Digital Tools for Professional Presentation using Mathematics

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Abstract

For most students, mathematics work has traditionally been completed with pen and paper for K-12 courses. However, in higher education we seek to both ensure students have a strong understanding of their given field and possess the ability to translate this knowledge into the professional sector. Moreso, as the workforce becomes more dependent on technology, our learners must be prepared to use digital tools to present their mathematics calculations and work collaboratively with others in their field. We have identified a gap in instruction where our students have no previous experience integrating mathematics into word processing applications or shared documents. Further, they are unable to both learn new mathematics material while simultaneously attempting to pick up this needed skill. As we expect all students to submit professional-level assignments, the following eLearning initiative addresses this need through the creation of a 6-week intensive fully online course for Indiana University's Natural Science and Mathematics department.

Digital Tools for Professional Presentation using Mathematics

At the university level, students are transitioning. In today's landscape, higher education is comprised of both young students directly graduating the K-12 environment, as well as adult learners who are interested in furthering their education or moving to a new field. In both instances, for students in mathematics programs, upon completion of their degree learners will encounter career options that require an understanding of digital tools and online collaboration. However, there is not currently an offering that prepares students for this unique task. At Indiana University one of our five learning outcomes is to prepare learners to relate in a digitally connected world. In alignment with this, we seek to create a course that introduces students to the use of digital tools in mathematics. Our particular focus is for students to develop the ability to add mathematical content to word processing and collaborative documents. In addition, we briefly introduce students to LaTeX, the premier application for writing professional mathematics content. Further, our upper-level mathematics courses ask that students type their submitted course work. By offering this course early in the program, students will have the prerequisite knowledge to accomplish this task and in addition the opportunity to refine these skills throughout the program. The course will be offered as a 1-3 credit hour elective. It will be presented as a fully online 6-week intensive for students to learn how to enter mathematical content using digital tools to create professional quality presentations.

Objectives

Upon completion of the course students will:

- Demonstrate the ability to communicate clearly and effectively in written from.
- Generate professional documents and submissions using mathematical typeset
- Compose mathematical content using digital tools.
- Type a variety of mathematical statements, expression, and equations.
- Solve complex problems (troubleshoot) using reasoning and discovery.

We recognize that eLearning can be a double-edged sword. It allows students from all over the world to participate in a learning experience simultaneously, however this can often seem like a disconnected process. Because of this, our course will foster community and collaboration. The backbone of our community will lie in the discussion forums. To encourage student participation, discussion board contribution will count towards 10% of their final grade. We will begin with introductions for learners to locate similarities in location, goals, and hobbies. Discussions will occur in each Module with specific tasks to complete. Further, the discussions will facilitate a deep understanding of the material as students work through Bloom's revised taxonomy to explain, justify, and apply the content. It provides the opportunity for student-student learning as participants share their experiences. We have chosen the discussion forum as one of our collaborative technologies as it is integrated directly into Canvas, making it easy for students to locate and participate. In addition, Graham, Cagiltay, Lim, Craner, and Duffy (2001) list online discussion as one of their "seven principles of effective online teaching". Our discussions are model to include their recommendations which include "learners should be required to participate, discussion should be focused on a task, tasks should engage learners in the content, [and] learners should receive feedback on their discussions". To further the sense of community and collaboration, learners will participate in a group/partner project. We will use Google Docs to recreate a provided mathematical proof. This directly connects to our learning goals as Google Docs contains a LaTeX editor which will help students transition from Microsoft Word to Texmaker, becoming more familiar with LaTeX commands and syntax. Students must collaborate to complete the document sharpening their cooperative skills for the workplace. Google Docs is a great technology because it is used often in the professional sector and provides an easy way for students to contribute to the project from multiple locations.

The course will include multiple means of assessing learner understanding. The first will be homework assignments. These allow students the opportunity to apply the concepts. The instructor will also be able to locate weaknesses and intervene when needed based on these submissions. Next, the

course will contain two closed book quizzes focused on Unicode and LaTeX commands and syntax. This is important because students must be very familiar with the commands in order to effectively add mathematical content. By the end of the course learners should become fluent in this "language". The quizzes give students the opportunity to self-asses this knowledge as well as provide the instructor with data that will help to both intervene and determine if any changes should made to subsequent sections of the course. The final assessment will be a project. It is left open-ended intentionally to provide students the opportunity to reach the top tier of Bloom's revised taxonomy, create, as well as represent the principles of UDL. Students will have the choice of using Microsoft Word, Google Docs, or Texmaker. They will be required to complete an essay that includes mathematical content of their choice depending on their current level of knowledge. Our assessments are both formative (quizzes and homework assignments) that allow for intervention as well as summative (final project) to assess if the student has mastered the learning objectives.

