The Use of Descriptive Written Feedback for Enhancing Students' Mathematics Achievement

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ABSTRACT

Giving learners high-quality feedback as part of formative assessment is a high-yield method teachers can use to support learning and raise academic achievement. Despite its significance, the influence of Descriptive Written Feedback (DWF) on students' mathematics achievement has yet to be widely studied. This study, therefore, investigated the influence of the teachers' descriptive written feedback on mathematics achievement in selected secondary schools in Konoin Sub-County of Bomet County, Kenya. The study adopted a quasi-experimental design to establish a cause-and-effect relationship between the independent (Descriptive Written Feedback) and dependent variable (Mathematics Achievement). The Student Achievement Test (SAT) scores attained by the students right after covering the topic of the gradient and the equation of a straight line were used to measure the students' mathematics achievement. A simple random sampling method was employed to select the ten schools used in this study. ANOVA was used to analyse the data. The study findings showed that descriptive written feedback significantly influences mathematics achievement. The study suggested that mathematics teachers should provide students with descriptive written feedback for improved attainment of expected learning outcomes and enhanced student performance.

Keywords: Mathematics achievement, descriptive written feedback, teacher feedback, assessment, students' performance.

INTRODUCTION

Despite mathematics' broad relevance and significance, students' academic performance in the subject is typically low. As a result, policymakers, academics, educators, parents, and students have all expressed serious concerns about math achievement (Ayebale et al., 2020; Dorji et al., 2021; Gómez-García et al., 2020). Numerous reasons contribute to the decline in learning quality in mathematics teaching in schools. Fear and failure related to arithmetic, curricula, rudimentary methods of evaluation, inadequate support and preparation for teachers and improper teaching strategies are the main issues that need to be addressed

(Mabena et al., 2021). The effective teaching of mathematics depends heavily on effective instruction. Conventional methods of instruction are insufficient for imparting knowledge to pupils and inspiring them.

In order to inspire and motivate students, it is crucial that they are provided with high-quality feedback. Feedback techniques are applicable in a variety of contexts, particularly in educational settings (Chua et al., 2017; Fyfe & Brown, 2020). One of the most potent factors influencing learning, performance, and teaching is effective feedback (Chua et al., 2017; Lipsch-Wijnen & Dirkx, 2022; Selvaraj et al., 2021). Giving feedback is a recommended instructional approach, and is usually seen as a useful learning tool (Fyfe et al., 2015).

Globally, there has been a substantial shift in the field of educational assessment and feedback. The focus has shifted from using assessments to judge students' mastery of a particular skill or topic at the end of a learning process to recognising the importance of evaluation for learning. (Chua et al., 2017; Van den Heuvel-Panhuizen et al., 2021). Feedback is used widely in learning science and mathematics, just as it is in other courses. It can take many different forms, such as evaluating scores and descriptive comments (Chua et al., 2017).

The goal of a teacher's feedback to students is to correct any mistakes they made while completing the assignment (Lipsch-Wijnen & Dirkx, 2022). In this instance, the instructor must have had an expected learning outcome for the students to strive to achieve. Feedback's function is to close the performance gap between predicted and actual performance. Research generally indicates that various types of feedback should be interpreted as independent indicators of students' achievement (Cavalcanti et al., 2020; Wisniewski et al., 2020). Corrective feedback is also a formative assessment approach that can be used to remediate misconceptions and errors made by students in mathematics. Formative assessment techniques, including questioning and feedback, can be used as remedial instruments to rectify misconceptions and mistakes made by students. Teachers can identify specific evidence of students' misconceptions and make necessary instructional adjustments by integrating corrective feedback into regular learning activities. Teachers should provide corrective feedback comments about specific areas of improvement by giving instructions on rectifying their mistakes (Enu & Ngcobo, 2020; Manson & Ayres, 2021; Rakoczy et al., 2019). This implies that, corrective feedback can increase learning by assisting students in recognising their mistakes and making improvements in subsequent tests. Overall, feedback is essential in assisting students in identifying gaps and evaluating their progress in learning.

Several factors moderate the influence of feedback on students' achievement. They include the type of feedback, the channel and direction of feedback (student -teacher vs teacher student) and timing of feedback (Hattie & Timperley, 2007; Kiwanuka et al., 2015; Manson & Ayres, 2021; Wisniewski et al., 2020). A study by Hattie and Timperley (2007) showed that the type of feedback is a decisive factor on student achievement. On average, rewards, punishment, and praise all had moderate or low to medium impacts, whereas corrective feedback was found to be quite successful at facilitating the acquisition of new skills. Further, an analysis was conducted comparing computer-assisted and video/audio feedback in relation to the feedback channel with the outcome showing medium high to high effects for both. It was also shown that written comments with specificity outperform grades in terms of effectiveness. Additionally, Hattie and Timperley (2007) looked at the valence (positive/negative) and timeliness (immediate/delayed) of feedback, however, they came up with contradictory findings (Wisniewski et al., 2020). In general, feedback needs to be understood as a multifaceted, differentiated construct with a wide range of forms and, occasionally, drastically differing consequences on students' learning and achievement. The most crucial thing to remember is that feedback works better when it is well detailed (Wisniewski et al., 2020).

