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Can TILT Be Used to Teach Study Tactics? A Case Study in a Biology Classroom

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Abstract

Recently, there has been a movement encouraging instructors in higher education to use the Transparency in Learning and Teaching (TILT) framework when designing assignments. This framework helps instructors clarify their expectations and evaluation criteria. Making assignments more transparent may result in greater student success. However, it is less clear how this framework can be applied to classes that use exams as a main method of assessing student learning. One option might be to use a TILTed assignment to introduce students to learning tools to improve their studying. I did this by giving students in an introductory biology class an assignment to construct a concept map prior to their first exam. This intervention did not result in students performing better on the exam when compared to the performance of prior classes without the intervention. One assignment may not have been enough to train students in concept mapping or to convince them of the utility of concept mapping as a learning technique.

Faculty across all disciplines are interested in ways to improve student learning and success in their courses. One method for doing so involves making course assignments and the criteria for success more transparent to students (Winkelmes et al., 2016). Transparency in Learning and Teaching, or TILT, encourages instructors to explain why a particular assignment is of value to the students (Purpose), what steps students need to take to complete the assignment (Task), and how the assignment will be evaluated (Criteria for Success) ("Transparency in Learning and Teaching (TILT) Higher Ed.", n.d.; Winkelmes et al., 2016). This strategy seems to improve student outcomes across disciplines and works particularly well for historically underserved students (Winkelmes et al., 2016). The benefits of this strategy can manifest as a greater sense of student belonging, higher course completion rates, and higher scores on assessments (Ou, 2018; Winkelmes et al., 2016).

The TILT framework has mostly been applied to course assignments ("Transparency in Learning and Teaching (TILT) Higher Ed.", n.d.). The focus on assignments raises the question of how easily the TILT framework can be applied to classes in which exams are the primary mode of assessing student learning. While it may be possible to make the exam questions themselves more transparent (see LeJeune's article in this issue), another approach is to try to make the process of studying more transparent.

Study skills include both the tactics used to study (e.g. notecards, taking reading notes, etc.) as well as the knowledge of how to apply these tactics effectively to different tasks and material (Gettinger & Seibert, 2002). Students come in with their own ideas about which study tactics are commonly used, and some of those ideas may hinder effective studying (Anthenien et al., 2018). In fact, many students report using tactics that are not helpful for learning, such as rereading and highlighting (Dunlosky et al., 2013; Hartwig and Dunlosky, 2012). This suggests that students may benefit from exposure to more active studying methods.

One study tactic that students may employ to organize information is concept mapping (Gettinger & Seibert, 2002). Concept maps consist of a series of terms or concepts with links drawn in to show the connections between ideas. These links are usually labeled to clarify the connection (Novak et al., 1983). One main advantage of a concept map is that it shows how ideas are connected rather than viewing individual facts or terms in isolation. Building a concept map involves active learning, as the student must try to organize the material and make sense of it (Handelsman et al., 2007). While concept maps can be used as a form of assessment to gauge student understanding (McClure et al., 1999; Novak, 1990; Won et al., 2017), they also provide a potential tool to enhance learning (Baliga et al., 2021; Novak et al., 1983).

Purpose

The goal of this project was to determine whether using a TILTed assignment to expose students to a new study tactic could improve performance in an introductory biology course. While the assignment given in this study followed the TILT format (Purpose, Task, and Criteria for Success), the broader goal was to begin making the process of studying itself more transparent to students by providing them with a novel and concrete study tactic to employ. STEM fields, including Biology, often see high rates of attrition among students, particularly early on in their college experience (Sithole et al., 2017). I hoped that by adding some transparency to the process of studying, students would show improved learning on the exams, leading to better success in the class overall.

Methods

Participants

The participants were students enrolled in the first course of the introductory biology series at Georgia Southwestern State University. All students majoring in Biology must take this course as part of a two-semester sequence. Students must complete both the introductory courses in the sequence before they can move on to take upper-division classes in Biology. Most students take this course in their freshman or sophomore year. Failure rates in the course have historically been high, with the DWF rates ranging from 65% to 71% in 2017-2018. Receiving a D, W, or F in a foundational STEM course can result in students switching majors or not completing their STEM degree, and this impact seems to be particularly strong for underrepresented minorities (Hatfield et al., 2022). Thus, this course presents a major hurdle for many students trying to obtain a Biology degree.

