VillageMath Educational Review

Network for Grassroots Science and Mathematics Education (The VillageMath Network)

Department of Mathematics Education
Federal University of Agriculture, Makurdi, NIGERIA

Volume 2, Issue 1 | April, 2021 | CODEN: VERIAU

Attitude, Motivation and Self-Regulatory Skills as Predictors of Perception of Difficulty and Retention in Physics

Mrs. Veronica Enemarie

Department of Science, Mathematics and Computer Education,
Benue State University, Makurdi, Nigeria

DOI: 10.5281/zenodo.4705863
Article History: Received 6th April, 2021; Revised 15th April, 2021; Published 20th April, 2021.

How to Cite this Article:
Enemarie, V. (2021). Attitude, Motivation and Self-Regulatory Skills as Predictors of Perception of Difficulty and Retention in Physics. *VillageMath Educational Review (VER), 2(1)*, 23-31. https://ngsme.villagemath.net/journals/ver/v2i1/enemarie

Abstract

Physics is considered as one of the most prevailing and problematic subject by the students in the realm of science. Students perceived Physics as a difficult subject during secondary school days and become more evasive when they reach the higher education level. Since Physics Education is critical to the economic and technological development of every nation, students of Physics across all levels of education need to perform well in their academics and play an active role in the society. This pivotal role of Physics Education necessitates the need for researchers to focus on the role of attitude and motivation of self-regulatory skills as predictors of students' perception of difficulty and retention in Physics. This paper is theoretical exploration of the importance of this connection.

Keywords: Attitude, Motivation, Self-Regulatory Skills, Physics Education

Introduction

Physics is considered as the most problematic area within the realm of science, and it traditionally attracts fewer students than other sciences like Chemistry and Biology. Most of the students perceived Physics as a difficult subject during high school days and see the subject becomes more problematic when they are in college, and even more challenging in graduate education. In this setting, it is more perplexing to most students to study Physics because of the undesirable reputation long before time. With this, only students who do well in high school Physics and students that are exceptionally good in mathematics, remarkably talented and gifted in science can appreciate the role of Physics in their daily life.

With such discourse in the Physics Education, students tend to have a negative attitude towards the learning of Physics because of its computational exigency in every problem sets. But this could be different with self-regulators.

Good self-regulators have developed the skills and habits to be effective learners, exhibiting effective learning strategies, effort, and persistence. Self-regulated students are those students who are meta-cognitively, motivationally, and behaviorally active in their own learning processes and in achieving their own goals (Zimmerman & Schunk, 2008).

Specifically, self-regulated learning consists of three components: cognition, meta-cognition, and motivation. The cognition component includes the skills and habits that are necessary to encode, memorize, and recall information as well as think critically. Within the meta-cognition component are skills that enable learners to understand and monitor their own cognitive processes. The motivation component surfaces in the beliefs and attitudes that affect the use and development of both the cognitive and metacognitive skills.

Students' Attitude towards Learning

Attitude can distort the perception of information and affect the degree of their retention. Attitudes towards science, scientists, and learning of science have always been a concern for science educators. Attitude is very broadly used in discussing issues in science education and is often used in various contexts. Two broad categories are distinguishable. The first one is attitude toward science (e.g., interest in science, attitude toward scientists, or attitudes toward social responsibility in science). Attitude towards science can be defined as the feelings, beliefs, and values held about an object that may be the endeavor of science, school science, the impact of science and technology on society, or scientists. The second one is scientific attitude (i.e., open-mindedness, honesty, or skepticism). Scientific attitude is the desire to know and understand, question all statements, search for data and their meaning, search for verification, and consideration of consequences (Gardner, 1975; Osborne, Simon & Collins, 2003). According to Mbajiorgu and Reid (2006) and Reid (2006), attitudes have four issues that are important in physics. These are attitudes towards physics, attitudes towards physics subjects, attitude toward learning physics, and scientific (the methods) attitude. Attitude scale in this study is agreed with to attitudes towards physics, attitudes towards physics subjects, attitude toward learning physics.

One of the utmost significant factors which affect students' academic success in physics is their attitudes towards lessons and academic success. Attitude is a tendency for individuals to organize thoughts, emotions and behaviors towards a psychological object. Human beings are not born with attitudes; they learn them afterwards. Some attitudes are based on people's own experiences, knowledge and skills, and some are gained from other sources. However, attitude does not stay the same; it changes in the course of time (Erdemir & Bakirci, 2009).