Feedback is multifaceted, meaning it can be provided in various ways, such as verbally or in writing, by a facilitator, a peer, or a computer program, among other sources. Feedback can also be provided while, right after, or later on as delayed feedback on a task that has been attempted. Other methods exist to obtain feedback, such as individually or in a group. Feedback can also be used to clarify if something is accurate or offers further knowledge (Burns et al., 2021; Palm et al., 2017; Rakoczy et al., 2019; Wisniewski et al., 2020). Notably, descriptive written feedback for example enables the teacher to give details that inform improvement (Van den Heuvel-Panhuizen et al., 2021). A crucial component of every educational program's design is making it easier for participants to provide insightful, thorough, and helpful feedback (Newton et al., 2012).

Descriptive written feedback is useful in offering suggestions for learning development than a grade or score by itself. Descriptive feedback stimulates students' interest in the assignment itself, which may lead to a notable improvement in test scores and attitudes (Chua et al., 2017; Van den Heuvel-Panhuizen et al., 2021). In order to focus on more detailed and helpful descriptive feedback, teachers, students, and parents need to wean themselves of their reliance on grades and scores. Evidently, it seems that the potential for learning is undermined by stakeholders' and students' expectations for marks or grades (Chua et al., 2017). Studies in literature indicate that written feedback from the instructor to the students is a crucial component of formative assessment (Holmeier et al., 2018; Lee, 2008). Providing teacher feedback is one possible approach to counteract the downward global drifts in high school mathematics achievement. Corrective information (feedback) and recommendations for improvement (feedforward) make up effective feedback (Burns et al., 2021). Both the presence or absence of feedback and the nature of the feedback itself influence how much of an impact it has on students' academic performance. Thus, feedback plays a critical role in assisting students in identifying gaps and evaluating their learning.

METHODOLOGY

A quasi-experimental design was employed to achieve the study's goal. Comparing the effects of two groups (one receiving treatment and the other receiving none) is made easier by the quasi-experimental design of the non-equivalent group (Krishnan, 2023). In this instance, the experimental group received treatment from the mathematics teacher in the form of descriptive written feedback, while the control group received no input. Students who received written comments were split into two groups, one receiving goal-directed feedback and the other receiving general feedback. For the purpose of the study, goal directed feedback was an explanation written to the learner by the teacher detailing a step-by-step procedure of solving a task which a leaner did not get correct. General feedback (non- goal directed) was a short calculation showing how the learner would have solved a given task. The teacher split the group receiving goal directed feedback into two. One was given immediate feedback while the other was given delayed feedback after a week. The teacher also split the group receiving general feedback into two. The first group received immediate feedback while the second group received delayed feedback after a period of one week. This study's design worked well since the achievement of the groups that received descriptive written feedback was compared with those of the groups that did not. Because of the diversity in both the number and characteristics of the study participants, this research employed a non-equivalent design. The existing classroom environment was not altered in order to test out descriptive written feedback. Regular teachers taught the learners their usual lessons without the researcher's presence to avoid a situation whereby they responded to satisfy the researcher. Students in the study were assigned to either the control group or the experimental category. To ascertain each group's attitude toward mathematics, pre-tests were administered before placing them in treatment and control groups. They were also given a post-test to determine if their attitudes about mathematics had changed. The target population comprised of ten secondary schools, 360 form-two students, and 13 form-two mathematics teachers in the Konoin Sub-County of Bomet County, Kenya. The study's target population included math teachers and Form 2 students because they had yet to select the subjects for registration with KNEC in the KCSE, a nationwide examination. Despite the fact that mathematics is a compulsory subject, learners develop belief systems about mathematics after they make choices of their subjects of study. The belief systems such as "mathematics is a difficult subject", "mathematics is for boys" and "mathematics is for engineers" erode learners' interest in the subject and

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impacts negatively on their achievement. Since Form 1 is still new to Secondary School, they have yet to be exposed to such attitude and were deemed appropriate for the study. Meanwhile, Forms 3 and 4 have already made up their minds about what they will do. Forms 1, 3 and 4 were thus excluded from the study. The study used the Students' Achievement Test (SAT), which had ten questions from the topic gradient and equation of a straight line. After the material was covered, the test was utilized to assess the students' performance. The researcher ensured that the test items were similar in both instances to guarantee that the pre-test and post-test tests had the same difficulty. Nonetheless, it was necessary to give the students the impression that they were doing a different paper. This was accomplished by altering the value of the question items. The pre-test's likelihood of affecting the post-test's performance was significantly reduced because the SAT was administered one month later. Additionally, the researcher ensured that the students were unaware that similar questions would be asked again. In order to accomplish this, it was agreed with the teachers that the pre-test was not discussed in class. The test was scored out of thirty.

