Teacher Feedback Techniques: An Analyses of Students' Self-Efficacy in Mathematics

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Abstract

This study investigated how teacher feedback techniques affect mathematics students' self-efficacy in mathematics. The feedback approaches considered in the study were Knowledge of Result (KR), Knowledge of Correct Result (KCR), and Elaborate Response (ER). The study was conducted using a non-equivalent pretest post-test quasi-experimental research design. The study used three experimental groups and one control group. The sample for the study consisted of 197 JS2 students chosen from four intact classes using multi-stage sampling technique. An instrument called Mathematics Self-Efficacy Questionnaire (MSQ) was used for data collection. MSQ was validated and by three experts. The reliability of the instrument was computed using Cronbach Alpha coefficient with the reliability coefficient found to be 0.83. Four research questions and four hypotheses guided the study. ANCOVA, means and standard deviations were used as statistical tools. Results reveals that the mathematics self-efficacy mean ratings of students exposed to KR, KCR, and ER were all separately significantly higher than those in the control group with p-values found as $p = 0.00$, $p = 0.03$, and $p = 0.00$ respectively. Within the experimental groups, results indicated a significant difference among the means of the groups with $p = 0.00$. A Fishers' Least Significant Difference (LSD) post-hoc pairwise comparison analysis conducted shows that students exposed to KR significantly attained higher self-efficacy mean rating than those in KCR and ER. However, the mean self-efficacy rating of students in KCR and ER was not found to be significantly different with $p = 0.07$. The study concluded that teacher-feedback gives students the needed motivation to enhance their self-efficacy in mathematics. The study recommended that mathematics teachers should always include feedback in their lessons.

Key Words: Feedback, Knowledge of Results, Knowledge of Correct Result, Elaborate Response, Students' Self-Efficacy

Introduction

Self-efficacy is a psychological term used to determine an individual's belief in his/her ability to complete a task. The concept of self-efficacy grew out of HYPERLINK "https://positivepsychology.com/bandura-self-efficacy/"Bandura (1977) research when Bandura noticed that there was a mechanism that played a huge role in people's lives but up to that point, had not been defined or systematically observed. The mechanism was the beliefs that people have in them the ability to influence the events of their own lives. Bandura termed this self-efficacy.

According to Rakoczya, et al (2019) self-efficacy is one's goal-referenced, relatively context-specific, and future-oriented beliefs about one's competence. Self-efficacy reflects confidence in the ability to exert control over one's own motivation, behaviour, and social environment. These cognitive self-evaluations influence all manner of human experience, including the goals for which people strive, the amount of energy expended toward goal achievement, and likelihood of attaining particular levels of behavioural performance. Bandura (1998) further describes self-efficacy as a person's belief about capabilities to produce designated

levels of performance that exercise influence over events that affect one's live. It is self-efficacy that largely determine how people feel, think, motivate themselves and behave.

Self-efficacy can be influenced by a number of factors. The first factor that determine a strong sense of self-efficacy is success. Successes build a robust belief in one's personal efficacy while failures undermine it, especially if failures occur before a sense of efficacy is firmly established. The second factor is motivation provided through social models. Seeing people similar to oneself succeed by sustained effort raises one's beliefs that they too possess the capabilities to master comparable activities required to succeed. By the same token, observing others' fail despite high effort lowers one's judgments of their own efficacy and undermines their efforts. Social persuasion is a third way of strengthening people's beliefs that they have what it takes to succeed. People who are persuaded verbally that they possess the capabilities to master given activities are likely to mobilise greater effort and sustain it than if they harbor self-doubts and dwell on personal deficiencies when problems arise. Self-efficacy is therefore an important factor that determine a learner's ability to learn.

Bandura (1997), observed that certain behaviours will attain desired outcomes, individuals will not exert control unless they believe that they can produce these behaviours. Bandura (1999) extensive work on self-efficacy reports that self-efficacy affects one's level of motivation, affective states, actions, thought patterns and resilience. Also that individuals with high self-efficacy invest more effort and persistence than those with low self-efficacy, especially when they face setbacks. Bandura also added that individuals with high self-efficacy are more likely to attribute failure to situational factors, whereas those with low self-efficacy tend to attribute failure to lack of ability.

