To Learn or to be Taught? Harnessing Technology to Enhance Self Regulated Learning

Ornit Sagy
Department of Education in Technology and Science, Technion – Israel Institute of Technology
ornit_sagy@yahoo.com

Yael Kali
Department of Education in Technology and Science, Technion – Israel Institute of Technology;
The faculty of education, University of Haifa
yael.kali@gmail.com

Dan Zilberstein
Faculty of Biology, Technion – Israel Institute of Technology
danz@tx.technion.ac.il

Masha Tsaushu
Department of Education in Technology and Science, Technion – Israel Institute of Technology
tmasha@gmail.com

Tali Tal
Department of Education in Technology and Science, Technion – Israel Institute of Technology
rtal@technion.ac.il

Shimon Gepstein
Faculty of Biology, Technion – Israel Institute of Technology
gepstein@ technion.ac.il

Abstract

Instruction in large higher education introductory courses is usually based on lectures which discourage students from taking responsibility of their own learning. We developed an instructional model that harnesses technology to support students in assuming such responsibility, and gradually implemented it in a large introductory biology course. We examined how the gradual shift of responsibility from the instructor to the students affected their self regulation and self-efficacy. Verbal analysis of students' utterances revealed that students felt a sense of confidence when all course contents were provided to them in the lectures and the tutorial, which encouraged them to take responsibility of their own learning. However, when students were required to self-learn some of the course materials which were not covered in lectures, they became reluctant from taking that responsibility. We conclude that it's imperative to provide supports that will induce students' confidence, and encourage them to assume responsibility.

Keywords: self-regulated-learning, self-efficacy, large academic courses.

Introduction

In many universities across the world, courses (especially introductory ones), have large numbers of students. As such, they take place in spacious lecture halls, and constrain the teaching mainly to lectures. Research shows that such instruction fails to help students develop conceptual understanding because it does not encourage students to take responsibility of their own learning (McCray, DeHaan, & Schuck., 2003).The literature refers to two related entities that enable learners to take such responsibility: *self-efficacy* and *self-regulated-learning*.

According to Bandura (1994) *self-efficacy* is described as the person's belief in his or her capability to accomplish learning goals at a designated level of performance and to influence the process of getting to that level (*self-efficacy* is relevant in all areas of life but here we refer specifically to learning). Bandura (1994) describes *self-efficacy* as stemming from four sources: *mastery-experience, social-models, social-persuasion* and *emotional/physical state*.

Self-regulated-learning is described by Zimmerman (1998) as the self-directed process – that may include thoughts, feelings and actions a learner uses in order to attain a personal goal of learning. He claims that it is a cyclical process with three stages (see Figure 1) – (a) *forethought*, (b) *performance-control* and (c) *self-reflection*. The *forethought* stage deals with the preparation towards the actual learning, which occurs in the second stage. In the third stage the learner reflects on his/her current state and proceeds to another cycle of the preparation stage (*forethought*) to make required changes towards the continuation of the learning process (Zimmerman & Campillo, 2003). Each of the stages of the *Self-regulation* cycle involves several components, as can be seen in Figure 1.
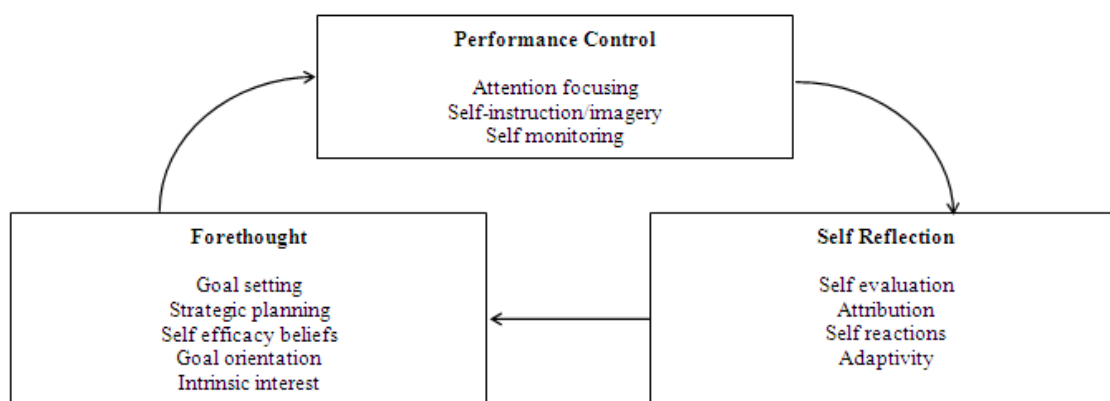

Figure 1. Self regulatory cycle, based on figure 1.1 in Zimmermann (1998)

Purpose of Current Research

In this research we developed an instructional model that harnesses technology to support students in assuming responsibility of their own learning. We gradually implemented the model in a large introductory biology course (about 250-350 students), which has been taught for years as a traditional lecture-based course. We introduced a web-based tutorial, which included videotaped lectures, interactive visualizations and self feedback questions as an additional resource for the course, as can be seen in Figure 2.

