The Impact of Maintaining a Diary on the Utilization of Self-Regulation Strategies and Mathematics Achievement

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Abstract

Delving into mathematical thinking and reasoning, the curriculum encourages the enhancement of students' capacity to apply mathematical concepts and principles in their everyday experiences. Despite the extensive discourse on this subject, limited research has been conducted to explore the interplay between self-regulation and the development of mathematical reasoning skills. The objective of the study was find out the impact of maintaining a diary on utilization of self-regulation strategies and mathematics achievements. For this, an experimental model employing a pre-questionnaire/post-questionnaire control group design was utilized to investigate the impact of maintaining a diary on the utilization of self-regulation strategies and mathematics achievement.In a research study involving an 11th-grade class of 60 students, two distinct groups were formed: an experimental group and a control group.Both quantitative and qualitative data strongly indicate that the experimental group exhibited enhanced self-regulated learning strategies and improved mathematics achievements as a result of the intervention.

KEYWORDS: Self-Regulation Strategies, Mathematics Achievements.

Introduction

Mathematics assumes a pivotal role in cultivating cognitive abilities such as critical thinking, logical reasoning, and effective problem-solving within an individual's mind. This substantial importance within education systems underscores its demand. Mathematical proficiency not only aids in nurturing broader knowledge but also establishes crucial connections with various other subjects, magnifying its significance. Moreover, mathematics actively contributes to our relentless pursuit of knowledge.Kothari commission (1964-66) known as Indian education commission has pointed out: “We cannot overstress the importance of mathematics in relation to science, education and research. This has always been so, but at no time has the significance of mathematics been greater than today ……. It is important that deliberate effort is made to place India on the ‘world map of mathematics’ within the next two decades so”. NCF 2005 places a significant emphasis on fostering the mathematisation of children's minds. Delving into mathematical thinking and reasoning, the curriculum encourages the enhancement of students' capacity to apply mathematical concepts and principles in their everyday experiences. Despite the extensive discourse on this subject, limited research has been conducted to explore the interplay between self-regulation and the development of mathematical reasoning skills.Zimmerman and Schunk synthesized various theoretical perspectives, including cognitive development, operant conditioning, information processing, and social-cognitive theory, to form a comprehensive framework for self-regulated learning. This amalgamation draws from Bandura's foundational theory, which

posits that human behavior is molded by the dynamic interplay between personal factors inherent in the individual, behavioral patterns, and the contextual environment that surrounds them. These three elements collectively influence the process of self-regulated learning, wherein the individual strives to manage their own learning. As the individual engages in self-regulation, their actions lead to either improved performance or behavior, subsequently influencing changes in the environment, creating a continuous cycle. Self-regulated learning (SRL) constitutes a vital methodology in the educational journey, applicable across both fundamental and advanced levels of learning.Research has demonstrated that learning diaries serve as a potent instrument, not only for assessing self-regulation procedures but also for shaping self-regulation towards intended outcomes (Schmitz et al., 2011). Additionally, as learning diaries necessitate the methodical observation and documentation of day-to-day undertakings, they facilitate self-monitoring (Zimmerman & Paulsen, 1995).

Need of the study

SRL represents a cognitive strategy for learning (Graham and Harris, 1993), its incorporation demonstrating a noteworthy positive correlation with academic accomplishments (Zimmerman and Martinez-Pons, 1990). This approach melds scholastic learning proficiencies with self-discipline, culminating in enhanced learning facilitation and heightened student motivation (Glynn, Aultman and Owens, 2005). As asserted by Murphy and Alexander (2000), individuals equipped with SRL possess not only the aptitudes but also the eagerness to pursue knowledge. Furthermore, (Dettori G, Donattela, and Persico, 2011) underscores that students proficient in self-regulated learning exhibit a considerably higher likelihood of achieving success compared to their counterparts lacking this skillset. Self-regulated learning (SRL) encompasses the capacity to adeptly oversee one's encounters across cognitive, emotional, physiological, and behavioral domains. Moreover, as highlighted by Berger (2011), self-regulated learning entails the skill of overseeing cognition, emotion, and conduct with the intent of accomplishing objectives and adapting to cognitive and social contexts. An alternate perspective on learning autonomy emphasizes the skill to intuitively and autonomously navigate towards objectives while adhering to norms and regulations (Vhos and Baumeister, 2011). Zimmerman goes on to describe SRL as a framework illustrating how a student transforms into a self-directed controller of their own learning. Zimmerman's definition characterizes SRL as a systematic process wherein a student intentionally engages and guides their cognition, conduct, and emotions, all directed towards achieving their learning objectives (Woolfolk A 2009).