From the perspective of social cognitive theory, teachers' feedback constitutes an environmental variable that influences self-efficacy. Individuals react to feedback by maintaining successful strategies and modifying unsuccessful ones. Research has shown that feedback that informed students of their mastery of learning strategies and those that linked students' success with their mastery of strategies both contributed positively to self-efficacy (Joanne & Chan, 2010). Joanne and Chan (2010) also reported that teachers' feedback can influence students' self-efficacy through its reinforcement ability.

Although the original work or Bandura was in psychology, its impact extent to the all aspects of education. For instance, self-efficacy within the context of mathematics education is conceptualized as the assessment of an individual's confidence in his or her ability to successfully perform or accomplish a particular task or problem in mathematics (Hackett and Betz, 2009). Mathematics self-efficacy thus is defined as an individuals' beliefs or perceptions regarding their abilities to solve problems in mathematics. Bandura (1997) suggested that students with higher levels of self-efficacy tend to be more motivated to learn and more likely to persist when presented with challenging tasks. This also implies that students with higher self-efficacy will be more likely motivated to persist with the rigour required in mathematics.

Mathematics self-efficacy encompasses students' self-appraisal of their ability and prior attainments as well as a personal estimation of subsequent performance in mathematics. It is an important construct that determines how students engage with mathematics tasks. Mathematics self-efficacy influences the amount of efforts a student will expend in solving a problem. It also determines students' level of perseverance and the amount of forbearance in difficult situations (Pajares, 1996). This explains why some students engage in tasks they feel confident to do and avoid others they believe are out of their competence level. Mathematics self-efficacy could also be seen as a self-evaluation of a student's competence about a mathematics task which constitutes an internal drive for the successful completion of the task. Poor mathematics self-efficacy will often decreases the motivation to learn and eventually can lead to low mathematics achievement. This collaborates Collins (2020) assertion that students whose self-efficacy is stronger are more accurate in their mathematics computation and show greater persistence on difficult items compare to students with low self-efficacy. This is suggestive that any teacher of mathematics that intend to boost his or her students' self-

efficacy must choose teaching strategies that targets students' confidence. One of such readily available strategy as suggested by literature is teacher-feedback strategies.

Feedback is considered as one of the most powerful factors influencing students' confidence in learning mathematics. The term teacher-feedback in instructional contexts refers to all post-response information from the teacher which informs learners about their actual state of learning or performance with a given task (Narciss, 2013) in this case, in mathematics. Teacher-feedback can come in any form, for the purpose of this study, three teacher-feedbacks were considered namely: Knowledge of Result (KR) feedback, Knowledge of Correct Response (KCR) feedback, and Elaborate Response (ER) feedback.

Knowledge of Result (KR) feedback is a system where students are allowed to have instant knowledge of the result of their efforts but only indicates whether the students is successful or otherwise. It does not indicate the extent to which a learner is wrong or what was wrong with their efforts. The aim of this feedback pattern is to inform the learner whether the answer is correct or wrong. KR feedback is beneficial to learning mathematics because students often use KR to confirm their own assessment of the task (intrinsic feedback). KR feedback motivate learners to continue practicing until the desired goal is achieved. The teacher may want the students to keep on practicing until they discover their errors and correct them like a discovery learning class (Dempsey, Driscoll & Swindell, 2012).

Knowledge of Correct Response (KCR) feedback is when a learner is provided with the correct answer to a task after the first attempt. The main purpose of KCR feedback is to reverse the learner's incorrect response. This could save the time needed for the learner to do trial and error and could be a motivator of learning as quick solutions are available. The Knowledge of Correct Response could also provide the learner with information of what went wrong during the wrong attempt (Joanne & Chan, 2010).

Elaborate Response (ER) feedback goes beyond the learner knowing whether the answer is correct or not, or given the correct answer to a question, to a form of new instruction. In this feedback approach, more is done after the learner's attempt. It could be an explanation regarding the wrong answer given by the learner or a worked out solution or reference to study material or cues/prompts that could correct the wrong solution path taken previously by the learner (Shute, 2008).