The different features of the tutorial were designed to increase the students' control over the learning process: the video recordings are synchronized with the lecture slides and annotated with sub-topics. The students can choose to skip parts they feel that they already comprehend and repeat others that they don't. The feedback questions direct the students to additional resources related to each question (a section of the video recording, a page in the textbook, or an interactive visualization).

In the first phase of the study, the use of the online tutorial was optional; course meetings were still devoted to lectures, in which all course contents were covered, similarly to the way this course has been taught for many years prior to this study's intervention. In the second phase, students were *required* to learn some of the course contents using the online tutorial. This enabled the lecturer to skip some of the details and to go into more depth of the contents and make connections between different concepts and course topics.

The purpose of the research was to examine how the gradual shift of responsibility from the instructor to the students affects the *self-regulation* and *self-efficacy* of students in three successive course enactments. Specifically, we wanted to explore whether (and to what extent) there will be a change in specific components of *self-regulation* and *self-efficacy*, and how these relate with other factors such as students' attitudes toward the course, and their final grades.

Figure 2. The web-based tutorial

Methods

A total of 834 freshmen students in biology participated in three semester-long enactments of the introductory biology course between 2008 and 2010: 250 in a pre-intervention stage (one year before the online tutorial was introduced) 320 in phase-1(optional tutorial; regular lectures) and 280 in phase-2 (required self-learning from tutorial; in-depth instruction of particular topics in lectures).

Data sources

Data sources included:

1. *Feedback survey* that was given to all students toward the end of the course. Most of the survey was comprised of Likert type questions about the usage of specific features of the instructional model and their contribution to student's learning. One open question at the end of this survey enabled students to write general comments about how they perceived the course.

2. *Interviews* with 18 selected students from the second and third enactments who were chosen based on their usage of the tutorial ("heavy-users", "typical-users" and "none-users") were asked specifically about their use of the online tutorial and their attitudes towards the instructional model.

3. *Server log files* that provided us with information regarding the number of times each student accessed each webpage.

4. *Test scores*, based on 30-40 multiple-choice questions developed and assessed by the course instructors.

Students' utterances in the written comments and the interviews were analyzed using a verbal analysis technique (Chi, 1997), with the categories shown in Table 1. The categories we chose to use as indicators for *self-regulated-learning* and *self-efficacy* were those that appeared in more than 10% of utterances. The quantitative data (server logs and test scores) was analyzed using descriptive statistics.

Table 1. Verbal analysis categories

Category	Explanation	Examples from student utterances in interviews
Self efficacy: *Mastery experience*	Gaining successful experience in complex tasks	"Regarding the course's web site - it was amazing to my opinion. An excellent service for us, the students, with the relevant questions and links to the book. [These links] were really impressive"
Self efficacy: *Emotional state*	Having a supportive environment which reduces the stress	"The material is organized superbly, [it's] very comfortable"
Self regulated learning: *Intrinsic interest*	Genuine interest in the subject itself – the will to expand the knowledge	"I would consider expanding the syllabus and including additional topics". "The material is very interesting"
Self regulated learning: *Strategic planning*	The choice of methods for carrying out a learning task	"The lectures were excellent, but video lectures would still be useful. We need more copies of the textbook in the libraries because it is a very important learning tool as part of the course"

Findings and Discussion
Use of the online tutorial, satisfaction and test scores
The analysis indicates that once the tutorial was introduced (phase-1) its usage was high (server data shows that more than 90% of the students used it at least once). About 50% of the students who filled the surveys in the year that the tutorial was first introduced declared that they use the tutorial often ("for all/most of the course topics"). The usage became even more extensive in phase-2. For example: based on the server data, in phase-1 each student watched, on average, eight different video recordings (out of twenty-eight). In phase-2 the average went up to eighteen – 64% of the video recordings. Students' satisfaction from the tutorial is evident from the survey results - 78% of the students' that answered the survey indicated that the tutorial had a large positive impact on their learning process, and 80% of the utterances regarding the tutorial were positive - e.g. "The new website is a great tool for learning". The interviews revealed the same picture; only one out of seven interviewees that participated in the first phase did not see the online tutorial as a useful tool for learning. One of the interviewees even said "without the site I would have been lost". It is important to note that no difference was found in the final exam scores in the three semesters. This is an indication for the ability of the students in the second phase, in which they had to learn some of the course topics on their own, to cope with the requirement of self-learning.

