Using Metacognitive Strategies and Learning Styles to Create Self-Directed Learners

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Abstract

The purpose of this action research project was to help students become self-directed learners by determining what metacognitive strategies would be the most effective for a student's specific learning styles. Students were surveyed using the Perceptual Modality Preference Survey to determine their dominant learning styles. Students were then introduced to a new metacognitive strategy each week and asked to apply the strategy to their daily learning processes. Students were then asked to reflect on which metacognitive strategies best fit their learning styles. The results were then tallied to determine which strategies were preferred within the seven learning style groups.

Introduction

Each Friday, when the researcher was in fourth grade, the teacher reminded the class to "think about how we think," when studying for the spelling tests. She would explain that when she was in school, she would always sit at her desk in her room, quiet, to make sure that she was able to focus on her homework. She would rewrite her notes and try to link any new concepts that were taught to something she already knew in order to try to help her learn the new material that was being taught. As she would retell this story to us, the researcher would find himself daydreaming of his favorite cartoon, GI Joe. GI Joe and his band of warriors would fight the bad guys from COBRA. As usual, good would triumph over evil and the cartoon would end with a member of GI Joe's team giving a public service announcement (PSA) to a child that would expound on a life's lesson. The child in the PSA would respond to this newfound knowledge "Now I know!" and the GI Joe character would reply "And knowing is half the battle!" Little did the researcher know that that fourth grade teacher and GI Joe were trying to teach a similar lesson: that knowledge is power, especially when that knowledge is of how we learn best. That fourth grade teacher was trying to teach the students how to become a self-directed learner using metagcognition.

What is Self-Directed Learning?

As stated by Abdullah (2001), self-directed learners are "responsible owners and managers of their own learning process" (p. 1). Self-directed learning integrates self-management (management of the context, including social setting, resources, and

actions) with self-monitoring (the process whereby learners monitor, evaluate, and regulate their cognitive learning strategies) (Bolhuis, 1996; Garrison, 1997).

Characteristics of a Self-Directed Learner

In order to help students understand how to become self-directed learners, teachers must first understand both the educational and motivational psychology behind self-directed learning. Even though a student can become a self-directed learner without understanding its psychological characteristics and the development of these traits, it is more likely to occur when teachers help foster them within the classroom (Biemiller & Meichenbaum, 1992).

According to Nelson & Conner (2008), teachers and administrators, along with parents and students, must have an understanding of the following characteristics of becoming a self-directed learner: student motivation, goal orientation, self-efficacy, and locus of control, self-regulation, and metacognition. These concepts provide a framework for helping students to truly gain an understanding of themselves as learners and how they can improve their self-awareness as a learner.

Student Motivation

Student motivation deals with a student's desire to actively participate in the learning process. But student motivation also focuses on the reasons that underlie a person's involvement or noninvolvement in academic activities. One of the main problems with determining a student's motivation level is that the sources of their motivation may differ.

A student who is intrinsically motivated undertakes an activity "for its own sake, for the enjoyment it provides, the learning it permits, or the feelings of accomplishment it evokes" (Lepper, 1988, p. 292). In contrast, an extrinsically motivated student performs "in order to obtain some reward or avoid some punishment external to the activity itself," such as grades, stickers, or teacher approval (Lepper, 1988, p. 292). Although student motivation is inherently affected by the intrinsic motivation of the individual, there are many extrinsic factors that can positively influence the development of students' motivation, as well. Brophy (1986) states that "student motivation to learn is construed as a student tendency to find academic activities meaningful and worthwhile, and to try and get the intended academic benefits from them" (p. 8)

Goal Orientation

As defined by Caraway, Tucker, Reinke, and Hall (2003), it is the individual's ability to make plans and set goals, and works in combination with self-efficacy, to

increase a student's motivation. One theory that focuses on the components of goal orientation is the target achievement goal theory, developed by Dr. Donna Woolard. The central focus of target achievement goal theory focuses on the method in which individuals determine their goals in achievement settings such as athletics or academics.

