



Understanding Perceptions of Conceptual Information Technology Adaptive Learning

Kamal Kakish, Cindy Robertson and Lorraine Jonassen

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March 5, 2020

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Kamal Kakish

Georgia Gwinnett College
School of Science & Technology
Information Technology
Lawrenceville, GA 30043
kkakish@ggc.edu

Cindy Robertson

Georgia Gwinnett College
School of Science & Technology
Information Technology
Lawrenceville, GA 30043
crobertson2@ggc.edu

Lorraine Jonassen

Georgia Gwinnett College
School of Science & Technology
Information Technology
Lawrenceville, GA 30043
ljonassen@ggc.edu

ABSTRACT

The purpose of this research paper is to understand student and instructor perceptions of conceptual Information Technology adaptive learning. An adaptive learning system was implemented in a large multi-section general education-computing course to cover the conceptual technology topics covered in that course. Students were required to complete an adaptive learning session for each major computing topic. At the end of the semester, a survey was given to 584 students and 25 instructors to understand the impact the adaptive learning system had on the course material, the students and the instructors. Students were surveyed on their impressions of how the adaptive learning system helped them learn, and they gave feedback on the various tools provided by the system. Instructors were asked to compare the adaptive learning tool to the traditional e-book previously used in the course. We found that both students and instructors viewed adaptive learning as a beneficial addition to this computing course for the ability to focus on topics that students do not understand and for the tools it provides to motivate and engage the students.

Keywords: Adaptive Teaching and Learning, Agile Teaching and Learning, Student Perception, Instructor Perception, Student Retention, Saving Course Preparation Time.

1. ADAPTIVE LEARNING

Adaptive learning (AL) is an intelligent software platform that adjusts to the student's unique and essential learning style (Jonsdottir, 2015). Students are presented with a personalized lesson plan based on responses to questions, tasks, practices, and other skills. For example, if a student answers a question incorrectly, the system offers background information related to the topic before moving onto the next section or area of focus (O'Connell, 2018).

Numerous studies have confirmed that an increasing number of colleges and universities are turning to AL as a solution to the antiquated one-size-fits-all approach to teaching (Cai, 2018). As a personalized learning tool, AL offers students the flexibility to learn new-to-them course content. Learning can be achieved online using mobile devices and while working at their own pace. Moreover, research has proven that a tailored approach to learning is an effective teaching technique for millennials (Miner, 2017).

While scholars, educators, and students may differ in their definition of AL approaches, models, factors, and systems, the basic idea underlining the purpose remains firm. AL is a way to produce positive educational outcomes for both students and instructors. The system's dynamic design provides students with the opportunity to become an active participant, and collaborator, in the expansion of their knowledge base versus a passive receptor of information (Khouri, 2014). As a result, students have improved metacognitive awareness of course material and are able to demonstrate mastery of the assigned content (Gebhardt, 2018). The AL system also equips instructors with the ability to concentrate on teaching the course content that students struggle with the most while allowing learners to grasp the information based on their individual learning styles.

The motivation for this study was inspired by a previous longitudinal 3-year study conducted at Georgia Gwinnett College from May 2014 to June 2017. Kakish and Pollacia (2018) collected data which validated the implementation of AL in their Introduction to Computer class which resulted in a 10% increase in exam scores and student pass rate. Their study revealed a rise in A's and B's with a decline of D's and F's. Lastly, their research confirmed that instructors spent less time preparing lectures, administering quizzes, and assigning grades. With the previous study in mind, this study intended to uncover the perceptions of both students and instructors to determine if the transition from a traditional e-book to an adaptive learning methodology would enhance the student's ability to understand the course material and master the skills.

1. COURSE PROFILE

Introduction to Computing (ITEC1001) is a 4-credit hour course that is required of every student intending to graduate from Georgia Gwinnett College, a 4-year liberal arts college. It provides an introduction to computers and productivity application software. The course also focuses on conceptual topics that address system and application software, hardware, problem-solving, the Internet, networking, security, ethical practices, and emerging technologies in various industries. The computer concepts are taught using the McGraw Hill Adaptive Platform "Connect SmartBook." In addition, this course provides hands-on learning of application packages such as word processing, spreadsheets, database, and presentation software, using MS Office as the example application. The Office applications component of the course uses the McGraw Hill Adaptive Simulation Platform "SimNet" as well as the native Microsoft Office application software (Office 2016 for Windows and Apple Mac) to achieve its objective. This course is management by a committee of IT Faculty to maintain

consistency and commonality among the large number of sections being offered each semester.

