THE EFFECTS OF TUTORIAL FEEDBACK TYPE ON PRE-SERVICE TEACHERS' CHOICE OF FEEDBACK TYPE IN THEIR DEVELOPMENT OF LEARNING OBJECTS

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DECLARATION OF ORIGINALITY

I, Burç Çeken, certify that

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ABSTRACT

The Effects of Tutorial Feedback Type
on Pre-Service Teachers' Choice of Feedback Type
in Their Development of Learning Objects

This study aims to investigate the effect of different knowledge representation types in feedback presented in learning object (LO) development tutorials on the quality of pre-service teachers' LOs as well as the representation type of feedback used in authoring the LO. The study, with a post-test only quasi-experimental design in nature, investigated six types of feedback representation: text, audio, video, video with text, video with audio, and video with audio and text feedback. Pre-service teachers' (n=202) feedback preferences were collected with a questionnaire prior to the experiments. They then, studied how to develop LOs in an authoring environment, Articulate, in six different tutorials for seven weeks. The tutorials were identical in terms of teaching how to develop LOs, but were different in terms of the feedback provided. Pre-service teachers were assigned to one of the experiment groups by the researcher. Learning objects developed by pre-service teachers were assessed using the Learning Object Review Instrument (LORI). Analysis of the data showed that feedback presented by video was the most effective feedback representation type, based on both overall scores and feedback quality scores of LOs developed by the pre-services teachers. Additionally, interaction between feedback types presented by the LO development tutorial and pre-service teachers' actual use of feedback in authoring LOs was not meaningful. The study compares findings with similar studies presented in the literature.

ÖZET

Eğitsel Materyalde Kullanılan Farklı Dönüt Türlerinin Öğretmen Adaylarının Öğrenme Nesnesi Tasarımında Kullandıkları Dönüt Türlerine Etkisi

Bu çalışma, eğitsel materyalde sunulan farklı dönüt türlerinin öğretmen adaylarının tasarladıkları öğrenme nesnelerinde kullandıkları dönüt türlerine ve bu öğrenme nesnelerinin kalitesine etkisini incelemiştir. Çalışmada yarı-deneysel sadece son testli araştırma deseni kullanılmıştır. Metin, ses, video, metinli video, sesli video, metinli ve sesli video olmak üzere altı dönüt gösterimi incelenmiştir. Öğretmen adaylarına (n=202) dönüt tercihlerini içeren bir anket verildikten sonra 7 hafta boyunca 6 farklı eğitsel materyal ile nasıl öğrenme nesnesi geliştirecekleri öğretilmiştir. Öğretmen adayları araştırmacı tarafından atandıkları bir deney gruplarında çalışmışlardır. Öğretmen adaylarının tasarladıkları öğrenme nesnelerini değerlendirmek için *Öğrenme Nesnesi İnceleme Aracı* (ONİA) kullanılmıştır. Veri analizlerine göre; öğretmen adaylarının geliştirdikleri öğrenme nesnelerinin ortalama ONİA puan ve dönüt kalite puanlarını en çok etkileyen dönüt türünün video olduğu gözlemlenmiştir. Diğer bir bulguysa, öğretmen adaylarının öğrenme nesnesi geliştirme aracında kullandıkları dönüt türleri ile geliştirdikleri öğrenme nesnelerindeki dönüt türleri kullanımları arasında anlamlı bir etkileşim gözlemlenmemiştir.

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CHAPTER 1

INTRODUCTION

Learning is viewed as an interactional process between students and their environments. Bangert-Drowns, Kulik, Kulik, and Morgan (1991) stated that quality of interaction is very much dependent on feedback. Feedback is presented to the learner as information after any input for shaping the perception of a learner (Sales, 1993). It is one of the most effective variables influencing student achievement (Hattie & Timperley, 2007). According to Kulhavy and Wager (1993), feedback is generally used for three main purposes: as a reinforcer, as a motivator, and as information.

Feedback as reinforcement is basically used for strengthening certain response tendencies. It originally stemmed from Thorndike's law of effect (Thorndike, 1927). By using his principles, Skinner (1957) suggested designing programmed instruction by using feedback as a reinforcement so that learners could learn step-by-step and their behaviors would be shaped and strengthened until they performed the desired responses. Reinforcement can be classified into two categories: positive and negative. The aim of negative reinforcement is to strengthen the stimulus by removing a negative outcome as an effect of the behavior. However, positive reinforcement is used for strengthening correct responses so as to increase the likelihood that these will occur in the future. Thus, learning can be improved by increasing the use of positive reinforcement in questions (Langdon, 1991).

Feedback as a motivator has an important role to play in gaining and keeping the learner's attention (Langdon, 1991). Motivational feedback is used for increasing response rate/accuracy (Kulhavy & Wager, 1993), and it is more concentrated on the learner rather than specific task content (Pyke, 2007). According to Locke et al. (1968), feedback is provided to the learner to facilitate learning with the help of motivation by requiring more effort on a specific task and engaging for a longer time. Further, Hoska (1993) argued that feedback as a motivator helps the learners reduce the effect of the difficulty level of the task by persuading them that errors are an essential part of the learning process instead of seeing them as their lack of ability.

Informative feedback is used for providing information to learners, validating or altering their responses (Kulhavy & Wager, 1993). In other words, it is given to learners to remedy their errors by presenting content that helps them know where they make a mistake or why their response is wrong. Learners can also get information about how well they understand the instructional message by means of informative feedback (Langdon, 1991). In addition to this, it may be beneficial for detecting and correcting inappropriate task strategies, misconceptions or procedural errors (Shute, 2008).

As the purpose and forms of feedback differ, feedback delivery sources may differ. Johnson and Johnson (1993) asserted that there are at least three feedback sources in a learning process: the learner (individual feedback), the technology used (computer, video, audio recording etc.), and other people (teacher, peers). Bangert-Drowns et al. (1991) argued that "any theory that depicts learning as a process of mutual influence between learners and their environments must involve feedback implicitly or explicitly because, without feedback, mutual influence is by definition impossible" (p. 214). Langdon (1991) states that learners engage in some kind of mental processing when they receive feedback. Bangert-Drowns et al. (1991) described this mental process in five stages: initial states, search and retrieval strategies, response, evaluation, and adjustment. Initial state is the current knowledge of the learners affected by prior knowledge, interests, goals, and self-efficacy. The second phase is activated by a question, and proper strategies are searched. Then, the learner gives a response when she feels some degree of sureness about it. After that, the response is evaluated in the light of received feedback. Lastly, “adjustments are made to relevant knowledge, self-efficacy, interest, and goals as a result of the response evaluation” (p. 217). This is also the initial state for a new feedback cycle.

1.1 Statement of the problem

Prior research shows that feedback interventions generally contribute to students’ performance improvement (e.g. Kluger & DeNisi, 1996). Earlier research was generally focused on comparisons of conditions such as feedback vs no feedback, corrective feedback vs reinforcement feedback, and immediate vs delayed feedback (Bationo, 1992). With the rapid development of technology, new feedback representation strategies have been used in computer-based instruction in order to enhance student learning by presenting visually attractive feedback (e.g. video, animation, and pictures), audial feedback and a combination of these two. Although different representation modes are available, there is currently insufficient research on the most influential feedback representation type on learning. This paucity of such research has been confirmed in a recent meta-analysis by Van der Kleij, Feskens, and Eggen (2015) that multimedia feedback needs to be investigated because of the limited number of studies.

Another important issue is implementation of theoretical findings about feedback. Determination of the most beneficial feedback representation is important for the use of feedback in the classroom and in learning materials. For this reason, teachers have an essential role in this issue because they can directly make use of them in their lessons or in learning objects (LOs). In particular, people who train pre-service teachers should be encouraged to use the most beneficial feedback representation because “when the recipient is dissatisfied with the feedback, or considers the feedback inaccurate or useless, it is likely that the recipient will ignore the feedback” (Dobbelaer, Prins, & van Dongen, 2013, p.88). Additionally, high quality feedback may affect teachers’ feedback perceptions and intentions positively in terms of using the feedback for their professional development (Dobbelaer et al., 2013). Therefore, the quality and different representations of feedback may play a significant role in pre-service teachers’ feedback preference for they use in their future classrooms. However, there are insufficient empirical findings about this issue.

1.2 Purpose of the study

The purpose of the study is to examine the effect of different knowledge representation types of feedback presented in LO development tutorials on the quality of pre-service teachers’ learning objects as well as the representation type of feedback used in authoring LO.

1.3 Research questions

This study was designed to answer the following main research questions:

1. To what extent do the different types of feedback presented by LO development tutorial influence the quality of LOs developed by pre-service teachers?
2. To what extent do different types of feedback presented by LO development tutorial influence pre-service teachers’ choice of feedback type in their development of LOs?

1.4 Significance of the study

There are three main areas of significance of the study. Firstly, although many studies investigated feedback in terms of timing, level or types, the number of studies comparing effects of a multimedia form of feedback on learning is limited; Kleij et al. (2015) suggested that additional research be undertaken regarding the role of different representations of feedback in computer-based environments. The current study seeks to contribute to fill this gap. The results of the study may guide courseware designers to use the most effective feedback representation type in order to improve e-learning experiences.

Secondly, although the body of knowledge on the use of multimedia, modality, and redundancy of multimedia learning is extensive, there are only a few studies investigating them in terms of feedback. Mayer (2014) draws attention to the role of feedback in multimedia learning under a new principle called the feedback principle. It is focused mostly on the effect of the amount of feedback such as knowledge of response vs elaborated feedback rather than testing multimedia principles by representing information with feedback. When all prior known research is considered, a gap in the literature on this issue is clear. This research may also contribute to the body of research provided by Mayer (2014).

Thirdly, teachers who train pre-service teachers have a crucial role in the education system. They lay the foundations of the future, hoping that pre-service teachers are going to apply what they learn in their future classrooms. There are several factors such as perceived usefulness, self-efficacy, and students/learning expectations affecting their intentions to transform what they learn into actual behavior (Sadaf et al., 2016). Although Sadaf et al., (2016) found that pre-service teachers' intentions transform into actual behaviors, the findings are based on the participants’ statements about this issue. The current study provides more accurate results by examining actual feedback usage in the authoring of learning objects. By gaining more accurate results about whether pre-service teachers are affected by provided feedback or not, instructors may pay more attention to training and choosing feedback type for their classrooms.

CHAPTER 2

LITERATURE REVIEW

2.1 Feedback in education

The concept of feedback has been studied extensively in the fields of education, training and psychology for many years because of its significant role in the learning process. In a meta-analysis Kluger and DeNisi (1996) conducted, it was shown that feedback interventions generally contribute to performance improvement with a moderate effect (0.41). Feedback helps learners to close the divergence between current understanding and intended learning outcomes (Hattie & Timperley, 2007). By using feedback, students can be informed when they make a mistake so that they learn from it and teachers can monitor their students' learning progress and give specific feedback again.

