

Learning How to Learn: A Model for Teaching Students Learning Strategies

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Abstract: Incoming freshmen frequently struggle with the transition from high school to collegiate academics. This appears to be particularly evident in the sciences. Students often lack the self assessment skills and metacognition skills required to self-identify problems with their academic learning strategy. This does not allow them to diagnose and modify their learning strategies to allow them to be successful. Instructors often have little experience with such learning challenges and therefore may not be able to offer students appropriate learning strategy modifications. I present and assess a model for teaching learning strategies to students in an introductory biology course. This model presents specific techniques to assist students in accurate self assessment which then leads to recommendations for modifying their learning strategies. This model was used in an introductory biology course and students who attended these learning strategy workshops performed significantly better in the subsequent exam than students who did not attend a workshop. I present an outline of the workshop and learning strategy modifications and discuss the ramifications of incorporating learning strategy workshops on a broad scale for freshmen.

Keywords: learning strategy, freshman, introductory biology, metacognition, self assessment, study skills

Introduction

Many colleges have programs designed to prepare and guide incoming freshman students as they transition from high school to the college experience. Many of these programs (almost 60% according to the National Survey on First Year Seminars (<http://www.sc.edu/fye/index.html>) focus on the social aspects of this transition (e.g. creating new social networks, adjusting to the new independence of college living, etc.) which is an important component contributing to the successful college transition. However, the transition from high school to higher education academic expectations is often not addressed at all or, at best, only superficially even though the successful use of study skills and learning strategies is strongly correlated with academic achievement (Zimmerman 1998). Time management skill workshops are often the only academic skill presented at these college transition sessions to help students prepare for their new academic life and less than a quarter of the First Year Seminar programs offer basic study skills seminars (<http://www.sc.edu/fye/index.html>).

Incoming students (especially freshmen) often were moderately or even highly successful in high school and their expectation is that the skills that produced success in high school will transfer successfully to college academics. However, the expectations and learning model in high school is often very different than they are in college. The high school

learning model often requires students to attend class five days a week for a whole semester or year and students are in class for 30 hours per week. Class time in this model is not just about presenting material but is also the place where students learn the class material. Topics may be repeated and discussed with a fairly small number of students numerous times. In this model, students often spend the majority of their learning time in class and there is frequent testing on more focused knowledge than students are presented with in college.

The higher education model differs in that material is often presented at a brisk pace once during lecture and the majority of learning is expected to occur out of class (students are in class only 12-16 hours per week). The quantity of knowledge learned, the pace of academic learning and the ability to synthesize and utilize knowledge at the college level is usually at a much higher pace or level than students have previously experienced. Therefore, it can be very challenging for new college students to understand and be successful using this different model of higher education learning.

In college, students are expected to be self-motivated, able to self-assess their learning strategies, self-diagnose and then modify any learning hindrances. Metacognition, being able to self assess understanding and decide whether or not it is adequate (Bransford et al 2000), is critical for students to accept any modifications to their learning strategies. However, given their success in the high school learning

environment and the many years of ingraining those high school learning strategies, it is often difficult for incoming college students to even self-identify that there is a problem with their academic learning strategy much less self-diagnose and modify those ingrained learning strategies. Several studies have found that students often fail to adapt and implement new study strategies when needed (e.g. Broekkamp and Van Hout-Wolters 2007). College students often report that “looking over their notes” before the exam has served them well in the past (Ruban and Reis 2006). Low achieving students, in particular, often report that “they felt that they knew the material well going into the exam but then were shocked at their exam grade.” Compounding the problem is the fact that most higher education faculty have little or no training in study skills or learning strategies. Also, given that many faculty were exceptional students (hence their academic success) they may have no experience with such learning challenges. So when a student approaches an instructor on “how to do well in their course” many faculty truly have little to offer to the student other than “study harder”. This can be extremely frustrating for both the student and the faculty member.

