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THE EFFECTS OF USING ASSESSMENT RUBRICS ON THE ASSESSMENT AND GRADING OF PUPIL'S CONCEPTUAL UNDERSTANDING OF ALGEBRA

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ABSTRACT

In an effort to improve performance in mathematics, this quasi-experimental non-equivalent control group pre-test post-test study was designed to establish the effects of using assessment rubrics on the assessment and grading of pupil's conceptual understanding of algebra. This was done using Algebra Achievement Test (α=0.9) and Attitude Questionnaire Math (α=0.832) as data collection instruments. In the study, two groups of pupils (control, n=30 and experimental, n=34) doing 10th grade ordinary level mathematics were randomly selected at Muyombe Boarding Secondary School. Both groups received Problem Based classroom instructions on the topic. Then the experimental group was assessed using assessment rubrics. Data collected were analyzed using statistical tests through SPSS version 16. The independent t-test results showed that the experimental group exhibited a statistical significance with higher Mean Achievement Score (μ =62.76 SD=21.844) than the control group (μ =49.72 SD=14.027), $t_{(62, 0.05)}$ =3.590, p<0.05). The Manny Whitney U test also showed that the experimental group (μ=92.92, SD=3.11) had a statistical significance with a higher positive attitude toward mathematics than the control group (μ=84.35, SD=8.59), p<0.001. The results of the study showed that assessment rubrics could serve as a powerful tool for assessment and grading of pupils' work that led to improved performance in mathematics. The study recommended that teacher educators should consider including assessment rubrics in their respective methodologies and assessment courses for pre-service teachers, and suggestions were provided for further research studies.

Contribution/Originality: This study is one of the very few studies which have investigated the effects of using assessment rubrics on the assessment and grading of pupils' conceptual understanding of algebra, and also how to design and use rubrics in a mathematics classroom.

1. INTRODUCTION

One of the purposes of teaching Mathematics is to equip the learner with knowledge and skills to live effectively in the modern age of Science and Technology and to enable the learner to contribute to the social and economic development of the nation (Adedeji, 2007; ECZ, 2015). This is why Mathematics is examined at Grade 7, 9 and 12 levels of education in Zambia (ECZ, 2014; ECZ, 2015).

Mathematics is also a requirement by higher institutions of learning that a pupil obtains a credit or better in Mathematics for them to be considered for training and the world of work. However, performance in Mathematics at all levels, over the years, has been poor (ECZ, 2015).

The ECZ performance reports also showed that the mean performance in Mathematics Examinations at Grade 12 was 28.3%, 24.39%, 17.4%, 26.5% in 2017, 2016, 2014 and 2013 respectively (ECZ, 2014; ECZ, 2015; ECZ, 2017; ECZ, 2018). One major challenge faced by some candidates was the lack of mastery of the content.

The ECZ (2014) Examination Performance Reports also indicated that, the poor performance in Mathematics at all levels could be partly attributed to the way teachers marked class work and provided feedback to the learners. Concentrating on the final answer only without critically analyzing the working does not help the teacher to provide appropriate feedback that would improve performance.

The analysis of the work in the sampled scripts in the 2014 ECZ report showed that, Algebra, Trigonometry, Earth Geometry and also Linear Programming in ordinary level Mathematics have been challenging to the pupils even in the previous years (ECZ, 2014; ECZ, 2015).

The fact that pupils have continued to face challenges in these topics calls for interventions in order to improve performance (ECZ, 2014; ECZ, 2015). One such intervention proposed by researches is to change the way teachers mark pupils' work and provide feedback through the use of assessment rubrics when assessing pupils work (Stevens, n.d). This is because rubric provides an objectivity that is not found in marking pupils work without a rubric since rubrics ensure that teachers have a basis for their final assessment (Soiferman, 2015).

A rubric also known as an assessment rubric, usually represented in the form of a matrix or a grid, is a tool to interpret and grade pupils work against criteria and set standards. Rubrics are also referred to as criteria sheet or grading scheme or scoring guide (UNSW, 2017). In other words, the rubric is a type of scoring guide that assesses and articulates specific components and expectations for an assignment.

