Exploring of mathematics classroom goal structures in senior high school: An engaging in academic work for student

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Abstract. This study aimed to investigate classroom goal structures based on the teacher's learning objectives for students in the mathematics classroom. The study used survey methods with involved 319 students at senior high school level. Data analysis based upon Rasch model as the framework of modern psychometrics approach. The internal consistency and psychometrics properties for quality of instruments, was appropriate. The results of this study showed that students tend to refuse to labelling as embarrassment behaviour if any student who cannot answer or do math problems in the classroom. The students argue although answering math problems properly is a pride or achievement; but, create a judge “poor students” in mathematics should not occur in the classroom because typically all students are still in the learning stage. Another interesting side of this research findings is that male and female students have differences in looking at the learning climate of mathematics in relation to engaging in academic work. In the context of teacher-student interaction in the classroom, it is vital to consider that a constructive classroom situation and solid learning experienced can avoid to declining students’ academic motivation and achievement.

1. Introduction
It requires to be underlined that the science of education ontology is an educational situation, that is the synergy between learners and educators who are committed with the purpose of education with learning materials, which are dynamic by the learning process. Epistemology represents the learning joints and backbones of the learning process leads to learning outcomes. Epistemology that indicates the rules of educational science oriented to the authenticity of learners and educators as God's creatures that uphold the human dignity. Furthermore, it also means the rules of learning and learning as well as judgments that glorify human authenticity [1].

Students succeed or failed on the task depends on the quality of interaction between the teachers and students. Although many variables affect the quality of learning, especially the learning situation in the classroom is particularly significant in fostering students' interest and enthusiasm in learning [2]. On the other hand, teachers are concerned to the design and implementation of the objectives of the spreading well. Learning objectives and content are a combination of objectives and subject matter as listed in the curriculum with depth and comprehensiveness [1]. The issue in related to the student, the subject being the initial and principal target of the teacher, the measurement is usually applied to the
basic components possessed by the individual, especially pointed out as a result of student learning. In fact, learning outcomes are constructs that must be understood multidimensional. In other words, it is necessary to unearth the precise factors that determine student learning outcomes.

Classroom Goal Structure (CGS) in recent decades is a fundamental study of the students learning process [3]. Classroom goal structure can be illustrated as the ways in which students will interact with each other and the teacher to achieve the goal [4, 5]. CGS is strictly linked to the viewpoint, motivation and learning outcomes of students in schools [6] for all subjects. For math learning, measuring CGS becomes very important considering that mathematics learning is known as one of the subjects that demand high concentration and a constructive learning climate. Not all students have the same enthusiasm in learning math at school. For that, teachers require to observe the perceptions that students have in learning math. Students' perceptions of subjects greatly influence the activity and learning climate in the classroom outside the classroom.

This study aimed to measure how students' perceptions of goal orientation in the relation between learning environment and students' motivation, affect, and behavior engaging in academic work for student on mathematics classroom.

2. Method

2.1. Instrumentations
Research data collected by Patterns of Adaptive Learning Scales (PALS) and have been developed and refined over time by a group of researchers using goal orientation theory to examine the relation between learning environment and students' motivation, affect, and behaviour [6]. Previous studies PALS have appropriate psychometrics properties with GFI = 0.96, AGFI = 0.94 [6] and subsequently adapted into Bahasa and modified in accordance with the purposes of this study. PALS contains 14 items to measure perceptions of the goal structures in the mathematics classroom (MCGS). PALS-MCGS use five-point Likert-type scales. Items on the student scales are anchored at 1 = Strong Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, 5 = Strong Agree for favourable items, and vice versa for unfavourable items.

2.2. Procedures
This research was organized since December 2017 - February 2018. Administration of PALS-MCGS is completed by Survey Monkey Platform® [7]. Data participants are logged into Survey Monkey Server. In the data collection period we found 387 people who pick up the survey, but purely 319 people who did the survey completely; and 68 people have partial responses. All student movements in this research is a credential. Students are informed that the survey is not a test and that there are no correct or incorrect answers. No credit received by students from the schools where the student performs for his/her presence in this research.

2.3. Participants
The study involved 319 students (Mean Age = 14.6 years old) in senior high school. Demographically, sample of participants were taken randomly in Jakarta, Singaraja-Bali, Sibolga-North Sumatra, Raha-Southeast Sulawesi, and Kerinci-Jambi.

2.4. Data analysis
PALS-MCGS data collected was analysed using the Rasch Model approach performed by WINSTEPS 3.73 [8]. This research dataset can be accessed via osf.io/2dyae Open Science Frameworks [9].
3. Results and discussions

3.1. Study 1: Initial measuring properties of PALS mathematics classroom goal structures

The initial study aims to assessed the measurement properties of PALS Mathematics Classroom Goal Structures (PALS-MCGS) focused at gaining useful measurement report. In the PALS-MCGS properties measurement, we measure the value of the item and person that conforms into the model. The quality of PALS-MCGS items is excellent (.99). Unfortunately, the quality of the item is not adhered to the quality of person when PALS-MCGS is performed; where the value of person reliability (.82) is one level below, that is in the good category. The psychometrics capability of PALS-MCGS is also supported through the separation index person (2.12), and item (13.40). Nevertheless, the interaction between students and items when PALS-MCGS is conducted is excellent (α = .82).

