Data Analysis of an Automated Learning Tool for the Instruction of Definitions for Communication in a Humanities Senior Seminar

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Abstract

The paper presents an instructional design utilizing automated-learning tools to teach about defining terms in an online Humanities senior seminar at the New Jersey Institute of Technology. By leveraging digital learning tools in a Moodle environment, a system was produced that students could access independently and work through at their own pace in order to be introduced to, learn more deeply about and provide evidence of progress and mastery for the task of defining terms in a clear effective way. The research presented here gathered data from students about their impression of the tool as well as from analytics provided by Moodle. Quantitative and qualitative data were analyzed and results presented for 200 students. It was shown that the tool was effective to engage students, attain learning goals and not consume significant instructional time or that of the educator beyond initial design and implementation of the tools and resources.

Key Words: Communication, Definition, Automated-Learning, Adaptive E-Learning, Digital Assessment.

1. Introduction

Modern technology enables learning to reach more students content delivery to be more efficient, effective, and differentiated. This allows more students the increased freedom to attain learning outcomes. Digital learning (also known as e-learning or virtual education) is herein defined as the application of digital media, information, and communication technologies for the purpose of education. These tools are now embedded as part of daily life for the iGeneration – in socializing, leisure activities, information gathering, communication, gaming, commerce, and learning. The iGeneration does not view their world in terms of face-to-face, on-line, or blended; rather, it is all one world. In this new world, curriculum delivery expands independent of time and place, yet allows for participation in any of these three modes: Traditional Classroom - same time, same place, Synchronous Distance Learning - same time, different place, and Asynchronous Distance Learning - different time, different place (Rosen, 2010).

In all of these modes, curriculum delivery involves faculty using active and collaborative learning methods, engaging students in experiences, emphasizing higher-order cognitive activities, interacting with students, and challenging them academically. An important aspect of curriculum is connected to the idea of instruction. Robert Gagné (1974, 1988) discussed the Conditions of Learning, defining curriculum as a sequence of content units organized so that they can be accomplished through a single experience, assuming proper preparation (prior knowledge) has already been mastered by the learner. Gagné went on to discuss that instruction is a, “set of planned external events which influence the process of learning and thus promote learning." In this view, curriculum and instruction are tied together, but organized at different levels with different scopes.

Both deal with the concept of planning experiences and activities for the learner and working to optimize them for delivery to learners in a specific context and situation. Ralph Tyler (1949) put forth his ideas of scientific curriculum making as a means for crafting effective plans for curriculum and instruction. He identified four fundamental questions that need to be answered in developing any curriculum and plan of instruction:

1. What educational purposes should one seek to attain?
2. What educational experiences can be provided that is likely to attain these purposes?
3. How can these educational experiences be effectively organized?
4. How can we determine whether these purposes are being attained?

Therefore, the major components of Tyler's Model of Curriculum Development are:

- State objectives
- Select learning activities
- Organize learning activities
- Develop means of evaluation

Two ideas underpin curriculum and instructional design. One is the Critical Learning Path (CLP), the idea that at the lowest level of instructional design there is an organization to the way content is to be taught connected to pedagogy, instructional methods, situational variables, and learning outcomes tied to assessments. Decisions about all of these contribute to and depend upon the teacher's own teaching style. The CLP informs the design by helping teachers identify key issues of learner needs, timing, ways of reinforcing instructional objectives, and checks for learner mastery. Some practitioners approach the design of instruction from a specific starting point, such as content to be taught, method of delivery, learning context, etc. Instead of defaulting to a preferred perspective, this paper will look at the concept of Constructive Alignment for Learning (CAL), to explore its components and then choose how to design instruction for the CLP in any given situation using digital learning tools. CAL is the idea that the content, Pedagogical Content Knowledge (PCK), methods of instruction and delivery, as well as assessments must all connect and reinforce one another. CAL begins with a clearly written and specified system laid out initially in the task description and carried out in the instructional process supported with resources and connected to the methods of formative and summative assessments (Biggs, 2012).