The purpose of this paper is to present and assess a model for teaching study skills strategies to help students self assess and diagnose their studying strategies and then develop new successful studying strategies. This model presents techniques to help students assess and modify their studying strategies for all levels of questions ranging from simple knowledge, to conceptual to critical thinking.

Methods

Students from two lecture sections of a large introductory majors level biology course (n = 348 students) were offered a one hour Advanced Study Skills workshop during the Fall 2006 semester shortly after the first lecture exam. The term “advanced” was added to indicate that this was not a remedial workshop and to encourage more students to attend. The workshop was interactive and developed to present self assessment tools, study skills strategies and student learning styles information to students. A PowerPoint presentation accompanied the workshop. Four identical workshop sessions were offered immediately after the first lecture exam. Almost all of these students in the course are traditional first year freshmen students and a majority of them self describe as being preprofessional health students who aspire to enter professional schools such as medicine, dentistry, optometry, podiatry and veterinary sciences.

The difference between the first and second exam score was examined using a t-test for unequal

variances (Sokal and Rohlf 1995). By examining the difference between the two exams this eliminated the need for standardizing the scores for each exam. Each exam was made up of three types of multiple choice questions, recall, conceptual and application. The majority of questions were recall or conceptual based questions. Exam 1 had 44 multiple choice questions covering four chapters and Exam 2 had 46 questions covering five chapters. Both exams covered material on cell and molecular biology and were held during a 50 minute period.

At the end of the semester students were assessed on their perceptions of the effectiveness of each of the study skills strategies.

Workshop Contents

1) Self-Assessment of Learning Techniques

The workshop begins with a series of three interactive exercises that allow students to self evaluate their current study techniques: 1) assessment of Mona Lisa recall ; 2) multiplication table analogy, 3) current knowledge assessment.

As discussed previously, most low achieving students are not able to self diagnose problems with their studying strategies. The most basic issue of self diagnosis is having students identify when they actually “know” something. Memory or knowledge is the basis for learning and problem solving (Tulving 1983). For instructors, it often seems needless even to discuss this first step of acquiring a knowledge base with students because our expectation is that students must know how to learn this information. Many students report that their study skills often entail “looking over” their notes numerous times and feeling confident that they understood the material using this strategy. However, there is a large chasm between understanding information and actually knowing information without the use of any external information (e.g. notes). The three exercises presented here demonstrate this difference for students.

Assessment of Recall Knowledge - Mona Lisa

Example - In order to help students self assess their levels of learning, I have developed an exercise which allows them to demonstrate their recall knowledge to describe a familiar object. At the beginning of my study skills workshops, students are asked to describe in detail an object that they could all identify easily, the painting the Mona Lisa by Leonardo da Vinci. Even though most students have never seen this portrait in person almost all acknowledge prior to the exercise that they are aware of and can recognize this painting (e.g. it is often considered the most easily identifiable painting in the world) . Numerous other examples that might be more relevant to students such as describing

the White House or describing an object (such as a school mascot) or building on their campus could be used. The key is that the object must be familiar enough to students that their prior self assessment is that they can easily identify this object and feel that they “know” it.

The students are given a short time limit of 3-4 minutes to write down every detail they can remember of the painting (or object) as if they were describing it in detail to someone who had never seen the painting. Giving students a well defined and short time limit impels them to focus on the task.

After the assigned time, students are asked to share the details that they remembered of the object. For the Mona Lisa, students can almost always identify that it is a woman, the painting is overall dark in color, she has an odd smile/ smirk on her face and that her hands are showing but they are not sure how they are shown. Students responses on hair length, its nature (curly or straight), her clothing, and the background, etc. vary widely. In other words, students remember the very superficial or most rudimentary aspects of the painting but little of the details or nuances. This is analogous to many students studying/ learning strategies. Students overwhelmingly report that they look at the information in their notes or in their textbook and understand the basic information but have not learned the more specific aspects of the knowledge or how to analyze this knowledge. They might be able to identify a concept when it is presented to them as they saw it in the textbook or notes but they have not absorbed and synthesized this information in order to be able to use this knowledge in other contexts.