According to this theory, there are three factors that act together to determine a person's motivation: development of achievement goals, a person's self-perceived ability level, and the achievement behavior of the individual. In following this theory, individuals in an achievement setting are usually driven to follow one of two possible goals when determining whether or not they have been successful in goal setting. A person may have a task goal orientation, "where the focus is on improving performance relative to past performance, not on comparison with others. They have a stronger work ethic, are more persistent, and are better motivated because the factors they focus on are internal and more controllable" (Woolard, 2008, p. 1).

Others may have an outcome goal, or ego orientation, "…where they constantly compare themselves with others. Such factors are external and uncontrollable. They tend to give up more easily, and select tasks that are easier to perform" (Woolard, 2008, p. 1). Even though researchers continue to discuss whether the concept of task orientation or outcome goal orientation is more advantageous to an individual's ability to set and achieve goals, the majority of the literature related to goal orientation tends to support that task orientation is more favorable to positive behaviors in achievement settings.

Self-Efficacy

Perceived self-efficacy is defined as people's beliefs about their capabilities to produce designated levels of performance that exercise influence over events that affect their lives (Bandura, 1994). Self-efficacy beliefs determine how people behave, think, feel, and motivate themselves. Self-efficacy, although somewhat similar to self-esteem, differs in one main concept. Self-efficacy is a personal belief of competency, rather than one's emotional reaction to an actual accomplishment (Nelson & Conner, 2008). It is also much more specific to an assignment (e.g. "I can determine the proper number of significant digits in a multiplication problem") instead of a general idea of proficiency (e.g. "I understand math"). A person with a strong feeling of efficacy strongly influences a person's achievement levels and personal comfort in many ways.

People with greater self-confidence in their capabilities approach complicated tasks as challenges to be mastered rather than as tasks to be avoided. Having a positive outlook and feeling of self-confidence helps to foster an intrinsic interest and deep fixation in activities. Individuals will set challenging goals for themselves and maintain a strong commitment to achieving them. When faced with new challenges, these

individuals will intensify and sustain their efforts in the face of failure. They are also able to quickly recover their sense of efficacy after failures or setbacks. These individuals will attribute failure to inadequate effort or insufficient knowledge and skills, which can be acquired (Bandura, 1994). In contrast, people who doubt their capabilities tend to withdraw from difficult tasks which they view as personal challenges. These individuals, often times, have low aspirations and a limited dedication to the goals they choose to pursue. An individual with low efficacy, when faced with difficult tasks, often dwell on their personal deficiencies, on the obstacles they will encounter, and all kinds of adverse outcomes rather than concentrate on how to successfully achieve their goals. They usually give less than stellar level of effort and quickly give up in the face of adversity. They are slow to recover their sense of efficacy following failure or setbacks (Bandura, 1994).

The most effective way of creating a strong sense of efficacy is through mastery experiences. Successes build a robust belief in one's personal efficacy. A resilient sense of efficacy requires experience in overcoming obstacles through perseverant effort. Some setbacks and difficulties in human pursuits serve a useful purpose in teaching that success usually requires sustained effort.

Locus of Control

Locus of control as defined by Miller, Fitch, and Marshall (2003) is "the tendency students have to ascribe achievements and failures to either internal factors that they control (effort, ability, motivation) or external factors that are beyond control (chance, luck, others' actions)" (p. 549). A person who is considered a self-directed learner would be described as having a greater internal locus of control then that of an external locus of control. In simple terms, the more internal the level of control, the greater the ability of the individual to deal with changes within their learning environment.

Self-Regulation

Zimmerman (2001) stated "self-regulated learning refers to learning that results from students' self-generated thoughts and behaviors that are systematically oriented toward the attainment of their learning goals" (p. 125). This technique is the method used by learners to help organize their thoughts and manage and adapt them into skills that are directed towards learning (Reid, 2008). Self-regulation is the practice of continuously monitoring one's progress toward a goal, examining outcomes, and redirecting unsuccessful efforts (Berk, 2003). In order for students to be self-regulated they need to be aware of their own thought process, and be motivated to actively participate in their own learning process (Zimmerman, 2001).