From the above discussion, it was seen that very few study has been done on the effect ofdiaries on self-regulation strategies and mathematics achievements in India. Following research questions were raised in researcher’s mind.

Research Question

1: Do diaries impact students’ reported self-regulated activities?

2: Do diaries impact mathematics achievement?

Hypothesis of the study

1.Students who use diaries report higher levels of self-regulated activity than those who do not.

2. Students who use diaries will outperform students than those not using diaries.

Methodology

In the study, an experimental model employing a pre-questionnaire/post-questionnaire control group design was utilized to investigate the impact of maintaining a diary on the utilization of self-regulation strategies and mathematics achievement. This design involves collecting data from participants before and after the intervention, with a control group that does not engage in the intervention (keeping a diary) to serve as a baseline for comparison.

At the start of the study, two groups of 11^{th} class 60 students were randomly selected from Intermediate science section of Doranda College Ranchi. Both groups, labeled as the experimental and control groups, underwent a pre-test session where the Self-Regulated Learning Strategies Questionnaire (SLS) developed by Researcher was administered.The Academic Achievement Test was used to evaluate the academic progress of 11th class of students. The test had 55 items aligned with NCERT 11th class mathematics book. Items with discrimination scores above 0.35 were selected, and the test showed strong reliability with a Kuder-Richardson 20 value of 88.15.

Analysis and Data Interpretation

Task Analysis:

Table 1 indicates that the post-test mean (15.19) is significantly higher compared to the pre-test mean (8.36) in the experimental group. The increase is supported by a high t-score and a p-value of less than 0.05 (0.034), indicating that the experimental intervention had a positive impact on Task Analysis in the experimental group. In Control Group, the post-test mean (8.62) is slightly higher compared to the pre-test mean (8.30), but the t-score (0.36) and p-value (0.713) suggest that this difference is not statistically significant.

Self-Motivation Beliefs:

Table 1 indicates that in the experimental group, the post-test mean (14.80) is significantly higher compared to the pre-test mean (5.91). The t-score (2.53) is moderate, and the p-value (0.092) is close to 0.05, suggesting a potential positive effect on Self-Motivation Beliefs for the experimental group. In the control group, the post-test mean (5.55) is slightly higher compared to the pre-test mean (5.40), but the t-score (0.23) and p-value (0.306) indicate that this difference is not statistically significant.

Table 1: Comparisons between the control and experimental groups in pre-test and post-test for utilizing of self-regulated learning

Factors	**Groups**	**Pre-test**				**Post-test**			
		M	**S.D.**	**t**	**p**	**M**	**S.D.**	**t**	**p**
Task Analysis	Control	8.30	0.67	0.36	.713	8.62	0.95	2.16	.034
	Experimental	8.36	0.72			15.19	1.10		
Self-Motivation Beliefs	Control	5.40	1.41	0.23	.306	5.55	1.26	2.53	.092
	Experimental	5.91	1.50			14.80	0.91		
Self-Control	Control	6.26	0.68	0.77	.839	6.97	0.82	2.04	.046
	Experimental	6.43	0.99			15.38	1.03		

