THE RELATIONSHIP OF SELF-EFFICACY FOR LEARNING AND PERFORMANCE IN PHYSICS AND METACOGNITIVE SELF-REGULATED PHYSICS LEARNING WITH PHYSICS ACHIEVEMENT OF FORM 3 STUDENTS AT DOMASI DEMONSTRATION SECONDARY SCHOOL IN MALAWI

Austin Bondawambinga Kalambo[1]
Richard Lynch[2]

Received: *28th May 2020*
Revised: *6th August 2021*
Accepted: *10th September 2021*

Abstract: The study was aimed at determining the relationships among self-efficacy for learning and performance in physics, metacognitive self-regulated physics learning and physics achievement of Form 3 physics students at Domasi Demonstration Secondary School in Malawi. The Motivated Strategies for Learning Questionnaire (MSLQ) was adapted and used to collect data on self-efficacy for learning and performance in physics and metacognitive self-regulated physics learning from 40 Form 3 physics students at Domasi Demonstration Secondary School in Malawi in their Term 3 of the 2019 academic year. The physics achievement scores of the students were collected by an End of Term 3 Physics Examination. A multiple correlation coefficient analysis was used to determine the relationships among self-efficacy for learning and performance in physics, metacognitive self-regulated physics learning and physics achievement of the Form 3 physics students. It was revealed that the relationship of self-efficacy for learning and performance in physics and metacognitive self-regulated physics was moderately strong and positively correlated. Similarly, physics achievement and self-efficacy for learning and performance in physics were also moderately strong and positively correlated. Lastly, the relationship between physics achievement and metacognitive self-regulated physics learning was revealed to be weak but positively correlated. The findings, further, indicated that a moderately strong and positive significant relationship existed between self-efficacy for learning and performance in physics and metacognitive self-regulated physics learning with physics achievement. Recommendations for students' support, teaching strategies, and future research are provided.

[1] M.Ed. Director of Curriculum Development, Malawi Institute of Education, Malawi. akalambo@gmail.com
[2] Ph.D., Assistant Professor, Graduate School of Human Sciences, Assumption University, Thailand. richardlynch2002@yahoo.com

Keywords: secondary physics; student achievement; self-efficacy; self-regulation; meta-cognition; motivation; Domasi Demonstration Secondary School; Malawi.

Introduction

The advancement of education that typifies science in Malawi is backed by the Malawi Vision 2020 (Government of Malawi, 2015), the 2017 Science and Technology Policy for Malawi (National Commission for Science and Technology, 2017) and Secondary School Curriculum and Assessment Review (SSCAR) Framework (Malawi Institute of Education, 2015). Further, the Malawi government has singled out science as a remedy to enhance development and economic growth as indicated by policy direction which underlines a move from a net expending and importing nation to rather a net exporting one (Ministry of Finance Economic Planning and Development, 2016). In spite of these policy directions, minimal learners' involvement and achievement in science subjects, both in primary and secondary levels have been observed countrywide (Dzama, 2006). This has an enormous effect on the learners' career routes. To address the poor performance and participation in science subjects, the Ministry of Education, Science and Technology (MoEST) has taken a number of interventional measures to address the challenges such as multi-modal training of physics teachers and provision of physics teaching and learning resources. These interventions, at Domasi Demonstration Secondary School, were expected to positively transform Form 3 physics students' thinking about their ability to learn physics and their physics learning strategies. However, as observed by a physics teacher at the school (F. Kasenda, personal communication, February 27, 2019), students' physics achievement of Form 3 students was still low. To further understand the problem, Bandura (1989) explained that learning takes place in a social context with a dynamic and bi-directional interplay of individual cognitive factors, learning environmental factors, and individual behaviors(Bandura, 1989). The reasons for low student achievement in physics can, therefore, be understood as consequences of deficits in the social learning contexts of students' self-efficacy for learning and performance in physics, as well as their metacognitive self-regulation of physics learning.

Research Objectives

The research objectives for this study were as follows.

1. To determine the level of self-efficacy for learning and performance in physics of Form 3 students at Domasi Demonstration Secondary School in Malawi.
2. To determine the level of metacognitive self-regulated physics learning of Form 3 students at Domasi Demonstration Secondary School in Malawi.

3. To determine the level of physics achievement of Form 3 students at Domasi Demonstration Secondary School in Malawi.
4. To determine whether there is a significant relationship of self-efficacy for learning and performance in physics and metacognitive self-regulated physics learning with physics achievement of Form 3 students at Domasi Demonstration Secondary School in Malawi.