2.1.1 Definition of feedback

Although feedback rooted in Thorndike's law of effect as "a stimulus-response paradigm" (Thorndike, 1927), most researchers (e.g. Bationo, 1992; Carter, 1984; Kulhavy, 1977; Sales, 1993) have defined feedback differently. In the instructional context, feedback may be defined simply as the message which follows a learner's response (Bationo, 1992). Hattie and Timperley (2007) stated that feedback on one's performance or understanding can be presented as information by a teacher, peer, or a book. According to Kulhavy (1977), feedback is any procedure which is informs a learner whether a response to an instruction is wrong or right. It can also be described as any communication or method which is given to learners for the purpose of informing them whether a response given to an instructional question is accurate enough or not (Carter, 1984; Cohen, 1985). Feedback is presented to the learner as information after any input for shaping the perception of a learner (Sales, 1993).

Recently, Thurlings, Vermeulen, Bastiaens, and Stijnen (2013) also described feedback from the perspective of five different learning theories: “behaviorism, cognitivism, social cultural theory, meta-cognitivism, and social constructivism” (p. 4). In behaviorist learning theory, the feedback process is linear and straightforward (Figure 1). In this process, it is focused on students’ behaviors that can be manipulated with the help of stimuli such as praise and punishment (Skinner, 1968). The feedback is given. Then, an outcome occurs at the end of the process (e.g. until performing a desired behavior, the learner is given the stimuli every time she does not perform the behavior). In cognitivism, as in behaviorism, the process is also linear and the mental activities of learner have an active role in this process (Figure 2). For example, learners received feedback, which is then processed by them, and then an outcome occurs. In social cultural theory, there is a dialog between receivers and providers, which is fundamental for the learning theory, and the feedback process is also linear (Figure 3). Feedback is given to the learners to help them proceed to the following step (i.e. zone of proximal development), meaning that responses by the learner are successful. In meta-cognitivism, students learn to learn by regulating themselves under the guidance of teachers. On the other hand, in social constructivism, learners construct their knowledge with the help of teachers and peers. In both of them, feedback is given by a provider. Then, this causes an outcome that moves learners to the beginning of another stage. Thus, the feedback process is cyclic (Figure 4).

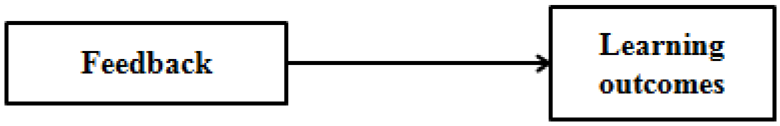

Figure 1 The feedback process for behaviorism
Source: Thurlings et al., 2013, p. 3

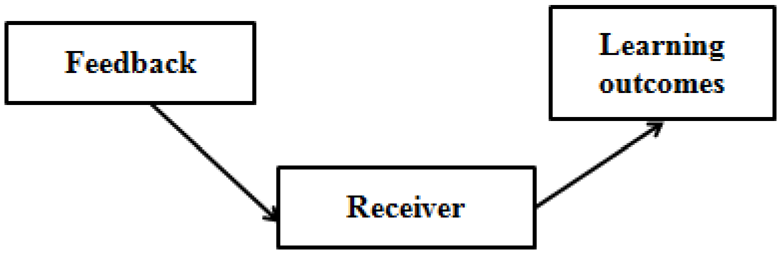

Figure 2 The feedback process for cognitivism
Source: Thurlings et al., 2013, p. 4

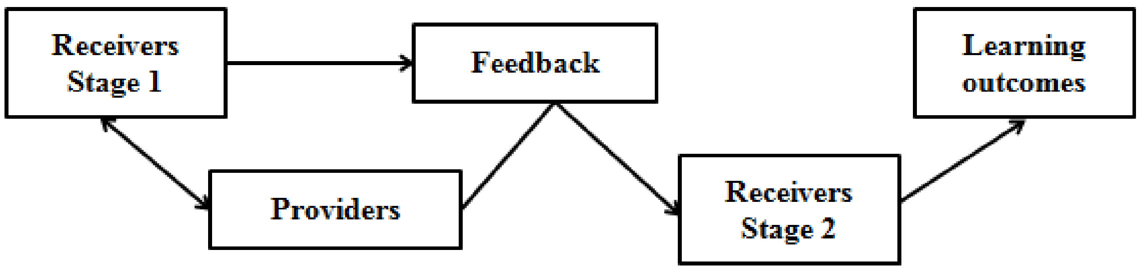

Figure 3 The feedback process for social cultural theory
Source: Thurlings et al., 2013, p. 4

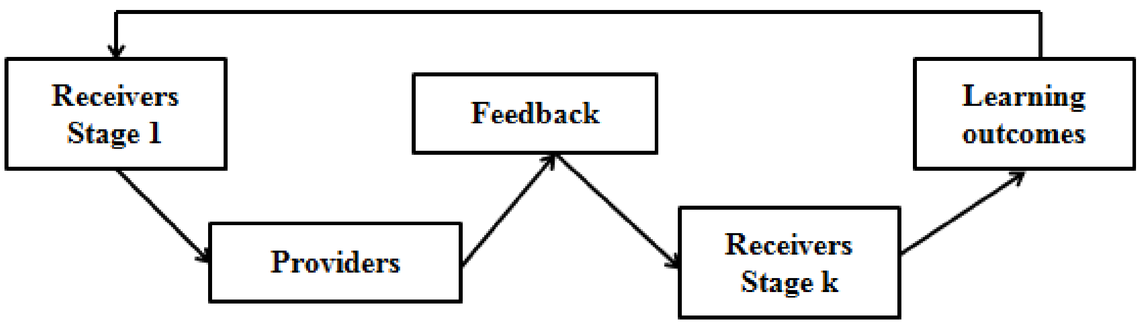

Figure 4 The feedback process for meta-cognitivism and social constructivism
Source: Thurlings et al., 2013, p. 4

Çabakçor, Akşan, Öztürk, and Çimer, (2011) argued that good feedback should have the following characteristics: It informs students about their current situation, encourages students to think about their performance, informs students about expected performance (targets, criteria), and leads students to fill the gap between their current and desired performance.

2.1.2 Types of feedback

There are many procedures and ways to tell a learner whether a response is correct or not. Because of the various features of feedback, authors categorize feedback differently. There is much research on feedback types in the literature, such as corrective feedback (Roper, 1977; Dempsey, Driscoll, & Swindell, 1993; Kulhavy & Stock, 1989), formative feedback (Sadler, 1989; Shute, 2008), informative feedback (Hansen, 1974), immediate feedback (Bationo, 1992; Dempsey & Wager, 1988; Epstein, 1997), delayed feedback (Kulhavy & Anderson, 1972; Van der Kleij , Feskens, & Eggen, 2015), and motivational feedback (Pyke, 2007).

Blignaut and Trollip (2003) categorized feedback (with academic content) into three groups: corrective feedback, informative feedback, and Socratic feedback. In corrective feedback, the teacher provides the correct content of a student's posting. In informative feedback, teachers express their thoughts about a student's posting from a content perspective. For example, "this is a good posting but it would be better to give examples in addition to just answering the question." In Socratic feedback teachers ask reflective (Socratic) questions about the student's posting (e.g. "you answered the question from the perspective of a teacher, but now please explain the same situation from student perspective").

There are also several classifications of corrective feedback. According to Ferreira, Moore, and Mellish (2007), there are two forms of corrective feedback in the area of second language acquisition (SLA). These are the giving an answer strategy (GAS), where the teacher provides the correct answer for students; and the prompting an answer strategy (PAS), which is used when teachers support students less directly to notice and remedy their errors. In second language learning research, Van Beuningen, de Jong, and Kuiken (2012) divide corrective feedback into two types: Direct corrective feedback (demonstrates the error and gives the correct answer), and indirect corrective feedback (only indicates the error that is made).

Roper (1977) used three different feedback versions as a response in their studies. The first one is no feedback. The second is knowledge of response (KR) informing students about whether a response is correct or wrong. In the third one, knowledge of correct response (KCR) informing students what the correct answer is. The results showed that KCR is more effective than KR feedback and no feedback. After synthesizing the literature, Dempsey, Driscoll, and Swindell (1993) also use similar categorization. They divided corrective feedback into five categories. These are no feedback, KR feedback, KCR feedback, elaborated feedback (information about whether a response was correct or wrong, with an explanation), and try-again feedback (information about whether a response was correct or wrong, using interactive teaching). Among these five different kinds of feedback, the research showed that elaborated feedback is more effective than the other corrective feedback types (Kulhavy & Stock, 1989). In the same research, the authors divided elaborated feedback into three subgroups: instruction based, task specific, and extra instructional feedback.

Another feedback type frequently investigated in the literature is formative feedback. Shute (2008) described formative feedback as “information communicated to the learner that is intended to modify the learner’s thinking or behavior for the purpose of improving learning” and it is regarded as “multidimensional, nonevaluative, supportive, learner-controlled, timely, specific, credible, infrequent, contingent, and genuine". Formative feedback is also used for the purpose of enabling learners to reform their understandings/skills to more powerful ideas and capabilities.

Hattie and Timperley (2007) classified feedback into four levels: task, regulation, process, and personal (self) levels. Feedback at the level of self is directly associated with the characteristics of the learner instead of specifics of the task performed, such as "You are a great student." Feedback at the task level is focused on how well a task is done or performed, such as telling whether the response is accurate or not. Feedback at the level of process is more related to the procedure from beginning to end to be pursued to finish the task. For example, teachers give questions with their solutions to learners. Feedback at the level of regulation is the process in learner's brain (e.g., self-control, self-discipline, self-assessment). Van der Kleij et al. (2012) also linked feedback levels (Hattie & Timperley, 2007) with feedback types and timing (Shute, 2008) in order to develop more comprehensive view of how feedback can be provided in different ways, as shown in Figure 5.

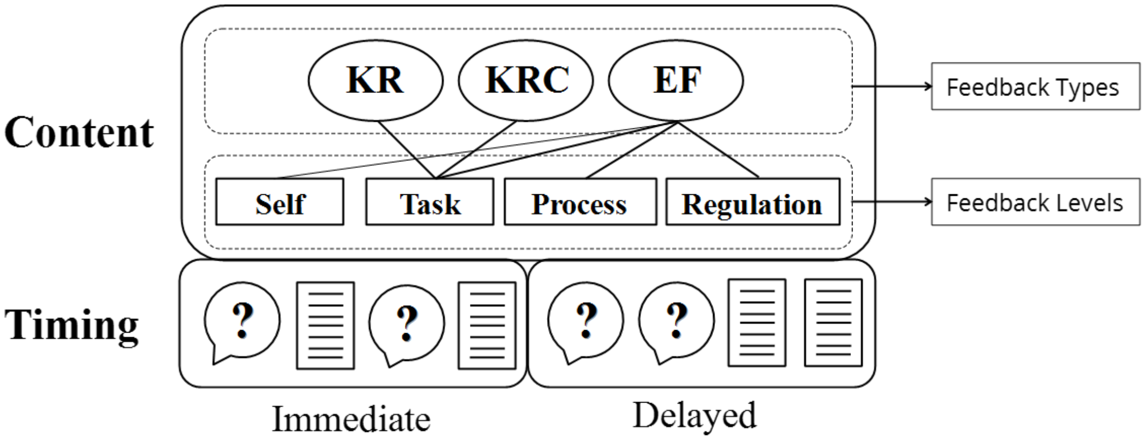

Figure 5 Combined demonstration of feedback interventions
Source: Adapted from Van der Kleij et al., 2012, p. 2

2.1.3 Timing of feedback

There are many studies about feedback timing that examine the influence of timing alterations (Azevedo & Bernard, 1995; Kulik & Kulik, 1988; Kulhavy & Anderson, 1972). Feedback can be either immediate or delayed. In feedback which is instant, information is presented to the learners about whether their answer is correct subsequent to each test element or after performing a task (Dihoff, Brosvic, & Epstein, 2003). In delayed feedback, information is given to the learners about whether given responses are correct or not after all items on a task have been performed (Kulhavy & Anderson, 1972).