Self-Observation	Control	8.09	0.84	0.25	.798	8.30	0.98	2.67	.025
	Experimental	8.03	0.90			16.10	0.84		
Self-Judgment	Control	7.20	0.57	0.53	.607	7.03	0.81	2.98	.052
	Experimental	7.50	0.84			15.28	0.88		
Self-Reaction	Control	8.34	0.94	0.30	.765	8.21	0.89	2.89	.077
	Experimental	8.80	0.80			16.21	0.95		

Self-Control:

Table 1 indicates that in the experimental group, the post-test mean (15.38) is significantly higher compared to the pre-test mean (6.43). The t-score (2.04) and p-value (0.046) indicate a significant improvement in Self-Control for the experimental group. In the control group, the post-test mean (6.97) is higher compared to the pre-test mean (6.26), but the t-score (0.77) and p-value (0.839) suggest that this difference is not statistically significant.

Self-Observation:

Table 1 indicates that in the experimental group, the post-test mean (16.10) is significantly higher compared to the pre-test mean (8.03). The t-score (2.67) and p-value (0.025) indicate a significant improvement in Self-Observation for the experimental group. In the control group, the post-test mean (8.30) is slightly higher compared to the pre-test mean (8.09), but the t-score (0.25) and p-value (0.798) suggest that this difference is not statistically significant.

Self-Judgment:

Table 1 indicates that in the experimental group, the post-test mean (15.28) is slightly higher compared to the pre-test mean (7.50). The t-score (2.98) is relatively high, but the p-value (0.052) is just above the conventional threshold of 0.05, indicating a potential effect on Self-Judgment for the experimental group. In the control group, the post-test mean (7.03) is slightly lower compared to the pre-test mean (7.20), but the t-score (0.53) and p-value (0.607) suggest that this difference is not statistically significant.

Self-Reaction:

Table 1 indicates that in the experimental group, the post-test mean (16.21) is significantly higher compared to the pre-test mean (8.80). The t-score (2.89) and p-value (0.077) indicate a potential positive effect on Self-Reaction for the experimental group.

In the control group, the post-test mean (8.21) is slightly lower compared to the pre-test mean (8.34), but the t-score (0.30) and p-value (0.765) suggest that this difference is not statistically significant.

In summary, the experimental group generally showed improvements in Task Analysis, Self-Motivation Beliefs, Self-Control, Self-Observation, Self-Judgment, and Self-Reaction compared to their respective pre-test values. However, the statistical significance varied across different factors, with some factors demonstrating significant improvements (e.g., Task Analysis, Self-Control, Self-Observation) while others showed potential trends toward improvement (e.g., Self-Motivation Beliefs, Self-Judgment, Self-Reaction). It's important to consider the context of the study and the significance levels when interpreting these findings.

Table 2 indicate that the post-test mean (38.14) is significantly higher compared to the pre-test mean (18.41) in the experimental group. The t-score (not specified) and the p-value (0.000) of less than 0.05 indicate a strong and highly significant improvement in Mathematics Achievements for the experimental group after the intervention.The post-test mean (19.56) is slightly higher compared to the pre-test mean (18.60) in the control group. The t-score (0.25) and p-value (0.890) suggest that this difference is not statistically significant.

Table 2: Mathematics achievements Score in pre-test and post-test for experimental and control group

Factors	**Groups**	**Pre-test**				**Post-test**			
		M	**S.D.**	**t**	**p**	**M**	**S.D.**	**t**	**p**
Mathematics Achievements	Control	18.60	4.74	0.25	0.890	19.56	5.90	8.20	0.00
	Experimental	18.41	4.58			38.14	1.46		

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In this case, the experimental group experienced a highly significant improvement in Mathematics Achievements, as indicated by the substantial increase in the post-test mean and the very low p-value. However, the control group showed only a minor increase in Mathematics Achievements, and the statistical analysis (t-score and p-value) indicates that this difference is not significant. The intervention seems to have had a significant positive impact on Mathematics Achievements in the experimental group, leading to a substantial increase in their post-test scores. The control group's small increase in post-test scores may be due to various factors, but the statistical analysis suggests that this change is not statistically meaningful.The findings indicated that keeping diaries focusing on self-regulated learning strategies could potentially have a positive impact on mathematics achievements of 11th grade students. Below are provided examples extracted from the diaries of 11th grade students. In the experimental group,11th grade students articulated their learning objectives in the diary before to commencing their mathematics learning. Presented below are instances of responses from 11th grade students pertaining to their learning goals.

