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Advanced Instructional Design for Successive E-Learning: Based on the Successive Approximation Model (SAM)

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With its agile and iterative approaches, the Successive Approximation Model (SAM) is suggested as an alternative ISD model for ADDIE. However, few studies have been conducted to provide real-world examples of how SAM can be used by instructional designers to develop e-learning content. The purpose of this study was to develop e-learning content based on SAM and to provide empirical descriptions of the instructional design process for researchers and practitioners. This model was designed and developed through three phases: preparation phase, iterative design phase, and iterative development phase. The participants were learners, subject matter experts (SME), instuctional designers (ID), and prototypers. The alpha, beta, and gold versions of the e-learning content were developed based on the SAM method. The results revealed that the final (Gold) version, based on SAM, was more

impactful and user-friendly, compared to the traditional e-learning environment, according to the learner's perspective.

***Keywords*:** SAM, Instructional Design, E-Learning

INTRODUCTION

As vast amounts of new information and ideas are rapidly emerging, instructional designers are confronted with demands, not only to create high quality content, but also to reduce time and cost for the design and development process. Training departments, management, learners and even shareholders have pointed out that a majority of e-learning content was created without the consideration of learner's needs (Hort, 2011; Jones & Richey, 2000). This suggests that the traditional ISD processes need improvement. For these reasons, rapid prototyping methodology was evolved as a solution (Hort, 2011; Jones & Richey, 2000).

To quickly and meaningfully design and develop learner-friendly e-learning content, the interest in SAM (Allen & Sites, 2012) has increased. This model is a rapid prototyping methodology which is considered as an alternative model for traditional ISD models - such as ADDIE. However, few studies have been conducted to provide empirical descriptions of design and development efforts using SAM. Therefore, the purpose of this study is to share our experience of designing e-learning content based on SAM, and this study also proved the effectiveness of the SAM framework by interviewing learners for their perception on the e-learning contents.

Needs of Alternative ISD Model for ADDIE

A huge number of traditional e-learning contents have been developed based on the ADDIE model (Morrison, Ross, Kalman, & Kemp, 2011). The ADDIE model provides instructional designers with systematic design procedures and helps them make more effective and productive instructional programs (Gustafson & Branch, 2002). However, ADDIE has been criticized for being too systematic; meaning it is too linear, too inflexible, too constraining, and even too time consuming to implement (Kruse, 2009). It has long been considered too rigid and drawn-out for most instructional design projects, especially for the fast-paced e-learning design.

To make up for these weak points of the ADDIE model, Allen and Sites (2012) created an alternative ISD model -SAM. SAM utilizes a more iterative process that emphasizes prototyping more heavily than the other models. This model assumes that stakeholders will change their minds about what is necessary, what will work, what they need, and who will be included in the group of learners. The change that will be made in each stage of the project will need to be updated through an iterative process. With this model, collaboration is crucial to prevent potential problems (Allen & Sites, 2012).

Main Characteristics of SAM

One of the primary differences between SAM and ADDIE is that SAM is a more agile approach (Allen & Sites, 2012). SAM focuses on speed, flexibility and collaboration for the purpose of generating more effective and efficient e-learning content. Moreover, SAM focuses on learner experiences, engagement, and motivation over the entire process of design and development (such as content organization, presentation of information, and post-tests). Every project, project team, and project sponsor bring a whole new set of challenges - requiring agility and flexibility by the project team. SAM provides the options, strategies, and tools for these teams to be successful. These characteristics of SAM require project members to meet often. As a result, project teams collaborate more effectively. For example, they can generate more ideas and opinions, share experiences, and employ the knowledge of team members.

The distinguishing characteristic of SAM (versus ADDIE) is its iterative process. An iterative process provides opportunities to experiment, test, and revise the designs. Development in small steps, with frequent evaluations, allows for changes that can be modified or reversed at a time when changes cost the least. Thus, SAM is efficient and effective. With limited resources, edits or changes to e-learning content can be conducted efficiently.

