| 1.70 | 0.29           |

One way MANOVA analysis was conducted to determine the difference in students’ view of mathematics between SMK and SMA. Table 3 shows the findings of the MANOVA analysis on the types of schools. A one-way MANOVA analysis revealed a significant multivariate main effect for types of schools, Wilks’ $\lambda = .31$, $F(6, 269) = 98.30, p < .001$. Partial eta squared = .69. Power to detect the effect was 1.00. Given the significance of the overall test, the univariate main effects were examined. The significant univariate main effect for types of schools was obtained for the percentage of self-competence, $F(1, 274) = 242.13,(p = .00, p < .05)$, partial eta squared = .47, power = 1.00; mastery goal orientations, $F(1, 274) = 6.42,(p = .01, p < .05)$, partial eta squared = .023, power = .71; and self-confidence, $F(1, 274) = 15.71,(p = .00, p < .05)$, partial eta squared = .054, power = .98.

Table 3. MANOVA Results: SMK and SMA

| Component | Types of Schools | Mean | Std. Deviation | df  | df Error | F     | Sig  |
|-----------|-----------------|------|----------------|-----|----------|-------|------|
| Competence| SMK             | 1.55 | 0.33           | 1   | 274      | 242.13| .00  |
|           | SMA             | 2.16 | 0.31           |     |          |       |      |
| Effort    | SMK             | 1.73 | 0.30           | 1   | 274      | 0.15  | .70  |
|           | SMA             | 1.71 | 0.30           |     |          |       |      |
| MGO       | SMK             | 1.37 | 0.33           | 1   | 274      | 6.42  | .01  |
|           | SMA             | 1.27 | 0.32           |     |          |       |      |
| EOM       | SMK             | 1.86 | 0.30           | 1   | 274      | 0.44  | .50  |
|           | SMA             | 1.88 | 0.27           |     |          |       |      |
Confidence  | SMK  | 1.84 | 0.37 | 1   | 274  | 15.71 | .00  
          | SMA  | 1.66 | 0.38 |
Difficulty| SMK  | 1.70 | 0.31 | 1   | 274  | 0.10  | .74  
          | SMA  | 1.69 | 0.26 |

4.2. Discussion
In the current research, the relationship between self-competence, self-confidence, difficulty of mathematics, enjoyment of mathematics, mastery goal orientations and effort had been determined. In the light of the findings, our results revealed that the factors of view of mathematics had correlation with one and another. However, it was much appreciated that almost all the correlations of those factors were at a very low level. According to Tuohilampi et al., (2015), emotions are related to competence for Chilean pupils while enjoyment of mathematics is associated with mastery goal orientations for Finnish students [14]. Again, another study also reveals that mastery goal orientation is also much more connected to self-competence [23]. The current research was line with the previous research yet it was a very low correlation between mastery goal orientations, self-competence, and enjoyment of mathematics. Children holding a mastery goal orientation show the most worthwhile performance and motivational patterns [24,25] for all of the instructional circumstances. Moreover, our finding also revealed that not only correlation among these factors but also correlation between enjoyment of mathematics and difficulty of mathematics was much higher than other factors.

When we look at the profile of view of mathematics, according to our study, Indonesian secondary students generally appreciated the factors of enjoyment of mathematics and self-competence. Similarly, the results of the current study emerged to be consistent with the analyses in TIMSS 2015 study [26] that shows students have a stronger view, in terms of engaging in teaching mathematics lessons. Interestingly, although SMK and SMA had similar level of education but SMK had a more positive view than SMA. Indeed, SMK had a higher effort, mastery goal orientation and self-confidence. For example, in terms of mastery goal orientation, SMK was richly linked to the development of students' ability and professional attitude. One possible explanation is that SMK is involved in the programmes and qualifications which are organised for specific works or careers [27] during their education and learning. As a result, they have strong purposes of learning mathematics. Another interpretation why the students who attend SMK has a better mastery goal orientation than those of SMA is closely associated with higher scores of effort and self-confidence. This finding also coincides with the findings of the studies performed by Koopman et al. (2011) which state that students' mastery goal, in turn, influence their preferences for the use of deep and surface information processing strategies [10]. At the same time, SMA had lower mastery goal orientation and self-confidence. This finding is in line with other researchers which state that SMA has lack of belief about usefulness of and competence in mathematics [6,8].

Concerning the difficulty of mathematics, SMK felt more difficult in tasks than SMA. In line with the work of Malmberg et al., (2008) on the levels of task difficulty, SMK finds a much higher level of normative difficulty. This reflects that they express a lower level of agency beliefs in effort and effort exertion [7]. One possible reason, for example, is that they do not hold a strong mathematics background so that they have lack of adequate knowledge of mathematical lessons easily [9]. Another explanation of this result might be closely associated with the finding of enjoyment of mathematics in SMK which is lower than SMA, in spite of not significantly different. Moreover, the task factors have a much more affect to students' emotional experience [28]. This means that students holding more difficulty in mathematical tasks are likely to perceive a negative emotion in mathematical lessons. Eventually, they have a lower exam achievement than SMA.
5. Conclusion

In Indonesia, the results of the current study showed that although SMK and SMA had the same level of education, students in SMK thought positively than SMA. In addition, students of SMK had a higher effort, mastery goal orientation and self-confidence. Future studies should investigate whether the view of mathematics correlates towards certain mathematics competency such as mathematical modelling competency. Additionally, since this study found that SMA and SMK had different views toward mathematics, it should be necessary for upcoming research to replicate this study in broad and use a more sophisticated statistical model such as structural equation modeling (SEM) analysis.

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