To investigate the outcomes of the timing of feedback, Kulik and Kulik (1988) examined 53 studies in their meta-analysis, and reported that immediate feedback brought about better performance than delayed feedback in actual classrooms. Learners are allowed to practice errors if the feedback is given in delayed mode. This may also cause them to learn to perform skills incorrectly. In a second meta-analysis of feedback research, Azevedo and Bernard (1995) examined the effect of feedback in computer-based lessons and confirmed the result of Kulik and Kulik's meta-analysis. Further, Gibson (2000) also reported that the delayed feedback for decisions may affect learning negatively in a dynamic environment.

Although many studies showed that immediate feedback is more favorable than delayed, some investigations found that delayed feedback is better for learning. For example, in eight of 11 studies on feedback timing showed that delayed feedback resulted in better performance than immediate feedback (Kulhavy & Anderson, 1972). In another study, Kippel (1975) conducted a study with sixth-grade students solving a multiple choice test. Feedback was given immediately and one, two and three days later. The result showed that learners that received feedback one day later had a greater recognition score than the others. Although there are contradictory views about the effectiveness of the timing of feedback, the majority of empirical studies indicate that immediate feedback is more beneficial for learning than delayed feedback.

Dempsey and Wager (1988) defined immediate and delayed feedback in CAI settings, and divided them into sub-categories as shown in Table 1.

Table 1. Immediate and Delayed Feedback: Definition and Categories

Type of Feedback	
Definition	Type of feedback
Immediate feedback is informative, corrective feedback provided learners as quick as computer software during instruction or testing.	1. Item by item 2. Learner control 3. Logical content break 4. End of module (end of session) 5. Break by learner 6. Time controlled (end of session)
Delayed feedback is informative, corrective feedback provided learners after a specified time interval during instruction or testing.	1. Item by item 2. Learner control 3. Less than 1 hr (end of session) 4. 1-24 hr (end of session) 5. 1-7 days (end of session) 6. Extended delay (end of session) 7. Break next session

Source: Adapted from Dempsey and Wager, 1988, p. 23

2.2 Use of feedback in technology-based learning settings

In technology integration, feedback is one of the most important and frequently addressed elements. There is some research about the use of feedback in CAI such as corrective feedback, informative feedback, immediate feedback, and delayed feedback. Mason and Bruning (2015) grouped feedback commonly used in computer-based instruction into seven categories after examination of the literature: knowledge-of-response (KR), knowledge-of-correct-response (KCR), answer-until-correct (it is asked learners to try again until giving the correct answer), bug-related (it controls the answer and provide common errors made by learners), response-contingent (it checks the response and elaborates with an explanation about why the answer is correct or incorrect), topic-contingent (it checks the response and elaborates with general information), and attribute-isolation (it controls the answer and underline key aspects of targeted concept).

Langdon (1991) examined in detail the effects of both types of feedback and the timing of feedback on the acquisition of declarative and procedural knowledge in a CAI environment. There were four treatment groups: the immediate knowledge-of-correct-response group (KCR), the immediate knowledge-of-correct-response with additional information group (KCRI), the delayed KCR and the delayed KRCI. Additional information consists of relevant declarative explanations. The outcomes showed there were no statistically significant effects of treatment with respect to the timing of feedback or the type of feedback (KRC and KRCI) on the acquisition of declarative, procedural and overall knowledge.

In a more recent study, Smits et al. (2008) analyzed the effects of feedback content (elaborated vs global) and timing of feedback on learning genetics for students having different level of background knowledge (low vs high) in a web-based learning environment. The researchers also investigated students' perception of the feedback they received. The perception scale (proved reliability) consists of four scales: usage (whether learners use the feedback they received), quality, effect and appreciation. The results demonstrated that higher prior knowledge learners learned significantly better with global feedback, although they preferred more elaborated feedback to global feedback. It was also observed that there was no considerable main or interaction consequence of timing and content on four perception scale sections for the learners with either low or high prior knowledge, except for the case stated above.

Adams (2006) studied pre-service teachers to examine the effect of computer-assisted feedback strategies (KR, KCR and no feedback) on the learning of basic computer components and attitudes towards multimedia-based instruction. The results revealed that there was no significant difference among treatment groups on learning outcomes or attitude toward multimedia-based learning. A similar study (Van der Kleij et al., 2012) examined written feedback on students' learning. There were three groups in the study: the immediate knowledge of correct response (KCR) with elaborated feedback (EF) group, the delayed KCR with EF group and the delayed knowledge of result (KR) group. The results revealed that there was no notable difference among feedback conditions on student achievement scores. On the other hand, according to perception questionnaire about usefulness, students found immediate KCR and EF together more useful than KR for learning.

In a meta-analysis by Azevedo and Bernard (1995), the posttest data of 22 CBI studies with immediate feedback and 9 CBI studies with delayed feedback were examined. Effect sizes were 0.80 for immediate feedback and 0.35 for delayed feedback, showing that immediate feedback is preferable to delayed feedback, at least in CBI. In a similar meta-analysis, Van der Kleij et al. (2015) examined 40 studies with 70 effect sizes; results suggested that immediate feedback was more advantageous than delayed feedback in a CBI for lower order learning. On the other hand, elaborated feedback with effect size (0.49) was more effective than knowledge of result (0.05) and knowledge of correct response (0.32).

Three forms of immediate feedback were examined by Bationo (1992) by using a computer-based tutorial in teaching a foreign language. The aim of the study was to ascertain which feedback form (spoken feedback, written feedback or both spoken and written feedback) is more beneficial for learning intellectual skills by means of computer-based language learning tutorial. The results showed that combination of written and spoken immediate feedback group outperformed no feedback group and written immediate feedback group on posttest scores. However, there was no significant difference among delayed versions of these feedback forms.

A similar study, Ice et al. (2010) focused on students' preferences for different feedback forms provided by instructors: text-based, audio-based and combination of text- and audio-based feedback. Seven educators were trained how to use electronic tools (e.g. inserting comments as text and audio format in Adobe Acrobat Pro). Students (n=196) from 3 different universities in the USA participated in the study. According to the survey results, students preferred a combination of text and audio feedback to stand-alone feedback with text or audio. Feedback based on text was also preferred to feedback based on audio. In another study about feedback preferences, Cavanaugh and Song (2014) examined written feedback and audio feedback in an online course, but from the perspective of both instructors and students. The findings showed that instructors preferred to use audio feedback in global issues (e.g. overall structure, topic of the paper, etc.), whereas written feedback was used more in micro-level issues (e.g. grammar, spelling, etc.). On the other hand, most students preferred audio feedback in general.

There is another study comparing video feedback to text feedback (Lalley, 1998) that investigated the effect of video and text feedback on different levels of learning scores (knowledge level and comprehension level) and retention scores in a computer assisted learning environment. Learners used two different computer-based learning materials in biology subject. They include key characteristics about mammals and reptiles. In video version, feedback was given learners with video segments including sounds as feedback whereas the same information was provided learners in textual form. Although text and narration is the same word for word, some images was described when the narration referred them. The findings showed that the video feedback group had significantly higher learning scores (for both knowledge and comprehension scores) and retention scores than text feedback group. The study also indicated the feedback preferences. According to preference scores, a significant number of students preferred video feedback to text feedback.

2.3 Technology integration

Beside the effectiveness of instructional materials used by teachers in their computer-based lessons, another important issue is the integration of them effectively into the learning process. Therefore, “teacher candidates must be prepared to implement technology for student learning once they have completed their teacher education programs” (Clark, Zhang, & Strudler, 2015, p. 93). Today, although teacher candidates take some courses in technology integration, they may not intend or prefer to use the technology in their class. In a study by Bayhan, Olgun, and Yelland (2002), the results showed that many teachers did not use computers for instructional purposes even though 81.8% of schools had computers.

Teo (2009) examined factors that influence technology acceptance. The findings revealed that approaches towards computer use, anticipated usefulness, and computer self-efficacy directly affected teacher candidates’ intents to benefit from technology, whereas ease of use, facilitating conditions, and technological complexity influenced their intentions indirectly. Sadaf, Newby, and Ertmer (2012) also investigated beliefs of pre-service teachers and intents to make use of Web 2.0 technologies in their future teaching by using the theory of planned behavior (Ajzen, 1991), which consists of three constructs: attitude, subjective norm and perceived behavioral control. Findings indicated that prospective teachers' beliefs (behavioral, normative and control beliefs) affected their aims to integrate Web 2.0 technology in their future teaching.

Sadaf, Newby, and Ertmer (2016) further conducted a study to address intentions of prospective teachers about the integration of the Web 2.0 tool in their future classrooms and to explore whether their intentions transfer to actual behaviors or not. The findings revealed that anticipated usefulness, self-efficacy and student learning/expectation are the most powerful determinants of pre-service teachers' intentions. Moreover, there was also considerable relationship between their intentions and actual behaviors. In other words, intentions were consistent with actions, according pre-service teachers' self-reports.

As mentioned before, much research has been carried out to investigate the effects of different feedback types, timing of feedback or forms of feedback by creating computer-based learning environments. For creating such environments, the production of some tools (e.g. drills, tutorials, simulations) may be required. In order to produce them, some different platforms should be used. The following section provides detailed information about these platforms and their types.

2.4 Authoring systems/tools

Authoring systems are defined by Locatis et al. (1992) as tools that allow users to create computer-based instruction without having to do programming. Authoring systems are computer programs that enable materials design by non-programmers because they guide the author and minimize the need for programming effort by providing useful tools and a user-friendly design (Dori, Alon, & Dori, 1994). According to Kearsley (1982), authoring systems have three advantages. First, they enable instructors to develop courseware without knowing a programming language. Second, they decrease development costs and time in developing courseware. Finally, they facilitate the transportability of courseware.

Authoring systems have been improved by advancing technology. Current generations of authoring systems try to fix previous deficiencies by (a) providing easier copying and modifying the screen objects that they develop for users, (b) enabling the use of script languages that makes it possible to extend the system capabilities, (c) serving some programming templates and wizards for whatever the users need to add (Locatis & Al-Nuaim, 1999). Authoring systems were seen by Blattner (1994) as tools to integrate multimedia. Authoring systems have on-screen tools such as icons, menus, and prompts that make it easier to enter text, create graphics, and modify them (Locatis & Al-Nuaim, 1999). The design and modification of interactive computer-based presentations by integrating graphics, audio, text and video is defined as multimedia authoring (Koegel & Heines, 1993).

