

SAAMEE: A model for academic success

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Alchemists of the Middle Ages were concerned with finding the so-called philosophers' stone. They desired to use the philosophers' stone – an elixir that they believed had the power to transmute base metals into gold – to generate wealth. Unfortunately for alchemists, the philosophers' stone does not exist. As with alchemy, there is no philosophers' stone in the area of education either. No matter how hard teachers try, not all students will learn everything expected of them. Nonetheless, this doesn't preclude educators helping students find ways to maximize academic success. SAAMEE is a hypothetical model that, if shared effectively with students, could lead to significant increases in academic success.

Educators are not concerned with transmuting base metals into gold – would that they had such a simple problem! Gone are the days when the role of schools was merely to sort and rank students on the basis of test scores. Today, all students are expected to achieve, and all are expected to exhibit a minimum degree of competency so that no child will be left behind (Stiggins, 2005). In some cases, this appears to be a very elusive goal. While there is no equivalent to the philosophers' stone in education, there are several things that educational researchers have shown to be effective, in general, that can help students achieve the goal of academic success. Among them are the identification, confrontation and resolution of preconceptions, the use of organizational patterns, and promotion of metacognition and student self-regulation (NRC, 1999, 2005). The proposed model takes advantage of two of these principles.

As a physics teacher educator, as well as a former physics and astronomy teacher, I've often wondered about how best to get my students to achieve the aims, goals, and objectives of my instruction. Like other teachers, I've also wondered why some students succeed while other students fail. Over the years many students – both successful and not so successful – have asked me to help them maximize their academic performance. I've come to realize that there is no "science" of teaching and no "science" of learning; that is, there is no set of rules that I as teacher and students as learners can follow to guarantee across-the-board academic success. On the contrary, I have come to realize that teaching and learning are art forms for which there are few hard and fast rules. Still, I have struggled to make sense of what I have seen take place in my classrooms since I started college teaching in 1977. I have come to a conclusion based on nearly three decades of reflection that student success in science (and probably all other subject matter areas) is strongly dependent upon five more or less independent factors. I have organized these factors into a model called *SAAMEE* to help students realize academic success. As I tell students who seek assistance to improve academic performance, "If you want to be as successful as the best students in my course, you must use the "saamee" approach that more successful students are known to use." The recommendations stemming from *SAAMEE* are clearly in line with what common sense and research-based best practice appear

to suggest. If anecdotal reports are to be believed, experiences with *SAAMEE* have shown it be helpful. It is my hope that readers will share *SAAMEE* with their students in an effort to increase academic success.

SAAMEE: A Hypothetical Model

SAAMEE states that a student's academic success (S) is a function of innate ability (A_i), learned ability (A_l), motivation (M), effort (E_1), and environment (E_2). The relationship between these factors is given by the following expression:

$$S = A_i A_l M E_1 E_2$$

Student academic success is critically dependent upon each of the five independent variables contained in the equation. The fact that *SAAMEE* is a series of multiplicative terms should not be lost on the reader or the students being introduced to the model. Because success is a product of terms, a low "score" on any one of the terms will result in a low overall score for academic success no matter high the scores in other areas. Scores range from 0 to 1, where a lesser amount of a characteristic is represented by a lower number and visa versa. For instance, if $A_i=1$, $A_l=1$, $M=1$, $E_1=0$, and $E_2=1$, there will be zero success ($1 \times 1 \times 1 \times 0 \times 1 = 0$). The model appears to explain such things as the varied degrees of student success associated with learning disorders, the success and failure of gifted and not so gifted students, changes in student performance over time, and the high impact of a single inadequacy. The model is not intended as a mathematical equation used to predict actual success; rather, it is intended merely to suggest the nature of the relationship between the dependent and independent variables.

Under *SAAMEE*, a student's academic success, S , in simplest terms is related to course assessment or evaluation where a "1" would represent the highest possible score or grade. Innate ability, A_i , appears to be most closely associated with what some call I.Q. Students who have a gift for learning are said to have high innate ability. Learned ability, A_l , can be related to such knowledge as study and test-taking skills, as well as other factors in the areas of metacognition and self-regulation. Motivation, M , is a

drive internal to the student; it must not be confused with external coercion. Effort, E_p , is closely associated with such things as quality time on task. Environment, E_e , is closely associated with factors external to the student such as living and study conditions, and even human relationships. *SAAMEE* deals with learning from a student perspective. There is a similar model that deals with learning from the teacher perspective.