Goodrich and Popham in Andrade (2005) have defined the rubric as an assessment tool that gives the criteria for a task and articulates gradations of quality for each criterion, from excellent to poor. It lists things that pupils, either as individuals or groups, must do or include in their responses in order to receive a certain grade. As such, it makes pupils be aware of what to do and strive toward excellent expectations (feed forward).

In order to serve the intended purposes, Soiferman (2015) in his research wrote that, a good rubric should leave no doubt in pupils' minds as to what they are being asked to do on the assignment and the scoring of the indices should provide enough breadth to make distinctions between those who fulfilled the criteria and those who only managed to get part of the criteria right. In keeping up with Soiferman, Illinois Rubrics For Mathematics provided an example of an assessment rubric which was used to assess and grade pupil's final work as shown in Table 1.

Stevens and Levi in the study by Stevens and Levi (2005) said that there is no single right way to design and use a rubic. Another method includes four key stages: Reflecting, Listing, Grouping and Labeling, and Application.

Stage 1: Reflecting involves thinking about the desired learning outcomes of the assignment and what your expectations are.

Stage 2: Listing focuses on details of the assignment and the learning objectives.

Stage 3: Grouping and labeling, you organize your reflections into groups of similar expectations that will likely become the dimensions of the rubric.

Stage 4: Application is where you apply the dimensions and descriptions from Stage 3 to the grid format of the rubric.

Based on the rubrics by Illinois Rubrics For Mathematics, a rubric is a great tool for teachers as well as pupils because it is a simple way to set up grading criteria for assignments. There are basically two forms of rubrics, and these are scoring and instructional rubrics. A scoring rubric is used solely for scoring pupil's work while an instructional rubric which is used to assess the level of mastery of the instructions taught.

1.1. Problem Statement

The ECZ performance report showed that the mean performance in Mathematics Examinations at Grade 12 was 28.3%, 24.39%, 17.4%, 26.5% in 2017, 2016, 2014 and 2013 respectively (ECZ, 2014; ECZ, 2015; ECZ, 2017;

ECZ, 2018). This performance has been labelled poor. The reports further indicated that, the poor performance in Mathematics at all levels could be partly attributed to the way teachers mark class work and provide feedback to the learners. Concentrating on the final answer only without critically analyzing the working does not help the teacher to provide appropriate feedback that would improve performance (feedforward).

A research by Kenneth and Ellen (2007) highlighted a similar scenario in which an undergraduate student in an American History course who had spent many hours working on her task received a "B" with no other comments. She expressed concern that she had met the task guidelines and asked the professor what she could have done to get an "A." The professor responded, that he reserved 'A' for a highly creative product of work." What was the problem there…?

Well, from the scenario, there were no explicit performance criteria to inform students in completing their tasks nor to guide the professor in assessing them. So the grading was subjective.

Table-1. Example of a Rubric used to assess and grade pupils.

CRITERIOR	Levels of descriptions			
	Excellent = 5	**Proficient = 3**	**Unsatisfactory = 1**	**Score**
↓ Construction, use and interpretation of tables, Coordinate graphs, and symbolic models to solve problems involving linear or quadratic scenarios.	Correctly interprets graphs and tables and uses information to find a solution, including the use of extrapolation. Accurately constructs and uses tables and graphs in a manner that supports a complete solution. Tables and graphs are accurately and precisely labeled.	In most cases correctly interprets and uses information from tables and graphs to answer a question if extrapolation is not required. Usually can accurately construct linear equations from tables, graphs, and verbal descriptions. In most cases can successfully use given info to construct tables and graphs to answer a question but difficulty setting an Appropriate window may impede finding a solution.	Graphs or tables are frequently misinterpreted. Attempts to construct tables and graphs, but work is incomplete, unorganized, inappropriately scaled, or incorrect. No clear labeling. Consistently has difficulty constructing equations from information given in any form.	