Attempts to improve passing rates in the course led to the creation of a Recitation section (described below) to accompany the

regular course. The course traditionally includes both a lecture and lab component, although I focus primarily on the lecture. The course is team taught, with one instructor covering the first half of the class and a second instructor covering the second half. The same two instructors have co-taught the class for the last four years; thus, comparisons between years are possible.

Research Design

The intervention took the form of an assignment to make a concept map on a topic relevant to the first exam. The goal of the concept map assignment was less about assessing students' understanding of a specific topic and more about introducing them to a potential study method. The idea was to encourage students to actively engage with their course notes rather than adopt passive strategies like simply rereading notes. Students were allowed to select any topic from the first four chapters of the book as the basis of their map. Because students could (and did) select different topics, no set of key terms/concepts was provided in advance.

The assignment sheet provided for the concept map included the typical elements of a TILT assignment, namely a statement of purpose, a description of the task, and a section on how the assignment would be evaluated that included a sample concept map on the topic of chemical bonding (Appendix A). The whole assignment was given as homework, and students brought their completed concept maps to class in the week before the first exam. They then exchanged these maps with a classmate and provided feedback to each other. Students had the opportunity to modify their maps during this exchange. The concept maps were turned in at the end of the class period and scored holistically based on completion and accuracy of the links drawn. Because each student was allowed to choose a different topic on which to focus, it was not possible to use a single, master concept map during assessment.

The concept map assignment was added as part of a new recitation section associated with the course. This recitation section was first taught in the fall semester of 2021 as a zero credit, co-requisite course. Scores earned from the recitation assignments counted towards the overall course grade in the introductory biology class. The recitation course met for 50 minutes once a week during the semester. All students taking the main lecture/lab class were also enrolled in the recitation. The purpose of the recitation was to teach students the skills needed to be a successful Biology major. The first weeks of the recitation section were devoted to notetaking and reading for content. The concept map assignment was the third major topic and took place shortly before the first exam in the course. Later topics in the recitation included science skills such as how to convert between units, graphing skills, and so on. The class did not discuss these other topics until after the first exam in the course.

To evaluate the effectiveness of this intervention, I looked at grade distributions from the first major exam in the class. I chose this exam because students had completed the concept map assignment just prior. Also, this exam marks the first major checkpoint for students in the course, and their scores on the exam may influence their subsequent decision to remain in the course or withdraw. I compared exam grades from fall of 2021 with grades from the previous two fall semesters. The format of the exam and material covered was the same across all three years of the study. The main mode of instruction used in each year was lecture interspersed with

periodic questions to check understanding. In fall semester of 2020, the pandemic caused the lecture to be delivered virtually rather than in-person. However, lectures were done synchronously at the regular class time to mimic in-person instruction as much as possible.

When comparing exam scores, I focused on two questions. First, did the average score on the first exam improve after the intervention as compared to the previous years without the intervention? Second, did a higher proportion of students score a 60% or better on the first exam after the intervention? 60% was chosen because this is equivalent to a D, which is the minimum grade needed in the class to progress to the second course in the sequence.

Data Analysis

All data were taken from saved midterm grade sheets. This dataset included any students who were still in the class at midterm. Students who withdrew from the course before midterm were automatically dropped from the gradebook in the Learning Management System, and their grades were therefore unavailable when the instructor downloaded the grade sheets at midterm. Thus, any student who withdrew before midterm was excluded from the dataset. Students who withdrew after midterm were still included. I compared exam scores between years using an ANOVA. To compare the proportion of students scoring 60% or better across years, I used a Chi Squared test.

Results

We had exam scores from 21 students in 2021. However, only 16 of them had also completed the concept map assignment and so were included in the analysis. 2021 Exam scores from students who completed the concept map tended to be higher than those of students who had failed to turn in the map, but that difference was not significant, likely owing to the small sample size ($t_{19} = 1.12$, $p = .27$).