Conceptual Framework

The conceptual framework was developed based on the knowledge base in education and previous empirical studies. There were two independent variables which were self-efficacy for learning and performance in physics and metacognitive self-regulated physics learning. The dependent variable was physics achievement. These variables were tested in Malawi on 40 Form 3 physics students studying at Domasi Demonstration Secondary School using multiple correlation analysis. Figure 1 shows the conceptual framework used in the study.

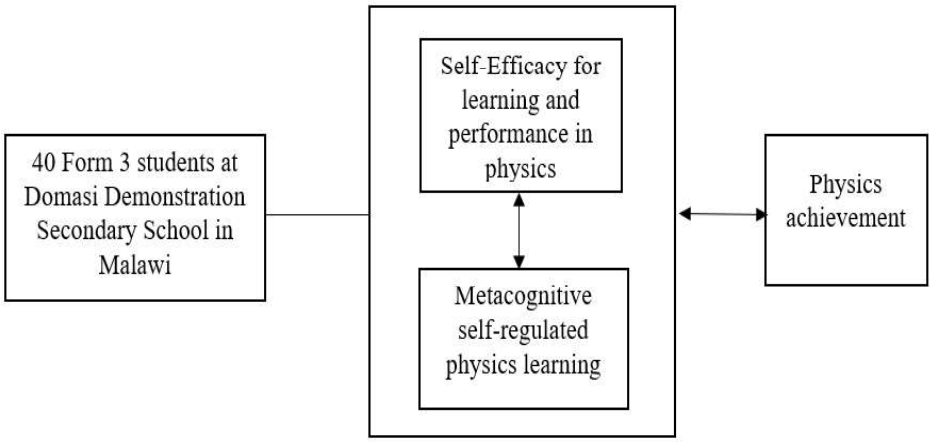

Figure 1. ***Conceptual Framework for the Study.***

Literature Review

Social Cognitive Theory

Social cognitive theory (SCT), developed by Bandura in 1986, postulates that learning takes place in a social setting with a dynamic and reciprocal interaction of the person, the condition, and behavior (Bandura, 1989). The special feature of SCT is the stress on social impact, external and internal social reinforcement. SCT takes into account the special manner by which individuals obtain and sustain behavior, while additionally considering the social conditions in which people execute specific behaviors. The theory, further, considers an individual's past encounters, which predict whether

behavioral activity will take place. These past experiences impact reinforcements, prospects, and expectancies, all of which shape whether an individual will participate in a particular behavior and the reasons why an individual takes part in that behavior (Bandura, 1989).

Social cognitive theory, therefore, depicts a model of causation that emphasizes the dynamic interaction between people (personal factors), their behavior, and their environments as demonstrated in a construct called triadic reciprocal determinism (Bandura, 1989).

Self-efficacy Theory

Self-efficacy alludes to an individual's inner self-belief about their capacity to accomplish a fruitful result in a given assignment (Bandura, 1989). Self-efficacy is affected by four critical sources of information: performance accomplishments, vicarious experience, verbal persuasion, and physiological information (Alegre, 2014; Bandura, 1989; Bernstein et al., 1996; Sadi & Uyar, 2013). Bandura (1994) expressed the most grounded contributing source to self-efficacy is mastery experience. Achievement increases self-efficacy. Failure diminishes self-efficacy, particularly if it happens before a solid feeling of self-efficacy is developed.

Self-regulation Theory

Self-regulation theory (SRT) is a system of cognizant individual management that includes the way toward controlling one's own thoughts, practices, and emotions to achieve objectives. Self-Regulation is comprised of three stages, and people must function as providers of their own inspiration, conduct, and improvement inside a system of reciprocally interrelating influences (Bandura, 1991). Further, Baumeister, Schmeichel and Vohs (2005) distinguish four segments of self-regulation: standards of desirable behavior, motivation to meet standards, monitoring of situations and thoughts that lead ending said standards, and finally, willpower.

Motivated Strategies for Learning Questionnaire (MSLQ)

The MSLQ created by Pintrich, Smith, Garcia and McKeachie in 1991 as a self-administering questionnaire. The research instrument was initially used to measure high school and university students' motivation and learning strategies (Pintrich, Smith, Garcia & McKeachie, 1991). The instrument consists of two sections - a learning strategies section (50 items total) and a motivation section (31 items total). This study will adapt and utilize only one of the nine subscales of learning strategies – metacognitive self-regulation, and one of the six subscales of the motivation section of the MSLQ – self-

efficacy for learning and performance. Other subscales of the instrument will not be used in the current research.