Source: Illinois Rubrics For Mathematics.

How do you think this student felt? Probably the same way those pupils taking mathematics feel when the criteria for a task are not clearly defined and the assessment and grading seems arbitrary.

A good rubric, therefore, can help take the mystery out of all assignments for all pupils and improve the performance in mathematics. (Eisner, 1991) explains that, more than what teachers say, more than what they write in teachers guides, assessment and grading practices tell both pupils and teachers what is more important. How these practices are employed, what they address and what they neglect, and the form in which they occur speak forcefully to pupils about what teachers believe is important. The effective and efficient use of assessment rubrics in mathematics may, therefore, help take away all the mystery by defining what is expected of the pupils before an assignment is given. Therefore, this study sought to establish the effects of using assessment rubrics in assessing and grading of pupils' conceptual understanding of mathematical concepts, and particularly algebra was chosen for this study.

1.2. Significance

This study was designed to help mathematics teachers and teacher educators define a rubric, and how they can construct their own rubrics. The study was significant as it could also serve as a resource to all the mathematics teachers and researchers for improving performance in mathematics at all levels.

1.3. Research Questions

The following research questions guided the study;

1. What is the difference between the Mean Achievement Score (MAS) of the pupils assessed using assessment rubrics and those assessed using conventional forms of assessment (without assessment rubrics)?
2. What is the difference between the performance gains of the pupils' assessed using assessment rubrics and those assessed using conventional forms of assessment?
3. What is the difference in the attitude toward mathematics between the pupils assessed using assessment rubrics and those assessed using conventional forms of assessment?

2. RESEARCH METHODOLOGY

2.1. Description of Study Area

The study was conducted from Muyombe Boarding Secondary School in Mafinga District of Muchinga Province which was conveniently selected because the researcher found that pupil performance in mathematics was below average. Results of National Achievement Tests for several years showed that pupils were poor in mathematics refer to Table 2. It is located 41 km away from Central Business Area.

Table-2. Final Grade 12 Results in Mathematics for Muyombe Boarding Secondary School.

YEAR	2010	2011	2012	2013	2014	2015	2016
RESULTS (%)	21.2	59.2	42.6	46.7	*	36.6	77.4

*results could not be found.
Source: Head of Mathematics Department (2017).

2.2. Research Design

This research employed a pre-test, post-test quasi-experimental control group design. This was because two intact classes were randomly selected in order not to disrupt school activities and organizations.

2.3. Study Population

The target population for the study comprised of three classes of Senior Secondary grade 10 pupils who were taking ordinary level Mathematics at Muyombe Boarding Secondary. The population size was 110 pupils.

2.4. Study Participants

In the study, 64 pupils in total were randomly sampled to be included. A simple random sampling of hart-shuffle-draw method with replacements was used to select the two classes, while the simple sampling of tossing the coin was used to randomly assign the classes into the experimental group and the control group respectively. Consequently, the class with 34 pupils became the experimental group and the class with 30 pupils became the control group.

2.5. Data Collection Instruments, Techniques and Methods

The data collection instrument for this study was the researcher made Algebra Achievement Test (AAT) used together with an assessment rubric. The test was used to assess the pupils' conceptual understanding of algebra and an Assessment Rubric (AR) was used to assess and grade pupil performance in the experimental group. The test consisted of twenty test items which were measuring topic specific outcomes drawn from the ordinary level Zambian Mathematics Syllabus Grade 10.

An Attitude Questionnaire Maths (AQM) adopted from the research done by the Faculty of Education at the University of Cambridge (2010) was used to measure pupils' attitudes toward mathematics. This consisted of 25 5-point Likert scale items ranging from strongly agree to strongly disagree.

2.6. Interventions

Prior to the study, the teacher explained to the pupils in the experimental group that the new method of assessment using assessment rubric would be used for research purposes. However, all tasks and tests of the unit (Algebra) would be assessed using assessment rubrics.