SAM Process

SAM consists of three main phases: preparation, iterative design, and iterative development (Figure 1). First, in the preparation phase, SAM starts with gathering all the information and background knowledge relevant to the project. This process is called “savvy start”. The savvy start serves as

a kick-off meeting and gives project members opportunities to review the collected background information and generate initial ideas for designing e-learning content (Sites, & Green, 2014).

Second, in the iterative design phase, all design, prototyping, and evaluation rotate iteratively in small steps. Prototyping is a vital part in the design phase. A prototype can function as a means of communication among team members by making conceptual ideas visible, instead of describing and listing all the design specifications. Several prototypes are developed with each evaluation (Sites, & Green, 2014).

Finally, in the iterative development phase, the project team members rotate through development, implementation, and evaluation. Design proof, the product of the first cycle, is made at the beginning of the development phase. After presenting and testing the design proof, an alpha version is released, and then evolves to a beta version before finally rolling out the gold version.

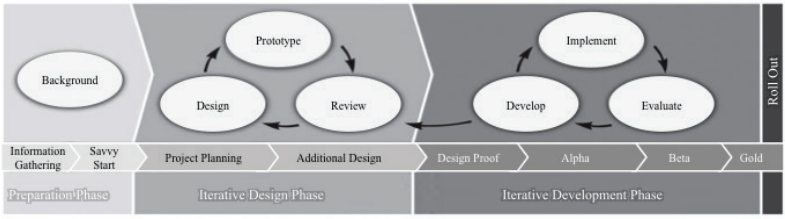


Figure 1. Process of SAM (Sites, & Green, 2014).

METHOD

To collect data, interviews, surveys, and observations were used. Eight students voluntarily joined the interview and survey activities. The interviews and surveys asked the learners what they thought about previous e-learning content, and how they used the courses. They were asked about cognitive load and perception regarding previous e-learning content. They were taking the online courses at H university in South Korea. The participants agreed to join in the beginning of the study, and they were informed about the confidentiality of their responses.

During the savvy start, a total of eleven people worked together. These eleven people were SMEs, recent learners, potential learners, IDs, and prototypers. The SMEs, IDs, and eight leaners worked together from the first stage of the savvy start. After the alpha and beta versions were revised, po-

tential learners joined for a usability evaluation of the gold version, which is the final version.

Design and Development for Tool

The course was designed and developed with three phases: preparation phase, iterative design phase, and iterative development phase. Learning experience was thoroughly scoped and developed with minimal costs. A small amount of learning content was presented in the lecture, in order to reduce cognitive load. We produced bite-sized (five to ten-minute-long) video lectures to let learners focus on and process information more effectively. This also helps with updating video lectures and learning materials; for example, an instructor can update a smaller segment of the lesson, rather than re-recording and uploading an entirely new 45-minute or hour-long lecture. Finally, we chose HTML5 to publish content that is readily accessible from various devices (such as a computer, tablet, or mobile phone).

Preparation Phase

This phase consists of four substages; information gathering, understanding learners' needs, savvy start, and analyzing roles and opinions. The following explains each stage in detail.

Information Gathering

Students who had previously taken an e-learning course were surveyed, and they were also interviewed with the questions below (Table 1). The survey asked about their perception regarding the previous e-learning content. The survey (regarding the previous e-learning content) indicated that achievement, pace, interest, and concentration were relatively higher than difficulty, fatigue, and irritation (Figure 2). The learners also considered some of the content to be unnecessary and stagnant (Figure 3). For example, there were too many click activities to go to the next slide. They had a positive perception about the previous e-learning content (Figure 3), and this is because the lectures were provided for free. The interviews and surveys were used to develop a new prototype and scenario.

