Student's engagement behaviour and their success in abstract algebra: structural equation modelling approach

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Abstract. One of the essential subjects in Mathematics is abstract algebra, in which algebra is the science which the basis for another. So, it is imperative to know the student's engagement behaviour that supports the success of the students in learning. This research aims to look at the influence of student engagement behaviour as well as their success in an abstract algebra course. This influence was analysed using the SEM (Structural Equation Modelling) approach. The subject in this study is as much as 300 randomly selected from students who once attended abstract algebra courses from 2014 through 2018; this influence is measured by using the indicator of Engagement NSSE (National Survey of Student Engagement) and CSPCA (Characteristics of Successful Programs in College Algebra). With these purposes, a validated and reliable of the CSPCA were employed. The results of the analysis showed that the engagement has significant effects on components the success of the students. Also, female students tend to involve himself higher than male students.

1. Introduction
In Indonesia, STEM is a priority area for now. STEM is an interdisciplinary learning approach between Science, Technology, Engineering and Mathematics. Torlakson [1] states that the method of these four aspects is a harmonious pair between problems that occur in the real world and problem-based learning. In the United States, the government has identified student retention in the STEM field which is the key to the success of the United States in becoming a leader in the STEM field to date [2]. At present data is obtained that less than 40% of students who want to continue their studies majoring in science, technology, engineering and mathematics [2]. Furthermore, in the field of mathematics, algebra plays a significant role in the graduation of a mathematics degree program, so that an educator must develop a better understanding of things that can affect student success in Algebra Structure and how to help students achieve that success.

At present, the behaviour of student involvement in learning is getting attention. Student involvement has a vital role in education [3-8]. Some experts define engagement as student involvement in the learning process in academic activities and non-academic activities that are seen through the behaviours, emotions, and cognitive displayed by students in school and classroom environments [5,9,10]. However, there are results of research in the United States which are quite surprising, that student participation does not have a significant influence on student success [11].

In Indonesia, research on student involvement has been carried out quite a lot, including research conducted by Kumara & Wirawan [12] shows that student involvement in school plays a decisive role in student academic achievement. Furthermore, a study conducted by Kumara & Wirawan [12]
researched the effect of student involvement on student academic achievement. The results of his study indicate that student involvement has a significant relationship to student achievement, besides in his research shows that students from science majors tend to have higher participation than students from the social studies department. Furthermore, the research conducted by this researcher is to determine the contribution of each component to student involvement in each element of student success.

This study was designed to measure the influence of students' involvement behaviour on their success in abstract algebra courses so that the questions that will be answered in this study are: a) Is there a significant influence on student engagement behaviour on their learning success?; b) Is there a substantial difference between male student involvement and female students which then affects their learning success?

2. Review of Literature

2.1. Student engagement

Student involvement in learning is crucial. Student involvement is one of the determining factors in student learning success [13]. When students are involved in the learning process, then they will enjoy the learning to the end [14-15]. Astin [16] defines student involvement as some physical and psychological energies devoted by students to gain academic experience. Students can be involved even tied to campus life through good learning services, learning that provides opportunities for students to explore their abilities [17,18]. So that this student involvement needs to be continuously pursued, namely by steadily improving the quality of learning, increasing the role of lecturers in education and giving more attention to students.

The involvement of these students in the learning process will have an impact on increasing student retention [19], which ultimately impacts on learning outcomes and the quality of the students themselves. There are several vital elements in student involvement, according to Fletcher [20], namely a) Learning that is student involvement can develop learning with complex skills for students. A learning environment that empowers students as active learners, teachers and leaders; b) Partnership is to involve students with adults as equal partners throughout education; c) Equity, this student involvement contributes to all students, signs of discrimination in terms of race, ethnicity, culture, gender, religion, economic status, etc.; d) Infusion, namely this involvement can improve a profound, coherent and systematic attitude change; e) Quality is this involvement trying to continue to deal with critical educational problems; f) Evidence that this involvement has evidence of effectiveness that can be measured and meets general standards that apply.

While Trowler[21] distinguishes student involvement into three, namely positive involvement, no participation and negative involvement. Fredricks [22] identify three measures to state that students are involved in learning; a) Student behaviour. The behaviour here means students have positive actions such as obeying rules, being present on time and not disturbing the course of learning; b) Student emotions. Students who are emotionally involved will show positive reactions such as showing interest and enjoying the learning process; c) Cognitive students. Students who are involved cognitively will spend all their abilities in learning and love challenges.

Engagement behaviour consists of two things, namely involvement in the academic field and involvement in the social environment. There are three main categories in this involvement behaviour, namely positive behaviour, participation in learning, and participation in school activities [22].