Metacognition

Metacognition can be loosely defined as "thinking about one's own thinking." More specifically, metacognition is "an appreciation of what one already knows, together with a correct apprehension of the learning task and what knowledge and skills it requires, combined with the ability to make correct inferences about how to apply one's strategic knowledge to a particular situation, and to do so efficiently and reliably" (Peirce, 2003, p. 2).   Students who are able to identify suitable learning strategies in the proper situation are using metacognition. For example, a student may understand that he has difficulty in finding the connection between important concepts within a story. If he/she has been taught to use a graphic organizer, such as a concept map, to identify the main concepts and link them together using lines, similar to a spider web, then that student has used metacognition to complete the task (Nelson & Conner, 2008). In general, metacognition is the engine that drives self-directed learning.

One of the main struggles that students face in trying to develop an understanding of metacognition and ways to develop strategies that positively impact themselves is an overall lack of awareness to their own learning process. Students, even at a rudimentary level, have some basic understanding of their own knowledge and thinking. Flavell (1979) describes three basic types of awareness, related to metacognitive knowledge. The first is an awareness of knowledge, which is described as an understanding of what one does and does not know, and what one wants to know. Second, there is an awareness of thinking, which describes an understanding of cognitive tasks and the nature of what is required to complete them. Finally, there is an awareness of thinking strategies, which describes an understanding of approaches to directed learning.

Students can be encouraged to develop a sense of their own knowledge by asking questions such as, "What do I know?", "What don't I know?" and "What do I need to know?" These types of reflective questions can help students become more self-aware and help them to make real world connections to the information they are currently learning. In effective classrooms, teachers are responsible for helping students develop better metacognitive skills by incorporating active reflection throughout the learning process. Darling-Hammond, Austin, Cheung, and Martin (2008) listed the following examples of effective metacognitive strategies:
> *Predicting outcomes* – Helps students to understand what kinds of information they might need to successfully solve a problem.
> *Evaluating work* – Reviewing of work to determine where their strengths and weaknesses lie within their work.
> *Questioning by the teacher* – The teacher asks students as they work. "What are you working on now?, Why are you working on it?, and "How does it help you?"

Self-assessing – Students reflect on their learning and determine how well they have learned something.
Self-questioning – Students use questions to check their own knowledge as they are learning.
Selecting strategies – Students decide which strategies are useful for a given task.
Using directed or selective thinking – Students choose consciously to follow a specific *line of thinking.*
Using discourse – Students discuss ideas with each other and their teacher.
Critiquing – Students provide feedback to other students about their work in a constructive way.
Revising – Students return their work after receiving feedback.

Metacognition affects a student's motivation to learn because it directly affects attribution and self-efficacy (Peirce, 2003). When students get results from assessments and grades on general assignments, especially when they receive unexpected results such as failure, students will try to mentally grasp and explain why these results occurred. When a student achieves good results, those with a strong sense of efficacy will attribute these results internally, to their own efforts and abilities. When a student achieves the same good results, but with a weaker sense of efficacy, will attribute there results to "being lucky" or "guessing correctly."

When students fail, some students will also focus on the same two internal reasons, while others will take more of a self-protective stance, choosing to focus on extrinsic factors, such as intrapersonal relationships, to allow the blame to fall elsewhere for their poor academic performance. A student with an extrinsic focus could make the following statement: "Well, Mr. Shannon only likes athletes, so I never get a good grade on his assignments." By modeling effective metacognitive strategies teachers allow their students to develop a deeper understanding of which strategies work best for their individual learning styles.

What are Learning Styles?

Learning styles refer to the concept that we, as individuals, process and perceive information in different ways. There are many different factors that can lead to the differences that arise within learning styles. These factors include, but are not limited to, personality, ability to process information, self-efficacy, sensory intake processes or some complex combination of these and other differences (Institute for Learning Styles Research, 2003). Using a variety of assessment tools, individuals can gauge their own interest levels for a set of criteria to help establish the methods in which they obtain much of their information about the world around them. One assessment tool that can be used in establishing a person's learning style is the Perceptual Modality Preference Survey (PMPS).

This survey focuses on seven perceptual sensory intake methods that help shape how, we as individuals, view the world around us. There are seven perceptual styles: print, aural, visual, interactive, haptic, kinesthetic, and olfactory (Institute for Learning Styles Research, 2003).