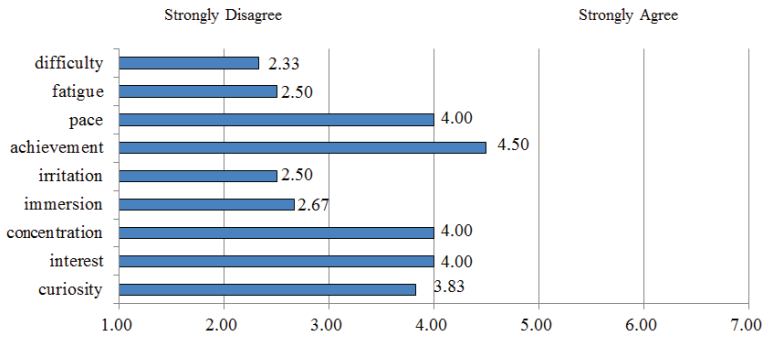


Figure 2. The Result for Cognitive Load from Learners about the Previous E-Learning.

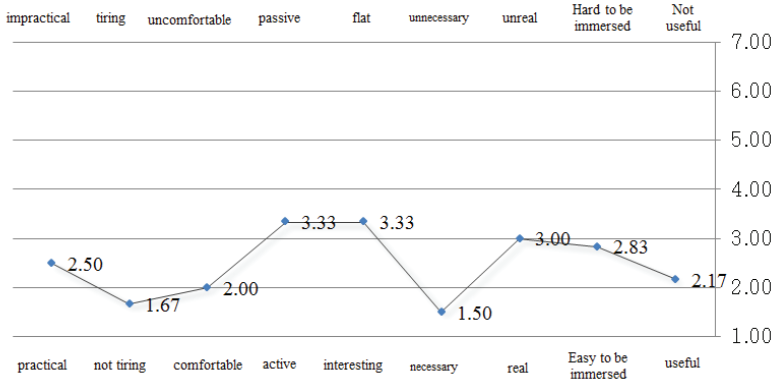


Figure 3. Learners' Perception about the Previous E-learning Content.

Table 1
Interview Questions

Learners	E-learning Content
• How do you find information that you need for your work? • Can you share your recent learning experience? • If there was any enjoyable learning experience, can you share it? • Can you share your recent online learning experience? • If there was any enjoyable online experience, can you share it? • What is the most difficult or challenging learning activity? • How was the assessment in the course? • What determines your success or failure in your learning?	• Where are learners from? • Where does the learner's performance take place? • What does it sound like? • What does it look like? • What does it feel like (hot or cold)? • Are there any dangers the learners need to be aware of? • What are learners doing for living? • What needs to be done? • Are there any people involved? • What are the risks involved?

The Learners' Needs

Based on the survey and interviews, core needs were extracted (Figure 4). Core needs were matched with current e-learning trends. Based on the needs and trends, we integrated technologies such as HTML5 and responsive web into the instructional design.

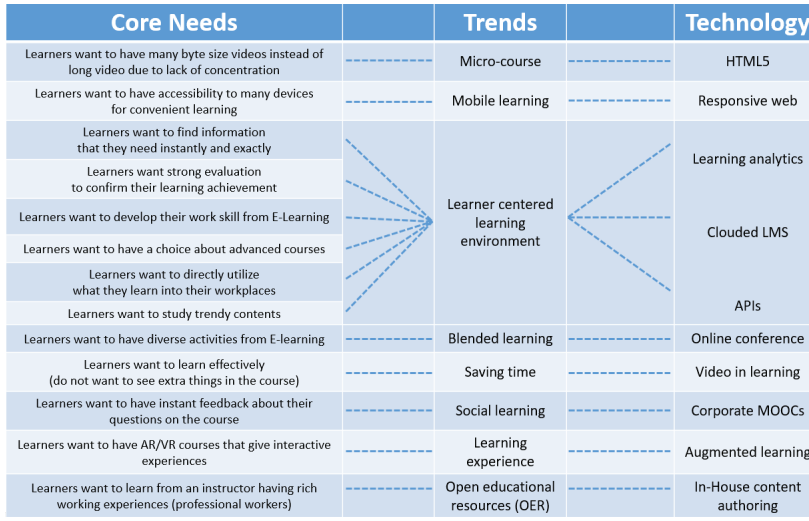


Figure 4. Core Needs from Learners, Trends, and Technology.