Once course development is completed, Digital Tools for Professional Presentation using Mathematics will be offered as a 1 to 3 credit hour course available to all students pursuing a degree in the Natural Sciences and Mathematics Department and Indiana University. The course is designed in that it does not require any prerequisite mathematics courses, so students of all levels are encouraged to participate. In addition, the course introduces students to a variety of mathematical content to prepare them for all upper-level courses.

In conclusion, our online course will address a need in the university: bridging the gap between mathematical content and digital tools. This will prepare students for upper-level course work as well as provide them with the technological skills needed in the workforce. Our course is founded on three main principles: creating a community and fostering collaboration, adhering to the principles of UDL to ensure multiple learning styles are accommodated, and integrating technology to mathematics content. Students will participate in both formative and summative assessments and receive mastery-oriented feedback. This in combination with course design focused on Bloom's revised taxonomy will ensure that upon

Appendix A

Our course is designed based on standards from the Indiana University Learning Objectives, ITSE Standards for Teachers, and the Universal Design for Learning.

Indiana University Campus Learning Outcomes

Retrieved From:
https://www.iue.edu/academics/assessment/documents/IUE_Learning_Outcomes.pdf

1. Communicate clearly and effectively in written and standard form.
3. Apply principles of inquiry to define and analyze complex problems through reasoning and discovery.
4. Demonstrate the ability to relate within a multicultural and digitally connected world.

ITSE Standards for Teachers

Retrieved From:

http://www.iste.org/standards/standards/standards-for-teachers

2. A. Design or adapt relevant learning experiences that incorporate digital tools as resources to promote student learning and creativity.
2. C. Customize and personalize learning activities to address students' diverse learning styles, working strategies, and abilities using digital tools and resources.
2. D. Provide students with multiple and varied formative and summative assessments aligned with content and technology standards, and use resulting data to inform learning and teaching.
3. A. Demonstrate fluency in technology systems and the transfer of current knowledge to new technologies and situations.

Universal Design for Learning

Retrieved From:

http://udlguidelines.cast.org/

1. Offer multiple means of representation
5. (1) Use multiple media for communication
5. (3) Build fluencies with graduated levels of support for practice and performance
7. (1) Optimize individual choice and autonomy
8. (3) Foster collaboration and community
8. (4) Increase mastery-oriented feedback

Appendix B: Course Schedule

Module	**Lesson Topic**	**Assignments**
1 – Adding mathematical content to word processing document	Introduction to Microsoft Word Equation Editor - Document Formatting (header/page #/personalization) - Opening Equation Editor - Keyboard shortcut - Justification	Homework 1 – Formatting a document and adding mathematical content Discussion Module 1
	Using Microsoft Word Equation Editor - Locating Design Tab - Inserting correct symbols and formatting - Fractions, Logical operators, Exponents, Radicals, Geometry	Homework 2 – Entering equations and mathematical content in correct form. Fixing an improper document
	Using Unicode in Microsoft Word - Introduction to syntax and code words - Hovering Resource	Quiz – Unicode and Equation Editor
	Using Math Autocorrect - Applying Autocorrect - Formatting with Autocorrect - Uses and Limitations	Homework 3 – Using Autocorrect and entering mathematical content outside the equation editor. Discuss uses and limitations.
2 – Introduction to LaTeX syntax and adding mathematical content to shared documents	Introduction to LaTeX language - Using LaTeX in Microsoft Word - Difference between Unicode and LaTeX LaTeX Math Codes	
	Entering Mathematical Symbols & Content with LaTeX	Quiz – LaTeX commands & syntax
	Using LaTeX in Canvas	Discussion Module 2 – Practice LaTeX in Canvas
	Introduction to Google Docs - LaTeX editor Add-On - Using LaTeX in Shared Document	Group/ Partner Project – Using LaTeX in Google Docs
3 - LaTeX	Introduction to LaTeX - Downloading and Opening - Beginning Basics (Creating Document) LaTeX for Beginners	Homework 4 – Creating a document using LaTeX
	Using Knowledge built from Modules 1-2 to create with LaTeX	Homework 5 – LaTeX document including mathematical content
	Final Project Overview	Final Exam

Resources

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