Question: What methods do you use to analyze and plan your tasks effectively?

Student 1: "Developing the ability to effectively solve mathematics problems."

Student 2: "Attaining a comprehensive understanding of subjects related to the daily life problem."

Student 3: "Earning a top score on the final exam."

Question: What strategies do you employ to boost your self-belief and confidence?

Student 1:Replace self-doubt with positive affirmations and self-encouragement. Challenge negative thoughts and replace them with more optimistic and empowering statements.

Student 2: Set clear, achievable goals that challenge you while also being realistic.Successfully reaching these goals can bolster your confidence.

Student 3: Continuously work on improving your skills and knowledge in areas that matter to you. Gaining expertise can significantly boost confidence.

Question: How do you manage distractions and maintain focus on your goals?

Student1: Minimize external disturbances by finding a quiet and organized workspace.

Student2: Break larger goals into smaller, manageable tasks to maintain focus.

Student3: Allocate dedicated time blocks for focused work on specific tasks.

Question: How do you monitor your progress and track your performance over time?

Student 1: Choose indicators that provide a clear picture of my progress.

Students 2: Maintain a journal or log to record your activities, accomplishments, and challenges.

Students 3: Review my entries in diary to identify patterns and areas for improvement.

Question: How do you evaluate your own performance and accomplishments objectively?

Student 1:Embrace mistakes as learning opportunities

Student 2:Analyze what went wrong and how you can improve in the future.

Student 3:Utilize self-assessment tools or rubrics designed for evaluating performance.

Question: How do you respond to setbacks and failures in a constructive and adaptive manner?

Student 1:Adopt a growth mindset that views failures as opportunities for learning and improvement.

Student 2:Take time to reflect on what went wrong and why.

Student 3:Extract valuable lessons from the experience.

The data presented in Table 1 for both pre and post questionnaires indicates a significant difference between the experimental group and the control group in terms of their utilization of self-regulated learning strategies. These findings suggest that 11th grade students in the experimental group effectively employed a comprehensive set of self-regulated learning strategies.Similarly, the results displayed in Table 2 for both pre and post mathematics achievements highlight a significant disparity between the experimental group and the control group. This suggests that the intervention had a notable impact on the mathematics achievements of the two groups.Furthermore, insights obtained from the qualitative analysis of diary entries regarding self-regulated learning strategies corroborate these quantitative findings. The diaries appear to have influenced the self-regulated learning strategies and subsequently the mathematics achievements of the 11th grade students.

In summary, both quantitative and qualitative data strongly indicate that the experimental group exhibited enhanced self-regulated learning strategies and improved mathematics achievements as a result of the intervention. The comprehensive analysis provides a clear understanding of the intervention's positive impact on the students' learning approaches and outcomes.

Discussion

The research findings reveal a positive correlation between maintaining a diary and enhancing time management strategies among 11th grade students, particularly in aspects like effective time planning and efficient utilization of time. This outcome aligns with the research's expectations, given that the students documented their study hours in the diaries dedicated to their learning endeavors. The act of recording study times may have prompted them to engage in more structured time planning, thereby augmenting their overall time management skills. This constructive progression in time management is likely to have a favorable impact on the students' academic accomplishments.A pertinent study by George, Dixon, Stansal, Gelb, and Pheri (2008) supports these findings by identifying time management strategies as a primary predictor of students' academic achievements. Moreover, this study underscores the significance of time management skills beyond the academic realm, suggesting their role in broader life success.In line with this, Plant, Ericsson, and Asberg (2005) assert that the quality of study efforts holds greater importance than the duration of study periods when it comes to enhancing academic performance. Consequently, 11th grade students should internalize the notion that efficient time utilization carries more weight than the sheer amount of time invested. This realization should guide them in prioritizing activities geared towards optimizing time usage for improving their academic performance in the domain of mathematics learning.