Joseph Schwab identified four commonplaces of curriculum design: content, teacher, learner, and milieu (situational demands and influences of the larger world). It is the role of the curriculum maker to consider all of these and make the design of the curriculum work for all as it is reformed and reworked continually. Tyler saw it as a scientific process to identify common areas of concern specify goals and methods and his followers later on added assessments and accountability measures. Schwab's approach deals with the practical rather than the theoretical—curriculum decisions do not require a curriculum theory. Some key aspects of Schwab's practical approach include the idea that changes should be made by piecemeal improvement, not by major overhaul so that you are determining the whole array of possible effects of proposed changes. He proposed the curriculum makers needed to diagnose the issues and problems with the curriculum to fix what was not working and thus not just make changes for the sake of change. He felt that deliberation was an essential component to effective curriculum so that the careful consideration of a variety of alternative courses of action in specific situations would result in an effective flexible curriculum that met the needs of all learners. This process required a sophisticated understanding of the existing practices and their effects so that changes that might be made could be implemented in a way to improve and not just change what was being done.

Once specified, the lesson plan and relevant assessments can be developed and put into place so that instruction can commence. The most common model for instructional design is to assess needs, Design, Develop, Implement, and Evaluate (ADDIE). The process is iterative so that the design can be improved as it is used and needs for improvement is identified. It is important to be as prepared as possible the first time you teach a lesson so that it is effective. Even the best planned lessons can have surprise issues, but teachers should be prepared to attain the learning objectives for the students despite any setbacks. It is also necessary to be aware that each set of students in each specific learning environment will pose a new set of challenges. Teachers must be ready to adjust accordingly in order to differentiate instruction. To augment all stages of the process, leveraging digital learning tools and opportunities to increase the impact of lessons and resources for learning can be achieved with the integration of automated learning tools, digital resources, interactive forums and other blended learning materials in a learning management system (LMS).

By opening the LMS as a place for learning aligned with course tasks and assessments, educators allow students the flexibility of time, place, space and pace in learning so things can be accessed repeatedly prior to, during, and after class for preparation, learning, reinforcement, review, remediation, test preparation, or further study and extension. In the real world of education, teachers function as "teacher-designers" who determine the need for instruction, design and develop, revise, and teach the materials they develop. There are essentially five phases to designing any instruction, from entire courses to individual lessons: Analyze Design, Develop, Implement, and Evaluate (ADDIE). There are many models for designing instruction just as there are many learning theories. Instructional design is in fact based on learning theories from educational psychology. Design models may range from very prescriptive, behaviorist (instructivist) presentations to more free-flowing constructivist forms. In every case, however, there are certain design elements that must be addressed at some point or other in the process to produce effective and relevant instructional materials and lessons. A common model for this step-by-step process is a modified version of an instructivist model developed by Dick and Carey (1992).

1. Analyze the instructional goals, learners' needs, and their prior knowledge
2. Design and construct aligned lessons and assessments (consider goals, learners' needs, and prior knowledge)
3. Develop instructional strategies and select instructional media that best facilitates student understanding of new knowledge and supports the instructional strategies.
4. Implement the design: teaching/learning experience and assessments
5. Evaluate the actual lesson or course you designed: evaluate the connection between goals and understanding, effectiveness of instructional strategies and media. Revise for the next course or lesson. Revise for the next time you teach the class

The author used the digital learning object described below in the methods section to introduce and review the basics of effective communication and clarity of terms through a reflective discussion of definitions. The learning object is designed for teaching students about clear definitions and automated-learning tools. It was created for use in a 400-level Humanities senior seminar at the New Jersey Institute of Technology (NJIT) in a fully online set of courses. NJIT is a four-year university located in Newark New Jersey that serves as the states main Science and Technology University. The senior seminar serves as a culminating experience for all majors across the university in which juniors and senior students bring together their learning experience in the interdisciplinary Humanities department, which offers courses required for all majors as part of the General University Requirements. By leveraging digital learning tools in a Moodle environment learning management system (LMS), the author was able to produce a system of resources and materials that students could access on their own schedule to work through at their own pace. Students are introduced to, learn more deeply about, and provide evidence of progress and mastery for the task of defining terms in a clear effective way.