According to the Institute for Learning Styles Research (2003), print learning refers to seeing printed or written words. This type of learner often take notes, remember things easily that are read, recall information more readily after seeing or writing something, and often times, grasp important concepts on a first reading of material. Aural learning refers to listening. These learners excel within a lecture setting, are usually excellent listeners, can learn concepts by listening to a visual medium, such as pod casts or audio recordings, can reproduce symbols, letters or words by hearing them, and can repeat or fulfill verbal instructions with relative ease.

Interactive learning refers to verbalization (Institute for Learning Styles Research, 2003). These learners prefer group discussions, enjoy question and answer sessions, and like to use other people as a sounding board. Visual learning refers to seeing visual depictions (Institute for Learning Styles Research, 2003). These learners function well by seeing and by watching demonstrations, often have a vivid imagination, prefer to gain knowledge through visual media, and prefer visual stimuli such as pictures, slides and graphs. Haptic learning refers to the sense of touch or grasp (Institute for Learning Styles Research, 2003). These learners prefer a "hands on" approach to learning, tend to doodle on notebooks, and succeed with tasks requiring "hands on" manipulation. Kinesthetic learning refers to whole body movement (Institute for Learning Styles Research, 2003). These learners focus with direct involvement in things. They often fidget or find a reason to move, often find success in physical response activities, use movement to help concentrate, are usually poor listeners, and are not particularly attentive to visual or auditory presentations. Olfactory learning refers to sense of smell and taste (Institute for Learning Styles Research, 2003). These learners use smell to enhance learning, are frequently able to identify smells, and can associate a particular smell with specific past memories.

After researching the concepts of self-directed learning, learning styles, and metacognition, the goal for this research study was to determine the chemistry students' individual learning styles using the PMPS. Next, a new metacognitive strategy was introduced to the students each week. Then the students reflected on each strategy to see if it positively affected their learning process, with the overall focus of helping the students to become more self-directed learners.

Methods

       The study took place at a high school in a Midwestern Class C-1 school district. The district's enrollment is approximately 282 students in grades nine through twelve, with a 27% free/reduced lunch population and 14% of students receiving special education services. For this study, a total of 40 students participated in the action research project within the three chemistry classes. Of the 40 students, there were 20 females and 20 males. There were a total of four seniors, 28 juniors, eight sophomores, and no freshmen. Only one of the students participating in the study was on a modified special education plan and was able to receive services in the special needs room.

       The teacher collected research data throughout the study in the form of anecdotal notes, teacher & student reflections, and classroom observations. The PMPS was administered at the beginning of the study, while teacher observations, reflections, and anecdotal notes occurred daily. In order to analyze the data, the PMPS results were analyzed and individual findings separated into the seven learning style groups and percentages were compiled. The researcher proceeded to determine which metacognitive strategies were preferred within each learning style group through the use of student comments and classroom observations. Comments were also sought from participants regarding the study.

       During week one, the PMPS was administered online to the research group. The survey was analyzed by ranking each individual's learning styles, from highest to lowest. These individual results were then combined and ranked to determine the most prevalent learning styles within the group. In week two, students were asked to define what it means to be a self-directed learner. One student, a visual learner stated, "It is when a person takes ownership of what they want to learn." When the class was asked to expand upon this definition, another student replied "Ownership is when you give something value, that you need or want to keep". Other classes echoed the concept of ownership when asked about self-directed learning. An interactive learner stated, "It is when I decide to learn more about a topic then I am told to learn." Next, the students were given a more formal definition what is a self-directed learner taken from Abdullah (2001) that states that self-directed learners are "responsible owners and managers of their own learning process" (p. 1).

       The students then discussed different factors that they felt affected a student, both positively and negatively, from becoming a self-directed learner. Most of the positive factors discussed were extrinsic factors, such as praise from parents, financial gains, and scholarships. Some of the negative factors listed were pressure to maintain grades, lack of knowledge on how to become better learners, and lack of motivation, which were predominantly intrinsic.

After week two, students were introduced to the overall concept of metacognition and its role in the development of self-directed learners. A new metacognitive strategy was introduced and modeled within a chemistry lesson during the week and students were then asked to incorporate the metacognitive strategy into their weekly study routine, when applicable. Students were then asked to use their laboratory journals to reflect on each strategy and whether it positively affected their learning process and their ability to become more of a self-directed learner. This routine was repeated throughout the ten-week study. The following schedule was used to introduce and implement a new metacognitive strategy each week, with the strategy listed below.