Method

This study employed a quantitative correlational research design where data obtained from study variables' measurements was analyzed to determine the extent of the relationship variables among them. The levels of student self-efficacy for learning and performance in physics, and metacognitive self-regulated physics learning were measured by the by the relevant sub-scales drawn from the Motivated Strategies for Learning Questionnaire **(**MSLQ) (Pintrich et al., 1991) with minor adaptations to reflect physics learning. Physics achievement was measured by the Form 3 End of Term 3 Physics Examination at Domasi Demonstration Secondary School. At the end of the research, descriptive statistics (means and standard deviations) and correlational analysis (multiple correlation coefficient, *R*) were used to determine whether there was a significant relationship of self-efficacy for learning and performance in physics and metacognitive self-regulated physics learning with physics achievement of the Form 3 students.

Population and Sample

There were 80 students in Form 3 at Domasi Demonstration Secondary School in Term 3, 2019. The sample for the study was the 40 students (19 female, 21 male) who were studying physics.

Research Instruments

There were two research instruments used in this study. The first was the Motivated Strategies for Learning Physics Questionnaire (MSLPQ) which examined students' levels of self-efficacy for learning and performance in physics, and their meta-cognitive self-regulated physics learning. The second was the End of Term 3 Physics Examination which assessed students' physics achievement.

MSLPQ

The Motivated Strategies for Learning Physics Questionnaire (MSLPQ) used in this study was adapted from the Motivated Strategies for Learning Questionnaire (MSLQ) created in 1991 by Pintrich, Garcia, Smith and McKeachie. MSLQ has 81items and six subscales. This study utilized two subscales i.e., self-efficacy for learning and performance, and metacognitive self-regulation. Table 1 shows the internal reliability of the MSLQ.

Table 1. *Internal Reliability of MSLQ*

Questionnaire	Cronbach's alpha			
	MSLQ by Pintrich et al. (1991)	Said and Uyar's research (2013)	Lin and Lynch's research (2016)	This study
Self-efficacy for learning and performance	.93	.80	.95	.87
Metacognitive self-regulation	.79	.72	-	.73

All items in the subscales use a 7-point Likert-type scale, ranging from 1 *(not at all true of me)* to 7 *(very true of me)*. Scoring of the questionnaire required students to rate themselves on the scale The MSLQ matches the mean value scores to an interpretation, ranging from very low to very high levels as shown in Table 2.

Table 2. *Interpretation of the Scores of Motivated Strategies for Learning Physics Questionnaire Results*

Likert-type scale	Score	Scale	Interpretation
Not all true of me	1	1.00 – 1.50	Very low
	2	1.51 – 2.50	Moderately low
	3	2.51 – 3.50	Slightly low
	4	3.51 – 4.50	Neither high nor low
	5	4.51 – 5.50	Slightly high
	6	5.51 – 6.50	Moderately high
Very true of me	7	6.51 – 7.00	Very high

End of Term 3 Physics Examination

The second instrument in this study was the End of Term 3 Physics Examination. The examinations were developed by two qualified physics teachers in accordance with the physics national examinations' standards and based on the physics curriculum to measure students' physics achievement. The examination comprised 26 objective items and 18 items that required varied responses (e.g., essay, calculations). A marking scheme indicating how each item should be scored was developed for the examination to avoid bias in grading. The scores from the examination were translated into a percentage score and reported as physics achievement in this study.

The reliability of the examination was further estimated using a split-half method and inter-rater reliability. Table 3 indicates the internal reliability of the 26 objective items.

Table 3. *Internal Reliability of Objective Items of End of Term 3 Physics Examination*

Measure			Coefficient
Cronbach's alpha	Part 1	Value	.81
		N of items	13
	Part 2	Value	.73
		N of items	13
	Total *N* of items		26
Correlation between forms			.76
Spearman-Brown Coefficient	Equal length		.86
	Unequal length		.86
Guttman-Brown split-half coefficient			.85

Further, they were 18 items that required varied responses (e.g., essay, calculations). These items were also isolated from the examination paper. The 18 items were graded by two teachers to generate inter-rater reliability. One marking scheme was used by both raters. The students' grades were calculated by finding the average of two scores from the raters. The grades indicated minor differences in scoring by both raters (M = 37.10, SD = 2.15). The percentage agreement of the two raters was 79%. This suggested that the inter-rater reliability was high.