Learner's motivation in learning is affected by their attitudes towards learning the subject. The relation between motivation and attitudes has been considered a prime concern in learning. Gardner (1980) elaborates attitude as the sum total of a man's instincts and feelings, prejudice or bias, preconceived notions, fears, threats, and convictions about any specified topic. For instance, a study conducted by Shuib (2009) revealed that most students had positive attitudes towards the social value and educational status of learning, in addition, the findings showed the students' positive orientation toward the language learning. Ajzan (1988) considers attitude as a disposition to respond favorably or unfavorably to an object, person, institution or event.

The measurement of students' attitudes towards physics should take into account their attitudes towards the learning environment (Crawley & Black, 1992). The effect of student's attitude toward science is incredibly important, because in problem solving requires patience, persistence, perseverance and willingness to accept risk (Charles, Lester & O'Daffer, 1987). Pintrich and Maehr (2004) classify students in three groups such as the ones who avoid failure, the ones who would like to satisfy their curiosity and the ones who want to get high marks. The study shows that with students in the same class, their motivation degrees and strategies are different. When students have positive attitudes, they show positive behaviors and they fulfill their academic necessities.

Eryilmaz, Yildiz & Akin (2011) examined the relationship between attitudes of high school students towards physics laboratory and being motivated for class engagement or not. They concluded that students who have high-level motivation for class engagement have also positive attitudes towards physics laboratory. In contrast with this conclusion, students who have low-level motivation for class engagement have negative attitudes towards physics laboratory.

Achievement, motivation and student interest are influenced by positive and negative attitudes (Miller, Abraham, Cohen, Graser, Harnack, & Land, 1961). Additionally, it is found out that students with positive attitudes towards physics had positive attitudes towards their science teachers, science curriculum and science-classroom climate. Students' attitude towards science is more likely to influence the success in science courses than success in influencing attitude (Morse & Morse, 1995).

If students have negative attitudes towards science, they also do not like physics courses and physics teachers. Based on this premise, numerous studies have been conducted to determine the factors that affect the students' attitudes in science. There are basic factors including: teaching-learning approaches, the use of the presentation graphics, the type of science courses taken, methods of studying, intelligence, gender, motivation, attitudes, science teachers and their attitudes, self-adequacy, previous learning, cognitive styles of students, career interest, socioeconomic levels, influence of parents, social implications of science and achievement (Craker, 2006).

Many researchers believed that if students were allowed to demonstrate higher cognitive abilities through problem solving, either through a teacher-centered approach or a student-centered approach, their attitudes towards physics might be positively affected (Erdemir, 2009). Furthermore, it was concluded that the poor student attitudes towards physics was due to the lack of information, lack of problem solving skills, lack of self-confidence, using a formula incorrectly and lack of acting like experts while they solve physics problems.

Students' Motivation towards Learning

Motivation is a very complex phenomenon with many facets. This is because the term motivation has been viewed differently by different schools of thought. Brown (2000) identified motivation as quite simply the anticipation of reward, he also asserts that motivation of learners often refer to a distinction between two types of motivation namely, instrumental versus integrative motivation.

Students' motivation can be external or intrinsic. External motivation generally consists of recognition and praise for good work. In a college student, this might be in the form of sustainability of the scholarships, or good impression in the class and at home. Students' grades are one of the most prominent factors as their extrinsic goal orientation. While intrinsic motivation generally consists of an internal desire to learn about a specific topic. According to Vansteenkiste, Simons, Lens, Soenens, Matos, & Lacante (2004) students with intrinsic motivation processed reading material more deeply, achieved higher grades, and showed more persistence than students with extrinsic motivation.

Learners' motivation has been widely accepted as a key factor which influences the rate and success in Physics. There are many factors that might cause the students' low proficiency. According to McDonough (1983), motivation of the students is one of the most important factors influencing their success or failure in learning. A better understanding of students' motivation and attitudes may assist curriculum and instruction designers to devise language teaching programs that generate the attitudes and motivation most conducive to the production of more successful student.

According to Maehr and Midgley (1991), motivation for class engagement is one of variables. Motivation has a significant role in teaching and learning. But today, according to motivational perspective, students are considered as individuals who are able to reach a decision by assessing possibilities and consequences that can transfer their aims into life and form meaning. Motivation to class engagement means that students want to engage the class activities if they have motivation.

Based on the study of Eryilmaz, Yildiz & Akin (2011), on investigating the relationships between attitudes towards physics laboratories, motivation and motivation for the class engagement, shows that the most significant problem that teachers confront in physics lessons is that abstract or concrete subjects cannot be comprehended by students correctly or efficiently. It was observed that the students who have negative attitude towards physics have lack of motivation for class engagement, and also the students who have positive attitudes towards physics have motivation for class engagement. Craker (2006) demonstrated that attitudes towards science change with exposure to science, but the direction of change may be related to the quality of that exposure, the learning environment, and teaching method. Similar results were obtained in the study conducted by Mattern and Schau (2002) after exposing students to a self-learning device.