After the students share their responses of their recollection of the Mona Lisa, a slide is shown of the painting and I discuss the contradictory aspects they reported. The analogy to their learning of their notes is then discussed with the students. The students are asked to compare how this experience relates to their current learning experience. The students overwhelmingly report that they can identify “where” a concept is located in their notes but they can not remember the details. This is analogous to being able to identify the Mona Lisa but not being able to carefully describe her appearance.

Recall Learning Example - Multiplication Tables - In order to emphasize this point, students are next asked to recall how they learned their multiplication tables while in elementary school. Most students report that they spent a great deal of time repeatedly going through each multiplication example where they would recite the example without looking at their notes or the multiplication table. Students are asked if they felt that they could have learned how to multiply numbers if they had only “looked at” their multiplication table and did not repeatedly go through each example without

their notes. Overwhelmingly they report that they could not. I stress that this is again analogous to their usual learning procedure where they look over their notes rather than actually learn the material.

Course Knowledge Recall Example - The next technique allows students to self assess their memory and their ability to organize and understand the main concepts from a recent course lecture. I select a chapter or topic that has been discussed in lecture recently that students have read and/or studied. Students are asked to write down the two or three most important main concepts on that recent chapter/ topic. Again, the students are given a short, limited amount of time (2-3 minutes) to complete this task. Students are then asked to share their understanding of the main concepts. Overwhelmingly, the students cannot remember or report the main concepts of a chapter that they heard for an hour in lecture and then may have spent several hours reading the textbook or going over their notes. Most students have no responses at all or at best may remember a key word or phrase. I emphasize that they reported spending considerable time and effort studying this material but do not appear to have learned that material. I stress that this indicates that their current studying strategies do not appear to be effective or this would be a fairly simple recall task.

2) Study Skills Strategies

Next, a series of study skills strategies are presented to help students prepare for class, take effective class notes, actively read their textbook, and prepare for exams. These strategies prepare students for learning in and out of the classroom.

Preparing for Lecture - Keywords or Terms

Biology is a discipline that is full of discipline-specific terms. In lecture, students may not have time to fully recognize and learn these new terms and as such, their ability to follow and comprehend the lecture topic is hindered. In courses such as introductory biology, each chapter is often a self contained mini-course in a new sub-discipline each replete with its own set of terms and keywords. For the student who is not familiar with these, listening to the lecture can sometime be analogous to listening to a foreign language. It does not allow for adequate retention and comprehension of lecture material. To remedy this, I recommend that students go through each chapter prior to lecture and make a list of new keywords and their definitions. By doing this the student is already engaged in the material and will have a better opportunity to follow the lecture topic. During the study skills workshop, students are asked to go through the textbook reading for the next chapter and look for words in bold font and section headings. Many textbooks use a different font to identify these key terms and definitions or use these as headers for

each section. Students are encouraged to create a list of key terms and definitions for each chapter that they can refer to during the class time if needed to remind them of the meaning of the terms being discussed.

Preparing for Lecture - Passive vs Active Reading

Students reading each and every sentence of a new chapter prior to class may find the information to be a bewildering array of facts and terms. It is often useful for instructors to give students specific pages or figures for them to preview prior to class in order to focus their pre-class learning to a manageable amount and to emphasize the most important concepts on that topic. Students are asked to preview the text headings to use as a road map for the chapter. By asking what is the major concept illustrated in a figure they can begin to examine the conceptual underpinnings of the chapter. By having these concepts be familiar but not yet fully understood creates a greater learning potential during class. In addition, as students do not fully comprehend all concepts in this section they create internal questions (Walter et al. 2002) about the concepts that can drive their interest in the concept and this can lead to higher rates of retention of material.