Overall, the observed trend was the opposite of the predicted trend; exam scores in fall 2021 were lower than the two preceding years (Table 1). However, the difference between years was not significant overall ($F_{2,87} = 1.75$, $p > .1$). The proportion of students scoring 60% or better showed a similar trend, with 2021 having the lowest passing rate; however, this trend was not significant ($\chi^2 = 2.02$, $df = 2$, $p = .36$), possibly due to low sample size.

Table 1

A comparison of Exam 1 scores and passing patterns across years.

Year	*N*	*M*	*SD*	*Percent Passing*
2019	41	68.8	15.7	73.2
2020	33	62.8	18.5	60.6
2021	16	60.0	22.2	56.3

Discussion

The TILT assignment used in this study was intended to help students learn concept mapping as a study tactic. However, this strategy failed to improve student performance on the first exam. These data do not allow for a careful examination of the effects of TILT in isolation. The assignment was integrated into the course as part of a pre-

planned change: the addition of the recitation section to the course. Moreover, the TILT assignment cannot be compared to an unTILTed assignment, as the concept map assignment was an addition to the course that only started in fall 2021. However, neither the TILT assignment nor the recitation overall seems to have improved student success. If anything, the data suggest a downward trend in student performance, one that will need to be countered in future years. This trend began before the intervention, but the intervention did nothing to counter it.

It is possible that the assignment would have benefitted from even more transparency in the form of repeated in-class training. One of the challenges to using concept maps is the time needed to train students properly in their use (McClure et al., 1999). A possible flaw in this intervention is that students were not given sufficient time in class to practice making concept maps. The assignment itself included a general description of a concept map as well as a sample map. However, without prior practice on the part of the students, these may not have been sufficient to allow them to construct a useful concept map. Had I devoted more class time to teaching concept maps and required students to turn in multiple maps on different topics, the outcome might have been different. The "one and done" nature of the assignment may also have prevented students from appreciating the utility of concept maps, which might prevent students from using them as a study tool in the future.

The difference in format between the concept map assignment and the exam itself may also explain the lack of positive results. Student scores on concept maps are not always correlated to their scores on other forms of assessment (Novak et al., 1983). Moreover, the use of concept maps as a teaching tool may not impact all students equally. Some evidence suggests that higher-performing students are less likely to show learning gains from concept mapping compared to lower-performing students (BouJaoude & Attieh, 2008; Stensvold & Wilson, 1990).

The poorer performance of students in fall of 2021 may also be related to the ongoing COVID pandemic. Many of the students in introductory biology are incoming freshmen straight out of high school, and these students may have seen as much as a year and a half of learning disrupted by the pandemic. The pandemic has resulted in losses in student learning, particularly for schools that relied more on remote learning (Goldhaber et al., 2022). A single intervention may not have been enough to overcome these difficulties.

Several other issues may have contributed to the lack of effect observed here. One problem I observed during the class was a lack of attendance and participation in the recitation sections where the TILT assignment was implemented. This problem contributed to the small sample size from fall 2021. Moreover, the problem got progressively worse as the semester went on. The recitation scores counted for 10% of the grade for the lecture class, but this incentive was not sufficient to motivate students to attend. In future years, I will try to reiterate the importance of the skills learned in recitation and possibly make the recitations count more strongly towards the overall course grade.

References

Anthenien, A. M., DeLozier, S. J., Neighbors, C., & Rhodes, M. G. (2018). College student normative misperceptions of

peer study habit use. *Social Psychology of Education*, *21*(2), 303-322.

Baliga, S. S., Walvekar, P. R., & Mahantshetti, G. J. (2021). Concept map as a teaching and learning tool for medical students. *Journal of Education and Health Promotion*, *10*.

BouJaoude, S., & Attieh, M. (2008). The effect of using concept maps as study tools on achievement in chemistry. *Eurasia Journal of Mathematics, Science and Technology Education*, *4*(3), 233-246.

Dunlosky, J., Rawson, K. A., Marsh, E. J., Nathan, M. J., & Willingham, D. T. (2013). Improving Students' Learning with Effective Learning Techniques: Promising Directions from Cognitive and Educational Psychology. *Psychological Science in the Public Interest*, *14*(1), 4-58.