Furthermore, the National Survey of Student Engagement (NSEE) has formulated ten indicators for student involvement in learning, namely 1) higher-order learning; 2) Reflective & integrative Learning; 3) Learning Strategies; 4) Quantitative Reasoning; 5) Collaborative Learning; 6) Discussions with diverse other; 7) student-faculty interaction; 8) Effective teaching practices; 9) Quality of interactions; 10) supportive environment. Each indicator is translated back into several items. The first indicator consists of 4 elements, the second indicator comprises of 7 questions, the third indicator consists of 3 pieces, the fourth indicator consists of 3 components, the fifth indicator consists of 4 elements, the sixth indicator includes of 4 items, the seventh indicator comprises of 4 parts, signs The eighth consists of 5
components, the ninth sign consists of 5 things, and the tenth indicator comprises of 8 items. So the total is 47 items.

In recent years, there have been many studies on student involvement in learning [7,15,23,24], in their research with the aim of knowing student involvement based on their status (regular and transfer), the findings of his study were that regular students had high involvement, while transfer students from other universities had low involvement. In another study, Zhao & Kuh [25] have researched the relationship between the learning community and student involvement, based on their research found that the learning community is positively correlated with student involvement.

2.2. Learning success

Seeing that the early years of college, college administrators and professors planned at supposing their students with the proficiency needed to attain success [26,27]. However, definitions of success and the tools for its accomplishment mixed and developed over the years. Such changes happened to suit the goals of students, purposes of the institutions, needs of the society, or trends of the respective era.

Over history, scholars have attempted to define higher education success through different approaches and concerning various aspects of college life, goals, institutional policies and academic practices. However, these definitions differed by case according to the diversity of the student body and the different types of institutions [28-30]. Other endeavours tried to define responsibilities where students would be responsible for achieving the stated level of performance in each area, faculty would be responsible for developing teaching strategies that would give students the opportunity to acquire the requisite skills as they progressed through the general education curriculum, and the college would be responsible for providing every reasonable means for the student to obtain the necessary skills and support faculty in the teaching process [31,32].

Therefore, student success can be viewed as students’ academic achievement paired with their engagement in educationally purposeful activities in consideration of their satisfaction, persistence, and gained outcomes as evidence of acquisition of desired knowledge, skills, and competencies towards the achievement of educational objectives [6,29].

3. Method

The research of this study were 300 abstract algebra learners at mathematics department the University of muhmmadiyah gresik, East Java Province, Indonesia during the period 2014-2018.

3.1. Instruments

Two different instruments were prepared in this study; namely, students engagements scale (SE-S) from the National Survey of Students Engagement (NSSE) and Characteristics of Successful Programs in the College of Algebra Scale (CSPCA-S) adopted from the National Science Foundation of America.

3.1.1. Students Engagements Scale (SE-S)

To measure student involvement comprehensively using indicators of student involvement recommended by the National Survey of Student Engagement (NSSE). In this case, NSSE (2016) proposes 47 indicators of items of student engagement. Furthermore, the student engagement indicators items were then elaborated into the following questions, namely higher-order learning (4 issues), reflective and integrative learning (7 points), learning strategies (3 items), quantitative reasoning (3 items), collaborative learning (4 items), heterogeneous discussion (4 questions), active teaching practice (5 issues), quality of interaction (5 items), and supportive environment (8 items). This questionnaire uses a Likert scale of 1 to 5.

3.1.2. Characteristics of Successful Programs in College Algebra Scale (CSPCA-S)

The symptoms of students’ success in abstract algebra lectures were measured using the CSPCA-S questionnaire adopted from the National Science Foundation of America. This questionnaire consists of 61 question items, which represent four indicators namely confidence, enjoyment, mindset and achievement. This questionnaire uses a Likert scale of 1 to 5.

3.2. Procedures

In the beginning, the total number of Abstract algebra learners from all four periods were calculated. The researchers prepared the online version of the two existing questionnaires. Then, the researchers
socialise the research program to students and them to fill out the two online surveys. The data were collected through two different type of questionnaires. After the gathering, a Structural Equation Modelling (SEM) was used to analyse the correlation.

4. Result and Discussion

There are two crucial variables (students engagement and students success) in this study. An SPSS program was managed to scrutinise descriptive statistics, Pearson correlation, and an independent sample t-test. The mean and deviation standard of the two variables are presented in table 1.