Many students report that they spent numerous hours reading their textbook either before and/or after class and yet when quizzed on this knowledge have very little recall of this material. During the study skills workshop, I ask students to provide details of their most recent non-academic reading. In contrast to their academic reading, many students can provide elaborate plot and character details of this reading demonstrating that reading material once can allow for a large amount of comprehension and recall. This shows students that their ability to recall and retain knowledge is possible from their initial reading. However, in their non-academic reading they are usually actively making connections between characters and plotlines. Their inability to recall basic information from their textbook likely occurs because of the passive state of activity during their reading - they are reading the words but are retaining almost no information. Students were actively engaged in their non-academic reading which resulted in higher retention rates of information.

Another technique that students can use to be more actively involved during reading is to set up the relevance of the topic. If students ask themselves “why is this topic important” or “how might this topic relate to me” it creates relevance in their lives and this can increase student engagement and information retention. Another technique is for students to ask themselves “what do I already know about this topic” as this allows them to create connections with the topic and their previous learning. This creates an internal learning map to guide their learning for this topic.

During Lecture - Taking Thorough Notes

It may seem abundantly clear to instructors that all (or most) of the material discussed in lecture is important and relevant to the topic and as such students should be taking notes on this topic. However, students often are not effective at determining which information is important and many only take notes on what is on a PowerPoint slide, the chalk board or what the instructor writes down during class. In order to retain information it is important for students’ to review these notes shortly after lecture. For some students learning styles recopying their notes can reinforce material. Students are also encouraged to create their own quiz questions of each day’s lecture material. They can then share these with other students in the class or some students may form study groups to share their questions. Students are encouraged to create quiz questions that are in a format similar to the exam format (e.g. short answer, multiple choice, etc.) in order to best simulate this experience.

Actively Reading the Textbook After Class

Another strategy for reinforcing knowledge is to review the textbook on the pertinent course material. This can be used to fill in knowledge gaps and again create more quiz questions in the appropriate testing format. Almost all biology textbooks (as well as other disciplines) outline the main concepts of each chapter at the beginning of the chapter. Many often do this as a short bullet list of concepts. Students do not usually read these or find them relevant but I show students that these can be used as study tools to develop the connections between topics. In addition, asking student to use their notes to determine the two or three main concepts after a specific lecture allows the students to review their notes and identify the underlying themes or concepts for this topic.

Studying Lecture Material and Self Assessment of Knowledge

Students often report that they read through their notes and understood them fully but yet their test scores indicate that they had not mastered the knowledge. They do not seem to make the connection between reading and understanding their notes and knowing the material. One strategy that students can use to self identify their knowledge is to ask them to explain the terms and/or concepts of the material to a friend, dog, plant, etc. without using their lecture notes or textbook. Students may need to practice doing this first with their lecture notes but eventually must be able to do this without the aid of any lecture notes or textbook.

Flash cards can be useful for students to utilize during short study sessions throughout the day to learn specific terms. This allows students to quickly ascertain their level of knowledge. It is also important to stress that this may take many repetitions until they

know all terms and can explain a complex concept without using any notes or course material at all. Another useful technique for learning concepts is to have students draw a complete figure of a concept from memory without using any course materials. This again allows students to self assess their level of knowledge.

Even in classes that involve problem sets, students often do not realize the difference between “going over” the problems numerous times while looking at their notes versus being able to explain a problem to someone else without looking at their notes. Students are advised to be able to “teach” a problem or concept to another student without using their notes at all. This very simple solution is usually not utilized by students prior to these study skills workshops.

Using Concept Maps to Create a Hierarchical Construction of Knowledge

Even if students have learned all the terms and can fully explain each concept they may not yet understand the connections between concepts. Often the organization of their knowledge is in a linear fashion of facts and terms and concepts. This linear organization does not enhance the development of critical thinking nor their understanding of the critical relationships between concepts.

Concept maps are an excellent way to have students create a hierarchical construction of knowledge that reinforces their understandings and allows them to see connections between concepts. This allows them to practice their critical thinking skills. A concept map is a flow diagram that links important concepts with the key terms that explain the relationship between these concepts or terms (Allen and Tanner 2003).