In week three, the strategy of predicting outcomes, which helps students to understand what kinds of information they might need to successfully solve a problem, was introduced. Students were given a teacher-created metacognitive form that outlined the three basic phases of metacognition: 1) developing a plan of action, 2) maintaining or monitoring the plan, and 3) evaluating the plan. Students were then given a "black box" lab activity in which an unknown object is placed within a container and students must use their senses, other than sight, to figure out what the object is. Students were given a series of questions, for each phase, to help them begin to think about the process of learning. For example, when students are in the first phase of developing a plan of action, one question that is listed asks, "What in my prior knowledge will help me with this particular task?"

In week four they were evaluating work (reviewing of work to determine where their strengths and weaknesses lie within their work). Students were given the concept "Density of Water" and asked to develop a lab procedure to accurately determine the density of water, which is a known constant of one. Students were then asked to reflect on the strengths and weaknesses of their lab procedure and to make suggestions on how they could improve their procedures.

Week five consisted of questioning by the teacher (The teacher asks students probing questions as they work). The teacher walked around the chemistry room and asked students questions such as, "Why did you choose the following measuring tool?" This was during a lab as students measured different items throughout the classroom. Students then had to explain their reasoning for choosing the measuring tool they used.

Week six involved self-assessments (Students reflect on their learning and determine how well they have learned something). Students were asked to reflect on how well prepared they were for an upcoming quiz on the different phases of matter and what concepts they still had not mastered.

During week seven, the students were self-questioning (Students use questions to check their own knowledge as they are learning). Students were asked to use their metacognitive forms again to analyze their use of a Venn diagram to compare and contrast Dalton's atomic theory to the modern atomic theory. Students were asked to reflect on the advantages and disadvantages of using this strategy and to give another example of a subject where a Venn diagram would be useful.

Week eight involved selecting strategies (Students decide which strategies are useful for a given task). Students were asked to develop a "visual project" to show the history of the atom and were given the freedom to use any visual medium they chose. They decided which strategy they wanted to use, e.g. PowerPoint™ presentations, poster board, etc., and what strategies they would use to put the project together. Week nine consisted of critiquing and revising (Students provide feedback to other students about their work in a constructive way and then students return their work after receiving feedback). Students were given cards that represented the original elements discovered by Mendeleev and asked to create their own periodic tables of elements using atomic mass as their guide. Students were then asked present their periodic tables to another lab group to be evaluated. The second group would offer feedback on a strength and weakness of group one's periodic table. The groups would then switch roles. The groups would then revise their periodic tables, if necessary, and turn in their final versions to the teacher to be formally evaluated.

Findings

After analyzing the data from student lab journals and metacognitive forms, four themes were apparent and they included the connection between learning styles and metacognitive strategies, self-assessment, and student motivation. First, the connections between a student's learning styles and preferred metacognitives strategies, as determined by students, was determined. Next, the concept of motivation, related to metacognition and the self-directed learner was addressed. Finally, the student's ability to self-regulate themselves to become self-directed learners was reviewed.

Connection Between Learning Styles and Metacognitive Strategies

The PMPS results were analyzed and there were 73% students who had kinesthetic as one of their top two ranked learning styles. This was followed by interactive with 45%, haptic with 38%, visual with 30%, print with 15% aural with 10%, and finally olfactory with no students represented. These learning styles were then used to help classify which metacognitive strategies were preferred by each learning style later in the study.

In this research study, the kinesthetic learners preferred selecting strategies, where they were given a direct involvement in selecting how they were able to present

the material they learned. Conversely, interactive learners, which refers to verbalization, (Institute, 2003) preferred critiquing and revising, where they were allowed to share their opinions with others. Interactive learners were able to gain a greater depth of knowledge from the information that was shared within their study groups.

Similar to the kinesthetic learners, haptic learners, which refers to the sense of touch or grasp, (Institute, 2003) also preferred selecting strategies, which allowed them to have "hands-on" contact with the materials they were studying. In addition, visual learners, which refers to seeing visual depictions, preferred self-questioning and predicting outcomes, where they were able to use different forms of visual diagrams to help evaluate their learning process. While the ability to articulate is important for all learning styles, visual learners preferred being able to take the data they collected and use a variety of different visual methods, e.g. graphs, charts, to analyze it.