Issues before Implementing Adaptive Learning

Since this introductory course is required of all students intending to graduate from GGC, the course committee's decision to implement adaptive learning was largely attributed to the following issues:

1. Diversity of student backgrounds: ITEC 1001 classes have students from every major on campus. While some students have very little knowledge of computing, more tech-savvy students were frustrated because they felt that they were wasting time at home reading about and studying content that they already knew.
2. Inefficient use of class time: Due to various levels of student background knowledge, instructors felt that they needed to cover all of the material in totality. This resulted in covering material that students firmly grasped, while not knowing areas where they needed more help. This, in turn, came at the expense of not allowing enough time to cover complex topics.
3. Keeping content material current: The field of computing changes so rapidly that it is difficult to find a textbook that is current on computing topics and stays current long enough to be used for multiple semesters.
4. Need for dynamic content: Instructors wanted the ability to add content in a timely manner to the course material that they deemed relevant to their course. This is impossible with traditional paper books or even e-books.
5. Too much material and not enough time: The ITEC 1001 class was designed to give students a brief introduction to major computing

concepts as well as 4 Microsoft Office applications. This is a significant amount of material to cover in a 15-week semester.

Adaptive Content and Assessment

A typical week for IT conceptual topics includes an adaptive SmartBook assignment (in Connect) covering one chapter from the SmartBook due before class. This is accomplished by having the students complete practice questions to determine the level of knowledge they have regarding various "concept" topics related to the chapter.

The adaptive nature of the assignment is derived in two ways. Students are assessed on whether they answered a question correctly. In addition, there is a self-assessment aspect the student needs to answer honestly for each question. The self-assessment takes the form of a survey at the end of each question where they are required to indicate their perceived comfort level of their answer. Do they know the answer? Do they think they know the answer? Are they unsure of their answer? Or do they have no idea and they are just guessing? The question format shown in Figure 1 is an example question from the Hardware Chapter of the adaptive learning assignment.

Smartphones owe much of their popularity and computing flexibility to [dropdown menu] that give them far more capability.

Submit

Do you know the answer?

I know it Think so Unsure No idea

ASSIGNMENT PROGRESS: ITEC 1001 - Hardware 0%

Figure 1: Sample Adaptive Assignment Questions - Hardware Chapter.

Both the correctness of the question and the self-assessment data are used to drive the rest of the lesson. If a student got the question correct and is confident with their answer, the adaptive system will no longer ask questions related to that topic. However, if they got the question wrong or if they got it correct but they were not confident, the system will continue to quiz and teach those topics.

When the student provides an incorrect answer, the adaptive system will show the correct answer and present the student with the additional resources that cover the topic. In addition, the system provides the student access to the entire library of suggested learning resources for the chapter, thereby enabling the student to select the topics of interest. Figure 2 illustrates a sample picture of these suggested resources.

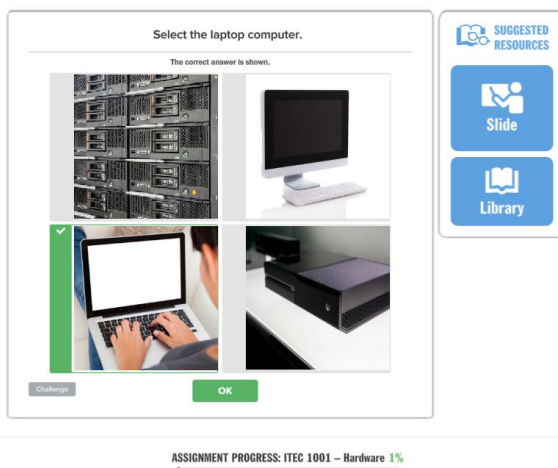


Figure 2: Suggested Learning Resources

Performance Reports

One of the helpful features of the Connect SmartBook is the ability to produce reports. These reports include progress and performance data for each student and the class as a whole. A snapshot of one of the reports, the "Section Averages by Topic" report is shown in Figure 3. It lists out each topic covered in the lesson, the average time spent per student completing each topic, the average mastery percentage and the average probe count. Requiring the

SmartBook activity to be completed before class allows the instructor to run the report feature and evaluate which topics the students struggled with and which topics do not need any further instruction. This enhances the student learning experience and allows for mastery of the more difficult topics.