RESULTS AND DISCUSSIONS

The sampled students were divided into two groups to ascertain the influence of teachers' Descriptive Written Feedback (DWF) on mathematical achievement. Two groups were involved in the experiment: the experimental group was exposed to DWF on the first test occasion, while the control group did not get DWF exposure during that test. A shared test, marked out of 30, was taken by both groups. The two student groups took an identical second SAT after a month had passed. Next, comparisons were made between the student groups' results as shown in Table 1.

Table 1. Achievement in SAT 1 and 2 for the two groups

Groups	SAT 1	Percentage	SAT 2	Percentage	Deviation	Percentage
Experimental	10.7	32.83	17.97	51.7	5.66	18.87
Control	10.97	39.33	11.74	41.33	1.92	2%

The findings indicate that the experimental group attained a mean score of 10.7 in SAT 1 and 17.97 in SAT 2. A mean rise of 7.27 was observed, translating to 18.87%. The 18.87% performance gain is attributed to the DWF given in the first SAT. The DWF scaffolded the learners to obtain the necessary answers. In contrast, the control group, attained a mean score of 10.97 in SAT 1and 11.74 in SAT 2. A mean rise of 0.77 was observed, translating to 2%. Other factors, such as some students revising their papers on their own initiative, might have contributed to this slight increase in performance. Overall, students in the experimental group outperformed those in the control group. This suggests that students' mathematics achievement was positively impacted by the DWF.

In order to further test the statistical significance of the usage of DWF on learner achievement in mathematics, the results of all learners in the experimental group were compared with those of the control group. Analysis of variance, ANOVA was applied. Table 2 presents the findings from this investigation.

Table 2. ANOVA for the experimental groups

	Sum of Squares	DF	Mean Squares	F	Sig.
Between Groups	96.90769	1	96.90769		
				9.3586	5.32
Within Groups	82.83953	8	10.35494		

The overall effect of the treatment was quite large, as indicated by the results of F=9.3586, which are greater

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than the tabled value of 5.32 (v1=8; v2=1) at the 0.05 significant level. The null hypothesis, which stated that there was no statistically significant difference between the scores of students who received DWF and those who did not, was rejected. This implies that there is a noteworthy distinction in mathematical achievement between students who received DWF and those who did not.

In order to determine whether the pre-testing had any impact on the final outcomes, the researchers also examined the F ratio of the students' squares in the control group. The findings are presented in Table 3.

Table 3. ANOVA for the Control Groups

	Sum of Squares	DF	Mean Squares	F	Sig.
Between Groups	0.1769	1	0.1769		
				0.05346	5.32
Within Groups	26.4723	8	3.30904		

The results indicate an F value of 0.05346 which is less than the tabled value of 5.32 (v1=8 and v2=1) at level of significance. This suggests that there isn't a discernible difference in the groups chosen to be in the control or experimental groups in terms of performance. This indicates that if both groups had received the same treatment, their chances of performing well would have been equal. This supports the finding that DWF positively influences students' achievement in mathematics.

The finding that DWF had a positive influence on students' mathematics achievement is consistent with the findings by Chua et al., (2017), which established that teacher's comments triggered students' self-correction process, enhancing their conceptual understanding of the subject by enabling them to identify and correct their mistakes. The teacher's comments also aid in memory retention throughout the learning process (Chua et al., 2017).

The finding that the control group also showed a marginal improvement in performance in spite of not having received descriptive written feedback is supported by literature that attributes the improvement in performance to factors other than feedback (Gómez-García et al., 2020; Kiwanuka et al., 2015). For instance, Kiwanuka et al., (2015) argues that mathematics achievement differences can be attributed to three level factors: student, classroom, and school. Explanatory variables considered significant predictors of mathematics achievement at the three levels include gender-related characteristics, socioeconomic status, past mathematics performance, parental support, peer influence, students' perception of a good assessment in the classroom, and the class mean of math attitude. Similarly, Gómez-García et al., (2020) identified the teaching strategies, the attitudes of the teachers, and the students' attitudes toward mathematics as important variables.

CONCLUSIONS

This study concludes that, giving learners Descriptive Written Feedback (DWF) during mathematics assessments significantly improves their mathematics achievement. Descriptive Written Feedback is a crucial instructional practice in mathematics assessment, impacting learner performance and attitudes. It can potentially alter their attitudes towards mathematics from negative to positive.

RECOMMENDATIONS

The study recommends that teachers utilise descriptive written feedback in mathematics to enhance students' mathematics achievements. Teacher trainers, curriculum developers, and instructional designers should incorporate the benefits of descriptive written feedback based on learner characteristics and learning context.

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