The percentage score obtained in the 2019 End of Term 3 Physics Examination and indicated in the student academic record were used in this research as the students' physics achievement. These scores were interpreted in equal intervals as indicated in Table 4.

Table 4. *Interpretation of the End of Term 3 Physics Achievement*

Physics score	Interpretation
0 – 20	Very low
21 – 40	Low
41 – 59	Moderate
60 – 79	High
80 – 100	Very high

Findings

Research Objective 1

Research Objective 1 was to determine the level of self-efficacy for learning and performance in physics of Form 3 students at Domasi Demonstration Secondary School in Malawi in Term 3 of the 2019 academic year. This was determined by calculating the students' self-efficacy for learning and performance in physics mean scores as shown in Table 5.

Table 5. *Mean, Standard Deviation and Interpretation for Students' Self-Efficacy for Learning and Performance in Physics*

N	*M*	*SD*	Interpretation
40	6.62	.21	Very high

The data in Table 5 show that the mean score of self-efficacy for learning and performance in physics for the whole sample was 6.62. According to Table 2 in and Table 5 above, this value is considered as very high self-efficacy for learning and performance in physics.

Research Objective 2

Research Objective 2 was to determine the level of metacognitive self-regulated physics learning of Form 3 students at Domasi Demonstration Secondary School in Malawi in Term 3 of the 2019 academic year. This was determined by calculating the students' metacognitive self-regulated physics learning mean scores as shown in Table 6.

Table 6. *Mean, Standard Deviation and Interpretation for Students' Metacognitive Self-Regulated Physics Learning*

N	*M*	*SD*	Interpretation
40	5.80	1.35	Moderately High

The data in Table 6 above show that the mean score of metacognitive self-regulated physics learning for the whole sample was 5.80. According to Table 2 and 6 above, this value is considered as moderately high metacognitive self-regulated physics learning for the students.

Research Objective 3

Research Objective 3 was to determine the level of physics achievement of Form 3 students at Domasi Demonstration Secondary School in Malawi in Term 3 of the 2019 academic year. This was determined by calculating the students' End of Term 3 Physics Examination mean scores as shown in Table 7.

Table 7. *Mean, Standard Deviation and Interpretation for Students' Physics Achievement*

N	Range	*M*	*SD*	Interpretation
40	11-88	49.72	21.76	Moderate

The data in Table 7 show that the average student's physics achievement was 49.72. This was based on the End of Term 3 Physics Examination results for the whole sample. According to the interpretation Table 4 and 7 above, this value is considered as moderate physics achievement.

Research Objective 4

Research Objective 4 was to determine whether there was a significant relationship of self-efficacy for learning and performance in physics and metacognitive self-regulated physics learning with physics achievement of Form 3 students at Domasi Demonstration Secondary School in Malawi in Term 3 of the 2019 academic year. This was determined by carrying out a multiple correlation analysis (using multiple correlation coefficient) using all data from the two research instruments. First, the bivariate correlation among the bivariate correlations among self-efficacy for learning and performance in physics, metacognitive self-regulated physics learning and physics achievement values of Form 3 students at Domasi Demonstration Secondary School in Malawi in Term 3 of the 2019 academic year was run as presented in Table 8.

Table 8. *Bivariate Correlations Between Self-Efficacy for Learning and Performance in Physics, Metacognitive Self-Regulated Physics Learning and Physics Achievement (N = 40)*

Variables	1	2	3
1. Self-efficacy for learning and performance in physics	-		
2. Metacognitive self-regulated physics learning	.46**	-	
3. Physics achievement	.40**	.39*	-

Note. **. indicates that correlation is significant at the 0.01 level (2-tailed) while *. indicates that correlation is significant at the 0.05 level (2-tailed).

Table 8 indicates a significant relationship of self-efficacy for learning and performance in physics and metacognitive self-regulated physics learning with physics achievement of Form 3 physics students at Domasi Demonstration Secondary School at .05 level. Table 8 also shows that multicollinearity was not a problem since the correlation between the independent variables were

relatively moderate, thus allowing for a multiple correlation analysis (using multiple correlation coefficient) as shown in Table 9 below.