Teacher-feedback constitutes social persuasion that affects students' self-efficacy. Feedbacks that confirms students' capabilities may enhance their self-efficacy. Continuously negative feedback may weaken a student's self-efficacy. The three feedback patterns discussed herein however do not use feedback in a manner that could weaken students' self-efficacy. Rather, the feedback are used within the teaching framework as an instruction process. This argument is consistent with Schunk (2003) report that successful students who received feedback that complimented their ability developed higher self-efficacy in addition to meeting their learning goals.

In an explanation of how feedback can affect students' self-efficacy, Zimmerman and Martinez-Pons (1990) observed that when teachers offer unsolicited assistance before the end of a task, students believe this help signals low ability. Graham, Harris, and Mason (2005) found that not only do the students being helped think of themselves as less capable, other students watching come to the same conclusion. Knowledge of Results avoids the scenario above by given the students multiple opportunities within the duration of the mathematics lesson to correct their errors. Similarly, the teacher can seize the opportunity of a student thinking of being less capable after a poor outing which could have a damp such a student's self-efficacy into an Elaborate Response situation where such a students will be given a new form of instruction and confidence.

Skinner's (1996) provides a theoretical explanation on how feedback affects self-efficacy. Skinner propounds that, in an academic setting, students are agents of control, learning strategies are the means of

control and designated educational goals are the ends of control. Feedback that convinces students that they, as the agent, they can exercise control over the means, enhances efficacy expectation. Moreso, feedback that provides students with the means to achieve their goals, strengthens outcome expectations.

Research evidence have also confirm that feedback affects self-efficacy. For instance, Turda, Feren?, and Claudia (2021) in a study on the impact of teacher's feedback on student's self-efficacy and motivation found that teacher offering direct, positive, immediate, criterion-related and corrective feedback significantly helps students change their study motivation and help to increase their self-efficacy feeling. Peifer, Schönfeld, Wolters, Aust and Margraf (2020) affirm that self-efficacy is a well-known psychological resource being positively associated with increased performance. Peifer, et al (2020) arrived at this affirmation after manipulating students' self-efficacy using Knowledge of Results (KR) feedback and Knowledge of Correct Response (KCR) feedback and reported that pupils exposed to Knowledge of Results significantly demonstrated higher self-efficacy ratings than those exposed to Knowledge of Correct Response (KCR) feedback while the group of Knowledge of Correct Response (KCR) feedback were also better in terms of self-efficacy compared to pupils in the controlled group who were not exposed to feedback.

Syarafina and Mahmudi (2019) investigated the effect of guided discovery learning on student self-efficacy in mathematics. The study provided evidence that self-efficacy of students in the experimental group was significantly higher than that of the controlled group which confirmed that guided discovery learning is an effective strategy in boosting students' self-efficacy in mathematics. It is worth noting that discovery learning model provides similar learning experiencing to Knowledge of Result feedback where a learning is given feedback and time to discover the correct result on multiple trials. In another report, Karl, O'Leary-Kelly, and Martocchio (2017) investigation on the impact of feedback and self-efficacy on performance in training submitted that the provision of feedback was beneficial to the subject self-efficacy. Subjects who received feedback on their performance experienced significantly greater increases in self-efficacy than subjects who received no feedback. Similarly, Smith (2017) reported that elaborate feedback enhanced students' self-efficacy skills in mathematical compare to knowledge of result.

More research works, like Saemi, Porter, Ahmad, Zarghami, Maleki (2012) investigation of learners' self-ef?cacy and motor learning found that learners' motor learning and self-ef?cacy were increased by providing learners Knowledge of Results feedback. Similarly, Joanne and Chan (2010) also investigated effects of different evaluative feedback on students' self-efficacy in learning where they reported that self-referenced feedback was more beneficial to students' self-efficacy than norm-referenced feedbacks. Comparably, Schunk and Zimmerman (2007) found that progress feedback together with learning goal are beneficial to students' self-efficacy. Closely, Zimmerman and Kitsantas (2002) found that feedback that informed students of their mastery of mathematics content contributed positively to self-efficacy. Having revealed all the aforementioned, the aim of this research is to provide empirical evidence on how the triadic feedback patterns of KR, KCR and ER can further our understanding of the effects of teachers' feedback on students' self-efficacy in mathematic.