Self-regulation and self-efficacy
The analysis of student answers for the survey's open question showed a rise in three *self-regulation* indicators (*intrinsic-interest*, *self-efficacy – mastery-experience* and *emotional-state*) in phase-1 – with the introduction of the site, and then a drop in phase-2 (Figure 3) when they were required to self-learn some of the course topics which were not covered in the lectures. However, with regards to *strategic-planning*, there was a gradual decrease throughout the three years of the study (Figure 4).
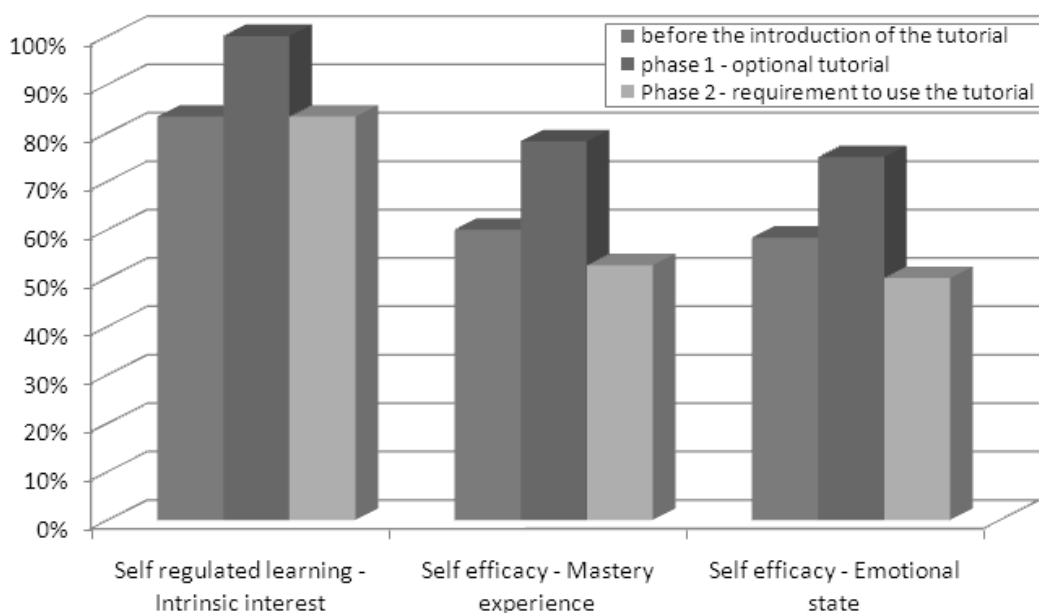
Figure 3. Rise and drop in positive self-regulation and *self-efficacy* indicators
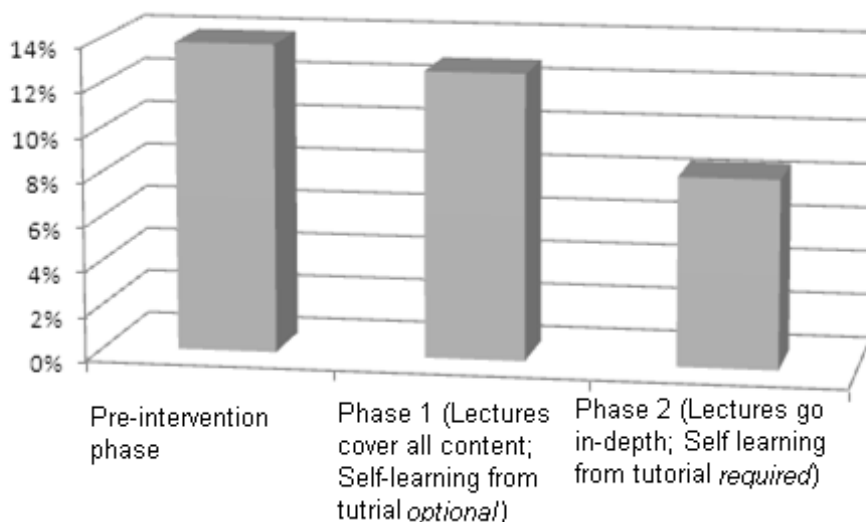