Table 1. Descriptive Statistics summary of students engagement and students success in abstract algebra

|                      | N    | Minimum | Maximum | Mean   | Std. Deviation |
|----------------------|------|---------|---------|--------|----------------|
| Student engagement   | 300  | 215.00  | 295.00  | 270.231| 1.62323        |
| Student success      | 300  | 219.00  | 301.00  | 285.954| 4.20749        |
| Valid N (listwise)   | 300  |         |         |        |                |

The possible score range for students engagement is between 60 and 300, and 61 and 305 for a students success range score. As it was exhibited in Table 1 above the mean score of students engagement was 270.23 with a standard deviation of 1.62, and the mean score of students success was 285.95.

Research question 1: Is there a significant influence on student involvement behaviour in their learning success?

Before addressing the first research question, the researchers conducted a model validity test to elucidate the influence between student's engagement behaviour and their success using Lisrel 9.1. The results of the validity basic model estimation test between student's engagement behaviour and their success and each parameter were exemplified in Figure 1 below:

Furthermore, based on the results of the statistical Goodness of Fit (GOF) analysis produced by LISREL 9.1, obtained Root Mean Square Error of Approximation (RMSEA) = 0.03, 90 Percent Confidence Interval for RMSEA = (0.03; 0.06), P-Value for Test of Close Fit (RMSEA <0.05) = 0.00. RMSEA<0.05 value indicates close fit. Expected Cross-Validation Index (ECVI) = 4.40, 90 Percent Confidence Interval for ECVI = (3.81; 5.07), ECVI for Saturated Model = 1.06, ECVI for Independence Model = 21.19, Chi-Square for Independence Model with 45 Degrees of Freedom = 2183.93 ECVI value = 4.40 is closer to the ECVI saturated model compared to ECVI Independence Model. This shows that the overall suitability of the model is good. Also, 90 Percent Confidence Interval for ECVI = (3.81; 5.07), and ECVI value = 4.40 is at this interval, this means that the estimated ECVI value has good precision. From the results of the analysis, it appears that most GOF sizes show good compatibility, so it can be concluded that the overall suitability of the model is good.
Figure 1 is the basic estimation model which shows a positive correlation between student's engagement behaviour. Before discussing the contribution of each variable, we need to explain the indicator variables of each latent variable. The latent variable "Academic Challenge" is measured by four indicator variables namely X1 (higher-order learning), X2 (Reflective & Integrative Learning), X3 (Learning Strategies), X4 (Quantitative Reasoning). The latent variable "Learning with Peers" is measured by two indicator variables namely X5 (Collaborative Learning) and X6 (Discussions with Diverse Others). The latent variable "Experiences with Faculty" is measured by two indicator variables, namely X7 (Student-Faculty Interaction) and X8 (Effective Teaching Practices). Furthermore, the latent variable "Campus Environment" is measured by variable indicators namely X9 (Quality of Interactions) and X10 (Supportive Environment).

Pay attention to the exogenous variable "student's engagement", from each of the latent variables showing a positive correlation; the academic challenge variable has a contribution of 0.76 to student's engagement with the largest contribution given by the X3 indicator namely learning strategies with a contribution value of 0.58. Another variable, "Learning with peers" contributed 0.87 to student's engagement with the largest contribution given by the X5 indicator, namely discussion with diverse other by 0.31. The next variable, "Experience with faculty" also has a significant effect on student engagement with the biggest contribution given by the X7 indicator, namely the teaching practice effect of 0.26. The last variable is the "campus environment" which has an effect of 0.98 on student's engagement with the most significant contribution given by the X10 indicator that is the quality of interaction is 0.77.

Furthermore, for the "characteristic of success" endogenous variable we can know that each variable also contributes significantly. Variable "enjoyment" is 0.78; variable "confidence" is 0.75; the "mindset" variable is 0.61 and the last "achievement" variable is 0.98.

The findings for the first question related to the presence of influence between student's engagement behaviour on student success in learning, it appears that student's engagement behaviour has a significant impact on student success. If we consider, of the four exogenous latent variables as a whole have a considerable influence. However, the second variable has the most direct impact on the student's success component so that this second variable will be the focus of the discussion in this study. In this study, student involvement was measured using Student engagement scale (SE-S) which was adopted from NSSE, which student involvement is measured using four latent variables, namely 1) academic challenge; 2) Learning with peers; 3) Experience with faculty; 4) Campus environment. Each of these
variables is measured by indicator variables which are Academic Challenges which are regulated by four indicator variables. Learning with peers is controlled by two indicator variables, Experiences with faculty is measured by two indicator variables, and Two indicator variables measure campus environment.