Statement of the Problem

Research works on self-efficacy have focused more on academic areas of Arts, science and social science with scant attention to mathematics, particularly at secondary school level in which these sorts of self-beliefs begin to take root. This is an unfortunate omission. Mathematics hold a prominent place in the academic curriculum and academic success in these subject is imperative in this age of rapid scientific and technological level that academic self-beliefs become more pronounced.

Also, despite the importance of mathematics, research works keep observing and reporting high percentage of poor performance of students in mathematics examinations. This has generated much concern among stakeholders such as educators, parents, and teachers. This low performance of students has being attributed

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to numerous factors among which include teaching approaches used by teachers of mathematics. Some of such approaches lack or uses improper teacher feedback.

Mathematics is a practical subject and requires a lot of practice for learners to be able to comprehend the various rules applicable to solving a single questions (Jimin, Chianson-Akaa, & Ityavzua, 2019). Some teachers of the subject attempt to teach the entire lesson before given pupils class work or assignments. This approach to teaching mathematics may not be beneficially to the young mind and could lead to low achievement and low self-efficacy of students. Research evidence has shown that students' self-efficacy and confidence in dealing with mathematics can be enhanced when introduced to various level of feedback (Turda, Feren?, & Claudia, 2021; Syarafina & Mahmudi, 2019; Joanne & Chan, 2010). Also, literature review on feedback and enhancing students' self-efficacy in mathematics has exposed the researcher to the fact that, such research works are not only scant in mathematics, but have not been conducted in the area of study. This research work became imperative to fill the gap created by lack of empirical report on teacher feedback and students' self-efficacy in mathematics in Kano State.

Purpose of the Study

The general purpose of this study is to determine the effectiveness of teacher feedback on junior secondary students' self-efficacy in learning mathematics. The study specifically sought to determine the influence of Knowledge of Result (KR) feedback, Knowledge of Correct Response (KCR) feedback and Elaborate Response (ER) feedback on students' self-efficacy in learning Mathematics in Kano State.

Methodology

This study adopted a non-equivalent pretest post-test quasi experimental research design. The design allowed the researcher teach number and numeration in mathematics to three experimental groups using varying teacher feedback (Treatment) and one control group which was taught same concepts with conventional method. The population comprised all Junior Secondary 2 students in Kano State. A sample of 197 JS2 students was chosen from four intact classes using multi-stage sampling technique. Mathematics Self-Efficacy Questionnaire (MSQ) was used to measure students' self-efficacy. The instrument was a 10-item 5-point Likert-type questionnaire with responses ranging from NA = Not at All, SL = Slightly, MO = Moderately, VW = Very Well, EX = Excellently. Cronbach Alpha coefficient was used to compute the reliability of the instrument and reported as 0.83 which was considered reliable since it was way above 0.70 which is the benchmark for determining that an instrument is reliable (Emaikwu, 2013). The researcher visited the selected schools and sought permission to administer the instrument to students with assistance of the students' teachers. Mean scores and standard deviation were used to answer research questions while Analysis of Covariance (ANCOVA) was used to test hypothesis at 0.05 level of significance. The choice of ANCOVA was to balance the use of non-equivalent intact classes.

Results

Results are presented according to the research questions and the hypotheses.

Research Question 1: What is the difference between the mean self-efficacy rating of students taught mathematics using Knowledge of Results (KR) feedback and those taught using conventional teaching method?

Table 1: Mean ratings of students exposed to KR and control group

Experimental Groups	N	Pre-MSQ		Post-MSQ		Mean Gains
		Mean	Std. Dev	Mean	Std. Dev	
Knowledge of Result	53	2.45	0.65	4.04	0.68	1.59
Control	45	2.56	0.78	2.93	1.01	0.37
Mean Difference		-0.11		1.11		1.22

Table 1 presents the mean ratings of students exposed to KR and control group. The table shows the mean difference as -0.11 at pre-MSQ and 1.11 at post-MSQ. The mean gained by KR was 1.59 while control group gained 0.37 with 1.22 as mean gained difference in favour of KR.