Kearsley (1982) divided authoring systems into three major categories: “macro-based, form-driven, and prompting” (p. 430). Macro-based authoring systems enables some high level commands (verbs) that help to present text, specify logic, and process answers. These macros reduce the need for authors to use languages such as screen coordinates, branching labels, and loading counters. Then, these systems compile the program according to the macros. In form-driven authoring systems, authors can use offline or online forms with scaffolding information that they need to design a lesson or a course. The third category is prompting authoring systems, which are used to develop interactive courseware by answering questions generated by the system. On the other hand, Guralnick and Kass (1994) divided authoring systems into two categories: theory-neutral and theory-rich. The authors defined the theory neutral authoring systems as ones that are built for producing educational software without a programming load when compared with software development in general. Theory-rich authoring systems are built to help the author to produce pedagogically-based effective educational environments easily and quickly.

The term authoring tools is generally used as a near-synonym of authoring systems. According to Locatis and Al-Nauim (1999), authoring systems are a subset of authoring tools that are products used for composing, editing and managing multimedia objects. All authoring tools are designed to make it easier for instructors to produce instructional material without the need to know programming languages (Otto & Pusack, 2009). Authoring tools decrease the technical workload because the authors can easily manipulate the “what you see is what you get” interface that provides the user some familiar visual objects and metaphors (Berking, 2016). He has categorized the authoring tools as shown in Table 2. However, the tools listed as authoring tools have a wide variety of purpose and scope; while some are able to provide a very rich content development environment, many others have limited capabilities for lesson design or even for the design of components of a lesson.

In this research, Articulate Storyline software will be used as an authoring tool. It is a desktop-based e-learning development tool. It is easy to use and has powerful features that let users create any interactive course and tutorial they can imagine. It can be possible to create e-learning content such as product demonstration, software simulations, branched scenarios, basic skills and compliance training, quizzes. Its design enables the author to develop rich media courses equipped with text plus images, flash animations, audios and videos. It also has predefined templates with fully customizable characters as well as quizzes and interactive tests and exams so as to create comprehensive multimedia learning materials.

Table 2. Types and Examples of Authoring Tools

Self-contained authoring environments	
1. Web site development tools	Dreamweaver, Visual Studio 2012
2. Rapid Application Development (RAD) tools	Flash, Flex,
3. E-learning development tools	
• Cloud-based e-learning development tools	Udutu, Lectora Online, SmartBuilder
• Desktop-based e-learning development	Captivate, Xerte, Storyline, eXe, Learn
4. Simulation development tools	
• System simulation development tools	Camtasia Studio, Captivate
• 2D simulation development tools	SimWriter, GoAnimate
• 3D simulation development tools	ESP, Flex SDK, SimWriter
• Video role play tools	Rehersal VRP
• Transmedia story-based tools	Conducttr
5. Game development environment	Unity Pro, Visual 3D, GameStudio
6. Virtual world development environments	Second Life, Protosphere, Vatspark
7. Database-delivered web application	ColdFusion, ASP.Net
Learning content management systems	ATutor, eXact Learning, Mindflash
Virtual classroom systems	Connect, Adobe Presenter
Mobile learning development tools	Mobile Study, Mobl 21, AppCooker
Performance support development tools	Ancile, Inkling
Social learning development tools	Wikis, Social networking, Blogs
External document converter/optimizer tools	
1. Web-based external document converter/optimizer tools	AuthorPoint, Brainshark Rapid Authoring
2. Desktop-based external document converter/optimizer tools	Content Point, Articulate Presenter, Elicitus
Intelligent Tutoring Systems (ITS)	ASPIRE, Autotutor Lite, Rashi
Auxiliary tools	
1. E-learning assemblers/packagers	eXact Packager, SCORM Driver, Trident
2. Specific interaction object creation tools	Quizmaker, Quiz Creator, Raptivity
3. Media asset production tools	Photoshop, Illustrator, Instagram
4. Word processors, page layout, and document format tools	Acrobat, Office, OpenOffice, QuarkXPress
5. Database applications	Access, Oracle
6. Web-based collaboration tools	ELGG, Adobe Connect, WebEx
7. Web page editors	Easy WebContent, Editor, CoffeeCup

Source: Berking, 2016, p. 11

2.5 Cognitive theory of multimedia learning

Multimedia is the presentation of material by utilizing both verbal form and pictorial form (Mayer, 2001). Mayer views the delivering of the instructional message in three forms: delivery media, presentation modes, and sensory modalities (Mayer, 2001). Delivery media claims that there is a variety of delivery devices. It focuses on systems to physically deliver information such as the screen and speaker of a computer. The second view is a presentation mode that focuses on the manner of representation of a material. For example, content can be represented using words and pictures. The third is the sensory modalities, which focuses on learner's receptors such as the eyes and the ears. Both the presentation mode view and the sensory modalities view are compatible with a cognitive theory of learning. The presentation mode view supposes that humans have discrete information process channels for verbal and pictorial knowledge whereas the sensory modalities view supposes that human have discrete information process channels for auditory and visual processing (Mayer, 2001).

The cognitive theory of multimedia learning is built on three hypotheses: "the dual channel, limited capacity and active processing hypotheses" (Mayer, 2005, p.31). The dual channel hypothesis claims that there are two distinct channels to process information visually and auditory. The dual coding theory by Paivio (1991) and the theory of working memory by Baddeley (1986) also contribute to the concept of separated information processing. The second hypothesis explains that processing information capacity in each channel at one time is restricted. The cognitive load theory by Chandley and Sweller (1991) and the theory of working memory by Baddeley (1986) also contribute to the concept of restricted capacity. The third is the active processing hypothesis, where humans actively take part in the learning process. This active cognitive process consists of three stages: selecting words and pictures, organizing incoming information and combining it with prior knowledge. Figure 6 presents the cognitive theory of multimedia learning and its three stages.

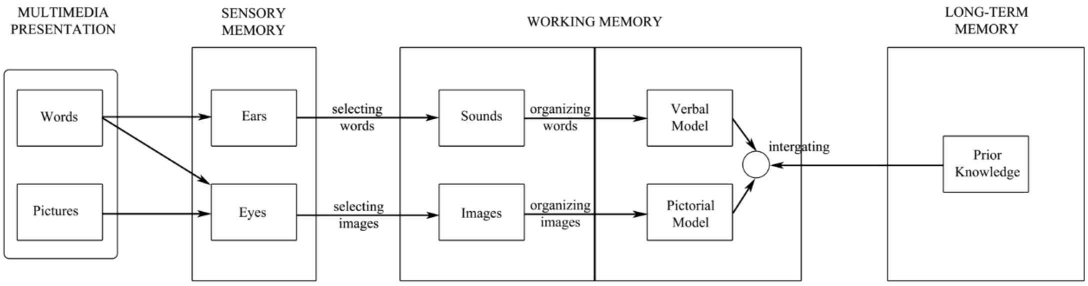

Figure 6 Cognitive theory of multimedia learning
Source: Mayer, 2014, p. 52

The multimedia learning theory outlines twelve design principles under three main categories (Mayer, 2009). These are (a) principles for reducing extraneous processing: coherence, signaling, redundancy, spatial contiguity, temporal contiguity principle; (b) principles for managing essential processing: segmenting, pre-training, modality principle; (c) principles for fostering generative processing: multimedia, personalization, voice, and image principle. Mayer (2009) described these twelve principles for successfully designing multimedia, as shown in Table 3.

Table 3. Principle of Multimedia Design

Principle for Reducing Extraneous Processing	
1. Coherence Principle	People learn better when extraneous words, sounds or pictures are excluded rather than included.
2. Signaling Principle	People learn better when multimedia explanations are signaled rather than non-signaled.
3. Redundancy Principle	People learn better when pictures are presented with narration rather than with both on-screen text and narration.
4. Spatial Contiguity Principle	People learn better when pictures are presented near with corresponding words rather than far on the screen or page.
5. Temporal Contiguity Principle	People learn better when pictures are presented simultaneously with corresponding words rather than successively.
Principles for Managing Essential Processing	
6. Segmenting Principle	People learn better when multimedia lessons are presented in user-paced segments rather than as a continuous unit.
7. Pre-training Principle	People learn better from multimedia lessons when they know key characteristics and names of main concepts.
8. Modality Principle	People learn better when pictures are presented with narration rather than with on-screen text.
Principles for Fostering Generative Processing	
9. Multimedia Principle	People learn better from word and pictures than from words alone
10. Personalization Principle	People learn better with words presenting in conversational style rather than formal style.
11. Voice Principle	People learn better from multimedia lessons with spoken friendly human voice rather than machine voice.
12. Image Principle	People do not necessarily learn better from multimedia lessons added speaker's image on the screen.

Source: Mayer, 2009, p.267

2.5.1 Multimedia principle

According to a common sense view, providing information with words is equivalent to providing information with pictures. For this reason, the cases that are presented with the help of both words and pictures are seen as redundant according to this view. Contrary to the previous idea, the cognitive theory of multimedia learning (Mayer, 2001) and the dual coding theory of Clark and Paivio (1991) claim that people learn more thoroughly when presented with information in both words and images rather than presenting only words because of connecting them mentally.

Regarding these, Mayer and Anderson (1991) examined three contrasting hypotheses: the single-code hypotheses, the separate dual-code hypotheses, and the integrated dual-code hypotheses. Their study consists of two experiments which explain this contradiction. According to the first experiment, performed with 30 university students at the University of California Santa Barbara, participants who studied with a words-with-pictures presentation outperformed the others, who studied words-before-picture presentation on problem solving cases. The second experiment was conducted with four groups: a words-only group, a picture-only group, a words-with-pictures group, and a control group (p. 489). In both experiments, the same two computer programs were displayed as a monochrome animation of a line drawing of a bicycle tire pump. The second experiment revealed that students in the words-with-picture presentation group surpassed other groups on the problem solving task. These results are also compatible with the dual coding theory of Paivio (1990), who asserted that humans have two distinct information process systems, verbal and visual, and they construct referential connection between them.

Mayer and his colleagues worked mostly with college students, however. Pawar (2011) replicated Mayer's study to test some multimedia principles with elementary school students. One hundred fifth-grade students took part in an Internet-based lesson on the human muscular system. There were three treatment groups: a pictures-only group (P), a words-only group (W) and a combination of words and pictures group (PW). There were two dependent variables: retention and transfer test scores. The findings showed that the PW group was significantly superior to both the P and the W group on transfer test scores with large effect size. PW groups also had higher scores on retention test than the P group with large effect size. In addition, the word group had higher scores than the P group on retention test (with large effect size) and transfer test (with medium effect size) as well.

The study conducted by Butcher (2006) aimed to examine the interaction effect between diagram representation and background knowledge and to test the multimedia principle with the current material and design. There were two experiments about the heart and circulations system with three treatment groups: one group was provided with text only, one group was provided with text and simplified diagrams, and one group was provided with text and detailed diagrams displaying a more precise representation. The results revealed that there was no interaction between diagram representation and background knowledge. Additionally, materials with both simplified and detailed diagrams were more beneficial than material with text only for mental development, whereas the simplified diagrams were contributed the most in the factual learning in the domain. Experiment 2 examined the students' comprehension process in three groups. Results showed that both diagram groups helped students in inference generation and reduced comprehension errors, whereas simplified diagrams were the best choice to support information integration during learning. Moreover, Experiment 2 also replicated Experiment 1 and the results were consistent.