Furthermore, referring to the mean person (.39) indicates that in general the type of all students to answer agrees on the statement on various PALS-MCGS items. However, there are two students (159P and 283L) that have maximum extreme measures scores, i.e. they correspond to infinite or indefinite measures on the latent variable, and so are not directly estimated. Thus, both students were dropped from the measurement model. In addition to taking into account the maximum extreme measures score, students' drop-offs from the measurement model were also performed on misfit-induced students, i.e. students who provided a disproportionate response pattern to PALS-MCGS. Misfit student norm relates to OUTFIT MNSQ value in the range 0.5 - 1.5 [10].

Table 1. Student Misfit on PALS-MCGS (N = 113 from 319).

| Student Codes | OUTFIT MNSQ | Student Codes | OUTFIT MNSQ | Student Codes | OUTFIT MNSQ | Student Codes | OUTFIT MNSQ | Student Codes | OUTFIT MNSQ |
|---------------|------------|---------------|------------|---------------|------------|---------------|------------|---------------|------------|
| 123L          | 6.02       | 220L          | 2.54       | 032L          | 2.07       | 266P          | 1.83       | 215P          | 1.69       |
| 227P          | 3.69       | 112P          | 2.51       | 122P          | 2.12       | 073L          | 1.85       | 267L          | 1.78       |
| 114L          | 3.27       | 165P          | 2.02       | 206L          | 2.12       | 284L          | 1.68       | 172P          | 1.78       |
| 229L          | 3.24       | 004L          | 2.45       | 006P          | 2.11       | 176P          | 1.88       | 198P          | 1.76       |
| 264P          | 2.76       | 201L          | 2.45       | 038L          | 2.05       | 138L          | 1.64       | 246P          | 1.73       |
| 273L          | 3.03       | 025P          | 2.41       | 288L          | 2.01       | 054P          | 1.84       | 033L          | 1.57       |
| 186P          | 2.97       | 145L          | 2.40       | 035L          | 1.91       | 232L          | 1.83       | 141P          | 1.60       |
| 002L          | 2.90       | 154P          | 2.14       | 105P          | 1.89       | 160L          | 1.61       | 147P          | 1.70       |
| 034P          | 2.63       | 120P          | 1.99       | 234L          | 1.61       | 053L          | 1.79       | 252L          | 1.67       |
| 161L          | 2.75       | 106P          | 1.52       | 081L          | 1.88       | 111P          | 1.69       | 277L          | 1.58       |
| 244P          | 1.58       | 203L          | 1.51       | 052P          | 1.56       | 086P          | 1.56       | 109P          | 1.55       |
| 177P          | 1.51       | 244P          | 1.58       | 106P          | 1.57       | 110P          | 1.50       | 315L          | 1.16       |
| 041P          | .23        | 126P          | .23        | 272P          | .23        | 155P          | .23        | 169P          | .22        |
| 083P          | .25        | 076P          | .26        | 125P          | .24        | 204P          | .24        | 095P          | .27        |
| 197L          | .27        | 230P          | .28        | 214L          | .30        | 300P          | .30        | 108P          | .31        |
| 048P          | .31        | 139P          | .31        | 259P          | .32        | 192P          | .33        | 090P          | .30        |
| 301P          | .31        | 260P          | .34        | 049L          | .33        | 008P          | .34        | 309L          | .35        |
| 084P          | .36        | 042P          | .37        | 250L          | .37        | 058P          | .40        | 248L          | .40        |
| 212L          | .42        | 011L          | .42        | 160P          | .43        | 132P          | .42        | 295P          | .40        |
| 022L          | .44        | 302P          | .44        | 190P          | .41        | 089L          | .44        | 219L          | .40        |
| 064P          | .44        | 135L          | .45        | 080P          | .42        | 261P          | .47        | 316P          | .47        |
| 285P          | .43        | 005P          | .47        | 180P          | .44        | 254P          | .49        | 307L          | .48        |
| 136P          | .49        | 091P          | .45        | 119P          | .49        |               |            |               |            |

Note: L=Male, and P= Female. OUTFIT MNSQ in Logs.

Based on table 1, there are 113 students indicated misfit, i.e. students having 0.5 logit ≥ OUTFIT MNSQ ≥ 1.5 logit. Misfit students are a group of students who are not serious in answering when PALS-MCGS is applied.
Figure 1. Expected and empirical of item characteristic curves (ICC).