Self-Regulated Learning (SRL)

Self-Regulated Learning (SRL) is one of the domains of self-regulation, and is aligned most closely with educational aims. Broadly speaking, it refers to learning that is guided by *metacognition* (thinking about one's thinking), *strategic action* (planning, monitoring, and evaluating personal progress against a standard), and *motivation to learn*. A self-regulated physics student monitors, directs, and regulates actions toward goals of information acquisition, expanding expertise, and self-improvement. In particular, self-regulated learners are cognizant of their academic strengths and weaknesses, and they have a repertoire of strategies they appropriately apply to tackle the day-to-day challenges of academic tasks. These learners hold incremental beliefs about intelligence (as opposed to entity, or fixed views of intelligence) and attribute their successes or failures to factors (e.g., effort expended on a task, effective use of strategies) within their control.

Finally, self-regulated learners take on challenging tasks, practice their learning, develop a deep understanding of subject matter, and exert effort will give rise to academic success. In part, these characteristics may help to explain why self-regulated learners usually exhibit a high sense of self-efficacy. In educational psychology literature, researchers have linked these characteristics to success in and beyond school.

Self-regulated learners are successful because they control their learning environment. They exert this control by directing and regulating their own actions toward their learning goals. Self-regulated learning should be used in three different phases of learning. The first phase is during the initial learning, the second phase is when troubleshooting a problem encountered during learning and the third phase is when they are trying to teach others.

Self-regulation unfolds over "four flexibly sequenced phases of recursive cognition." These phases are task perception, goal setting and planning, enacting, and adaptation.

i. During the task perception phase, students gather information about the task at hand and personalize their perception of it. This stage involves determining motivational states, self-efficacy, and information about the environment around them.
ii. Next, students set goals and plan how to accomplish the task. Several goals may be set concerning explicit behaviors, cognitive engagement, and motivation changes. The goals that are set depend on how the students perceive the task at hand.
iii. The students will then enact the plan they have developed by using study skills and other useful tactics they have in their repertoire of learning strategies.
iv. The last phase is an adaptation, wherein students evaluate their performance and determine how to modify their strategy in order to achieve higher performance in the future. They may change their goals or their plan; they may also choose not to attempt that particular task again. All academic tasks encompass these four phases.

Zimmerman & Schunk (2008) suggested that self-regulated learning process has three stages:

i. Forethought, learners' preparing work before the performance on their studying;
ii. Volitional control, which is also called "performance control", occurs in the learning process. It involves learners attention and willpower;
iii. Self-reflection happens in the final stage when learners review their performance toward final goals. At the same time, focusing on their learning strategies during the process is also efficient for their final outcomes.

Mousoulides and Philippou (2005) define self-regulated learning as a process in which personal, contextual, and behavioral factors interact and provide students an opportunity to control their learning. Similarly, Pintrich (1999) states that self-regulated learning are an active, constructive process that involves learners setting specific goals for actions related to their learning plans. After this, the students then continually monitor their plans and regulate their cognition, motivation and behavior to achieve their set goals.

Pintrich and De Groot (1990) have demonstrated that students' self-regulation of learning is positively correlated to retention & academic achievement in the classroom. Specifically, the researchers found a connection between students' scores on a self-report measure of self-regulated learning and students' work on certain classroom coursework. That is, students with higher self-regulated learning had obtained higher assignment grades. While this study was conducted at the secondary education level with seventh grade students, these findings remain significant and a formative base from which future work can extend. To help build upon the foundational work that was provided by Social Cognitive Theory, researchers extended the model into a framework that also addressed students' motivation. Pintrich (1999), now including motivation, defines self-regulated learning as an active and constructive process that first involves making academic objectives. After these are established, there are certain cognitive and behavioral components that one must use to work toward achieving his or her academic goals. The framework originally presented by Pintrich (1999) states that these components, which make up the necessary efforts in the self-regulated learning process, consist of monitoring, regulating, and controlling one's cognition, motivation, and behavior (Mousoulides & Philippou, 2005).

In the classic study previously described, Pintrich and De Groot (1990) also included a measure of students' motivational orientation. After employing a factor analysis, the authors focused their specific measure of motivation to include items related to self-efficacy (i.e., perceived competence and confidence in performance of class work), intrinsic value (i.e., a central interest in and perceived importance of course work), and test anxiety (i.e., worry about and cognitive interference on tests) (Pintrich & De Groot, 1990).