Topic/Learning Objective	Average time spent (hh:mm:ss)	Average mastery to date	Average probe count
3. Topic: ITEC 1001 3C Hardware			
4. Topic/Learning Objective			
5. Describe a computer.	0:05:03	92%	69%
6. Define a computer.	0:05:03	92%	69%
7. Identify the four basic computing functions.	0:01:33	95%	72%
8. Types of computers.	0:00:26	95%	83%
9. Describe what is meant by the term computer hardware***	0:00:36	95%	70%
10. Describe the system unit of a computer.	0:01:19	94%	72%
11. Topic/Learning Objective			
12. Identify a laptop computer.	0:01:15	93%	86%
13. Describe the uses of a laptop computer.	0:01:07	100%	79%
14. Topic/Learning Objective			
15. Identify a desktop computer.	0:02:16	95%	76%
16. Uses of a desktop computer.	0:00:42	95%	59%
17. Topic/Learning Objective			
18. Identify a tablet computer.	0:02:01	93%	92%
19. Uses of a tablet computer.	0:01:21	95%	95%
20. Topic/Learning Objective			
21. Identify an all-in-one computer.	0:01:33	95%	82%
22. Uses of an all-in-one computer.	0:01:02	95%	88%

Figure 3: Snapshot of reports feature

2. SURVEY & METHODOLOGY

In an attempt to determine the perceived effectiveness of implementing adaptive learning and teaching in the ITEC1001 Intro to Computing course from both student and instructor perspectives, two surveys were developed and implemented. A total of 584 students completed the student survey and 25 instructors completed the instructor survey. Both surveys focused on participants' own perceptions and experiences of using the Connect Adaptive Learning system. Both surveys used some questions that compared the ConnectMaster SmartBook content to a previously used traditional e-book. If the participant had never used the previous e-book, they skipped the non-applicable comparison questions and only answered the open-ended questions.

The student survey consisted of both quantitative and qualitative sections. Using a 5-point Likert scale, the quantitative section of the student survey focused on criteria such as overall impression and engagement experience. Specifically, they were asked about whether the adaptive textbook fit their learning style, the quality of content significance as it relates to the advancements in the real world, quality of content presentation - including images and

format, quality of the flow of content blocks and adaptive questions, and the need for printed vs. electronic copies, etc. The qualitative section of the student survey focused on open-ended questions asking about likes and dislikes of the adaptive content, and additional comments relating to criteria not covered in the survey.

The instructor survey also consisted of both quantitative and qualitative sections. It focused primarily on criteria from the faculty perspective and experience of Adaptive Teaching using Connect. Questions were related to: usefulness of adaptive activities, interactive experience, platform engagement, intuitiveness to the students, organization of content, logical/critical thinking requirements, real-world applicability, depth of concept, practical everyday life applications, use of tools and resources, package completeness for instructors, technical issues and challenges, tracking of student progress, better reflection of grades, and feedback to students.

3. ANALYSIS

The analysis process consisted of looking at student perceptions and instructor perceptions individually. There was no cross analysis between the student and the instructor. We found overall that both groups had a strong positive perception of adaptive learning, as illustrated in the following sections.

Student Perceptions

The first survey question asked students to express their overall impression of Connect on a 5-point Likert scale. As shown in Figure 4, the number of students who favor adaptive learning was overwhelmingly positive. Of the 584 students who responded, 24% liked it very much and 58% liked it. In contrast, 5% of the students do not like it, 3% conveyed they do not like it at all, and 10% stated they were unsure.

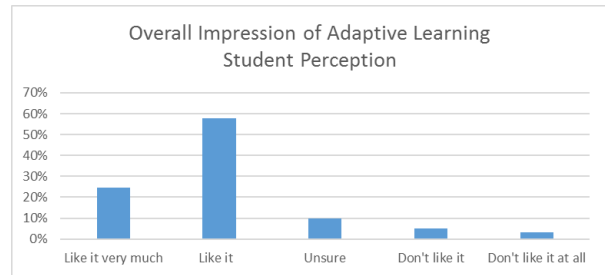


Figure 4: Overall Impression of Adaptive Learning - Student Perception

The next few questions asked the students to rank their perception of specific user interface (UI) features believed to add value and enhance the learning process. The UI features considered included the use of an adaptive digital textbook, the use of images to complete tasks, the use of bullets as compared to paragraphs to cover concepts, the engaging/fun approach to learning, and ease of use. Figure 5, similar to Figure 4, confirms that students overwhelmingly favor the adaptive learning features. At 42% like it very much and 47% like it, the students favored the engaging and fun aspects associated with adaptive learning. Closely following are the use of images at 36% and 51% and the use of bullets at 38% and 45% respectively. The use of the digital textbook and ease of use features earned high percentages of likes; yet they also received the highest amount of unsure responses from the students. Lastly, Figure 5, clearly depicts dislike status for all features at 5% or less.