$H0_1$: There is no significant difference between the mean self-efficacy rating of students taught mathematics using Knowledge of Results (KR) feedback and those taught using conventional teaching method.

Table 2: ANCOVA report on effect of KR on students' self-efficacy in mathematics

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	P Eta Sq
Corrected Model	31.90	2	15.95	22.78	0.00	0.32
Intercept	67.68	1	67.68	96.67	0.00	0.50
premsq	2.21	1	2.21	3.16	0.08	0.03
gp1	30.68	1	30.68	43.82	0.00	0.32
Error	66.51	95	0.70			
Total	1320.00	98				
Corrected Total	98.40	97				

Table 2 presents ANCOVA report on effect of KR on students' self-efficacy in mathematics. The table indicated that $F_{(1,97)} = 43.82$, $p = 0.00$. With $p<0.05$ the test statistic, the result was considered significant as such, the null hypothesis was rejected. Partial eta square of 0.32 meant that 32% in the variation of score between the groups was attributed to KR effectiveness.

Research Question 2: What is the difference between the mean self-efficacy rating of students taught mathematics using Knowledge of Correct Response (KCR) feedback and those taught using conventional teaching method?

Table 3: Mean ratings of students exposed to KCR and control group

Experimental Groups	N	Pre-MSQ		Post-MSQ		Mean Gains
		Mean	Std. Dev	Mean	Std. Dev	
Knowledge of Correct Result	37	2.41	0.70	3.27	0.96	0.86
Control	45	2.56	0.78	2.93	1.01	0.37
Mean Difference		-0.15		0.34		0.49

Table 3 presents the mean ratings of students exposed to KCR and control group. The table shows the mean difference at pre-MSQ as -0.15 while at post-MSQ it was 0.34. The KCR group gained 0.86 while the control group gained 0.37 with 0.49 as mean gained difference in favour of KCR group.

$H0_2$: There is no significant difference between the mean self-efficacy rating of students taughtmathematics using Knowledge of Correct Response (KCR) feedback and those taught using conventionalteaching method.

Table 4: ANCOVA report on effect of KCR on students' self-efficacy in mathematics

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	P Eta Sq
Corrected Model	23.82	2	11.91	16.63	0.00	0.29
Intercept	17.36	1	17.36	24.23	0.00	0.23
premsq	21.51	1	21.51	30.04	0.00	0.27
gp2	1.98	1	1.98	2.77	0.10	0.03
Error	56.58	79	0.71			
Total	861.00	82				
Corrected Total	80.40	81				

Table 4 presents ANCOVA report on effect of KCR on students' self-efficacy in mathematics. The table indicated that $F_{(1,81)} = 2.77$, $p = 0.10$. With $p>0.05$, the test statistic result was considered not to significant consequently, the null hypothesis was retained. Partial eta square value of 0.03 indicates that there was only 3% variation in the scores between KCR and control group.

Research Question 3: What is the difference between the mean self-efficacy rating of students taught mathematics using Elaborate Response feedback and conventional teaching method?

Table 5: Mean ratings of students exposed to ER and control group

Experimental Groups	N	Pre-MSQ		Post-MSQ		Mean Gains
		Mean	Std. Dev	Mean	Std. Dev	
Elaborate Response	62	2.50	0.69	3.56	0.86	1.06
Control	45	2.56	0.78	2.93	1.01	0.37
Mean Difference		-0.06		0.63		0.69

Table 5 presents the mean ratings of students exposed to ER and control group. Results reveals the mean difference at pre and post-MSQ as -0.06 and 0.63 respectively. The mean gained by ER and control group were 1.06 and 0.37 with 0.69 as the difference in mean gain in favour of ER.

$H0_3$: There is no significant difference between the mean self-efficacy rating of students taught mathematics using Elaborate Response (ER) feedback and those taught using conventional teaching method?