Rubrics were new methods of grading and assessing to the pupils since they had never used rubrics in any classroom. Therefore, the teacher provided the pupils in the experimental group with proper training before the use of the rubric. The training included defining rubrics, explaining their main objectives and the detailed mechanism for using them. The teacher also reviewed and discussed with the pupils some already made assessment rubrics for mathematics problem solving to serve as examples of assessment rubrics from the following sources;

a) Exemplars – Standard Rubrics For Math
b) Arizona Mathematics Rubrics
c) Illinois Rubrics For Mathematics
d) Teacher planet – Rubrics are organized by subject and level.

After an extensive review of the sampled rubrics, a general rule of thumb was that a rubric is one that articulates the expectations from the task by listing the criteria, or what should be done in the task and describing the levels of quality (Saddler and Andrade, 2004).

Pupils in the experimental group were also provided with the guidelines on constructing their own rubrics as proposed by Andrea (2012) and Stevens (n.d).

2.7. Procedure

At the onset of the study, the experimental group as well as the control group were assessed using an Algebra Achievement Test, called a pre-test. The pre-test is a preliminary test administered to determine pupils' base line knowledge at the start of the study (College Dictionary, online). At that stage, both groups were assessed and graded without using an assessment rubric.

An Attitude Questionnaire Maths (AQM) was also administered to both groups of pupils to measure their initial attitude toward mathematics at the start of the study.

2.8. Instructional Approach

During the study, the researcher who was the sole teacher to both groups taught algebra to both groups using same instructional materials, using the same syllabus content, and the pupils from both groups received the same number of tasks and tests. The learners submitted required work that the teacher personally graded, taught in the same manner (that is, Problem Based learning methods). Each class also met three days in the week across a seven-week period.

In the two classrooms, pupils were randomly assigned into groups of maximum five per group and were being required to discuss questions given to them as lessons unfolded. The Pupils were also required to nominate their respective group representative to present their findings to the rest of the class members. The teacher's role there was that of a facilitator. In the experimental group, seven groups were formed while six groups were formed in the control group.

2.9. Prior to Assessment

Prior to each assessment, the researcher and the pupils in the experimental group co-created task specific assessment rubric for each task before being given, and a quality rubric checklist was used to validate the final rubric. Each pupil was then given a copy of the consolidated rubric earlier before completing the task, while in the control group, an assessment rubric was not used.

Upon completion of the task, the pupils in the experimental group submitted their answer scripts together with the copy of a rubric for marking and grading, while those in the control group submitted their answer scripts only and were graded without an assessment rubric. After marking, both the answer scripts and the graded rubric were returned to the pupils in the experimental group but the control group received only their answer scripts.

2.10. Posttests

At the end of the topic, pupils in the experimental group as well as the control group were assessed using an Algebra Achievement Test, called a post-test, to determine the Mean Achievement Score (MAS) of pupils in each group at that level.

At that level, an assessment rubric which was co-created with inputs from the pupils was used to grade and assess achievement of the pupils in the experimental group. The rubric was constructed based on the following outcomes as possible criteria derived from the ordinary level mathematics Zambian syllabus.

2.11. Algebra Assessment Outcomes

Pupils Should**;**

1. Simplify algebraic expressions
2. Expand algebraic expressions by using distributive law
3. Factorize fully algebraic expressions
4. Evaluate algebraic expressions
5. Simplify algebraic fractions
6. Express algebraic fractions as single fractions in lowest term

The rubric was assumed to provide pupils in the experimental group with the informative feedback on the strengths and the weaknesses by critically analyzing every criterion included in the rubric.

3. DATA ANALYSIS, CALCULATION TECHNIQUES AND METHODS

3.1. Performance Achievement

Data collected in this study was appropriately coded and entered on the Statistical Package for the Social Sciences (SPSS version 16), and statistical tests were performed to compare the Mean Achievement Scores (MAS) of the two groups in the Algebra Achievement Test as well as the Attitude Questionnaire Math. The descriptive statistics of mean and standard deviation of the pre-test score (MAS_1) and the post-test score (MAS_2) were used to investigate the general characteristics of the data.