Students that were classified as print learners, which refers to seeing printed or written words (Institute, 2003) preferred self assessing, where they are able to reflect, usually in the form of a journal, to evaluate their learning process.   Print learners often choose to be the recorder for a lab group and often shy away from situations where they would be expected to verbally discuss their findings.

Alternately, aural learners, which refers to listening, (Institute, 2003) preferred questioning by the teacher, where the student is able to gain perspective from another person. These students preferred to present information in the form of questions and often struggled to take visual notes or prompts and preferred to focus on what was being stated at the time.

Self-Assessment

Throughout the study, the researcher found that no matter the learning style a student might prefer, all of the students, whether consciously or unconsciously, were continuously evaluating their performance and their progress. Beyond comparing their results with other students, they wanted to be able to answer the question, "Am I actually getting this?" After analyzing the students' lab journals and metacognitive forms, the researcher was able to determine that the majority of students in the study preferred to use some metacognitive questioning to determine if they were "getting it", based on their previous learning experiences, before, during, and after the activity. For example, before students began a new assignment, they were given a series of questions to choose from to assess what information they already understood or additional information they still need to obtain to assist in their learning progression. Some of the questions posed before the activity were:
"What in my prior knowledge will help me with this particular task?"
"In what direction do I want my thinking to take me?"

"What should I do first?"
"Why am I reading this selection?"
"How much time do I have to complete the task?"

These questions were used to help the students begin the process of assessing what prior knowledge they may have on a particular subject and whether additional information must be obtained before starting the task. Students were then asked to use a second set of metacognitive questions to assess their learning during the activity. Some of the questions posed during the activity were:
"How am I doing?"
"How should I proceed?"
"Am I on the right track?"
"What information is important to remember?"
"Should I move in a different direction?"
"What do I need to do if I do not understand?"

Finally, students were asked to use a closing set of metacognitive questions to assess their learning after the activity. Some of the questions posed after the activity were:
"How well did I do?"
"What could I have done differently?"
"Did my particular course of thinking produce more or less than I expected?"
"How might I apply this line of thinking to other problems?"
"Do I need to go back through this task to fill in any "blanks" in my understanding?"
By using these metacognitive questions, students were able to begin the process of being able to "self-assess" what they were learning and allowing themselves the opportunity to gain a greater grasp of the material presented.

Student Motivation

One of the main focuses of the study was to help the students within the research study to understand where their motivation for educational success lies. Too often, a student's focus on academic success is often times extrinsic. Although parents and teachers can offer many beneficial, extrinsic, motivational factors, but one important factor is the context and manner in which the motivation is given or received. As previously stated, the concepts of motivation and self-efficacy are interrelated. Primarily, an underlying self-efficacy must always be present because if a child believes she can do well, then she will (Pintrich, 2004).

If a student believes that a specific academic goal is unattainable, then a student will lack the self-motivation to attempt to achieve that goal. Extrinsic motivation causes students to perceive more goals as unattainable, whereas and intrinsically motivated student will see very few goals as unattainable because that student believes that

anything is possible with effort. Throughout the study, the focus for students was to provide encouragement as they were attempting to use their new metacognitive strategies. By encouraging the students to use new strategies, the focus was to assist students in their natural curiosity to discover more about how they learn best. Throughout school, in general, curiosity can be one of the strongest motivators with regards to motivation. This need will intrinsically motivate students to discover and understand new concepts that otherwise would remain untouched. This curiosity was evident throughout the study, as students began to use the metacognitive questions to help them determine if learning was occurring throughout each activity.

Conclusions

Based on these findings, teaching students metacognitive strategies is a valuable skill that helps students become more self-directed learners. Before the study, the majority of the students did not give any thought to "how they learn" and what type of learning style they have. But now, these students are interested in developing a "study skills" course that would be mandatory for all incoming freshmen. Students were interested in trying the learning styles survey to help them "think about how they think". That fourth grade teacher and GI Joe had it right all along, "Knowing is half the battle", especially when it comes to becoming a self-directed learner.

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