Table 6: ANCOVA report on effect of ER on students' self-efficacy in mathematics

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	P Eta Sq
Corrected Model	15.83	2	7.91	9.73	0.00	0.15
Intercept	53.96	1	53.96	66.34	0.00	0.38
premsq	5.44	1	5.44	6.69	0.01	0.06
gp3	10.92	1	10.92	13.43	0.00	0.11
Error	84.59	104	0.81			
Total	1265.00	107				
Corrected Total	100.43	106				

Table 6 presents ANCOVA report on effect of ER on students' self-efficacy in mathematics. The table indicated that $F_{(1,106)} = 13.43$, $p = 0.00$. With $p<0.05$, the test statistic result was considered significant which caused the rejection of the null hypothesis. Partial eta square was 0.11 which indicates that 11% of the variation in the scores was attributed to instructional variation.

Research Question 4: What is the difference in the mean self-efficacy rating of students taught mathematics using Knowledge of Results, Knowledge of Correct Response and Elaborate Response feedback?

Table 7: Mean ratings of students exposed to KR, KCR and ER

Experimental Groups	N	Pre-NNAT		Post-NNAT		Mean Gains
		Mean	Std. Dev	Mean	Std. Dev	
Knowledge of Result	53	2.45	0.65	4.04	0.68	1.59
Knowledge of Correct Result	37	2.41	0.70	3.27	0.96	0.86
Mean Difference		**0.04**		**0.77**		**0.73**
Knowledge of Result	53	2.45	0.65	4.04	0.68	1.59
Elaborate Response	62	2.50	0.69	3.56	0.86	1.06
Mean Difference		**-0.05**		**0.48**		**0.53**
Elaborate Response	62	2.50	0.69	3.56	0.86	1.06
Knowledge of Correct Result	37	2.41	0.70	3.27	0.96	0.86
Mean Difference		**0.09**		**0.29**		**0.20**

Table 7 presents the mean ratings of students exposed to KR, KCR and ER. The table shows the mean difference between KR and KCR at pre and post-MSQ as 0.04 and 0.77. The difference in the mean gains was 0.73 in favour of KR. Results from the table further reveals the mean difference between KR and ER at pre and post-MSQ as -0.05 and 0.48 respectively. The difference in the mean gains was 0.53 in favour of KR. For KCR and ER, results reveals their mean difference at pre and post MSQ as 0.09 and 0.29. The difference in the mean gains was 0.20 in favour of ER.

$H0_4$: There is no significant difference in the mean self-efficacy rating of students taught mathematics using Knowledge of Results, Knowledge of Correct Response and Elaborate Response feedback.

Table 8: ANCOVA report on effect of KR, KCR and ER on students' self-efficacy

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	P Eta Sq
Corrected Model	15.04	3	5.01	7.335	0.00	0.12
Intercept	139.04	1	139.04	203.41	0.00	0.57
premsq	1.29	1	1.29	1.89	0.17	0.01
gp4	14.25	2	7.12	10.42	0.00	0.12
Error	101.16	148	0.68			
Total	2150.00	152				
Corrected Total	116.21	151				

Table 8 presents ANCOVA report on effect of KR, KCR, and ER on students' self-efficacy in mathematics. The table indicated that $F_{(1,151)} = 10.42$, $p = 0.00$. Since $p<0.05$, it was considered to be significant. Partial

eta square also indicated 12% variation in the scores based on feedback style. The result was however subjected to a post hoc test.

Table 9: LSD Post-hoc pairwise comparison

(I) Experimental Groups	(J) Experimental Groups	Mean Difference (I-J)	Sig
Knowledge of Result	Knowledge of Correct Result	0.78	0.00
Knowledge of Result	Elaborate Response	0.47	0.02
Elaborate Response	Knowledge of Correct Result	0.30	0.05

Table 9 presents a Fishers' Least Significant Difference (LSD) post-hoc pairwise comparison analysis. The result shows that p = 0.00 for KR and KCR. This means the difference between the groups was considered to be significant in favour of KR. The result also indicated p = 0.02 for KR and ER which also conform that the difference in the mean scores between the groups was significant in favour of KR. The table further reveals that p =0.05 for ER and KCR which confirms that there was a significant difference in the mean rating of students in the groups.

