Supporting Peer Instruction with Evidence-Based Online Instructional Templates

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Abstract
This work examines whether templates designed from principles of multimedia learning design, and learning sciences research, can support peer instruction in creating more effective educational content on the web. Initial results show that the structure and guidelines within these templates can help novices produce meaningful learning content while improving the overall learning experience. This experiment provides insights into how to design and implement structured outlines online for web users to share learning content, and potentially shift researchers' focus to more learner-centered online education.

Author Keywords
online education; peer learning; peer instruction; templates; learning

Introduction
As Massive Open Online Courses (MOOCs) grow in both quality and popularity, the issue of scale remains at large with the sheer size of large-scale courses and resources required, hindering instructors in their ability to provide individual attention to students [8]. However, harnessing peer instruction for peers to teach and learn from each other is a promising solution to the challenges that large-scale online learning presents. Multimedia learning environments are of interest in supporting peer instruction, but much of the research in this area has been more instructor-focused than peer-

focused. This research seeks to understand whether templates designed based on learning sciences principles can help create a better online learning experience for novice "tutors" and "learners."

We hypothesize that tutors who use templates will be better able to create effective and organized educational content. We further hypothesize that learners who learn from template presentations will demonstrate greater learning gains, compared to learners who learn from non-template presentations. This paper introduces theory behind our hypotheses, our experimental paradigm, and initial results.

Related Work

Templates have been a useful approach in increasing faculty adoption of online learning practices. Hoffman and Ritchie [3] developed a workshop with templates that incorporate principles of connecting learning content, applying it, and reflecting upon it in asynchronous online learning environments to help faculty better organize their curriculum. While instructional templates have been useful in structuring of online content, the research done in this realm has been geared towards professional instructors. Further, these instructional templates are often designed to accommodate for an entire online course, illustrating a more instructor-centered focus.

One related project in templates for novices is the "Wallet Project" from the Institute of Design at Stanford University [1], which consists of an activity to guide design students through an entire design process, using templates and a facilitator's guide for instructors. These templates help students ideate, iterate, and collaborate on their projects. Similarly, our template is designed to facilitate novice tutors through the instructional process to create effective educational content online.

Template Design

To explore how to better support peer instruction online, we designed a template for novice tutors that incorporates guidelines based on Lohr's [4] principles for instructional interface design:

- Organization of elements into a meaningful hierarchy of learning tasks.
- Organize the sections into a coherent whole.

To accomplish the implementation of these principles, elements derived from learning sciences evidence were built into the template. These include: learning goals, external representations, and guided activities. Figure 1 shows the overall outline of the template.

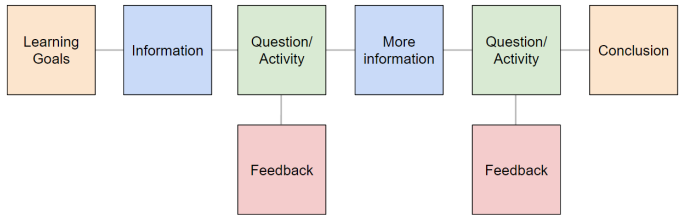
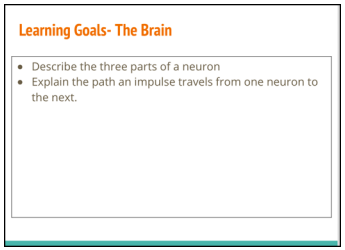


Figure 1. Overall outline of the template. The learning goals and conclusion serve to create a coherent whole of the learning activities and information in between.

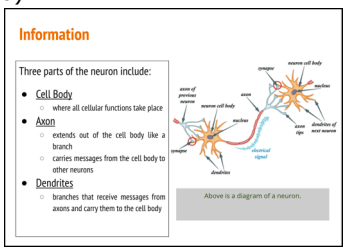
Learning Goals

Learning goals, or mastery goals, give learners a frame of reference prior to beginning a learning activity, which has positive consequences on learning gains [2]. By instructing tutors to state learning goals both at the beginning and at the end of their presentation (as a conclusion), our template attends to both design principles in giving learners a clear hierarchy of tasks

a)



b)



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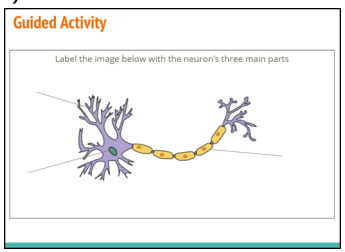

Figure 2. Example of a Learning Goal slide (a), External Representation (b), and Guided Activity (c) created by a template tutor.

and placing the entire context into a coherent whole (Figure 2a).