The steps to creating a concept map are:

- 1) **List** all the key words/ terms, concepts or phrases from that topic. Rank these from the most broad and inclusive to the most specific and least inclusive;
- 2) Cluster the key words/ concepts that interrelate closely;
- 3) Arrange the keywords/ concepts in a diagrammatic representation from the most specific key words to the broadest concepts;
- 4) **Link** each key word with a preposition or verb to indicate their relationship.

The concept map technique can be time consuming and may not appeal to students with aural learning strategies. So it may be best used as an assignment for students to use for particularly challenging chapters or topics. For example, the immunology chapter in most introductory biology is often perceived by students as a bewildering array of

T-cells, B-cells, etc. However, for the past three years I have assigned a required concept map assignment of the immune system for all of my introductory biology students. The students have overwhelmingly approved of this assignment and the number of student questions involving this chapter has decreased.

Preparing for the Exam

Time management is a critical component for success in exams. In high school, many students only studied the evening before an exam and still were successful on these exams. However, given that the quantity, depth of knowledge and pace is often much higher in college than in high school, this technique does not usually work for most college students. Students need to be able to identify which topics will require more studying time than others and make a realistic plan for studying at least one week before the exam. To help students with time management I present them with a week long hourly time chart that is posted on their course website that allows students to clearly identify actual times available for studying for this exam.

The week prior to each exam students are first asked to post in the time chart all of their other course activities as well as work responsibilities, clubs, sports, committees, etc. They are also asked to post all social obligations (e.g. dinner with friends or family, etc). In addition, they are asked to post in any other school work time commitments (e.g. writing papers, homework or assignments, etc.). Then, they are asked to rank the topics that will be covered on the exam from more challenging to less challenging. Students are asked to put each topic into an available study time during that week and to chart more time for more challenging topics than less challenging topics. This also allows students to break up the studying into management chunks of time and having a concrete schedule allows them to understand how much time it will take to study each topic for the next exam.

Results

In the Fall 2006 I presented this study skills model in four identical workshops shortly after the first exam. The workshops were held in the late afternoon or early evening for students in a majors level introductory biology course shortly after their first lecture exam and lasted approximately one hour. Out of a total lecture enrollment of 343 students, 68 (almost 20% of the class) students attended the workshops. The students in the workshops represented 10 different majors with Biology, Biochemistry, and Exercise Science Physical Therapy comprising the majority of these majors (n= 42) (Table 1).

Table 1. The majors of the students attending the study skills workshop (n = 68 students)

Major	Number of Students Attending Workshop
Biochemistry	6
Biology	21
Biomedical Engineering	2
Business Administration	1
Chemistry	4
Deciding	9
Exercise Science Physical Therapy	15
Nutrition and Dietetics	3
Nuclear Medicine Technology	1
Occupational Sciences	2
Psychology	4

The majority of the students who attended a workshop received a B or better on their first exam (46 of 68). Students who scored a B or higher on Exam 1 had the highest participation rates while students who scored a C+ or lower had the very lowest participation rates (22 of 68).

To examine the effectiveness of attending a study skills workshop I evaluated the performance of students on the second lecture exam for two groups of students: those that did attend a study skills workshop and those that did not attend a study skills workshop.

The mean of Exam 1 was higher than the mean of Exam 2, (mean exam 1 = 83.3% +/- S.E. .61; mean exam 2 = 68.7% +/- S.E. = .008) therefore the difference between the two exams was examined (e.g. Exam 1% - 2%). Students who did not attend a study skills workshop had a larger decrease (mean decrease = 15.5% +/- S.E. .7) than students who did attend a study skills workshop (mean decrease = 10.6% +/- S.E. 1.2) from Exam 1 to Exam 2 (t-test, p<.0008). This represents a five percent difference in the performance

between these two groups, equal to half of a letter grade.