Rescorla and Wagner (1972) enunciated a model for animal learning that is represented by a similar simple equation. The Rescorla-Wagner model explains a variety of psychological phenomena – acquisition, overshadowing, blocking, extinction, conditioned inhibition, and the overexpectation effect. The mathematical form of the Rescorla-Wagner model is presented as follows:

$$\Delta V = \alpha\beta(\lambda - V_{\text{sum}})$$

That is, the change in learning, ΔV , is equal to the motivation of the subject to learn (α) times the saliency of the stimulus (β) times the difference between what has already been learned (V_{sum}) and what constitutes peak learning (λ).

Recall that Behaviorists define change in learning as an observable difference in behavior. Note well that motivation to Behaviorists is an entirely physical phenomenon and relates to basic drives such as food, sex, and self-preservation. Thirst, hunger, danger, or a potential mate for instance, can be powerful motivators. Second, the greatest amount of learning occurs when the salience of the stimulus is high. Using reinforcement through unexpected events during training can serve to increase the salience of a phenomenon. Under the Rescorla-Wagner model the greatest amount of animal learning will be achieved when the subject's innate needs are addressed. Third, the maximum change in behavior will occur when the subject is learning something entirely new. If a subject has little to learn, then there will be very little learning despite high degrees of motivation and saliency. Whether or not this model for animal learning derived from the study of pigeons can be applied to humans is uncertain. Nonetheless, it provides educators with some interesting and potentially useful insights that cannot be entirely divorced from *SAAMEE*.

While the Rescorla-Wagner model has been empirically derived, *SAAMEE* is merely conjectural. Its factors are hard to define with precision, and even more difficult to measure. There is no claim to completeness, or that the model can account for all observed variances. Nevertheless, *SAAMEE* is based on the author's accumulated teaching experience, and appears to provide a fruitful approach for improving success in the area of student learning. It can also provide an instructor with a valuable tool for helping students gain a greater understanding of what they can do to achieve academic success. It can be a key that unlocks the door to student academic success, and even enhance teaching performance.

Behavioral and Environmental Factors of Academic Success

Assuming *SAAMEE* to be at least approximately correct, educators who wish to increase student learning can work to maximize each of the controllable factors upon which a student's academic success depends. This includes such things as speaking explicitly with students about *SAAMEE*, teaching appropriate learning and study practices, and modifying teaching practices. Consider an explanation of each of the model's factors along with implications for teaching and learning:

Innate Ability, A_i : Unfortunately, there is little that a teacher or student can do about innate ability; nonetheless, *SAAMEE* could be a key to unlocking hidden abilities. Some students are inherently gifted while others are not. Not every gifted student tests well, and not every student who appears at first to be a prodigy actually is one. Despite limitations imposed by innate ability, learned ability can often go a long way toward compensating for natural limitations.

Learned ability, A_l : Teachers can help students understand the difference between deep and surface learning styles, and use teaching strategies that promote the latter over the former. Some ways that teachers can encourage deep learning include using open-ended assessment tools, stating high expectations, and teaching for depth of understanding rather than breadth of coverage. Open-ended assignments such as essay questions, projects, or alternative assessments make students organize and process information. Setting high expectations means that students are always challenged and thinking. They cannot be passive and still "get by." Helping students develop improved listening and study skills is also a way of increasing students' abilities to learn with understanding – learning that lasts. Such practices might include any or all of the following: using active listening; conducting reciprocal reading and teaching; predicting outcomes on various tasks; comparing performance against a set of performance standards or stated objectives; completing practice tests and noting failures to understand; and conducting an analysis of one's study practices and explain what was done and why. Getting students to understand the processes of metacognition with its periodic self-assessments and self-regulation can also be powerful ways to raise learned ability.

Motivation, M : Students need to be motivated (as opposed to coerced) in order to effectively expend the time and effort needed to achieve academic success. Quay & Quaglia (2001) suggested a number of psychologically sound strategies that teachers can use to help build motivation and a sense of empowerment in students. These eight ideas are the following: provide a sense of belonging, familiarize students with heroes, provide students with a sense of achievement, make learning fun and exciting, use students' natural curiosity and creativity, provide a spirit of adventure, encourage leadership and responsibly, and build confidence in taking action.