Discussion of Results

This study was set up to investigate how three teacher-feedback styles could affect students' self-efficacy in mathematics. Results indicated that students exposed to KR, and ER significantly attained higher mean ratings in MSQ compared to those who were taught without feedback in the control group. The finding confirmed that teacher instruction with feedback is capable of enhancing students' self-efficacy in mathematics. The success recorded by the KR and ER feedback approaches strengthen the clam of Schunk (2003) that successful students who received feedback that compliments their ability developed higher self-efficacy. This could be attributed to the fact that feedback moderates the mental processing demand of learners. This finding also collaborates other research findings that feedback approaches are instrumental to students' self-efficacy (Turda, Feren?, & Claudia, 2021; Syarafina & Mahmudi, 2019; Karl, O'Leary-Kelly, & Martocchio, 2017; Saemi, Porter, Ahmad, Zarghami, & Maleki, 2012; Joanne & Chan, 2010; Schunk & Zimmerman, 2007).

Other results of this study were that the mean self-efficacy rating of students in KCR group was not significantly different from those in the control group. This finding is indicative that KCR feedback is a popular feedback pattern and was likely used by the control group as well. This finding collaborates Zimmerman and Martinez-Pons (1990) observation that when teachers offer unsolicited assistance, students believe the help signals low ability which damps their self-efficacy and Graham, Harris, and Mason (2005) conclusion that not only do the students being helped think of themselves as less capable, other students watching come to the same conclusion.

Another finding of the study was that students exposed to KR significantly attained higher mean rating than those in ER. This further strengthen the argument of Collins 2020 that students whose self-efficacy is stronger are show greater persistence on difficult items compare to students with low self-efficacy. The finding is in congruence with Peifer, Schönfeld, Wolters, Aust and Margraf (2020) reported that pupils exposed to Knowledge of Results significantly demonstrated higher self-efficacy ratings than those exposed to Knowledge of Correct Response (KCR) feedback.

Results further revealed that the mean rating of students exposed to ER was also significantly higher than those exposed to KCR. This was not surprising as the result of students exposed to KCR was not significantly higher than that of those in the control group.

Conclusion

The expectation of any teacher of mathematics is for the learning environment to effectively motivate students to learn mathematics. Considering that Bandura (1977) sees mathematic self-efficacy as the factor responsible for students' motivation, confidence and perseverance to learn, enhancing students' self-efficacy may be a step towards building an effective learning environment. The result of this study indicates that, appropriate teacher-feedback gives students the needed motivation to enhance their self-efficacy in mathematics. Furthermore, this study concludes that Knowledge of Results feedback is most beneficial to mathematics students' self-efficacy, followed by Elaborate Response. This study also concludes that Knowledge of Correct Result is insufficient in term of motivating learners.

Recommendations

Based on the findings of the study, the following recommendation were made.

1. That mathematics teachers should adapt KR and ER feedbacks styles in teaching students.
2. School authorities should provide adequate time for implementation KR and ER as students may require more time to go through their work severally to debug and correct themselves. Teaching mathematics everyday may not be enough if more time is not allotted to each lesson.
3. Mathematics teachers should also set regulation as to how much time would be adequate to spent on a single mathematical concept. KR could be turned into ER if a student cannot arrive at the correct answer after adequate time spent to avoid frustration on the part of the student.