Gettinger, M., & Seibert, J. K. (2002). Contributions of study skills to academic competence. *School Psychology Review*, *31*(3), 350-365.

Goldhaber, D., Kane, T., McEachin, A., Morton E., Patterson, T., & Staiger, D., (2022). *The Consequences of Remote and Hybrid Instruction During the Pandemic*. *Research Report.* Cambridge, MA: Center for Education Policy Research, Harvard University.

Handelsman, J., Miller, S., & Pfund, C. (2007). *Scientific Teaching.* W.H. Freeman and Company.

Hartwig, M. K., & Dunlosky, J. (2013). Study strategies of college students: Are self-testing and scheduling related to achievement? *Psychonomic Bulletin & Review, 19(1),* 126-134.

Hatfield, N., Brown, N., & Topaz, C.M. (2022). Do introductory courses disproportionately drive minoritized students out of STEM pathways? *PNAS Nexus 1(4),* 1-10.

McClure, J.R., Sonak, B., & Suen, H.K. (1999). Concept Map Assessment of Classroom Learning: Reliability, Validity, and Logistical Practicality. *Journal of Research in Science Teaching, 36(4),* 475-492.

Novak, J. D., Gowin D. B., & Johansen, G. T. (1983). The use of concept mapping and knowledge vee mapping with junior high school science students. *Science Education, 67(5),* 625-645.

Novak, J. D. (1990). Concept mapping: A useful tool for science education. *Journal of Research in Science Teaching, 10,* 923–949.

Ou, J. (2018). Work in progress: A study of transparent assignments and their impact on students in an introductory circuit course. In *2018 ASEE Annual Conference & Exposition*.

Sithole, A., Chiyaka, E. T., McCarthy, P., Mupinga, D. M., Bucklein, B. K., & Kibirige, J. (2017). Student attraction, persistence and retention in STEM programs: Successes and continuing challenges. *Higher Education Studies*, *7(1),* 46-59.

Stensvold, M. S., & Wilson, J. T. (1990). The interaction of verbal ability with concept mapping in learning from a chemistry laboratory activity. *Science Education, 74(4),* 473-480.

Transparency in Learning and Teaching (TILT) Higher Ed. (n.d.). *TILT higher ed examples and resources.* https://tilthighered.com/tiltexamplesandresources

Winkelmes, M.-A., Bernacki, M., Butler, J., Zochowski, M., Golanics, J., & Weavil, K. H. (2016). A teaching intervention that increases underserved college students' success. *Peer Review*, *18*(1/2), 31-36.

Won, M., Krabbe, H., Ley, S. L., Treagust, D. F., & Fischer, H. E. (2017) Science teachers' use of a concept map marking guide as a formative assessment tool for the concept of energy. *Educational Assessment*, *22*(2), 95-110.

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Appendix A

Concept Map Assignment

Purpose

A main goal of this class is to help you learn the language of Biology and build the foundational knowledge you'll need to understand more applied topics (topics like human physiology, DNA technology, and many, many more). This means that you're presented with large amounts of information and terminology. To help you remember and better understand this information, it is important to recognize and build connections between terms and ideas, rather than view them as isolated facts to be memorized. This will help strengthen your understanding of how biological systems work.

One way to help visualize the connections between terms and ideas is to make use of a concept map. These can take many forms, but the main idea is always to show how smaller details fit together to form a bigger picture by drawing out the links. These are a useful study tool in biology and other subjects.

Task

- Choose a topic you want to diagram in your concept map. Examples of topics could include types of bonds, monomers and polymers, functional groups, etc.
- From your notes or readings, gather any key terms or ideas that fall within under that topic.
- Draw lines to connect terms and topics. If the connection requires an explanation, include that next to the line connecting the terms/topics.

Criteria for Success

A good concept map begins with a topic that is sufficiently broad to include its own set of terms and ideas but is sufficiently narrow to be manageable. It is detailed enough to include all the major terms and ideas associated with the topic. The connections drawn should have explanations that make sense and are factually correct.

Grading

To earn full credit on this assignment, your concept map should meet the criteria below:

- Include the relevant terms and concepts associated with your topic
- Include explanations for links between terms
- All information in the concept map should be factually correct

A sample concept map for the topic of chemical bonds is included below.