As expected, the researchers found that students' motivation was positively related to their cognitive engagement and academic performance in their class. More specifically, the self-efficacy factor was positively related to cognitive engagement and class performance. Of particular note, self-efficacy's relationship with performance was non-significant once the authors statistically controlled for cognitive engagement. The authors state this finding suggests that self-efficacy plays a less direct, more facilitative role and that cognitive engagement is more directly related to students' actual achievement. It would seem that students' self-regulated learning (through cognitive and metacognitive engagement of learning strategies and effort management) is a stronger predictor of academic retention & performance. However, self-efficacy may help assist students' use of these self-regulated learning strategies (Pintrich & De Groot, 1990). Supporting this position, Komarraju and Nadler (2013) more recently reported that students with high self-efficacy tended to pursue mastery goals and performance goals, self-efficacy was predictive of students' retention, and that self-efficacious students meet their achievement goals through self-regulation and persistence. Pintrich and De Groot (1990) also reported that the second factor of their measure of motivation, intrinsic value, was closely related to students' self-regulated learning. Students who were more motivated to learn physics and believed it was interesting and important were more cognitively engaged and self-regulating when it came to their schoolwork. Again, self-regulation was a better predictor of performance. Yet, motivation, in the form of placing an intrinsic value on the material being learned, seems to be vital when determining whether or not students will choose to be engaged in their academic tasks (Pintrich & De Groot, 1990). Finally, test anxiety was not related to cognitive engagement or self-regulation. However, this facet of motivation was negatively related to both the self-efficacy factor of overall motivation and exam performance (Pintrich & De Groot, 1990). Although not significant, more test anxious students reported less self-regulation. Pintrich and De Groot (1990) stated that these results, in line with past research, reveal that test anxiety may be related more to retrieval problems during testing rather than any insufficient cognitive or metacognitive strategies that are a part of students' self-regulated learning process.

Student Performance Perspective

Studies have shown comparable student performance between instructor-led and self-regulated learning environments. Self-regulated learning has been shown to enable accelerated learning while maintaining long-term retention rates. Studies have also noted the importance of internal locus of control tendencies on successful academic performance, also compatible with self-regulated learning. Whyte recognized and appreciated external factors, to include the benefit of working with a good teacher, while encouraging self-regulated hard work, skill-building, and a positive attitude to perform better in academic situations.

To increase positive attitudes and academic performance, expert learners should be created. Expert learners develop self-regulated learning strategies. One of these strategies is the ability to develop and ask questions and use these questions to expand on their own prior knowledge. This technique allows the learners to test the true understanding of their knowledge and make correction about content areas that have a misunderstanding. When learners engage in questioning, it forces them to be more actively engaged in their learning. It also allows them to self-analyze and determine their level of comprehension.

This active engagement allows the learner to organize concepts into existing schemas. Through the use of questions, learners can accommodate and then assimilate their new knowledge with existing schema. This process allows the learner to solve novel problems and when the existing schema does not work on the novel problem the learner must reevaluate and assess their level of understanding.

The predictive value of the self-regulation strategies confirmed the fact that students who plan efficiently their study, monitor their learning progress, constantly adjusts their behavior to the requirements of learning situations, perform better and have higher levels of academic adjustment

(Cazan & Anitei, 2010). This agrees with previous research suggesting that self-regulation is an integral part of student academic achievement (Kornell & Metcalfe, 2006; Kitsantas, Winsler, & Huie, 2008) and of academic adjustment. Test anxiety was negatively correlated with both academic performances and academic adjustment, and it negatively influences academic adjustment, results which are in line with prior research (Bembenutty, 2008; Kitsantas, Winsler, & Huie, 2008).

Conclusion

Physics lessons being held in the classroom on the sole theoretical basis is one of the factors that influence attitude of the students toward these lessons in a negative manner. Thus, Physics topics consist abstract concepts should be lectured in the students' daily life, together with simulations, animations and other videos to keep the attention of the students alive. Learning by discovery is better than passive listening, so students should be shown how to associate physical concepts with their daily life of the students. Instead of increasing physics laboratory lessons' hours, hands-on-science experiments which may be executed with effective, attract attention with simple materials should be developed. Studio Physics which is a method of teaching that provides an integrated learning environment with hands-on lab measurements coupled with active student problem-solving should be applied in the Physics lessons. In order to make Physics lessons more interesting, Physics instructors should convince students that physics serves them. Physics instructors should spend more efforts to associate Physics–technology–daily life. Physics instructors should like their profession and reflect this to others. In such manners the instructors will improve the attitude of students towards Physics lessons and Physics experiments. However, it should be research whether teachers' training, teaching methods, students' families and environmental factors on influence students' attitude towards physics lessons.