Table 9. *Multiple Correlation Coefficient Analysis Between Self-Efficacy for Learning and Performance in Physics, and Metacognitive Self-Regulated Physics Learning with Physics Achievement*

			dfs			
Independent variables	*R*	R^2	Between groups	Within groups	*F*	*p*
Self-efficacy for learning and performance in physics and metacognitive self-regulated physics learning	.47	.22	2	37	5.14	.011

Table 9 indicated that there was a strong positive significant relationship between self-efficacy for learning and performance in physics and metacognitive self-regulated physics learning with physics achievement (R = .47, $p < .05$) at .05 significance level. It also showed that the independent variables explained 22% of the variance of physics achievement (R^2 = .22, F (2,37) = 5.14, $p < .05$). The other 78% of the variance of physics achievement is explained by other factors.

Discussion

The findings indicated a moderately strong, positive and significant relationship between the combined independent variables (self-efficacy for learning and performance in physics and metacognitive self-regulated physics learning) with the dependent variable, physics achievement. The combined independent variables also explained 22% of the variance of physics achievement. The findings mean that the higher the score the student gets in one of the variables, the higher the score the student will get on the other two variables, and *vice versa*. This suggests that, in the current study, the higher the students' self-efficacy for learning and performance in physics levels, the better the metacognitive self-regulated physics learning levels, and the higher the physics achievement levels.

The findings were expected considering the reported moderately strong and positive correlation of each independent variable with the dependent variable. Students who believe in their abilities to learn and perform take responsibility of their own learning and are inclined to achieve higher in their academics. Similarly, students with low self-efficacy exercise little control on their

learning and tend to achieve less in their studies (Bandura, 1997; Schunk & Pajares, 2002). Further, it was suggested that self-efficacy for learning and performance in physics contributed greatly to physics achievement compared to metacognitive self-regulated physics learning. These findings are consistent with theoretical reasoning in this study (Bandura, 1997) and is also reflected in a number of studies (e.g., Alegre, 2014; Bakar, Shuaibu & Bakar, 2017; Los, 2014; Shaine, 2015) for a basic reason that efficacious students are likely to engage into different learning strategies in addition to metacognitive self-regulation to achieve high scores.

Physics achievement for Form 3 students was expected to be low according to physics teachers at the school (F. Kasenda, personal communication, February 27, 2019). However, the findings indicated a moderate physics achievement. The positive change, though minor, in physics achievement can be attributed to interventional measures towards low achievement by the Malawi Ministry of Education, Science and Technology (Malawi Institute of Education, 2015). These measures included training of physics teachers, provision of different physics resources and sharing of best practices in physics instruction amongst physics teachers.

Recommendations

Recommendations for Students

The findings of this research have showed that students with high self-efficacy for learning and performance in physics will also have high use of metacognitive self-regulated physics learning strategies and high physics achievement, and *vice versa.* Through more dedicated practice on meta-cognitive learning, students should, therefore, develop positive self-confidence in their capabilities to learn and perform in physics, take control of their own learning, and think of what they are reading or studying as they do physics by setting personal goals and monitoring their activities put in place to achieving the goals. This will increase their scores in physics.

Recommendations for Teachers

The findings of the research have demonstrated that physics achievement can be increased by increasing self-efficacy for learning and performance in physics and metacognitive self-regulated physics learning. Teachers should strive in motivating students to have self-confidence in learning physics and taking control of their own learning in order to increase students' physics achievement. Teachers must model learning that promotes metacognitive learning in students.

Recommendations for administrators and Malawi Ministry of Education

This research has indicated that students who believe they can do better in physics and manage their physics learning have higher scores in physics. The administrators should, therefore, encourage physics teachers to motivate their students and mount professional development sessions to teach teachers how to model metacognitive learning in physics. The Malawi Ministry of Education and administrators should also provide and offer a learning environment that helps students develop self-confidence in learning physics. They can provide adequate resources such as laboratory materials, interactive workbooks, textbooks and models for physics learning and train teachers to effectively use the resources so that students develop self-confidence in learning physics as they interact with the resources. Administrators should also mount programs such as science fairs, class projects, field visits, design competitions so that students develop self-confidence in and control of their physics learning.

Recommendations for future researchers

This research had limitations as it was confined to a single grade level and at one school, small sample (N = 40), and one type of school setting, among others. It is necessary for future researchers to conduct further research with larger samples drawn from different schools in Malawi with a variety of teachers, students and in different education divisions in order to get representative relationship among metacognitive self-regulated physics learning, self-efficacy for learning and performance and physics achievement. Metacognitive self-regulated physics learning, and self-efficacy for learning and performance only explained 22% of the variance in physics achievement in this study. It is, therefore, recommended that future researchers should consider taking into account the role of other research variables including other variables such as resource management strategies, student values, and affective beliefs in physics learning.