Effort, E_1 : Effort, while strongly associated with motivation, must not be confused with it. Motivation reveals itself in effort. Even though students might have the best learning abilities, the best learning situations, and even a high degree of motivation, they still will not be successful if they fail to exert the effort required for success. For instance, a student might have great personal motivation to learn how to play an electric guitar well – prestige, fame, and fortune – but unless that person actually expends the necessary time for practice, he or she cannot expect to learn to play the electric guitar well no matter how willing. Sometimes effort is not as much of a problem as is proper time management. Students who start the day with a list of prioritized tasks that need to be accomplished are often much more successful in getting things done well and on time than those who fail to recognize what needs to be done and when. In addition, effort must be sustained; students must spend an appropriate amount of time exerting the required effort to achieve academic success.

Environment, E_2 : Environment plays an important role in student learning. Many students are immersed in “toxic” environments that are not always of their own choosing. Toxic environments might include the home where caregivers and/or siblings and/or friends can be a detriment to learning, study areas filled with any of a great variety of annoying and appealing distractions, or unengaging classroom conditions. Some distractions *are* of a student’s own choosing such as watching TV, listening to loud music, or talking with friends on the phone while attempting to complete schoolwork that requires undivided attention.

Deploying SAAMEE

The model suggested by the author is nothing more than a way of organizing conventional information in order to make it more accessible and meaningful for students. The recommendations with regard to A_p , A_p , M , E_1 , and E_2 are clearly in line with what common sense, craft wisdom, and research-based best practice appear to suggest. If teachers want to help students be more successful in class, then they might want to try promoting SAAMEE as a means for achieving that success. Readers are strongly encouraged to speak explicitly with their students about the model, and then provide them with and explain the practical implications of this model using a handout. Such a handout can be found following the references section of this article. This handout, which formerly was distributed by the author to students seeking academic help, has become part of the syllabus in each of his courses. The handout was originally patterned after work by Solomon and Nellen (1996), but has been extensively revised and extended. While SAAMEE is not the philosophers’ stone of modern educational practice, it should go a long way toward helping students obtain what seems to be for some a very elusive goal.

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Physics Teacher Education Program

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SAAMEE is a hypothetical relationship that states that a student's academic success (S) is a function of innate ability (A_i), learned ability (A_l), motivation (M), effort (E_1), and environment (E_2). The proposed relationship between these factors is given in the following expression:

$$S = A_i A_l M E_1 E_2$$

This relationship has not been tested empirically, but long experience suggests that these factors appear to be good predictors of academic success. Because success is a product of terms ranging from 0 (minimum) to 1 (maximum), a low "score" on any one of the terms will result in a low overall score for academic success no matter high the scores in other areas.

The following traits, behaviors, and conditions, while not mutually exclusive, tend to distinguish the typical "A" student from the typical "C" student in course work. The descriptors in the left column are characteristic of superior academic performance; they are not necessarily sufficient conditions that will guarantee success. Nonetheless, if students intend to earn a top grade, it would be best if the traits that describe them come from the left rather than the right column in the table below

A_i: Innate Ability

<p>"A" or superior students...have special aptitude in a wide variety of areas. These skills might include creativity and organizational skills, or special insights. They are good problem solvers, and can see relationships where others often do not. They are confident of their innate ability; they have an inner strength that allows them to strive for success because they know that success is well within their grasp.</p>	<p>"C" or average students...vary greatly in natural aptitude. Some might be quite talented in specific areas, but their success is limited by a lack of having a broad range of pertinent abilities. They question their ability as learners; they have lost confidence due to prior failings. This deprives them of the emotional energy that they need. Sometimes it seems easier to just not try than to lose face by trying and then failing.</p>
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A_l: Learned Ability