In order to test for the statistical significance difference between the Mean Achievement Score of the experimental group and the control group in the pre-test and the post-test, an independent sample t-test was conducted at 0.05 to answer research question 1.

Furthermore, a paired sample t-test was performed in order to test for the statistical significance improvement within the groups between the pre-test and the post-test (O_2-O_1, O_4–O_3) while an independent samples t-test was conducted to test for the statistical significance difference in the performance gains within the groups between the pre-test and the post-test and used to answer research question 2.

3.2. Effect Size

Effect size statistics provide an indication of the magnitude of the difference between the control group and the experimental group and not whether the difference has occurred by chance (Pallant, 2005). In this study Eta Squared (η^2) was used to estimate the effect size. Eta squared (η^2) represents the proportion of variance in the dependent variable that is explained by the independent variable, and it ranges from 0 to 1 (Pallant, 2005). It is calculated as follows;

$$\acute{\eta}^2 = \frac{t^2}{t^2 + df},$$

where $df =$ degrees of freedom

The guide lines proposed by Cohen in Pallant (2005) for interpreting Eta squared values are: 0.01 = small effect, 0.06 = moderate effect, 0.14 = large effect.

3.3. Attitude Score

The attitude score for each participant was calculated following the guidelines from Pallant (2005) as;

$$\frac{aggregated\ score}{125} \times 100$$

That score was used to predict the attitude of the participant toward mathematics using the new codes,

01.00 to 20.00 = Strongly Disagree = High Negative Attitude Toward Mathematics

21.00 To 40.00 = Disagree = Negative Attitude Toward Mathematics

41.00 To 60.00 = Neutral

61.00 to 80.00 = Agree = Positive Attitude Toward Mathematics

81.00 to 100 = Strongly Agree = High Positive Attitude Toward Mathematics

The attitude scores were then entered on the SPSS for the running of the test. To test for the statistical significance difference in the attitude towards mathematics between the experimental group and the control with regard to the attitude score in the pre-test and the post-test, a non-parametric Mann-Whitney U test was performed, and the statistics were used to answer research question 3.

4. RESULTS AND DISCUSSIONS

Pupils in the experimental group (n = 34) were associated with the Post-Mean Achievement Score of $\mu = 62.76$ *(SD* = 21.844*)*. By comparison, the control group (n = 30) was associated with a numerically smaller Post-Mean Achievement Score of $\mu = 49.72$ *(SD* = 14.027).To test the hypothesis that there is no statistical significance difference between the Mean Achievement Score (MAS) of pupils assessed using assessment rubrics and those assessed using conventional forms of assessment, an independent samples *t*-test was conducted.

The independent sample's t-test was associated with a statistical significance effect, $t_{(0.05,62)}=3.590$, $p<0.05$. The magnitude of the differences in the Means was large (Eta squared, $\acute{\eta}^2 = 0.17$).

The significance higher achievement score in the Algebra Achievement Post-test among the pupils in the experimental group constituted an important factor and implied that assessment rubrics had a positive influence on the assessment and grading of pupils' conceptual understanding of algebra which in turn led to improved performance.

The explanation to these findings can be linked to Dale (1960) statement that "Learning theory supports the idea that we retain the most when we are actively involving all of our senses in a doing mode. By creating, sharing, and accomplishing the criteria set by a rubric, the pupils in the experimental group were in charge of their own learning and assessment" (Dale, 1960). Another explanation is that, the use of rubrics supports the constructivism theories of learning, where pupils are given an opportunity to construct their own knowledge through interactions (Brunner, 1960). The results of this research were also in tandem with those by Arrufat who in her research found that using the rubric made the pupils an active part in the learning process since they knew what was expected from them and worked hard to achieving the required level (Arrufat, 2014). The findings related also to those findings by Bissell and Lemons in which a rubric was used to assess critical thinking in the biology classroom of 150 students at Duke university (Bissell, 2009). Their findings were that rubrics enabled students to think in advance about what they wanted questions to accomplish in terms of both content and critical thinking and also enabled them to be explicit with students about the skills they needed to develop in order to succeed in the course. In that

study, students in the experimental group were reported to have been more aware of the quality of responses they expected for questions and could easily cross-reference their own responses with the rubric explicit guidelines and helped them reflect on and improve their thinking (and writing) abilities, a concept referred to as metacognition (Bissell, 2009).