In a different study, Moreno and Valdez (2005) investigated the multimedia principle with different aspects. The aim of the study was to contribute to prior studies about multimedia learning by investigating the role of dual coding, interactivity and feedback forms. The study consisted of three experiments. The first experiment was conducted to test the effect of dual code by comparing three treatment groups: a picture (P), a word group (W), and a picture with word group (PW). According to result, the PW group had significantly higher retention and transfer scores than the W group, which also scored better than the P group. Moreover, students thought that the P version of the material was more difficult than other versions, according to rating scores. The second experiment examined the effect of interactivity and time control on transfer and retention tests. The findings showed that learners who used the interactive and user-timed version spent less time on the multimedia program than those who used interactive system-timed versions. Lastly, the feedback condition (user-self feedback vs system feedback) was tested. The result showed that students who used interactive-user-feedback (self-feedback) had significantly better scores on transfer tests than students who received interactive-system feedback. However, there was no noteworthy main or interaction effect of interactivity and feedback form on retention test scores.

2.5.2 Modality principle

According to a common sense view, there should be no difference between words provided as narration and words-on-screen text because they are equivalent information. However, the cognitive theory of multimedia learning (Mayer, 2001) claims that people learn more thoroughly when information is presented with words as narration instead of on-screen text. Mousavi, Low, and Sweller (1995) first identified the modality effect term in a paper-based environment where students learned to solve geometry problems better from a printed illustration with concurrent narration than from a printed illustration with text. According to the study, written text and narration use the same channel to process and integrate the information. That also leads to a split-attention situation (Mayer & Moreno, 1998), causing cognitive overload (Chandler & Sweller, 1991) when learners try to use their attentional resources for holding words and pictures in their visual working memory.

Mayer and Moreno (1998) tested the modality principle in their study with two experiments. There were two groups in both experiments; animation with coexisting narration (Group AN) and animation with coexisting on-screen text (Group AT). The second experiment is a replication of the first experiment, but with a different computer program. The process of lighting programs was used in the first experiments, whereas a car's breaking system program was used in the second experiment. In both experiments, findings showed that students in the AN group had greater retention, matching, and transfer scores than students in the AT group. The results of this study are compatible with the predictions of the dual-processing hypotheses.

Ginns (2005) reviewed the modality effect to test three hypotheses in terms of instructional materials, element interactivity and pacing of presentation with 39 between-subject studies and 4 within-subject studies. Findings revealed that learners using instructional material with graphics and spoken text outperformed the learners using instructional material with graphics and printed text. For the second hypothesis, element interactivity was examined at two level (low vs high). The results showed that materials with low element interactivity had higher mean effect size than high element interactivity. Another major finding was about the pace of presentation in terms of timing. The result also showed that system paced programs have greater mean effect than user paced programs.

The modality principle has generally been tested in lab settings. For this reason, Harskamp, Mayer, and Suhre (2007) tested the modality principle in authentic classroom environments—biology lessons with secondary school students: There were two experiments in the study. The result of Experiment 1 showed that animation with the narration group (AN) had higher points than animation with text (AT) on retention, transfer, and total scores with a large effect. In the second experiment, there were two independent variables as instruction type (AN vs AT) and learning rate (fast vs slow learners). There was significant interaction between the two variables. Results revealed that AN group had significantly higher scores on transfer and total scores than AT group for fast learners, whereas the AT group outperformed the AN group on only retention test scores.

Fiorella, Vogel-Walcutt, and Schatz (2012) also examined the modality effect in simulation-based training environment (SBT). Participants received feedback in different ways, such as spoken text (spoken group), on-screen text (printed group), and no feedback group (control group) (p. 223). Three decision-making scenarios were used in the study: two training (the second is more complex) and one assessment scenario. Results showed that the spoken group performed remarkably better than the printed group on decision-making during more complex training scenarios, whereas there was no significant difference between them in scenario 1. In line with the results of the more complex training scenario, results indicated that the spoken group was superior to the printed group on decision-making during the assessment scenario. After the assessment scenario, three paper-based knowledge tests were administered: declarative, procedural and integrated tests. According to the results, the spoken group had higher scores on the procedural knowledge test than the printed group, whereas there was no noteworthy discrepancy between groups on the declarative and integrated tests. Moreover, researchers also compared participants' self-reported cognitive loads regarding their experiences in the three scenarios. The findings showed no notable difference between groups on self-reported cognitive load in the three scenarios.

2.5.3 Redundancy principle

In a common sense view, it seems that it is better to present the same words in two formats: on-screen text and narration so that learners are capable of choosing the most suitable format for themselves. On the contrary, cognitive theory of multimedia learning (Mayer, 2001) claims that people acquire knowledge to a greater degree from animation with narration as opposed to animation with narration and on-screen text because learners are supposed to divide their attention when presenting information with narration, animation and on-screen text. A redundancy principle was originally put forward by Kalyuga, Chandler, and Sweller (1999), who found that learners performed better when eliminating redundant material rather than when redundant material was included.

Mayer, Heiser, and Lonn (2001) tested the redundancy principle with the first and second experiments in their study including four experiments. The aim of the first and second experiment was to examine the role of unnecessary on-screen text when learners receive animation and narration. There are four groups in the first experiment: "no-text/no-seductive details group, text/no-seductive details group, no-text/seductive details group, and text/seductive details group" (p. 191). All participants had a low level of knowledge about meteorology. Results showed that students who did not use the on-screen text version had significantly higher retention (effect size= 0.36) and transfer (effect size= 0.63) test scores than students who used the on-screen text version. On the other hand, students not using the seductive detail version performed significantly better on retention (effect size= 0.56) and transfer (effect size= 0.55) test scores than students using seductive detail version. The purpose of the second experiment was the same, but there are were groups: a no-text group, a summary text group, and a full text group. Procedures were essentially the same. Results revealed that no text group was superior to the full text group on retention test scores, although there was no considerable difference between the no text group and the summary text group. In addition to this, no text group had remarkably better transfer test scores than the other two groups, which were not significantly different from each other. As a result, adding redundant text (summary, full or seductive details) to a multimedia demonstration affects student learning negatively.

Mayer and Johnson (2008) examined the redundancy principle in a different way. They used a short version of narrated text for on-screen text, such as 2-3 words, instead of providing complete reproduction of the narration. Two different sets of materials were used: lighting formation for Experiment 1and a car's breaking system for Experiment 2. In the redundant group, the on screen text was short and placed near a graphic, whereas there was no on screen text in the non-redundant group. Results showed that redundant group notably outperformed the non-redundant group on retention test scores in both experiments. However, there was no particular difference between groups on transfer scores. Researchers concluded that redundant short text such as 2-3 words helped to foster essential processing by guiding the learner's attention, but generative processing was not affected positively by the redundant version of the material.

Lyles (2010) studied the effect of the redundancy principle on learning outcomes when presenting social science educational material. One hundred and fifty college and undergraduate students participated in the study. There were five groups: a narration only (N group), a picture and narration (PN group), a picture, narration, and full text (PNFT group), a picture, narration and summary text (PNST) group and a control group. Results suggested that the control group had significantly lower scores than all treatment groups on post-test scores. However, the result of the study is in contradiction to previous studies. There was no notable discrepancy between the PN and the PNFT groups and also no significant difference between the PNFT and the PNST groups on learning outcomes. The researcher suggested that further research is needed to ensure how redundancy affects learning outcomes, especially in the social science domain.

Schär and Kaiser (2006) examined the effect of different presentation forms on acquired knowledge scores (visual, verbal, and inference knowledge) in terms of three principles of multimedia learning (multimedia, modality, and redundancy principle). There were seven presentation forms in the study: textual (T), verbal (V), pictorial (P), textual and verbal (TV), textual and pictorial (TP), verbal and pictorial (VP), and textual + verbal + pictorial (TVP). The results showed that modality and redundancy principle were supported when comparing visual knowledge scores but not clearly multimedia principle. In verbal fact knowledge, the multimedia principle was supported but the modality principle was only partly supported. In inference knowledge, multimedia and modality were supported but partly redundancy principle. Moreover, researchers also examined the effect of presentation forms on preferences. Results revealed that test form was rated significantly higher than the P, VP, TV, and TVP forms. V and TP forms were also rated significantly higher than TV and TVP forms. In general, text form was the most preferred, whereas the picture form was the least preferred.

2.6 Summary of the literature

Feedback has been frequently studied in the field of education for many years because of substantial impacts on learning process. Meta-analysis by Kluger and DeNisi (1996) showed that feedback interventions enhanced student learning. Even though earlier studies mostly examined feedback in terms of timing, level or types, new feedback representation strategies started to be investigated with the widespread use of computers in education such as textual, audial and visual feedback. Bationo (1992) examined three forms of immediate feedback such as written, spoken and combination of the two. In a more recent study by Lalley (1998) also compared video feedback to text feedback. Besides, Ice et al (2010) and Cavanaugh and Song (2014) investigated written and audio feedback. However, there is currently insufficient empirical findings about which one is the most effective feedback representation type for learning. A recent meta-analysis by Kleij et al. (2015) also revealed that multimedia feedback needs to be investigated because of the limited number of studies.

Another important issue is implementation of theoretical findings about feedback. Determination of the most beneficial feedback representation is very crucial for the use of feedback in the classroom and in learning materials. For this reason, teachers have a crucial role in this issue because it is hoped that pre-service teachers are going to apply what they learn in their future classrooms. Teo (2009) and Sadaf et al (2012) investigated factors affecting pre-service teachers' intentions. Sadaf et al. (2016) further conducted a study to address intentions of prospective teachers about the integration of web 2.0 tool in their future classrooms and to explore whether their intentions transfer to actual behaviors or not. However, there is inadequate studies about how different representations of feedback affects pre-service teachers' choice of feedback type in developing a learning material.

When all these issues are taken into consideration, this study was designed to answer the following research questions and sub-questions:

1. To what extent do the different types of feedback presented by LO development tutorial influence the quality of LOs developed by pre-service teachers?
    1.1. To what extent do different types of feedback presented by LO development tutorial influence the overall LO quality of pre-service teachers' LOs?
    1.2. To what extent do different types of feedback presented by LO development tutorial influence the feedback and adaptation quality of pre-service teachers' LOs?
2. To what extent do different types of feedback presented by LO development tutorial influence pre-service teachers' choice of feedback type in their development of LOs?
    2.1. Is there a meaningful interaction between types of feedback studied in the LO development tutorial and the type of feedback used by pre-service teachers authoring LOs?
    2.2. Is there a meaningful interaction between pre-service teachers' intended use of feedback type and their usage of feedback type in authoring LOs?

2.3. Is there a meaningful interaction between pre-service teachers' intended use of feedback type and their recommended type of feedback?

2.4. Is there a meaningful relationship between the type of feedback used by pre-service teachers authoring LOs and their recommended type of feedback?

CHAPTER 3

METHODOLOGY

The purpose of the study was to examine the effect of different knowledge representation types of feedback presented by LO development tutorial on the quality of pre-service teachers' learning objects as well as the representation type of feedback used in authoring LOs. The methodology of the research will be detailed in this chapter, including research design, participants, instrumentation, data collection procedures, data scoring, and statistical analysis.