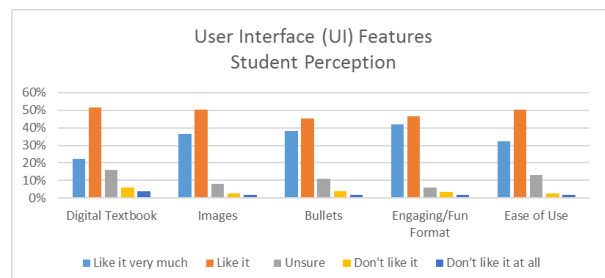


Figure 5: User Interface (UI) Features - Student Perception

The next set of questions evaluated the students' perceptions of the effectiveness of the adaptive learning tools on an agree/disagree scale. Figure 6 clearly

depicted the students' preference to clickable images as their favored option to effective learning. Secondly, 29% and 48% of the students either strongly agreed or agreed that the ability to customize a personal study schedule (days/week and minutes/day) proved to effectively help them understand the course content and make the most of their study time. Students agreed the slide library and the recharge option made it easier for them to understand and learn new material. While the students agreed real-world examples make topics relatable, 23% saw no difference between e-books and the adaptive learning tool in this respect.

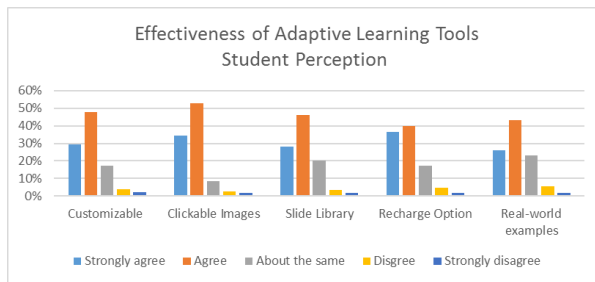


Figure 6: Effectiveness of Adaptive Learning Tools - Student Perception

A few of the remaining survey questions asked the students to share their perceptions related to the order in which the content was presented to them. Nearly 75% of the students either agreed or strongly agreed they like the way the content skipped around to different blocks, covering only what they needed to learn. In addition, students perceived the order of the questions as having a conducive and logical flow; thereby reinforcing their ability achieve a mastery level of the content.

The last section of the survey consisted of three open-ended qualitative questions that asked students to provide additional comments about their experience using Connect. They were specifically asked to share what they liked and disliked about the software. Overall, the comments were a reiteration of the above findings. One student summarized their opinion of the

technology with the following comment. "It offers various interesting ways of learning new information rather than the normal textbook." Several students stated, it was easy to navigate and they liked the repetition and rewording of questions as a way to reinforce the learning of the material. They positively commented on the freedom to be able to self-pace. Several students commented on the engagement of the adaptive learning software and even described it as fun.

Instructor Perceptions

Instructors were asked to compare the Connect Adaptive Learning environment to the traditional e-book previously used in the same course. While 25 instructors answered the survey, only 19 of them had used both systems and were able to accurately compare the two instructor resources. As Figure 7 shows, over 50% of the instructors preferred the Connect system, versus 26% that preferred the e-book. One instructor summarized their perception with the following comment, "I think the Connect platform is more suited for an introductory class in comparison to the traditional e-book because of the adaptive learning components. It quizzes students on topics that they need to know until they get it right."

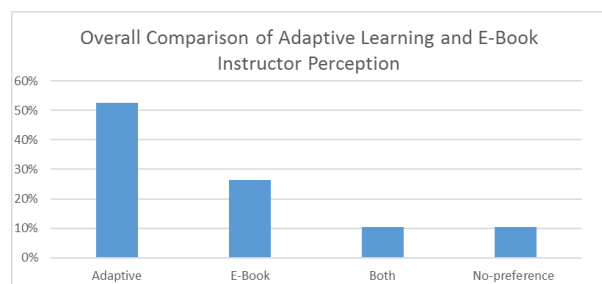


Figure 7: Overall Comparison of Adaptive Learning and E-Book - Instructor Perception

There are many reasons why the Connect adaptive learning system was preferred by instructors. Figure 8 shows a summary of the instructor perceptions of the user interface. Instructors thought that the adaptive interface was much more

interactive and hands-on. These features allowed the students to be more engaged with the material. In addition, instructors thought that the Connect system offered a better interface for allowing the students to keep track of their progress while completing each assignment. The assignment progress bar, as seen at the bottom of Figure 1, is a very clear depiction of how much of the assignment the student has completed. While instructors very clearly preferred the above mentioned features, they thought that the interface was only a little more intuitive than a traditional e-book.