The research questions examined here were how would students engage with materials, resources, and automated tools if not required to do so and what learners would offer as feedback when prompted for opinions about the learning experience. The author presents in the results section below the data gathered from students about their impression of the tool, as well as from analytics provided by the Moodle platform. Two hundred (200) students were drawn from courses offered during the spring and fall in 15-week semester and 6-week summer sessions. It was shown that the tool was effective to engage students, attain learning goals, while not consuming significant instructional time or that of the educator beyond the initial design and implementation of the tools and resources. Only two hundred responses were reviewed because not all students who consented completed all aspects of the task. In particular, the research results in this paper examine the use of automated learning in a fully online environment. The results show that this model is useful both for engaging students' interest and differentiating instruction to allow students to operate at their own pace. It is an effective means of delivering lessons that can be modified for use by a wide range of faculty and disciplines to orient students and encourage reflection and discussion on a variety of topics.

2. Materials and Methods:

When aligned constructively and tied to a CLP, digital learning tools, simple videos, or other resources become more valuable as educational tools. These are Persistent Learning Object for Teaching or PLOT. For a PLOT, the content taught should be self-contained and deliverable in less than 5 minutes (ideally), but can be longer if the needs and content demands as such. It is shown to be better if several videos are presented in a playlist, or are embedded consecutively on a page with guiding and clarifying materials around and between them.

This makes the learning experience differentiated and self-directed. Breaking content into smaller, varied knowledge objects also allows for activities, resources, and other educational materials to be interlaced with content delivery. This is especially the case in blended and fully virtual classrooms. Also, reducing the length of content allows for the easier review of materials, differentiation of content delivery for varied learning styles, as well as levels of content mastery and language proficiency. Delivered content should be at grade level for the desired area of teaching, and should be able to stand alone as if it to be posted for anyone to use. Multiple versions can also be produced of the same content for different age ranges and levels of sophistication to enhance the applicability of content and learning styles.

For this specific application, instructional videos (voice-over-PowerPoint and clips), documents in MS Word and PDF format, an interactive activity on defining terms built with the Moodle Quiz tool, a forum for feedback and discussion, as well as a written task submission tools were brought together into NJIT's LMS, Moodle. The latter consists of a diagnostic to help establish a baseline and initiate students into the process. Each of these elements were used to focus students on a simple task of learning how to define terms clearly in order to facilitate discussion in future class forums and build skills in critical thinking and online communication. The flow of the task with resources and activities is as follows:

1. Initial written definition task:

Students begin with a diagnostic task, to write a memo containing the definition of ***Technology*** and ***Communication*** in their own words, as the terms will be used in class. Students can consult outside sources, but cannot cut and paste or just slightly reword definitions drawn from a source.

2. Moodle Book resource with instructional materials on Clear Valid and good definitions of technology and communication:

This tool contains videos and descriptions to explain and aid in the process of defining terms, choosing words, and communicating clearly. A valid definition follows the rules and reduces vagueness. A good definition gives a clear picture of the parameters of what is and is not included in the list of things that fit those terms. Effective communication relies upon the ability to convey to others an understanding of the term that is accurate and follows these four rules:

1) Do not use the word you are defining in the definition or use a synonym to replace the word.
2) Do not give a list of examples instead of defining the word.
3) Do not include value judgments in the definitions.
4) Do not have cyclical or recursive definitions such that the words used in subsequent definitions are themselves defined by using the word initially being defined.

3. Automated learning activity, with quiz and feedback forum on definitions.

For this portion of the learning object path, students needed to work through an activity that had three steps. In step 1 student were asked to take a quiz that asked questions about the content of the videos presented in part 2 with specific applications of the rules related to valid and good clear definitions. Students were able to have up to 10 attempts on the quiz and were given the ability to check their answers as well as receive automated feedback when the answer is checked and when it is submitted. Step 2 of this activity used the same questions from step 1 but students only had a single attempt and the questions were shuffled.