Savvy Start

With basic information and ideas related to the study, the savvy start phase begins. The goal of savvy start is to collect useful information and gather various ideas (through brainstorming) for design and development of e-learning content. For gathering ideas and information, researchers, SMEs, IDs, content designers, current learners and potential learners participated in the savvy start. In this study, 3D printing was selected as the e-learning content. The following (Table 2) shows the question list and context during the savvy start.

Table 2
Question List and Context for the Savvy Start

Question List	Context
• What mistakes do people make when they are new? • What mistakes do they make or continue to make after one month? After one year? • How do you act differently than others? • If you could change one thing, what do you want to change? • Where do you go and what tools do you use when you need help? • What is the most difficult or challenging aspect of your tasks? • How does evaluation occur? • Which metrics determine success or failure?	• Where are learners from? • Where does the learner's performance take place? • What does it sound like? • What does it look like? • What does it feel like (hot or cold)? • Are there any dangers that the learners need to be aware of? • What are the learners doing? • What needs to be done? • Are there any people involved? • What are the risks involved?

Roles and Opinions

SMEs, recent learners, potential learners, IDs, and prototypers each have their own roles and opinions about designing and developing content. First, SMEs should be professionals on the topic, and their job is to provide insight and ideas for the lesson. SMEs said that when the lecture begins with interesting information, learners can easily focus on the lecture with motivation. Also, each goal in the lectures should be presented in a clear and direct manner. This gives the learner the opportunity to see how valuable the content will be in their life and increases their engagement. Second, recent learners contributed by choosing the content. Recent learners also help savvy starters to understand the strengths and weaknesses of current learning, which parts are easy or challenging to learn, and what content might be the

most relevant for their jobs. Third, potential learners support the ongoing development of the course through a user-test and review. They said that it was important to let learners understand how a 3D printer (selected content) relates to the real world, in business, or even in small companies that do not possess enough experts in a given field. In small companies, workers should possess a broad array of skills. Therefore, good content could help learners improve their skills at work. Fourth, IDs provided recommendations for instructional treatments, and kept the instruction focused on the learners. They said that the length of the previous lecture was approximately 20-30 minutes, but 10-minute lectures were more effective in keeping concentration. Finally, prototypers sketched and built the prototypes to give savvy starters the opportunity to visualize their ideas.

The Iterative Design Phase

In the iterative design phase, SMEs, IDs, and learners worked together for the entire process. First, SMEs designed a lecture by using text narration and giving directions to the IDs. Then, the IDs reviewed the text narration alongside the learning content (on PowerPoint slides) and provided suggestions to the SMEs. Based on the suggestions, the SMEs revised and recorded lectures. The IDs combined the lectures and learning activities, and then simulated the prototype using InVision which is an online prototyping tool. The learners reviewed the prototype and gave comments by pointing out necessary revisions. Finally, the IDs revised the entire lesson based on the feedback from the learners, and then published the final contents.

The Iterative Development Phase

We developed this iterative design based on the idea from savvy starters. During the iterative design phase, the IDs and SMEs rotated through designing, prototyping, and reviewing the content. We made the alpha version prototype from the iterative design process. In the alpha version, we tried to show the whole structure and the primary function of the HTML5 platform. Based on the opinions of version alpha, we developed version beta. The e-learning content was developed based on the script prepared by the SMEs, and then two types of lectures were created. Type 1 was designed for beginners, and type 2 was designed for helping workers who already have basic knowledge about the topic.

RESULTS

This section will show the feedback from the potential learners for the alpha and beta versions, and it will also show the learners' perception on the final version. During the beta version, we developed two different lessons for beginners and experienced learners. This helped us in designing the gold version.