Figure 2. Expected ICC and observed average on person responses.
Further psychometric evaluation is performed on potential misfits on items in PALS-MCGS. Figure 2 displayed the empirical value of Item Characteristic Curves (ICC) still at the measurement threshold (not out of 95% and Lower 95% CI). This means if the full item on the PALS-MCGS is not misfit. Deeply, in figure 3 there is a monotonic rise in the Expected ICC value, pointing out that items in PALS-MCGS work effectively to sketch the difficulty level of items from the most difficult to recognize to most easily passed. The implication of the discoveries in Study 1, 113 students who misfit, and connected with 2 students who have a maximum measure is inappropriate sufficient to provide measurement productivity. Therefore, simply 204 students reacted to satisfy objective measurements and could be converted into Study 2 and Study 3. On the other hand, there were no misfit-induced items, so items in PALS-MCGS all reached the measurement threshold in the model needed.

3.2. Study 2: Mathematics classroom goal structures in senior high school

Our second study concentrated on figuring out how students perceive the goal structures in the mathematics classroom. Data in this study involved 204 students in Study 1 that we conducted. In the Rasch perspective, all PALS-MCGS items have been calibrated so as to produce: (1) proper attributes measured, (2) consistent/invariant, (3) linear, (4) precise measurement estimates, and (5) independent measurement of the research parameters.

Table 2. Student perceived on mathematics classroom goal structures (N=204).

| Item | Statement                                                                 | Measure | Pt. M. Corr. |
|------|---------------------------------------------------------------------------|---------|--------------|
| 12   | In our class, not being capable to explain or do math questions is a ridicule | 1.99    | .55          |
| 11   | In our class, students may be inaccurate in dealing with mathematical questions in presence of the class. | 1.84    | .49          |
| 09   | In our classroom, the score of mathematics decides whether or not a student is successful in learning in school | .79     | .63          |
| 14   | In our class, every student is eager to pick up math lessons               | .43     | .51          |
| 13   | In our class, all students try not to looked "foolish" in mathematics     | .29     | .41          |
| 03   | In our classroom, well understanding the subject matter of mathematics is the primary objective | .01     | .57          |
| 05   | In our class, we developed other concepts of mathematics topics.           | -.10    | .51          |
| 07   | In our classrooms, having great math scores is the main objective of all students | -.23    | .55          |
| 02   | In our classroom, the better math learning is the stronger for the students. | -.24    | .55          |
| 10   | In our classroom, it is essential to realize a satisfactory math homework score | -.35    | .62          |
| 01   | In our class, studying hard for mathematics is extremely important        | -.42    | .56          |
| 04   | In our class, understanding the mathematical formulas is crucial to recognize, not just rote memory. | -.88    | .50          |
| 06   | In our class, misunderstanding math questions is pleasant, as long as it's studying. | -1.48   | .28          |
| 08   | In our classroom, if student can be solving the math questions accurately is an honour/achievement itself | -1.64   | .45          |

Note: All measure in Logits. Pt. M. Corr. = Point Measure Correlations

The distribution of table 2 is the entire item in the PALS-MCGS sorted from the most difficult items to agree (highest logit) to the most easily approved item (lowest logit value). Based on table 2 it is also noted that item No. 12 "in our class, not being capable to explain or do math questions is a ridicule" is the most difficult item for all students to conform on. Instead, item No. 08 "in our classroom, if student can be solving the math questions accurately is an honour/achievement itself" is the most
easily approved item. This means if psychologically students feel ashamed if not prepared to deal with math problems addressed by teachers. On the other hand, there is a feel of pride felt by students if prepared to defend and/or work on math questions.

Another interesting part is that if we seek at the situation in the classroom, suddenly we can look at the fact that students should not be mistaken in answering mathematical questions in front of the class (No. 11). This means that the overall classroom in full control of teachers and students is still subject to the principle of "must be correct and should not be mistaken". Meanwhile, students have the point of view that "incorrect in solving math problems" should be looked at not a major issue by the teacher because in the classroom students are yet in the learning stage. From the point of view of learning in the classroom, it is very important for the teacher to provide student's enthusiasm for learning. The existence of psychological pressure in the students leads to the loss of self-concept and reduced self-esteem of students thus influencing the motivation and achievement of students, especially in learning mathematics.

3.3. Study 3: Engaging in academic work on mathematics classroom based on gender effect

The last stage on this research, we evaluated how to addressed the situation of learning mathematics based on gender. It is essential to identify the typology of students in learning and its relationship to how male and female students recognize the situation, behaviour and environment of mathematics learning in the classroom.

Figure 3 describes that when compared to female students, male students are groups who felt that if they cannot answer or do math problems is something that is embarrassing (Item no 12) and assume that if students mis-answer mathematical questions it is not certain to questioned because students are in the learning phase (item no 6). On the contrary, when compared with male students, female students perceive if students should not be mistaken in dealing with mathematics questions in front of the class (Item no 11), and female students have a sense of pride when answering math problems accurately.

![Figure 3. Gender effect based on measuring of Different Item Functioning (DIF).](image-url)
4. Conclusion
Passing on to our three studies that have been organized, we confirmed that (1) the measurement property of the PALS-MCGS instrument is adequate, (2) the students felt embarrassed if they are incapable to deal with the mathematical challenges given by the teacher, and (3) there are different perceptions of the situation, behaviour and environment of mathematics learning in the classroom between male and female students.

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