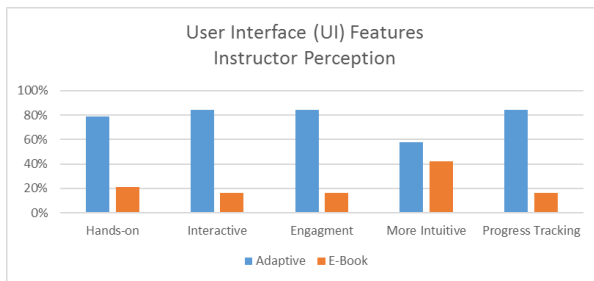


Figure 8: User Interface (UI) Features - Instructor Perception

In addition to the features of the user interface itself, the instructors also evaluated the tools and skills that Connect offered. The process of the adaptive learning assignment afforded students the ability to apply critical thinking skills to complete the assignments. Connect provides a library of resources that students can access to enrich their learning experience. This library contains information on computing concepts as well as real-world examples to augment student learning and comprehension. Comprehension is measured and reported to instructors via reports, as mentioned in the performance reports section. These reports are valuable because they allow instructors to focus their in-class time on concepts that the students do not understand. As seen in Figure 9, instructors overwhelmingly thought that the tools and resources provided by Connect outperformed the tools and resources of a traditional e-book.

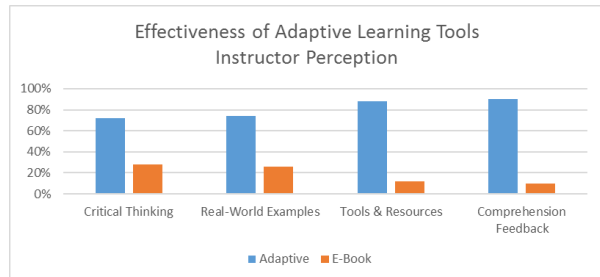


Figure 9: Effectiveness of Adaptive Learning Tools - Instructor Perception

4. CONCLUSIONS

Implementing Adaptive Learning in an introductory conceptual IT course provides tangible benefits to both students and instructors alike. Based on the results of a survey, both instructors and students saw the benefits to implementing an adaptive learning system in their classes.

Adaptive Learning and Teaching have proven to be an effective way for instructors to quickly view assignment results before class, and tailor lectures accordingly. This saves the instructors and their students from wasting time covering material that the students already understand. It also affords them adequate time to drill into the material that is challenging to the students.

From the student perspective, adaptive learning provides an engaging interface for learning complex concepts. The system allows for self-reflection keeps quizzing students until they have mastered the material. It also provides multiple tools to augment their learning experience.

Adaptive Learning has the potential to make teaching and learning substantial amounts of content, including complex computing concepts, manageable within a limited time frame and with limited resources. Based on our results, adaptive learning should become more commonplace in higher education courses.

5. FUTURE WORK

This research has served as a basic instrument to gauge the perceptions of students and faculty with regards to the feasibilities of employing adaptive learning in an introductory computing concepts course; However, in order to formulate an effective long-term adaptive learning strategy, we consider this effort as a starting point, and acknowledge that more research is warranted. In order to outline a long-term strategy for continuing the implementation of adaptive learning, additional areas of further research should include, but not be limited to the following: 1) enhance the quality of the survey to include other pedagogical fields of interest; 2) repeat the enhanced survey covering a larger audience and over a longer period of

time; 3) study the effects of leveraging emerging technologies such as Artificial Intelligence to advance adaptive learning as they could yield more desirable results; 4) study and analyze student outcomes using a traditional e-book versus adaptive learning; 5) Expand the adaptive content to include previews of the chapter material that could potentially yield interesting results; 6) include in future studies, additional student populations across multiple institutions; 7) investigate the impact of providing training on the adaptive system and adaptive methodologies for both instructors and students before they use the system; and 8) include adaptive assessment as part of future studies.

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