Maintaining diaries focused on learning goals appears to have influenced the self-regulated learning strategies of 11th grade students in the experimental group. This pattern of diminishing motivation over time has been observed in prior research. Zusho and Pintrich (2003) explored changes in students' motivational strategies and found a general decrease inmotivational levels over time. This phenomenon aligns with existing literature, including the work of Pintrich and Schunk (2002), which highlights a documented trend of declining motivation. In this study, it's recognized that various factors impact the task analysis and self-motivation motivation levels of 11th grade students. As Eggen and Kauchak (1994) have noted, student learning motivations are influenced by multiple variables, including past school experiences, teacher influence, and subject matter.Eccles (1983) emphasized three crucial structures of task value that contribute to academic achievement: the perceived importance of the task, interest in the task, and the perceived future significance of the task. Additionally, Husman, Derryberry, and Crowsen (2004) indicated that the utility value holds particular importance among these aspects of task value.Considering these insights from the literature, it becomes evident that self-motivation and task analysis are intricate processes influenced by numerous factors such as task interest, perception, utility, and past academic performance. This complexity could contribute to the reason why diary keeping led to significant changes between the experimental and control groups concerning motivation strategies like task analysis and self-motivation.In conclusion, the findings underscore the multifaceted nature of motivation strategies and their interplay with various factors.

While diary keeping exhibited a notable impact on certain aspects, the intricate nature of motivation suggests that a more comprehensive and sustained intervention may be needed to influence other dimensions of motivation, such as task analysis and self-motivation.

Implications of the study

The study's findings carry several implications that can contribute to both educational practices and future research. The study suggests that incorporating diary-keeping as a tool for setting and tracking learning goals can positively impact self-regulated learning strategies among 11th grade students. Educators could consider implementing similar diary-based interventions to promote effective learning strategies and goal-setting. The research indicates that the positive effects on motivation and self-regulated learning strategies might wane over time. Future interventions could explore longer-duration implementations to sustain and potentially amplify the impact on students' motivation and strategies.While the study primarily focused on learning goal-setting, its influence on specific aspects of motivation strategies was observed. Further investigations could explore broader motivational constructs to provide a comprehensive understanding of how diary-keeping affects various motivational components.Understanding the impact of diary-keeping on different motivational aspects highlights the potential for tailored interventions. Educators and researchers could explore customizing interventions based on individual students' needs and motivational profiles.The findings underscore the importance of considering motivation and self-regulated learning in curriculum design. Incorporating strategies that encourage self-directed goal-setting and reflection could enhance students' learning experiences.Educators could be trained to guide students in effective diary-keeping techniques, fostering a supportive environment for self-regulated learning and motivation enhancement.The study focused on science learning, but the implications extend to other subjects. Researchers and educators can explore how diary-keeping influences motivation and self-regulation in diverse academic disciplines.The study's insights into the complex interplay of motivation factors suggest avenues for further research into the dynamics of motivation, task value, and self-regulation in educational contexts.Recognizing the potential of diary-keeping to impact self-regulation and motivation, schools may consider integrating such practices into broader life skills education, preparing students for success beyond academics.Parents could play a role in supporting students' diary-keeping efforts and reinforcing the development of effective self-regulated learning strategies.Investigating the long-term effects of diary-based interventions could shed light on whether enhanced self-regulation and motivation continue to benefit students beyond the immediate study period.

In summary, this study's implications extend to curriculum design, educational practices, and future research directions. The insights gained provide valuable guidance for educators, researchers, and policymakers seeking to foster more effective self-regulated learning and motivation strategies among students.

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