On the other hand, the instructional approach of discussing the rubric and communicating its purpose and criteria in advance made the teacher's implicit expectations explicit (Brookhart, 2013). Personal interviews with the pupils in the experimental group regarding rubric use revealed that they (pupils) liked having the rubric in advance so that they knew "what was expected," and contrasted it with the "guessing game" they felt they had to play when the teacher did not provide a rubric, as was the case in the control group.

These findings are also supported by researches done by Andrade and Du, Stevens and Levi, Andrade as well as the findings by Kachergis who also found that increased use of rubrics in the classroom translates into improved academic performance on standardized tests (Andrade, 2000; Andrade, 2005; Stevens and Levi, 2005).

To test the hypothesis that there is no statistical significance difference between the performance gains of the pupils assessed using assessment rubrics and those assessed using conventional forms of assessments, an independent samples *t*-test was conducted. The experimental group (n = 34) was associated with mean performance gain of $\mu = 32.64$ $(SD = 7.079)$.By comparison, the control group (n = 30) was associated with a numerically smaller mean performance gain of $\mu = 11.60$ $(SD = 2.834)$. The independent samples t-test was associated with a statistically significance effect, $t_{(0.05,62)} = 3.843$, $p < 0.05$. The magnitude of the differences in the performance gain was large (Eta squared, $\eta^2 = 0.19$).

The higher performance gain scores in the Algebra Achievement post-test among the pupils in the experimental group of the study constituted an important factor and implied that assessment rubrics had a positive influence on the assessment and grading of pupil's conceptual understanding of algebra.

These results show that, the instructional benefits of using the rubric during assessment allowed the teacher to check the level of understanding for entire pupils every day, and motivated him to find the suitable way to help the individual pupils to understand what they are learning. The study by Arrufat supports these findings by mentioning that, using the rubric in assessment has the potential to enhance the pupils' learning, because rubric required a high quality answer from the pupils (Arrufat, 2014). During assessment, the explanation part of the rubric was very important as it helped the pupils in the experimental group to understand what they were doing and why, not only to solve the problem mechanically (Arrufat, 2014). Subsequently, the pupils in the experimental group had to study more in order to solve the problems according to the rubric which was not the case in the control group, and hence higher performance gains. A good body of literature supports these findings (Cooper and Gargan, 2009; Arrufat, 2014).

Nevertheless, to find out if there was an improvement in the achievement within the group between the Algebra Achievement pre-test and the Algebra Achievement post-test, paired sample t-tests were conducted for each group. For the control group the mean performance gain was $\mu = 11.60$ $(SD = 2.836)$, the test showed a statistical significance improvement in the performance between the pre-test and the post-test ($t_{(0.05,\ 29)} = 22.405$, $p < 0.001$). The magnitude of the differences in the means was large (Eta squared, $\eta^2 = 0.95$).

Likewise, the test also showed that there was a statistical significance improvement in the performance by the experimental group on post-test compared to the pre-test with mean performance gain of $\mu = 32.647$ $SD = 7.079$ ($t_{(0.05,\ 33)} = 26.891$, $p < 0.001$.The magnitude of the differences in the means was large (Eta squared, $\eta^2 = 0.96$).