3.1 Research design

A post-test-only quasi-experimental design was used in this study. Participants were not assigned randomly to groups. There were six treatment groups. The same researcher gave the same lecture about Articulate Storyline software to all groups, but interventions were different (see Table 4). The tutorials was intended to teach components and functions of Articulate Storyline software. The intervention was additional to the lecture time.

Table 4. Research Design of the Study

Groups	Intervention	Posttest
Text Group (T)	T version of feedback in the tutorial	Post-test
Audio Group (A)	A version of feedback in the tutorial	Post-test
Video Group (V)	V version of feedback in the tutorial	Post-test
Video + Text Group (VT)	VT version of feedback in the tutorial	Post-test
Video + Audio Group (VA)	VA version of feedback in the tutorial	Post-test
Video + Audio +Text Group (VAT)	VAT version of feedback in the tutorial	Post-test

3.2 Participants

Articulate Storyline Tutorial prepared for this study aims to teach pre-service teacher in Turkey all of the features of Articulate Storyline authoring system. Due to the fact that majority of the concerned population is not bilingual, tutorial was developed in Turkish. However, as the interface of the Articulate Storyline software is in English, the tutorial was designed with Turkish explanations including some English technical terms on the interface of the tutorial in order to make learning easy for the users. Although the target population of the tutorial used in the study is all of the pre-service teachers in Turkey, it was planned that bilingual ones in this population would be taken as a subpopulation and the study would be conducted on this subpopulation. That is why the population of this research is pre-service teachers having English medium education. There are five universities of which faculties of education give English medium education. The pre-service teachers of those five faculties of education are accepted as the population of this study. Though it was possible to do random sampling from the concerned population and then; to form a research sample from those who was selected, it was decided that sampling would be done from a convenient faculty. As a result, sample pre-service teachers was selected from the faculty of education of Bogazici University where Instructional Technologies and Material Development course and the laboratory sessions of this course can be handled. The sampling method was determined as convenience sampling of non-probability sampling. The sample was consisted of 8 sections from 2014 – 2015 academic year. Overall 8 sections from the academic year, where Articulate Storyline was taught as an Authoring System in Instructional Technologies and Material Development course, constituted the research sample.

At first, the sample of the study consisted of 204 pre-service teachers. Then, technology skill questionnaire was conducted to ensure the equality of initial technology skills of participants. Analysis of the questionnaire data showed that only two participants had high level of technology skills. Therefore, those two participants were excluded, and the final sample consisted of 202 pre-service teachers from four departments in the Faculty of Education at Boğaziçi University. These departments are Educational Sciences (ED), Primary Education (PRED), Secondary School Science and Mathematics Education (SCED), and Foreign Language Education (FLED). All participants were enrolled in Instructional Technologies and Material Development course that is a requirement for them in their curriculum. They had not taken an instructional material development course before the study. The departmental distribution and demographic information of the sample according to their groups is shown in Table 5 and Table 6.

Table 5. Departmental Distribution of Sample According to Their Groups

	PRED	SCED	ED	FLED	TOTAL
V	3	11	5	9	28
A	15	2	11	4	32
T	6	7	18	3	34
VT	15	12	5	4	36
VA	2	11	5	2	20
VAT	15	3	8	26	52
TOTAL	56	46	52	48	202

Table 6. Demographic Information of Sample According to Their Groups

	Average Age	Gender		TOTAL
		Male	Female	
V	21.7	4	24	28
A	22.0	1	31	32
T	21.9	7	27	34
VT	22.0	3	33	36
VA	22.6	6	14	20
VAT	21.4	4	48	52
TOTAL	21.9	25	177	202

3.3 Instrumentation

Two questionnaires about feedback preferences and technology skills, the Learning Object Review Instrument (LORI - version 1.5), and the LO development tutorial were used in the study. Each of them will be detailed in this section.

3.3.1 The questionnaire of feedback preferences

Participants took the questionnaire before treatment by using a web-based form. The feedback preferences questionnaire (see Appendix A) was designed to determine pre-service teachers' feedback preferences in terms of their intentions and recommendations in authoring LO. This information was used to compare intended, recommendation and actual feedback types used after the evaluating quality of learning objects was developed by pre-service teachers.

3.3.2 The questionnaire of technology skills

Participants answered the questionnaire before the treatment by using a web-based form. The technology skill questionnaire (see Appendix B) was designed to determine pre-service teachers' level of technology skill. There were 22 items in the questionnaire. The first six items were about participants' personal information such as name, age, grade, gender, and department. The other 16 items measured the participants' technology skills. 15 items were graded from one to five; one remaining item (12. item) consists of eight sub items which were also graded from one to five. Maximum score in this questionnaire could be 115 points. The participants who got under 70 points were regarded as having low technology skills while those who got above 69 points were regarded as having high technology skills.

3.3.3 Learning object review instrument

The first version of LORI was developed by Vargo, Nesbit, Belfer, and Archambault (2003) and the improved version by Nesbit, Belfer, and Leacock, (2007) (see Appendix D). It has nine items—content quality, learning goal alignment, feedback and adaptation, motivation, presentation design, interaction usability, accessibility, reusability, standards compliance—each with descriptive rubrics. Standards compliance item measures whether the LO meets international technical standards, however such technical content is not covered in pre-service teachers' courses. For this reason, standard compliance item was excluded from evaluation process

3.3.4 LO development tutorial

There is a lab room where lab sessions of the course take place. Each participant had a private computer and headphone. The questionnaire and the tutorial were served online. The LO development tutorial was designed specially for this study. The design process of the tutorial took approximately five months. There are six versions of the tutorial. Two domains and hosting services were used for publishing the tutorial, even though there is one database to be saved. In the introduction screen of the LO development tutorial (see Figure 7), users are asked to enter their personal information before starting the tutorial, because all these information is used when saving their actions, such as finishing one module. The screen in Figure 7 is the same for the six versions of the tutorial.

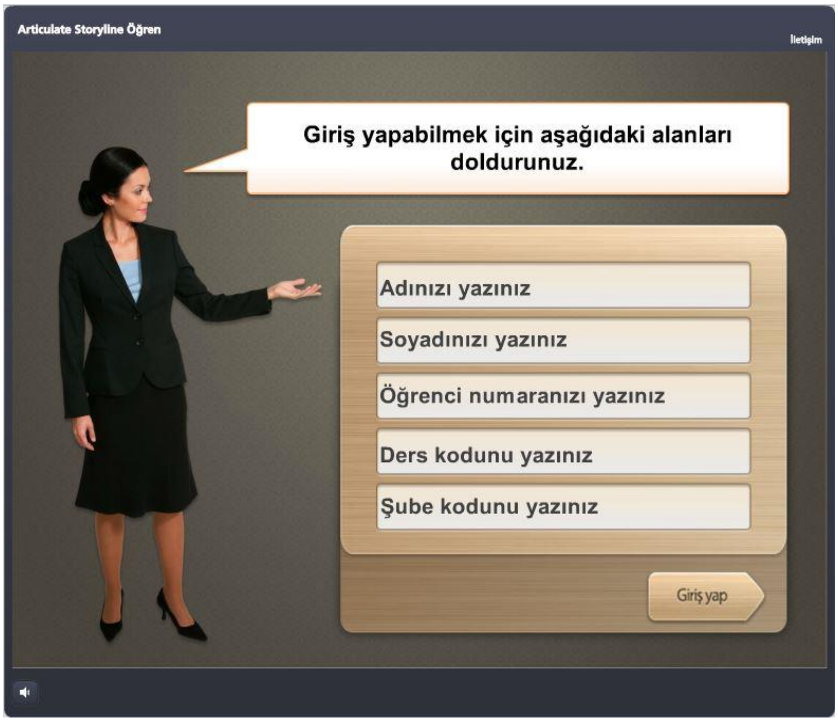

Figure 7 Login screen of LO development tutorial (for all versions)

In the module selection screen of the tutorial (see Figure 8), the users can select the module what they want to learn. Each module consists of 5 or 6 sub-topics. The aim of dividing the modules was to help protect the novice from overload.

In the screen of the selected task of the tutorial (Figure 9), it was expected that the user would try to explore ways to accomplish the task by using trial and error. If they clicked wrong place, a feedback screen appeared, offering two choices: "Tekrar Dene" (Try again) and "Öğren" (Learn) (see Figure 10).

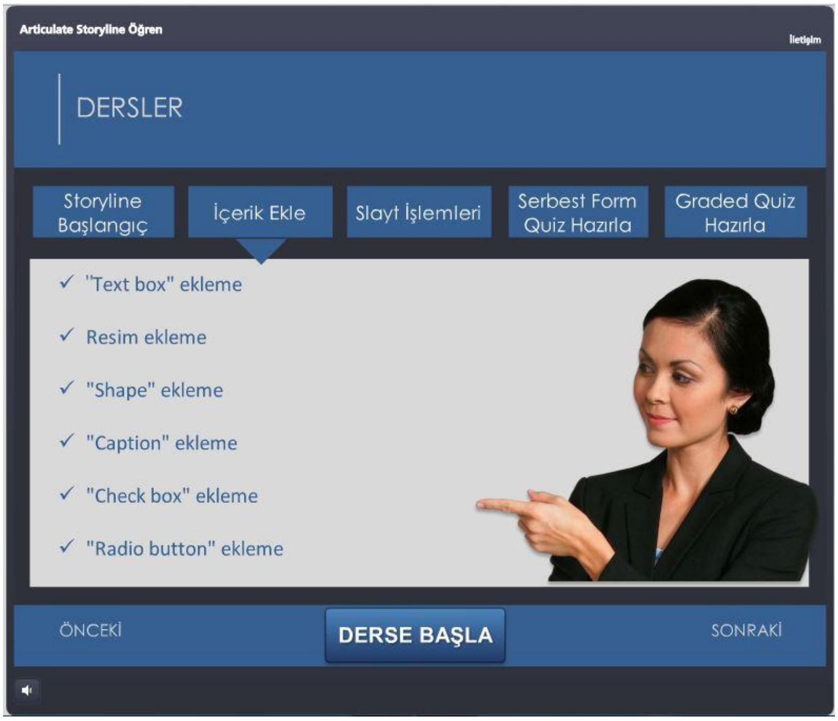

Figure 8 Module selection screen of LO development tutorial (for all versions)