The intention of this was to provide the impression of forcing even though the attempt was not timed and students could have notes and/or go back and watch videos. The intention was not to assign a grade but motivate students to learn. Some interesting comments about this aspect of the activity will be discussed in the results section Step 3 was a feedback forum that students were able to use to reflect on the use of the tool and volunteer suggestions. The students were asked to provide written feedback in a forum based on the following prompt: "What did you think about the adaptive quiz? Did you feel going through the quiz again helped you? Leave any further feedback and comments."

These steps taken together provided the student's opportunities to review content, test knowledge reflect and feel a sense of ownership and buy in for the process. Rather than just be shown or told information, they had a variety of methods of delivery and had to be active in the process of learning prior to engaging in a discussion about what they had learned applied to a task.

4. Discussion forum for conversation about refined definitions

After the learning activities, students were required to post a refined definition, reply with comments to other student posts and respond to the posts about their own definitions to engage in a discussion around the topics of the course related to the materials presented and lessons learned. The forum description is given here to help understand the task outcomes that relied on the materials and automated activities described above:

Students will refine and post a valid and good definition for the term 'Effective Communication' in your own words for fellow students. Then explain what sources or thought processes you used to formulate these definitions. Finally discuss your view of what is meant by "online communication." After this, reply to the post of at least two classmates--reply to one (1) person who has no replies or the fewest so far and at least one (1) other post that was made. When you reply, please comment on the following questions: Are any of the 4 rules violated and how, is the definition good or does it still need to be refined to eliminate YKWIM and/or vagueness, and is the writing in the post correct and clear? Finally, once someone has replied to your definition, you need to respond to their comments to explain if you agree, and if necessary repost a clarified valid and good definition.

This final step was formative as well as summative. Besides the grading rubric associated with the tool, the peer review and initiation of discussion and dialogue was meant to begin the learning process about effective communication and criticism. In future tasks students would need to be able to think critically, reflect, judge their own work and that of others as well as are able to engage in discussions about course content that has a range of possible answers requiring discourse and consensus.

As a follow up to the end of definition task the instructor sent an email to encourage students to move from a broadcast model of communicating in which a post is made through the direct feedback model of the reply towards the conversation. This method of engaging students with automated tools that prepare them to enter and carry on effective communication as listeners and participants in conversations rather than just consumers and broadcasters was an overarching aim of this method.

Though specifically tailored to the content in this course on effective communication, the methods and materials can be used by other courses. The specific terms can be changed and the prompts in forums or videos resources adjusted to fit different course needs and educator styles.

3. Results and Discussion:

Within the framework described above, data was gathered from students directly as stated opinions as well as shown preferences gathered from analytics provided by the LMS. Two hundred (200) responses were reviewed for the quantitative analysis (Table 1). Not all students who consented completed all aspects of the task so only ninety-two (92) usable respondent's data were able to be used for the qualitative data analysis and discussion provided (Table 2). The data was processed and analyzed based on the work of Babbie (2006) and Rossi (2003). Table 1 shows the distribution for number of attempts by students engaged in the task. The Moodle analytics do capture if students begin a quiz but do not mark any answers and end or leave it open until the term closes. Results like this were removed from discussion so for example, an attempt showing 2 days 17 hours for the quiz would not be counted or discussed.

It is clear that the majority of students went through the quiz tool 2 or three times. This however, only shows one part of the story. We also need to examine the amount of time each quiz attempt takes. The absolute longest time for the valid attempts was 31:22 as a single outlier and a group of 5 attempts around 21 minutes. On the other hand, the shortest times were clustered around 45 seconds. The overall average time to take the quiz over all the multiple attempts was four (4) minutes per attempt and about 10 minutes per person. Most interesting, everyone who took the learning activity quiz reduced the time to completion in each successive attempt every attempt. The extremely short times may be due to students going in to check a specific question or who have an issue by exiting the quiz early. Both of these cases were reported but only by a small number of students. An in depth analysis of time on task was not completed for this analysis due to a wide range of potential reasons why students might have for the amount of time spent in a quiz without any data having been collected on that particular aspect of the activity. As part of the automated tools we asked students to provide written feedback in a forum and provided the following prompt: "What did you think about the adaptive quiz? Did you feel going through the quiz again helped you? Leave any further feedback and comments." These qualitative open-ended questions generated 250 responses that could be processed and analyzed. The results of the qualitative analysis are provided below.