The Feedback from the Potential Learners for the Alpha and Beta Version

After reviewing the prototype from savvy start, the alpha version was finalized. Based on the feedback from learners about the alpha version, the beta version was then developed. The lecture was continuously updated based on the script by the SMEs, and then two types of lectures were made. Type 1 was designed for rudimentary learners who want to be experts (Figure 5). In this type, content was divided into several interactive pages, so learners could click to the next page step by step.

Type 2 was designed to help workers (experienced learners) that wanted to save time while studying (Figure 6). In this type, more contents were presented on fewer pages, and learners could easily check the content outline from the very first page. This was intended so that learners could use the scroll bar whenever they want to skip some content. The feedback described below (Table 3) is from the learners regarding the beta version prototype.

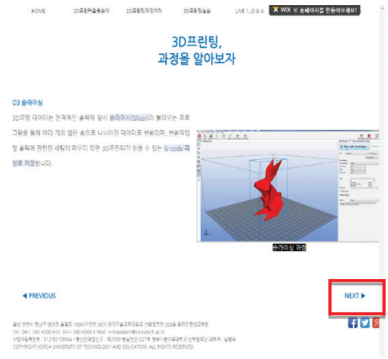


Figure 5. Beta Version 1.



Figure 6. Beta Version 2.

Table 3
Feedback from Learners Using the Beta Version Prototype

	Type one	Type two
I like	• Scrollbar was not needed. Just one glance is enough to see the entire contents. • The amount of content on each page was just right, so learners could feel comfortable with the content. • The divided content decreased the cognitive load.	• Neither next button nor clicking was needed for the learning process. • Using scrolling function made the learning process easier. • Learners could skim through (scan) the content, and it was easy to move to the next section. • Summary part was very intuitive.
I wish	• There was more content on each screen/page, so there would be less unnecessary clicking. • There was an option for scrolling instead of repeated clicking.	• Each page had less text and materials. • Excess content could be trimmed, and it could have a simpler structure.

The gold version was developed based on the potential learners' opinions about the beta version prototype. There were some necessary factors described from the learner's feedback. First, the beta version prototype should be more effective in content design and have more learning support, such as text related multimedia. As a result, instead of providing an entire video lecture, essential images or captured GIF files were posted for each activity in the gold version (Figure 7). Well-structured content and a proper volume of content helps to decrease cognitive overload. In the lecture teaching the 3D modeling process, each video lecture and supporting documents were attached as files instead of posting too many additional items. This was designed according to the learners' preference. Therefore, learners could choose what they preferred using among different learning tools. Another factor was the support for active interaction between learners and the contents. As a result, Tips and Q&A sections were developed (Figure 8). The Tips sections were created based on the content that learners might be curious about. There were additional interactive functions, such as a comment section, a search engine function, and online materials. They were intended for self-directed learning. Functions such as leaving comments, printing, and a like-button are available on every page. All of them were designed for supporting interaction. The last factor was usability. As a result, we used HTML5 to improve web accessibility. Moreover, subtitles and sign language were offered in the lecture.



Figure 7. Gold Version.



Figure 8. Gold Version.

Learner's Perception on Final Version

The following describes an evaluation on the usability. This evaluation was used to check if the final version was well developed or not. The traditional version, which was based on flash, was used as a comparison. The results show that the developed content got a higher score on the usability evaluation, and the gap between the two versions was quite high (Figures 9 and 10). Comparing the traditional version to the final content (gold version) we developed, learners preferred the final version because of suitability and accessibility (Figure 9). Other usability factors on the new version were higher than the ones on the traditional version (Figure 10). The following illustrates the opinions and preferences between the traditional version and the new version (Table 4).

Table 4

Opinions and Preferences between the Traditional Version and the Final Version

Traditional version	New version
• It was comfortable to learn, because it was a familiar structure. • Even though it was comfortable, sometimes learners felt pressure to finish the entire class when they saw the interface provided. • Sometimes, the length of video seemed too long and boring, which decreased focus on the content even though it was helpful for understanding the lesson.	• By using the search engine, searching the information was easy. • It was easy to explore the entire lesson with the preview and review functions. • Simple interface helped learners' concentration. • Well-structured videos, text, and guidelines improved learning activity. • There was less pressure to finish the entire lesson. • The video lecture was a comfortable length. • It was convenient to move to the next or previous content because of the design.