References

Adesoji, F.A. (2008). Managing Students' Attitudes towards science through problem-solving instructional strategy. *Anthropologist*, 10(1). 21-24

Aiken, L.R. (2000). *Psychological Testing and Assessment (10th Ed.).* Boston, MA: Allyn and Bacon.

Ajzan, I. (1988). *Attitudes, Personality and Behavior*. Chicago: Dorsey Press.

Bembenutty, H. (2008). Self-regulation of learning and test anxiety. *Psychology Journal*, *5,* 122–139.

Brown, H. (2000). *Principles of Language Learning and Teaching*. New Jersey: Prentice Hall.

Bruinsma, M. (2004). Motivation, cognitive processing and achievement in higher education. *Learning and Instruction, 14*, 549-568.

Cazan, A. M., & Ani□ei, M. (2010). Motivation, learning strategies and acadmic adjustement. *Romanian Journal of Experimental Applied Psychology, 1*(1), 61-69.

Cracker, D. (2006). "Attitudes towards science of Students enrolled in Introductory Level Science Courses". *UW-L Journal of Undergraduate Research* IX, 1-6.

Crawley, F. & Black, C. (1992). Casual modelling of secondary science students' intentions to enrol in physics. *Journal of Research in Science Teaching*, 9, 585-599.

Duckworth, A. L., & Seligman, M. E. P. (2005). Self-discipline outdoes IQ in predicting academic performance of adolescents. *Psychological Science, 16*, 939–944.

Eridemir, N. & Bakirci, H. (2009). "The Change and the Development of Attitudes of Science Teacher Candidates towards branches". *Kastamonu Education Journal*, 161-170.

Erol, M., Selcuk, G.S and Calishan, S. (2006). Evaluation of Problem solving behaviours of physics teachers' candidates, H.U. *Journal of Education*, 30, 73-81.

Eryilmaz, A., Yildiz, I. & Akin, S. (2011). Investigating of Relationship between Attitudes towards Physics Laboratories, Motivation and Amotivation for the Class Engagement. *Eurasian Journal of Physics and Chemistry Education*. 59-64

Gardner, R. (1980). On the validity of affective variables in second language acquisition: conceptual and statistical considerations, *Language Learning*, 30(2), 255-270. *EUROSLA*, 237-260.

Guido, R.M. and Dela Cruz R. (2011). Factors affecting Academic Performance of BS Astronomy Technology students. *RTU Academic Journal*. 4, 205-238.

Hammer, D. (1996). "The Physics Teacher". *American Journal of Physics*. 64, 13-16.

Haussler, P. & Hoffman, L. (2000). A curricular frame for physics education: Development, comparison with students' interests, and impact on students' achievement and self-concept". *Wiley & Sons, Inc.*, 84, 6, 689-705.

Kitsantas, A., Winsler, A, & Huie, F. (2008). Self Regulation and Ability Predictors of Academic Succes during College: A Predictive Validity Study. *Journal of Advanced Academics, 20*(1), 42-68.

Kornell, N., & Metcalfe, J. (2006). Study efficacy and the region of proximal learning framework. *Journal of Experimental*

Maehr, M. and Midgleg, C. (1991). Enhancing student motivation: A school wide approach. *Educational Psychologist*. 26, 399 - 427

Morse, L.W. & Morse, D.T. (1995). The Influence of problem-solving strategies and previous training on performance of convergent and divergent thinking. *Journal of Instructional Psychology*, 22, 4.

Olgren, C.H. (1998). *Improving Learning Outcomes: The Effects of Learning Strategies and Motivation*. Madison, Wl: Atwood Publishing.

Pintrich, P.R. & Maehr, M. L. (2004). Advances in motivation and achievement: Motivating students, improving schools (Vol. 13). Oxford, England: JAI, *Elsevier Science*.

Vansteenkiste, M., et.al. (2004). "Less is sometimes more: Goal content matters". *Journal of Educational Psychology*. 96(4), 755–764

Wilkinson, W.K. and Maxwell, S. (1991). The Influence of College Students' epistemological style on selected Problem solving processes. *Research in Higher Education* 32: 333-350.

Zimmerman, B. J., & Schunk, D. H. (2008). Motivation: An essential dimension of self-regulated learning. In D. H. Schunk & B. J.Zimmerman (Eds.), Motivation and self-regulated learning: Theory, research, and applications (pp. 1–30). Mahwah, NJ: Lawrence Erlbaum Associates.