The qualitative data was reduced down to a five point Likert scale for the three major categories identified in the honeycomb for usability. By reading each entry and determining which categories if any the responses fell into the student responses were disaggregated. Once collected into groups for each category, each response was then evaluated for the degree of strength of attitude toward that particular element of the tool. Each element was rated based upon a measure of positive, neutral, or negative comment. Then the positive and negative comments were evaluated for modifiers to strengthen or weaken the attitude indicator. For example, a comment might simply state that the tool taught definitions which would be neutral. If the phrase used the word helped it was rated as positive. If the response said extremely helpful this was a highly positive response. On the other end of the spectrum if it said did not help then it would be rated as negative. If the response had said that the tool really did nothing or was not helpful at all, it would have been rated as highly negative.

For free response data a qualitative analysis was done to separate responses into categories typically associated with online tools and web page usability and content testing to identify types of results expected and areas for testing to be conducted. Typical usability testing examines qualities, represented in Peter Moville's User Experience Honeycomb featured on the U.S. Department of Health and Human Services website (usability.gov), such as: "Useful: Your content should be original and fulfill a need. Usable: Site must be easy to use. Desirable: Image, identity, brand, and other design elements are used to evoke emotion and appreciation. Findable: Content needs to be navigable and locatable onsite and offsite. Accessible: Content needs to be accessible to people with disabilities. Credible: Users must trust and believe what you tell them" [7]. These factors all build into the core of user experience, which is Value, "ensuring that users find value in what you are providing to them" [1]. For this study, qualitative data responses were separated into four major categories: Functionality (including aesthetics as a large component), Effectiveness, and Content. Each category is aligned with one or more of the qualities within the User Experience Honeycomb. These categories are described as:

Functionality: This category groups comments about how the tool is intuitively set up with the aesthetics being a large component. The qualitative data from the forum allows us to evaluate if the tool can be used easily and as expected and designed, as well as the look and feel of it. This category fully encompasses three of the qualities: Usable, Findable, and Desirable [1]. Comments that fall into this category might mention, the Moodle tool was easy to use, I found the buttons easily, I found the layout really easy to follow, system fonts and themes made it difficult to find things or read the pages, or I could not make the thing work properly. The students' comments reveal a full narrative about the complete functionality of the tool. Any negative feedback gave us an opportunity to revise and improve the Moodle quiz to enhance the user experience. Negative comments about functionality that was part of the design or aesthetics of the LMS were excluded since the educator and designer have no control over those aspects and these vary from LMS and institution. In addition, most of the comments like this were typically neutral or negative demonstrating a preference issue related to length of page, color scheme or individual style or browser compatibility with mobile devices or other software interface issues outside of the control of the developers.

Content: This category groups comments related to the content being delivered rather than the methods and means of delivery. The content is what builds trust within the students to believe in what is being presented, giving the materials in the quiz Credibility [1]. In the Moodle quiz, some students questioned whether the questions, answers, and feedback regarding certain questions were correct. When a user questions content, there is an immediate red flag raised about the content and how it is presented, allowing for refinement to increase user confidence. Comments that might indicate this are things like, the terms were unclear, and I thought the answer given was not correct, or I like the words you picked to include in the tool.

Generally, the content feedback was positive and negative comments related to the fact that the automated quiz was not needed if the student watched the videos and read the provided materials. In these cases, students highlighted the potential redundancy of providing several different methods of instructing on the same materials. However, one student comments directly refuted this saying that being shown these in different ways aided learning. In addition, several highly positive comments on content related to the flow of the learning activities and the fact that students were clearly told what was expected and given the exact materials which were then tested in a low stakes way so that content was reinforced in a way that allowed students to make errors but check answers or see content multiple times.