The significance improvement in both group can be attributed to the instructional method used in both groups. Both groups were taught using problem based learning approaches. These findings are in tandem with oother researchers who also found that the combination of PBL with STEM enabled learners to develop mathematical conceptual understanding . Most of the reviews mention that learning mathematics through PBL allowed students to work in groups (Abdullah, 2010) and increased their confident level and motivation . Another explanation is that,

PBL is able to facilitate higher order thinking skills among high school pupils. This showed that PBL is able to foster the acquisition of knowledge and its applications in real life.

Another explanation as to why all the pupils improved in their achievement is that problem based learning motivated them to explore the aspects of the problem that they did not understand. When attempting to answer the problem, the pupils used their previous experiences and prior knowledge when gathering facts, strategizing and planning their solutions.

The findings of this study where problem based learning pupils improved in the achievement post-test were also consistent with studies by Duch, Groh and Allen reporting that skills such as working as a team and demonstrating effective communication skills are learnt in order to solve a problem. Other studies also showed that PBL enable pupils work well in teams and small groups , gained other skills such as working in teams and being more involved in the learning process and that a PBL classroom provided students with high level of interaction for peer learning, peer teaching and group presentation.

4.1. Findings on Attitude

Pupils in the experimental group (n = 34) were associated with a post Attitude Questionnaire Math (AQM) score of $\mu = 92.92$ (SD = 3.11). By comparison, the control group (n = 30) was associated with a numerically smaller post Attitude Questionnaire Math score of $\mu = 84.35$(SD = 8.59).To test the hypothesis that there is no statistical significance difference between the AQM mean score of pupils assessed using assessment rubrics and those assessed using conventional forms of assessment (without assessment rubrics), a 2-independent samples Mann Whitney U Test was performed.

The Mann Whitney U Test showed that, pupils in the experimental group scored a statistically higher mean attitude score on average than the pupils in the control group and that the two group differed significantly in the attitude score toward mathematics in the post-AQM (Mann-Whitney $\boldsymbol{U} = 125.00$, $p < 0.05$), which could not have been due to chance. These findings entailed that the experimental group expressed a significantly higher positive attitude toward mathematics than the control group which was as a result of the exposure to the use of assessment rubrics.

These findings are supported by many researchers who found that a well-designed rubric makes self-assessment easier, especially when used as a "goal-setting guide," and shared with pupils before starting a task to help them understand the nature of the levels of achievement goals and performance expectations for each level (Andrade and Du, 2005); (Arter and McTighe, 2001). Other possible explanations are linked to the following reasons:

Assessment rubrics set learning goals, guidelines, and levels of standards for performance of specific assignment (Andrade, 2000; Arter and McTighe, 2001).

Pupils' motivation, namely self-efficacy, for accomplishing a task may be increased when using a rubric, resulting in higher pupil achievement. Self-efficacy is a belief system proposed by Bandura (1986;1997) and is defined as a person's judgment of their ability to plan and carryout the actions required to achieve specific types of performances (Bandura, 1986; Bandura, 1997).

When pupils know the criteria in advance of their performance, they are provided with clear goals for their work. In the same way, when pupils have access to performance criteria and scoring guides, they have the opportunity to self-assess and improve their work as it is developed (Wiggins, 1998).

5. CONCLUSION

In this study, the following conclusions were made.

The experimental group, scored a higher Mean Achievement Score (MAS) than the control group in the post-test because of using assessment rubric. The instructional benefits of using assessment rubrics in the assessment

and grading of pupils' conceptual understanding of algebra go beyond teacher efficiency for grading, to clarifying and communicating the learning objectives for the pupils in the experimental group and helped them to perform better than the control group.

The experimental group recorded a higher Mean Performance Gain than the control group. The study found that assessment rubrics communicate the goals to pupils and help them plan an approach to an assignment. Rubrics also support the development of critical thinking skills and understanding and help pupils develop personal habits of self- assessment such as checking their work, revising and reflecting on the feedback. This enabled them to perform better in the post-test and hence improved more than their counterpart in the control group who did not use a rubric.

The experimental group had a higher Positive Attitude toward learning algebra than the control group.

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