In the first exogenous latent variable, the indicator variable that has the most influence is learning strategies, in which three sub-indicators measure this variable, namely identified vital information, review of after class notes and summarise course material. Furthermore, the second latent variable that is Learning with the most influential indicator variable is the discussion with various others, where the indicator variable is measured by four sub-indicators, namely discussion with other ethnic people, economic another background, religious beliefs different, political views different. This shows that students with their own will discuss with other groups that are very heterogeneous. Furthermore, the third latent variable is Experience with faculty with two variable indicators, with the variable having the most effect is active teaching practice. The last latent variable is a campus environment which is measured by two indicator variables, namely the quality of interaction and a supportive environment. The variable that has the most significant influence is the quality of communication

Furthermore, we can observe in the endogenous latent variable that all four variables have a substantial contribution to the success of students, ranging from those with the most meaningful gift of achievement of 0.98, then enjoyment to 0.78, then the confidence of 0.75, and the last variable is the mindset that contributes 0.61. It is evident that the characteristics of student success that are the easiest to see are from the achievements he achieved, although here enjoyment and confidence also contribute quite large.

Furthermore, the discussion relates to the effect of each exogenous latent variable on endogenous latent variables. First, the Academic challenge is having a direct impact on achievement. While Learning with peers has a direct influence on three variables, namely Enjoyment, Achievement and Confidence. While the experience with faculty and campus environment variables only affect variable Enjoyment. We can observe that out of the four latent variables of student engagement there is no direct effect on the student's mindset.

At present, especially in the course of the algebraic structure, students' behaviour in involving themselves in teaching and learning activities plays a crucial role in achieving their learning success. Their involvement determines student success during the learning process. This engagement includes engagement before learning takes place, during learning and after learning takes place [5]. Some people view the success of students as measured by the final value they get [32,33], but the characteristics of success are not only measured at the final value but also on other components, one of which is student confidence. Student involvement has a very significant influence on student learning outcomes [Carini, Kuh, & Klein, 2006; Kuh et al., 2007; Glanville & Wildhagen, 2007], Pascarella and Terenzini's (2005). This correlates with one measure of student learning success, which is self-confidence, as defined by the National Science Foundation of America. The success of students in learning, in addition to obtaining good academic grades, is about self-esteem. The formation of this confidence is indeed not an easy thing; in the learning process this character will be formed. With reasonable belief, student success can be achieved [34,35].

Research question 2: Is there a significant difference between male student involvement and female students which then affects their learning success?

To answer this second research question, the SPSS program was used to obtain descriptive statistics and test the independent sample t-test between male and female students, which is presented in Table 2.

| Table 2. Descriptive statistics summary of student’s engagement of male and female students |
|-------------------------------------------------|--------|--------|--------|--------|--------|
|                                                | N     | Minimum | Maximum | Mean   | Std. Deviation |
| Female students                                 | 185   | 218,00  | 297,00  | 272,2510 | 0,72323   |
| Male Students                                   | 115   | 212,00  | 275,00  | 256,4010 | 0,52323   |
Based on table 2, the student's engagement means score between female and male students was different. The finding described the student's involvement indicates the score of the female students were higher than those of male students. It also said that female students were more engaged in Abstract algebra course than male students.

| Levene’s Test for Equality of Variances | t-test for Equality of Means | 95% Confidence Interval of the Difference |
|----------------------------------------|----------------------------|------------------------------------------|
| F                                      | Sig.                      | t   | df | Sig. (2ailed) | Mean Difference | Std. Error Difference | Lower | Upper |
| Student engagement                     | Equal variances assumed    | 13.991 | .015 | .521 | 273 | .003 | .08138 | .00629 | .18857 | .22580 |
| Equal variances not assumed            |                            | .521 | 273,825 | .002 | .08138 | .00611 | .18822 | .22546 |

Based on Table 3, the results show that there are significant differences between female student involvement and male student involvement. From table 3, the considerable value is 0.015 (α = 0.05), so that there is a significant difference between female student involvement and male student involvement. According to the data, female students' have higher engagement scale than male students’ [36,37]. Fitriani [38] found that out of the ten indicators he used in his research, it was found that male students had lower involvement compared to female students.

5. Conclusion and Recommendation
This study presents a significant effect on student involvement behaviour on student success. Besides, it was also found that there were differences in the level of involvement of female students and male students. Overall, the results of the study show that student's engagement behaviour is positively correlated with student success. The results of this study also illustrate the contribution of measurement variables from student's engagement to student success characteristics, in which the results showed that none of the four measurement variables had a direct effect on the mindset. This is very interesting for further research. Of course, by using more research subjects, involving students representing universities in Indonesia.

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