External Representations

External representations are pictorial depictions of verbal or textual information. Relevant external representations displayed in conjunction with textual information have been shown to improve learner outcomes, particularly when displayed in synchrony [6]. Our template gives tutors guidelines on how to well integrate external representations with text, breaking the information into meaningful sections (Figure 2b).

Guided Activity

The guided activity principle suggests that people can learn better when content includes interactivity, which facilitates engagement and encourages greater reflection [5]. Our template's guided activities instruct tutors to create questions and activities to engage the learner with the presented material and provide feedback to help the learner better comprehend and apply the information (Figure 2c).

The Experiment

Participants were assigned as either tutors or learners. Tutors were asked to create an educational presentation in Google Slides using either our designed template or with a blank presentation template. The presentation was to be based on an introductory passage on "The Central Nervous System" (adapted from [7]).

We then randomly assigned tutor presentations to learners. Control learners saw presentations created by control tutors while template learners saw presentations created by template tutors. After going through the presentation, learners were directed to a separate web article and instructed to identify some details from the article as a distractor task. Learners were then given a six-question quiz on the information they learned in the presentation. After taking the quiz, learners were given a questionnaire to evaluate their enjoyment of the learning experience.

Participants

75 adult participants completed participation in this study and were recruited from Usertesting.com. All participants resided in the United States and were required to have a native or bilingual fluency level in speaking and reading English.

25 participants were assigned as tutors (mean age=22.48). 13 tutors (11 female) were placed in our control condition, and the other 12 (10 female) tutors created presentations with the designed template in our template condition.

50 participants (mean age=27.61) were assigned as learners, allowing each tutor's presentation to be seen by two learners. 26 learners (12 female) saw presentations created by tutors in the control condition while 24 learners (11 female) saw presentations created by tutors in the template condition. All learners had two or fewer high school or college courses in basic biology.

Results

A two-sample Kolmogorov-Smirnov (K-S) test revealed a significant difference in the distribution of the two groups (D-stat=0.25, D-crit=0.19). Template learner performance was more normally distributed with a positive skew, and control learner performance was more evenly distributed (Figure 3). This skew suggests that learning gains for template learners were more consistent for template learners than for control learners. We believe that the positive skew of scores could be due to greater variance in quality of the control presentations compared to the template presentations. Thus, these results show the potential of guided templates in supporting peers with minimal teaching experience in creating effective educational content to share on the web.

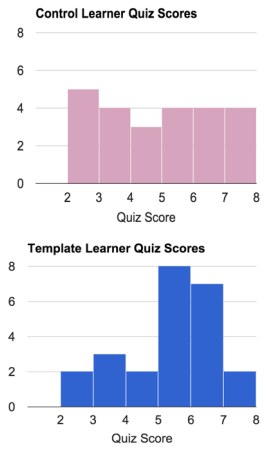

Figure 3. Histograms for quiz scores for control (top) and template (bottom) learners.

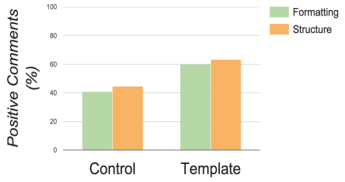

Figure 4. A larger percentage of template learners reported positive comments towards the formatting and structure of their assigned presentation than control learners.

We also examined learners' reported experience with the structure and formatting of all presentations. Template learners reported more positive views towards both presentation formatting and structure (60.0% and 66.2%, respectively) compared to control learners (40.9% and 44.7%, respectively) (Figure 4).

Future Directions & Conclusions

Future work will examine what type of guidance provided in the template is most beneficial for tutors. Another area of future work is understanding what design principles should be applied in order to make more flexible, general purpose teaching templates. The ultimate goal for this research will be to implement such templates and outlines in online education courses or platforms to allow peers to share educational content with each other.

Based on our findings, web presentation templates are helpful in guiding novice tutors in making content, and they improve both the quality of experience and learning outcomes of online learners. Our work explored how peer instruction can be harnessed through templates that provide structure and guidance for novices, allowing them to create effective educational content on the web. Further, we provided initial evidence showing how such templates could be implemented into online learning sites.

By providing better support for novices to create educational content online, we can further shift the focus of online education from instructor-focused learning to learner-centered learning.

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