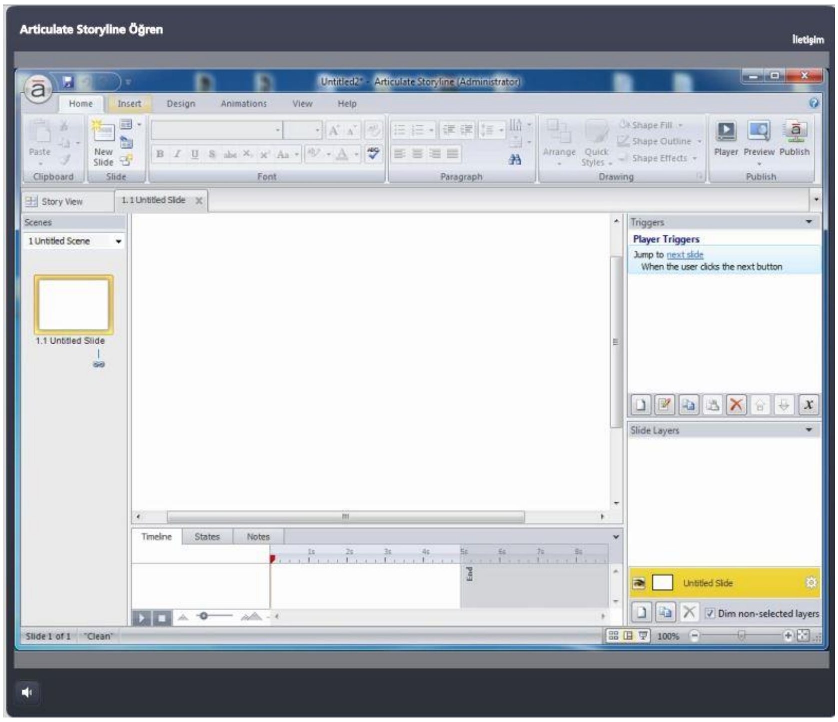

Figure 9 Screen of selected task (for all versions)

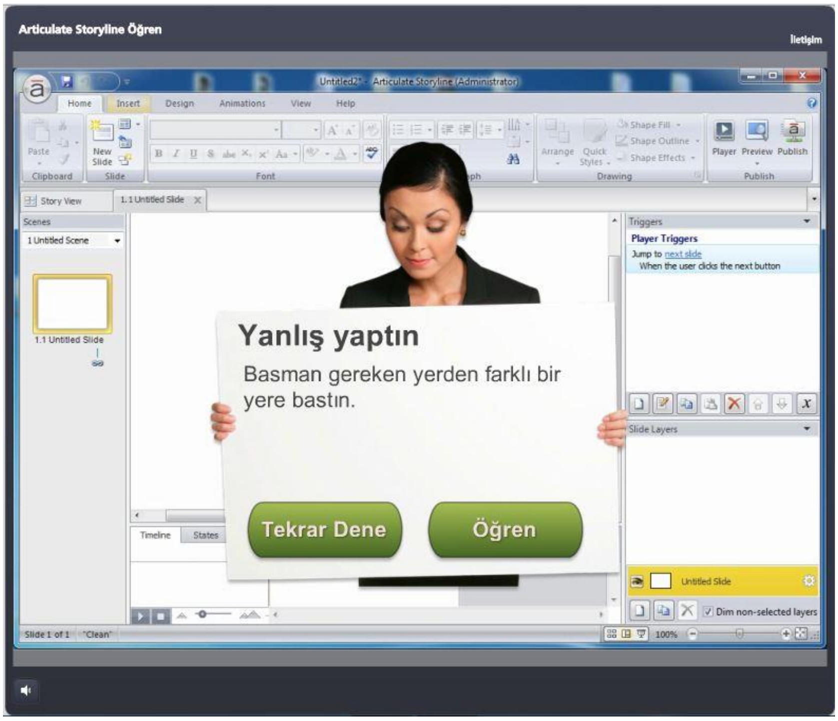

Figure 10 Feedback screen (for all versions)

If the users choose the "Öğren" (Learn) button, the following different feedback representations are shown on the screen. In the video version, the users watch a video which shows steps of the task (see Figure 11). For example, in order to insert a text box, the video shows a mouse cursor moving to insert button and clicking on it as a first step of the task. In the audio version of the tutorial, the users listen to the feedback for the steps of the task (see Figure 12). For example, in order to insert a text box, users hear the instruction "insert sekmesine basın" (click the insert button). The feedback is presented in written form (insert sekmesine basın) in the text version of the LO development tutorial (see Figure 13). The presented information is the text version of the same message presented as audio in the audio version.

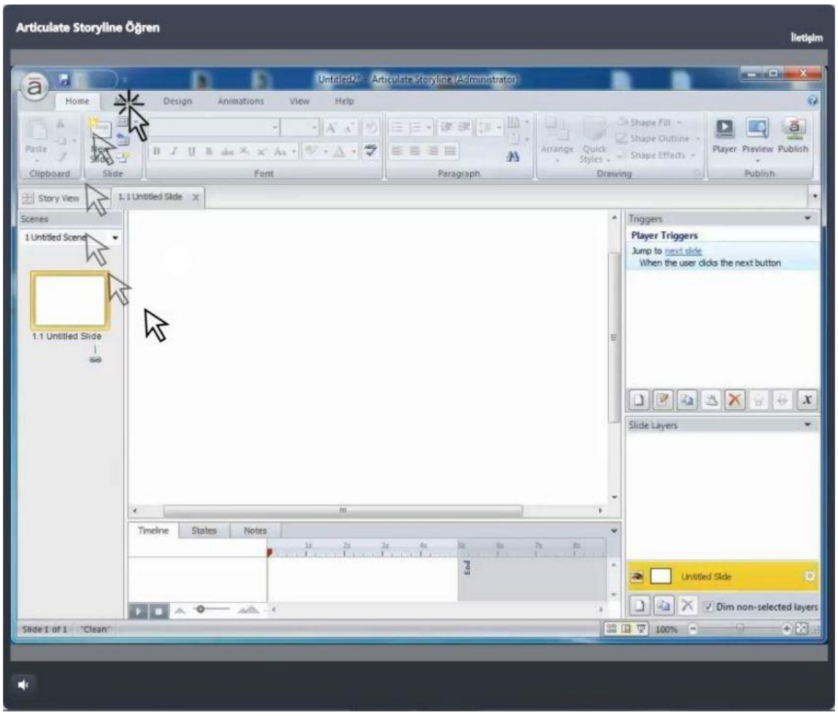

Figure 11 Feedback screen of selected task for V version

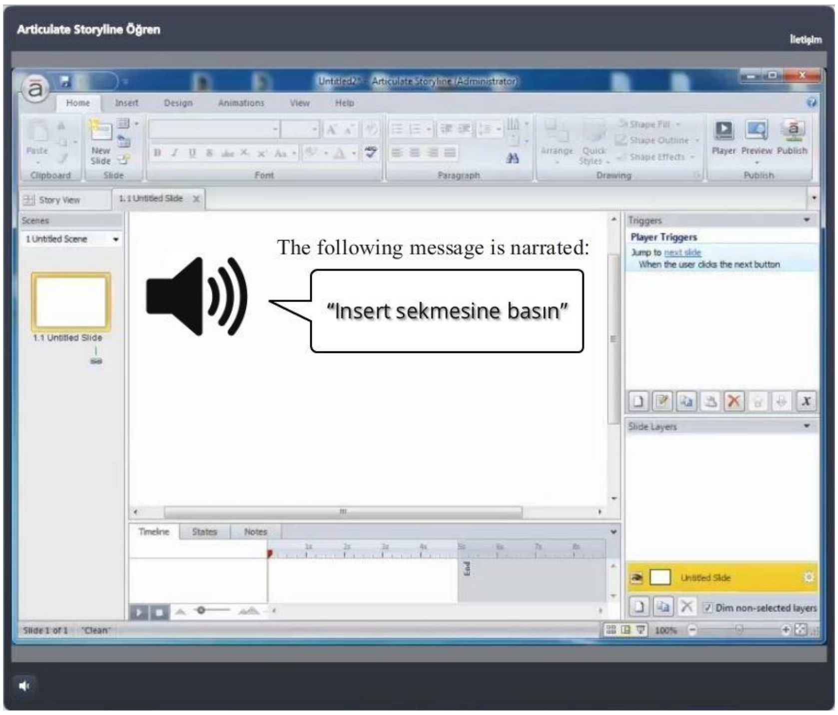

Figure 12 Feedback screen of selected task for A version

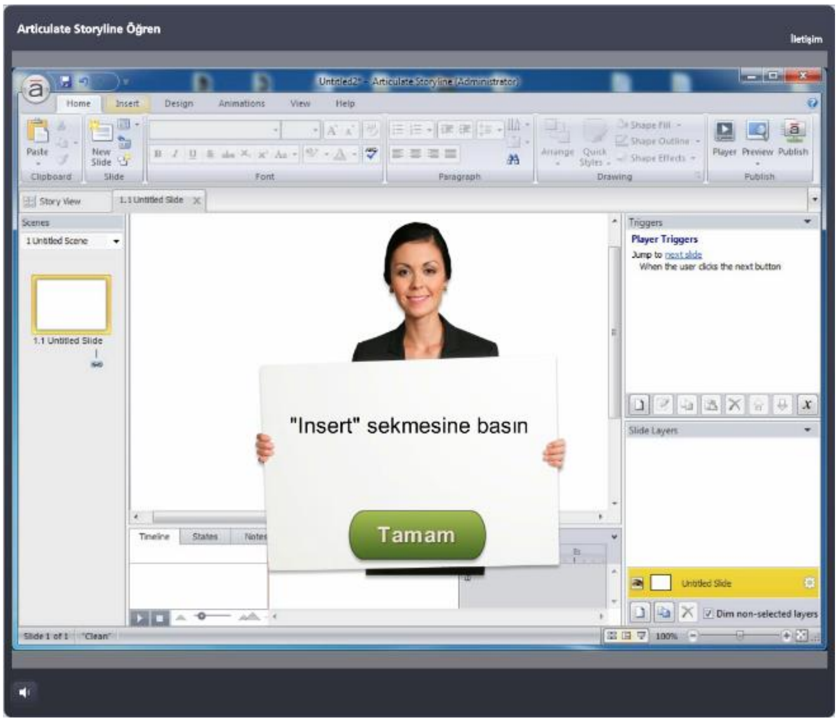

Figure 13 Feedback screen of selected task for T version

In video with text version, the same video as in the video version was presented. Additionally, the video included a caption with a written form of the feedback displayed simultaneously (see Figure 14). As for video with audio version, the same video was displayed simultaneously with an audio narrating the feedback corresponding to video (see Figure 15). Lastly, in the video with audio and text version, feedback is given to the user as a video with corresponding audio and text displayed simultaneously (see Figure 16).