<p>"A" or superior students...are always prepared for class, and are rarely if ever surprised by due dates or exams. They are always well prepared for tests, and complete their assignments on time. They always respond when called on in class discussions, and actively contribute even when not called upon. Their attention to detail sometimes results in catching text or teacher errors. Successful students are critical thinkers. Critical thinking is characterized by a set of attitudes more than anything else: trying to be well informed, staying focused, seeking precision, proceeding in an orderly manner. They show evidence of "deep learning" rather than "surface learning." They carefully read textbooks, seeking to understand each passage and paragraph; they can readily state with understanding what they have learned. They are active listeners, and good communicators. They are very concerned about learning with understanding. More successful students learn concepts with understanding rather than memorize details so that they are better able to connect past learning with present material. They can readily apply knowledge to a variety of new situations. Their written papers show a high degree of professionalism including empirical research findings. They exhibit test-taking skills such as an ability to budget their time and to deal with test anxiety. They put considerable effort into class projects that show a strong, consistent desire to exhibit the best possible performance.</p>	<p>"C" or average students...are not always prepared for class, and are often surprised by due dates or exams. They might not have fully completed an assignment, have completed it in a careless manner, or hand in their assignments late. They rarely contribute to class discussions unless called upon. When they do say something during class discussions, their answers often indicate a cursory understanding rather than a mastery of the material. Less successful students are rarely critical thinkers. They tend to "go with the flow" and follow the path of least resistance. They show evidence of "surface learning." They tend not to question and accept things on the basis of authority, often without understanding. They read textbooks without understanding and rarely can indicate what they have learned through reading. They are poor listeners – often listening without comprehension – and are poor communicators. They are more concerned with learning enough to pass a test than with understanding. Less successful students memorize details rather than learn concepts. Because they usually cram for tests, they perform relatively better on short quizzes than on more comprehensive tests such as the final exam. Written papers show lack of insight and are filled mostly with random opinion rather than detailed research findings. Less successful students obtain mediocre or inconsistent scores. They often do not budget their time well on exams and might not deal well with test anxiety.</p>
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M: Motivation

<p>“A” or superior students...show strong initiative. Their desire to excel makes them do more work than is required just to get by. They are dedicated to their work and like the work that they do. They are visibly interested during class and display interest in the subject matter active through active participation. They often volunteer thoughtful comments and ask interesting questions. They make effective and regular use of the instructor’s office hours; they benefit from insights provided by the course instructor. They take all course assignments seriously, and work diligently to achieve their goals. They are confident in their abilities, and are unlikely to give up at the first sign of resistance. They depend on themselves for answers to their questions.</p>	<p>“C” or average students...seldom show much personal initiative. They are more responsive to coercion. They never do more than required and sometimes do less. They often exhibit a low level of personal dedication. They participate in class without enthusiasm, with indifference, or even boredom. They show little, if any, interest in the subject matter. Their comments in class, when made, show lack of interest generally. They rarely if ever take advantage of the instructor’s office hours. They often lack self-confidence, believe they cannot do the work correctly, and give up at the first sign of difficulties. They often expect to glean information from the solutions of problems provided by others.</p>
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E₁: Effort

<p>“A” or superior students...maintain a regular study and homework schedule. They regularly prepare for each class no matter what the assignment. They average one to three hours of study for every hour in class; they work diligently and regularly on their course projects. They do not procrastinate. They attend class. Their commitment to the class resembles that of their instructor. Missing even a single class is not an option without a major reason. They think carefully about what they know and don’t know. They use such practices as reflective reading and teaching, take inventory of their own knowledge, administer self-tests, reflect on and learn from failings. They have good conceptual understanding, and seek to comprehend the “big picture.” More successful students see learning as a sustained effort and all learning activities as important to a comprehensive understanding.</p>	<p>“C” or average students...study or do homework only under pressure. When no assignment is due, they do not review or study ahead. They average no more than a few minutes of study for every hour in class. They cram for exams, and procrastinate on regular course assignments. They periodically miss class and/or are late. They place other priorities such as a job, ahead of class. They are generally unaware of what they know, don’t know, and need to know. They do not reflect on their intellectual state of affairs and fail to take an intellectual inventory. They tend not to seek or develop a broad conceptual understanding. They tend to focus on a myriad of details, and rarely see the “big picture.” Less successful students fail to see learning as a sustained effort, and study only from time to time – usually under the threat of an exam. They tend to value only that work which contributes significantly to course grade.</p>
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E₂: Environment

<p>“A” or superior students...are careful about the time and places they choose to study. Study spaces are generally conducive to learning. Study spaces are rarely filled with few if any distractions. More successful students tend to sit close to the front in class to avoid distractions. More successful students regulate and limit their relationships so that they don’t become a major disruptive influence on their lives. They often have jobs, but rarely ever exceed more than 10 hours per week so as not to allow a job to interfere with their education.</p>	<p>“C” or average students...are careless about their learning environments, and often study under unsuitable conditions. Study spaces are often filled with annoying and/or appealing distractions. Less successful students typically sit in the back of class where their attention can be distracted by any of a number of people or events taking place between them and the instructor. Less successful students have personal problems that limit their success. They sometimes work many hours that often interferes in the educational process.</p>
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