Discussion

Students attending a study skills workshop performed significantly better on the second lecture exam than students who did not attend a study skills workshop indicating that these workshops can enhance student academic performance. Most of the students who attended the workshops were already high achieving students and yet their performance increased after attending a study skills workshop. Study skills strategies, such as the ones described here, are rarely taught within a course setting and are also even rarely taught in freshman seminar classes. These results indicate that the addition of study skills strategies may be an important component to student achievement.

There are numerous papers (e.g. Chaplin 2007; Solon 2007, Miri et al. 2007) presenting strategies for helping students develop critical thinking

skills but few that present strategies to help students self identify and self diagnose problems with their basic learning strategy. These papers often emphasize the importance of critical thinking skills. However, in order for a student to utilize critical thinking skills they have to have knowledge of the facts, terms and processes involved with that concept (e.g. successful studying strategies). Students who are performing poorly in science courses almost always do not have the basic knowledge of a concept although they will repeatedly report that they felt that they did “know” the material.

Metacognition (Bransford et al 2000) is the ability to self-monitor your current level of knowledge and understanding and diagnose when it is or is not adequate. There are several studies that indicate that students are often poor gauges of their level of skill development (e.g. metacognition). Studies examining the relationship between self assessment and assessor assessment (graduate students or faculty) of students skills found that students self assessment ratings were much higher than that of the assessors ratings (Kirby and Downs 2007; McEnery and Blanchard 1999). Chaplin (2007) found that students with actual test scores of 60% or less in an introductory biology class tended to overestimate their exam performance by an average of 22%. This demonstrates that low achievers in particular are truly poor at self-identifying any studying problems. Students who come to me for class performance advice often self report that they felt like

they had “done well” on an exam only to be startled by their actual exam score. They also report that they “felt well prepared” for an exam based on their studying. These students may well have spent considerable time studying but may have been using ineffective studying strategies. Nonis and Hudson (2006) found that there was no correlation between amount of time business students spent studying and academic performance which again may indicate the importance of using appropriate studying strategies for effective studying.

At the end of the semester student assessment surveys examined students perceptions of the study skill strategies. Students were asked what aspects of their studying they modified after attending a study skills workshop (Table 2). Students could choose more than one answer. Overwhelmingly students responded that they changed their lecture preparation and note taking in lecture the most (56.2%). The next highest response was changes in making and using flash cards as a study aid and using an exam studying schedule (32.5%). However, few students reported using concept maps or creating their own quizzes (11.2%). Both of the later exercises are the most time demanding and skill demanding and students lack of utilizing these may be due to constraints on either of these (e.g. time or skill). Given the importance of these strategies for developing critical thinking skills future research should examine this result.

Table 2. Results of assessment survey regarding utilization of the strategies presented in the study skills workshop. Students were asked to reply to the following question: After attending an Advanced Study Techniques Workshop what specific aspect(s) of your studying did you modify or add to your studying. You can choose more than one answer.

Preparing for lecture (e.g. looking for key words or concepts in the textbook or in PowerPoint)	31.9%
Taking more detailed notes during lecture	24.3%
Making and using flash cards	13.9%
Making and using an exam studying schedule	18.6%
Making and using concept maps	6.6%
Creating Quizzes	4.6%

An important finding of this study indicates that the students who need the help the most are the least likely to seek it out. Low achieving students were the least likely to attend a study skills workshop. It is unclear whether this is due to their inability to self assess their need for assistance or their reluctance to seek assistance as they may consider this a remedial or punitive experience. However, given that the higher

achieving students were more likely to attend a workshop this may indicate that these low achieving students do not perceive a need for this assistance. Weinert and Luew (1987) found that skilled learners appear to adapt more easily to new learning situations than unskilled learners which further indicates the necessity of providing study skills workshops for incoming students to help them develop these important academic skills.

There are numerous possibilities to explain why students have poor metacognition abilities (Somers and Burnbaum 1991; Meyer 1980). However, Rohwer (1984) acknowledged that academic studying research was one of the most neglected topics. Clearly, poor self assessment is a widespread phenomenon in students and future research on strategies for helping students increase their metacognition skills is greatly needed.

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