REFERENCES

Alegre, A. A. (2014). Academic self-efficacy, self-regulated learning and academic performance in first-year university students. *Propósitosy Representaciones*, *2*(1), 101–120.

Bakar, N. A. & Shuaibu, A. & Bakar, R.A. (2017). Correlation of self-regulated learning and academic achievement among Universiti Sultan Zainal Abidin (UniSZA) Undergraduate Students. *International Journal of Academic Research in Business and Social Sciences*, *7*(4), 254-268.

Bandura, A. (1989). Social cognitive theory. In R. Vasta (Ed.), *Annals of Child Development,* 6, *Six theories of child development* (pp.1-60). Greenwich, CT: JAI Press.

Bandura, A. (1991). Social cognitive theory of self-regulation. *Organizational Behavior and Human Decision Processes, 50*(2), 248–287.

Bandura, A. (1994). Self-Efficacy. In V. S. Ramachaudran (Ed.), *Encyclopedia of Human Behavior* (Vol. 4, pp.71-81). New York: Academic Press.

Bandura, A. (1997). *Self-efficacy: The exercise of control*. New York: Freeman.

Baumeister, R. F., Schmeichel, B. J., & Vohs, K. D. (2005). Self regulation and the executive function of self (pp. 1–70). Retrieved from http://assets.csom.umn.edu/assets/71708.pdf

Bernstein, C. N., Pettigrew, N. M., El-Gabalawy, H. S., Sargent, M., Meu, Y., & Wilkins, J. (1996). The differential expression of a novel intestinal epithelial glycoprotein in various forms of inflammatory bowel disease. *American Journal of Clinical Pathology*, *106*(1),

Dzama, E. N. N. (2006). *Malawian secondary school students' learning of science: Historical background, performance and beliefs* (Doctoral thesis, University of the Western Cape, Republic of South Africa).

Government of Malawi. (2015). Malawi Vision 2020: National long-term development perspective for Malawi. Retrieved from https://cepa.rmportal.net/Library/government-publications/Vision 2020- The national long term development perspective for Malawi.pdf

Lin, C. & Lynch, R. (2006). The relationship between motivation for learning Chinese as a foreign language and Chinese achievement of Grade 9 students at Ekamai international school in Bangkok, Thailand. *Scholar: Human sciences, 8*(2), 63-77.

Los, R. (2014). The effects of self-regulation and self-efficacy on academic outcome. University of South Dokota. Retrieved from https://www.researchgate.net/publication/269106120_The_effects_of_self-regulation_and_self-efficacy_on_academic_outcome

Malawi Institute of Education. (2015). *Secondary school curriculum and assessment framework*. Zomba. Retrieved from http://www.mie.edu.mw

Ministry of Finance Economic Planning and Development. (2016). *Malawi growth and development strategy II: Review and country situation analysis report*. Retrieved from http://www.eisourcebook.org/cms/Malawi, Final Review, Malawi Growth and Development Strategy 2016.pdf

National Comission for Science and Technology. (2017). *National research agenda in energy, industry and engineering national research agenda in energy, industry and engineering (2017 – 2022)*. Lilongwe. Retrieved from https://www.ncst.mw/wp-content/uploads/2017/08/national-energy-industry-and-engineering-research-agenda-final-march-2017.pdf

Pintrich, P. R., Smith, D. A. F., Garcia, T., & McKeachie, W. J. (1991). A manual for the use of the motivated strategies for learning questionnaire (MSLQ). Retrieved from https://eric.ed.gov/?id=ED338122

Sadi, O., & Uyar, M. (2013). The relationship between self-efficacy, self-regulated learning strategies and achievement: A path model. *Journal of Baltic Science Education*, *12*(1), 21–33. https://doi.org/10.1016/j.sbspro.2013.09.291.

Schunk, D. H., & Pajares, F. (2002). The development of academic self-efficacy. In A. Wigfield & J. S. Eccles (Eds.), *Development of achievement motivation: A volume in the educational psychology series* (pp. 15–31). San Diego: Academic Press.

Shaine, M.H. (2015). The effect of self-regulated learning strategies and self-efficacy on academic achievement of primary school students. *Psychology and Behavioral Sciences*. *4*(3), 107-115.