Reference

1. Bandura, A. (1977). Self-efficacy: Toward a unifying theory of behavioral change. Psychological Review, 84, 191–215. doi:10.1037/0033-295X.84.2.191.
2. Bandura, A. (1999). Self-efficacy in changing societies. New York: Cambridge University Press.
3. Collins, S.T. (2020). Effect of formative assessment of students' self-efficacy. Jigawa Journal of Multidisciplinary Studies, 2(1): ISSN 2672-4790, 88-98.
4. Dempsey, J.V., Driscoll, M.P. & Swindell, L.K. (2012). Interactive instruction and feedback, Englewood Cliffs, NJ: Educational Technology Publications.
5. Graham, S., Harris, K. R., & Mason, L. (2005). The effects of self-regulated strategy on development of struggling young writers. Contemporary Educational Psychology, 30, 207–241. doi:10.1016/j.cedpsych.2004.08.001.
6. Hackett G., Betz N. E. (2009). An exploration of the mathematics self-efficacy/mathematics performance. Journal of Research in Mathematics Educ. 20, 261–273. Doi.10.2307/749515.
7. Jimin. N., Chianson-Akaa, M.M., & Ityavzua, T.M. (2019). Effect of study questions and the scaling-up of undergraduate students' achievement in Mathematics. International Journal of Educational Development, 1(24), 1-8. ISSN 1119-74-98,
8. Joanne, C.Y. & Chan, S.L. (2010). Effects of different evaluative feedback on students' self-efficacy in learning. Instructional Science, 38, 37–58. DOI 10.1007/s11251-008-9077-2.
9. Karl, A.K., O'Leary-Kelly, A.M., & Martocchio, J.J. (2017). The impact of feedback and self-efficacy on performance in training. Journal of Organizational Behaviour 14(4), 379-394.
10. Maleki, F., Seami. E., Porter, J.M., Ahmed, G., & Mehdi, Z.A. (2012). Knowledge of results after relatively good trials enhances self-efficacy and motor learning. Psychology of Sport and Exercise 13(4), 378-382.
11. Narciss, S. (2013). Designing and evaluating tutoring feedback strategies for digital learning environments on the basis of the interactive tutoring feedback model. Digital Education Review, 23, 7-

26.
12. Pajares, F. (1996). Self-efficacy beliefs in academic settings. Review of Educational Research, 66, 543–578.
13. Peifer, C., Schönfeld, P., Wolters, G., Aust, F. & Margraf, J. (2020). Effects of positive feedback on perceived pupils' self-efficacy and performance in a mental arithmetic task. Frontiers in Psychology, 11, np.
14. Rakoczya, K., Pingera, P., Hochweberb, J., Kliemea, E., Schützec, B. & Besser, M. (2019). Feedback's perceived usefulness and students' self-efficacy. Learning and Instruction 60, 154–165
15. Saemi, E., Porter, J.M., Ahmad G.V., Zarghami, M., Maleki, F. (2012). Knowledge of results after relatively good trials enhances self-ef?cacy and motor learning. Psychology of Sport and Exercise 13, 378-382.
16. Schunk, D. H. (2003). Self-efficacy for reading and writing: Influence of modeling and self-evaluation. Reading and Writing Quarterly, 19, 159–172. doi:10.1080/10573560308219.
17. Schunk, D. H., & Zimmerman, B. J. (2007). Influencing children's self-efficacy of reading. Reading & Writing Quarterly, 23, 7–25. doi:10.1080/ 10573560600837578.
18. Shute, J.V. 2008). Focus on formative feedback. Review of Educational Research, 78, 153-188.
19. Skinner, E. (1996). A guide to constructs of control. Journal of Personality and Social Psychology, 71, 549– 570. doi:10.1037/0022-3514.71.3.549.
20. Smith, A.R. (2017). The influences of feedback and praise on the academic self-efficacy and self-perception skills of primary elementary aged students in the area of mathematics. Retrieved on the 20th January, 2020 from http://dx.doi.org/10.1080/13538320500175118
21. Syarafina, D.N. & Mahmudi, A. (2019). The effect of guided discovery learning on student self-efficacy in mathematics. Journal of Physics Conference Series 1157(4): 1-8.
22. Turda, E.S., Feren?, P., and Claudia, C. (2021). The impact of teacher's feedback in increasing student's self-efficacy and motivation. The European Proceedings of Social and Behavioural Sciences, 2020, 509-519. Retrieved on the 12th August, 2022 from www.europeanproceedings.com. DOI: 10.15405/epsbs.2021.03.02.52
23. Zimmerman, B. J., & Kitsantas, A. (2002). Acquiring writing revision and self-regulatory skill through observation and emulation. Journal of Educational Psychology, 94, 660–668. doi:10.1037/0022- 0663.94.4.660.
24. Zimmerman, B. J., & Martinez-Pons, M. (1990). Student differences in self-regulated learning: Relating grade, sex, and giftedness to self-efficacy and strategy use. Journal of Educational Psychology, 82, 51– 59. doi:10.1037/0022-0663.82.1.51.