Effectiveness: this criteria groups comments about the tools ability to help students learn or accomplish the particular goal set out in the task for that tool. Effectiveness marks whether the tool can be considered Useful, as well as Accessible [1] for those with disabilities, and for the fact that if students do not understand the content, they are able to proceed through the quiz at a pace that is suitable for them, broadening the idea of what accessibility means when building a tool for the user experience. Comments that might reflect this category might be the tool was a great way to teach, I learned quickly and was able to remember, or I could not really understand what was being presented from the tool.

Effectiveness received the most positive comments including notes about the desire for automated learning to appear in other areas of the course and one response exhorting the professor to teach fellow professors at NJIT to use this type of tool in their classes. Several highly positive comments specifically mentioned aspects of how in this system materials are given different treatments in the different delivery styles with the freedom provided to the student to choose both which tool to access as well as the pace and order of consumption. Similarly, many students commented positively or highly positively about the ability to take a quiz that was clearly related to the materials taught in the videos that helped them learn and then reinforced the key points. One negative comment brought up that the videos and reading covered more than was tested on the quiz and so it is not good to make the student have to learn so much if it is not going to be on the quiz.

The facets of the User Experience Honeycomb underpin the three major categories used for our research, creating a system, or process, for the user to experience (see Table 2). This system creates Value, which is the core of the user experience [1].

4. Conclusion:

From the data collected, it is shown that students engage fully with the automated learning system and feel it is both effective and useful as a means of instruction and assessment. The amount of time needed for students to complete the automated instructional piece was not significant and student feedback showed that the ability to have a choice of materials to review and control over the flow of the learning path was an essential key to their satisfaction and engagement. Anecdotal evidence of student learning through reinforcement was shown to improve as students took a wide variety of paths to the final activity in the learning task, but all reached the end without direct instruction from faculty. The qualitative feedback revealed a highly satisfied group of students that, though diverse, had a similarly positive experience, which several students identified as something they hoped to see more of in the course and in other online courses. An unexpected, but significant result that was seen in the qualitative feedback was the desire for a more adaptive and rigorous second quiz so that new materials were presented to test and further knowledge, rather than test if the existing knowledge had been learned. These findings suggest that the instructional design model explained above, with automated tools, can be used effectively and can potentially be leveraged by other courses as a means of introduction and engagement with initial tasks to generate engagement with foundational terms and concepts, as well as connecting learners with materials and one another.

5. Tables:

Table 1: Distribution for number of attempts by students engaged in the task

Attempts made	0	1	2	3	4	5	10
# of Students	8	14	117	49	9	2	1

Table 2: User Experience Honeycomb

Aspect	Highly Positive	Positive	Neutral	Negative	Highly Negative	Total
Content Delivery	40	20	2	1	0	63
Design of Tool	32	22	4	4	0	62
Effectiveness	52	20	4	3	0	79
Total	124	62	10	8	0	204

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Bio Sketches

James M. Lipuma, PhD is a faculty member in the Humanities Department at the New Jersey Institute of Technology (NJIT). He is the Principal Investigator for a partnership with the New Jersey Department of Education (NJDOE) that developed an Online Professional Learning Exchange (OPLE) for teacher professional development for more than 150,000 Educators in the state of New Jersey. This online resource will be used virtually and in blended learning environments support principal and teacher learning around curriculum and instructional design, leadership, assessment, and differentiation, as well as content learning for math, English language arts, and STEM literacy available at www.online-plc.org. Jim also conducts extensive research in digital learning, curriculum, and instructional design and currently is piloting online converged course delivery methods with standard and honors sections of senior seminar students.

Jenna M. Corraro is an Instructional Technology Designer at the New Jersey Institute of Technology (NJIT). She trains faculty members on using the learning management system, Moodle. Jenna helps instructors infuse other instructional technologies, such as audience response systems and web-based applications and tools, into traditional, blended, and online courses. She has worked with Dr. James Lipuma since she has been an undergraduate. Building various online mechanisms to assess student knowledge and oral presentations has been a primary focus in our work.