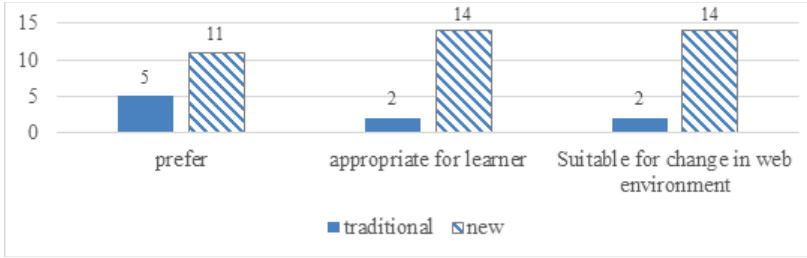


Figure 9. Comparison between the Traditional Version and the Final Version.

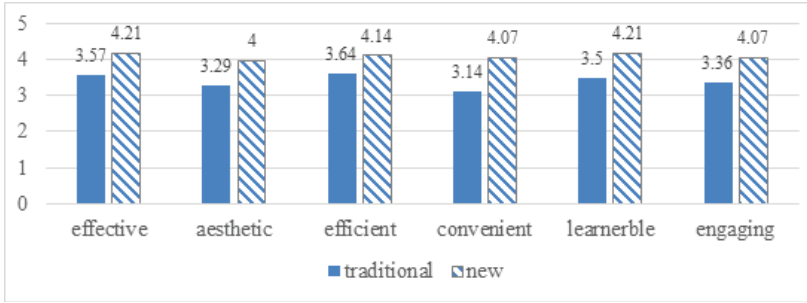


Figure 10. Comparison between the Traditional Version and the Final Version.

CONCLUSION

The purpose of this study was to develop e-learning content based on SAM. We proved that strategic collaboration amongst learners, IDs, and SMEs led to a successful re-design of the e-learning course. Collaboration for generating ideas and developing the course earned positive learning implications. Feedback from previous, current, and potential learners also helped in creating two different versions of the course. We concluded that SAM was effective in terms of allowing agile revisions and accommodating on-going learners' needs throughout the course; the weekly sessions could be rapidly created and revised.

Developing the content was a dynamic process. Since many people were involved in developing the content, making a schedule for meeting in each phase was challenging but still meaningful in terms of developing the final version. Here are our suggestions we have for the future study. The content we designed could be analyzed to explore more diverse perspectives, such as the relationship between content and learners' characteristics. Second, 3D printing was selected as the content in this study, because it is

a very trendy technology and many industries have begun using it. We assumed that there are many potential learners who want to study about 3D printing. Still, a systematic way to select attractive learning content for potential learners would be a great topic in a following study.

References

Allen, M. W., & Sites, R. (2012). Leaving ADDIE for SAM: An agile model for developing the best learning experiences. Alexandria, VA: American Society for Training and Development.

Gustafson, K. L., & Branch, R. M. (2002). What is instructional design. Trends and issues in instructional design and technology, 16-25.

Horton, W. (2011). E-learning by design. San Francisco: Pfeiffer.

Jones, T. S., & Richey, R. C. (2000). Rapid prototyping methodology in action: A developmental study. ETR&D, 48(2), 63-80.

Kruse, K. (2009). Introduction to instructional design and ADDIE model. Retrieved April 2009, from http://www.transformativedesigns.com/id_systems.html.

Morrison, G. R., Ross, S. M., Kalman, H. K., & Kemp, J. E. (2011). Introduction to the instructional design process. In Designing effective instruction (6th ed.) (pp. 1-26). Hoboken, NJ: John Wiley & Sons.

Sites, R., & Green, A. (2014). Leaving ADDIE for SAM field guide: Guidelines and templates for developing the best learning experiences. Alexandra, VA: ASTD Press.