Figure 4. *Strategic-planning* utterances

We interpret the rise and drop in Figure 3 using Maslow's most cited hierarchy of needs theory (1943). Maslow claimed that a person will desire higher-level self-actualization needs (the need for full realization of one's potential) only after the more basic psychological needs (such as personal-security) are fulfilled. Accordingly, we view the rise between the pre-intervention phase, and phase-1 in the three indicators in figure 3 as an indication of a sense of confidence that students felt when all course contents were provided to them both in the form of lectures and in the online tutorial in phase-1 (or in the words of one of the students: "I always prefer to rely more on the lectures. But there is like self confidence … a good feeling that you can't miss anything, there is always the website"). Building on Maslow's theory, we believe that this confidence provided students with an environment in which they felt comfortable enough to expand their self interests. However, in phase-2, when students knew that some of the contents are not covered in lectures, and others, not covered in the online tutorial (the lecturer's elaborations during lectures), this sense of confidence was shattered. This lowering of students'

confidence brought to a decline in all three indicators, or in Maslow's terms, students' psychological resources were directed towards their more basic needs – making sure they learn everything they should know for the test. This depressed their interest in expanding their horizons.

Our interpretation of the constant drop in the *strategic-planning* indicator (Figure 4) is that there is a certain gap between students' theoretical aspiration to be provided with a variety of learning resources that they will be able to use to expand their knowledge, and their actual desire to be taught via lectures. Thus, in the pre-intervention phase, when students thought about how they would have hypothetically liked to improve the course, they suggested additional learning sources, as one student says: "A video-taped lecture would be helpful. For sure". However, once additional tools were provided to them in phase-1, and especially when they were *required* to use them in phase-2, they drew back and avoided the responsibility. It seems that students prefer to keep their comfort zone in a situation in which the instructor has the responsibility for making the entire *strategic-planning*, as portrayed by one of the students:"Learning from the internet can be an addition, [but] not instead of [what is said in lectures]. The center [al place in which contents are being taught] should be the lectures".

Theoretical and Educational Significance and Implications

This study shows that indeed, technology can provide students with an environment that encourages *self-regulated-learning* and supports *self-efficacy*. However, when using technology to increase students' responsibility of their own learning, it is imperative to provide them with appropriate supports that will induce a level of comfort and confidence which is critical for *self-regulated-learning* and *self-efficacy* to develop. In terms of *self-efficacy* indicators, we need to provide a supportive environment that ensures a relaxed *emotional-state*. We believe that the drop in *self-efficacy* and *self-regulation* components in the second phase of this study is due to the fact that the transferring of responsibility from the instructor to the learner was not complete. We have evidence showing that students were confused regarding which of the contents they should be learning on their own and were worried about how these contents will be expressed in the final exam. It seems clear, based on Maslow's theory (1943), that in the second phase students were not provided with enough support to feel confident that they can succeed well in the course even though some of the responsibility has been passed to them.

That said, we would like to stress that we are not backing away from our goal to increase students responsibility of their own learning. Rather, we stress the importance of providing them with the appropriate support in doing so. We are currently conducting a third phase of the study, in which, instead of lectures, the instructor meets each week with several groups of students, who present and discuss a specific topic they study together, using an online learning environment that guides them in the collaborative endeavor. Building on the outcomes of the current research, we designed the online learning environment, and the way it is implemented to increase students' certainty regarding which of the contents they are responsible for learning on their own and to provide them with sufficient support to be able to do so. We believe that although students will be required to take greater responsibility of their learning, they will feel more confidence in doing so.

References

Bandura, A. (1994). Self efficacy. In V. S. Ramachaudran (Ed.). *Encyclopedia of human behavior* (Vol. 4, pp. 71-81). New York: Academic Press. (Reprinted in H. Friedman [Ed.], Encyclopedia of mental health. San Diego: Academic Press, 1998).

Chi, M., T., H., (1997). Quantifying qualitative analyses of verbal data: A practical guide. *The Journal of The Learning Sciences, 6*(3), 271-315.

Dweck, C. S., & Leggett E. L. (1988). A social-cognitive approach to motivation and personality. *Psychological Review, 95*(2), 256-27.

Maslow, A. (1943). A theory of human motivation. *Psychological Review, 50*, 370-396.

McCray,R A., DeHaan, R. L., & Schuck, J. A. (2003). Improving undergraduate instruction in science, technology, engineering, and mathematics. *Report of a workshop: National Research Council,* Washington, DC: National Academies Press.

Weiner, B. (1985). An attributional theory of achievement motivation and emotion. *Psychological Review, 92*(4), 548-573.

Zimmerman, B. J., & Campillo, M. (2003). Motivating self regulated problem solvers. In J.E. Davidson & R. Sternberg (Eds.), *The nature of problem solving* (pp. 233-262). New York: Cambridge University Press.

Zimmerman, B. J. (1998). Developing self-fulfilling cycles of academic regulation: An analysis of exemplary instructional models. In D. H. Schunk, & B. J. Zimmerman (Eds.), S*elf regulated learning: From teaching to self-reflective practice* (pp. 1-19). New York: Guilford Press.