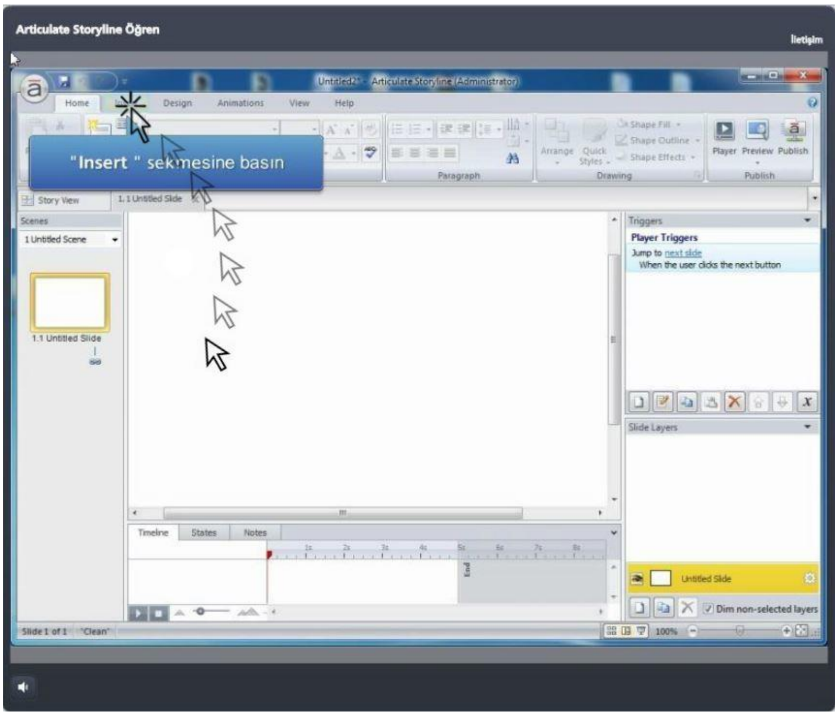

Figure 14 Feedback screen of selected task for VT version

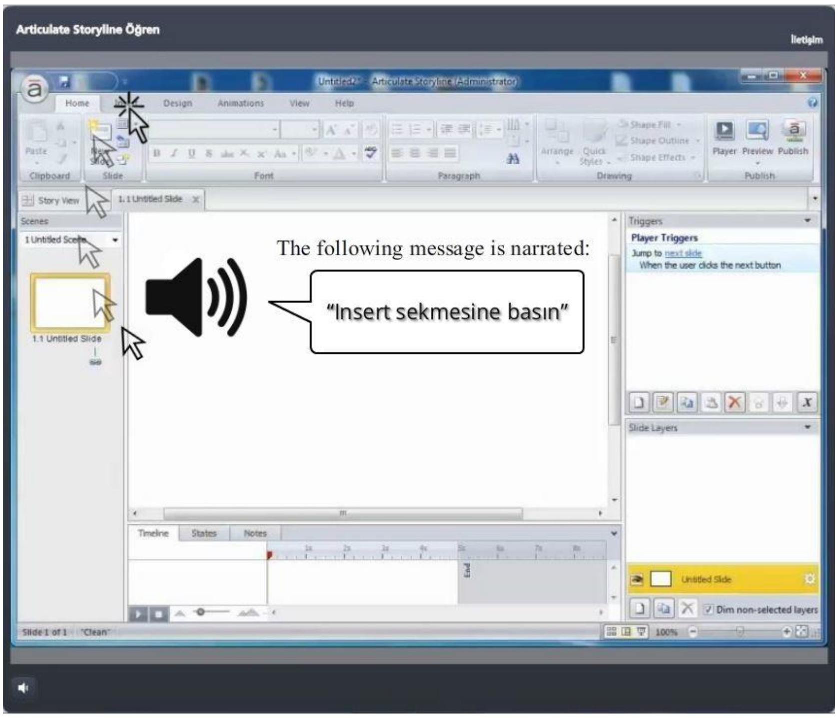

Figure 15 Feedback screen of selected task of VA version

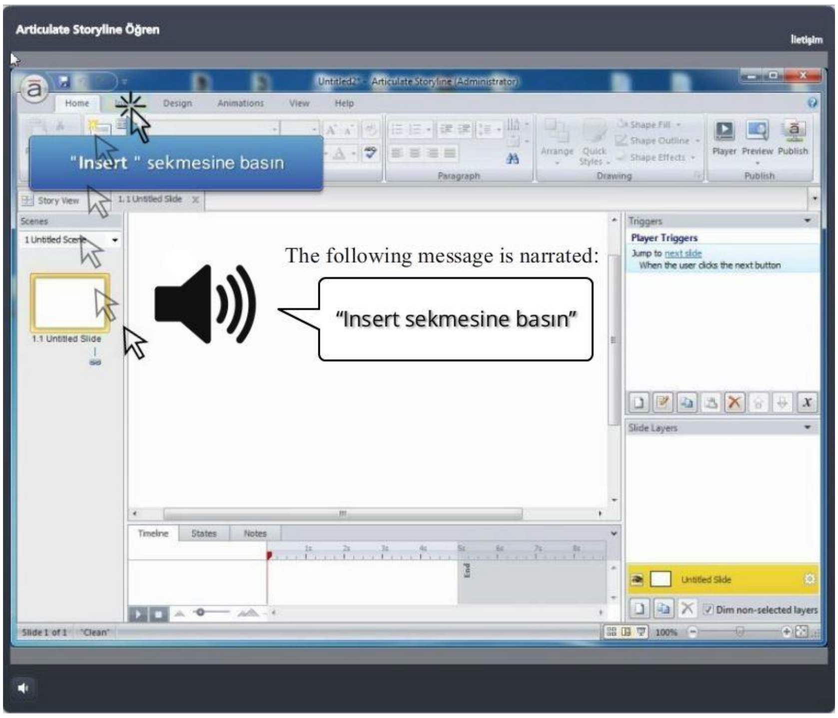

Figure 16 Feedback screen of selected task for VAT version

Figure 17 shows the screen that appears when the topic task is accomplished and Figure 18 shows the screen for the accomplishment of the module. When users accomplish the module, all traces and information related to them are saved in the database.

Figure 17 After accomplishing the module (for all versions)

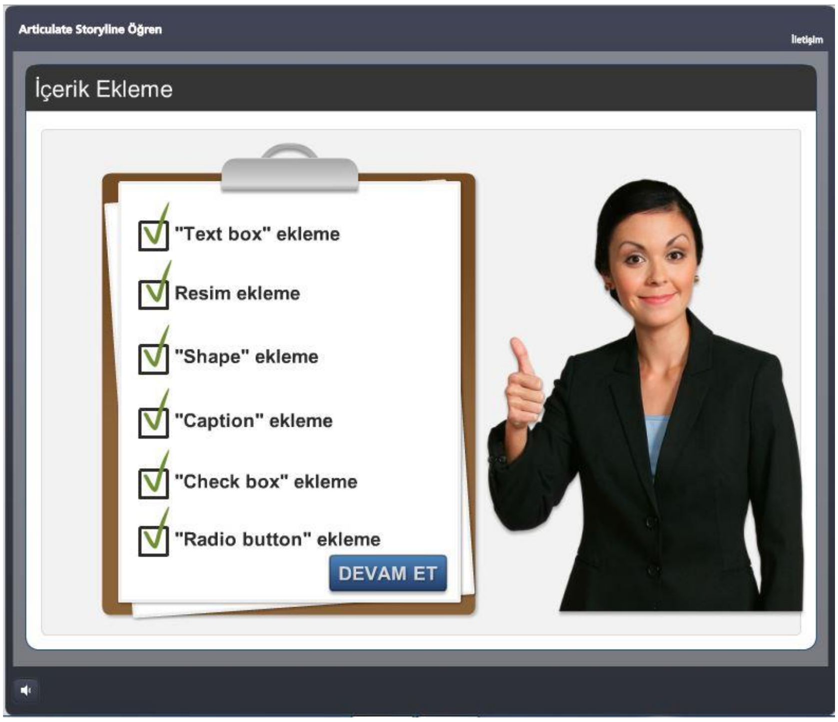

Figure 18 After accomplishing the module (for all versions)

3.4 Data collection procedures

The participants were informed about the experiment by the researcher before starting to conduct the study. Feedback preference and technology skill questionnaires were given to participants by using web-based forms. There are six links, one for each version of the tutorial. Each group used their own links, assigned randomly before starting the treatment. After collecting data with the questionnaire, the researcher introduced the tutorial and how to use it. The researcher informed the participants how the students would be graded in the course. The evaluation criteria are also stated in the syllabus. The researcher was able to ensure by tracking their activity that participants finished the tutorial modules weekly before the instruction of the course. For this purpose the topics of the tutorials were divided into modules. The researcher gave the same weekly lecture to all treatment groups. Participants learned and used the Articulate Storyline program during the semester. The treatment lasted seven weeks. Participants finished three or four modules for each week. After seven weeks, participants developed and submitted their learning objects as a final project of the course. These projects were evaluated by two experts, according to a rubric.

3.5 Data scoring

Two reviewers evaluated the participants' learning objects according to Learning Object Review Instrument (LORI). One of the reviewers is the researcher himself and the other is an educational technologist working as a research assistant in Computer Education and Educational Technology Department at Bogazici University. There were eight items and for each item, the quality of learning objects was evaluated on a rating scale consisting of five levels. The reviewer could select the “not applicable” option in any level, depending on the situation. In rating process, if the difference between scores for the same item rated by two reviewers was zero or one, final score of the item was estimated by averaging the two scores. If there were two points between the scores of the same item rated by two evaluators, the final score of the item was determined after the negotiation between the evaluators.

Feedback and adaptation item in the rubric refers to “adaptive content or feedback driven by differential learner input or learner modeling” (Nesbit, Belfer, & Leacock, 2007, p. 5). Learning object given five points should include elaborated feedback which is also adaptive to needs and characteristics of the learners. For example, one of the participants having high score got four points for the feedback and adaptation item because she used an elaborated feedback which was not adaptive, and review section for the quiz in her learning object. On the other hand, learning object with a score of one point is likely to use feedback indicating only correctness of the learner’s response. For example, the participants’ LOs received one point because she used feedback type which only informed users whether their response is correct or wrong

3.6 Data analysis

In this section, specific statistical procedures are listed below for each research question separately.

For the first question, (To what extent do different types of feedback presented by LO development tutorial influence overall LO quality of pre-service teachers’ LOs?), a one-way ANOVA test was conducted because the data was normally distributed and homogeneity of variance was observed. For the post-hoc test, Scheffe test was conducted because it is commonly described as the most conservative post-hoc analysis for one-way ANOVA (Akbulut, 2010).

For the second question, (To what extent do different types of feedback presented by LO development tutorial influence the feedback and adaptation quality of pre-service teachers' learning objects?), a Kruskal-Wallis H test was conducted because the data was not normally distributed, although homogeneity of variance was observed. For post-hoc test, Dunn's (1964) procedure was conducted for pairwise comparisons.

For the other four questions, a Chi-square test was conducted first. One assumption of the Chi-square test is that no more than 20% of a cell can have values lower than five (Büyüköztürk, 2013), and it was observed that the assumption of Chi-square test was not met for research questions three, four, five, and six. For this reason, some groups were combined as follows: Visual Group (V), Verbal Group (A, T), and Visual and Verbal Group (VA, VT, VAT). The assumption was not met again for this sort of grouping. Therefore, an exact method was applied to obtain more reliable results.

CHAPTER 4

RESULTS

The following sections present findings under each research question.

4.1 Research question 1

To what extent do different types of feedback presented by an LO development tutorial influence the overall LORI scores of pre-service teachers' LOs?

To examine the effects of different types of feedback on the quality of pre-service teachers' learning objects, a one-way ANOVA test was conducted. Prior to conducting the ANOVA test, the normality of the data sets was assessed using the Shapiro-Wilk's normality test for each cell of the design, and the homogeneity of variances was assessed by Levene's test. There were one outlier in the Video group and two outliers in Video, Audio, and Text group of the data set. The outlier in the video group was at the top whereas the outliers in Video, Audio, and Text group were both at the top and bottom. Because one of the assumptions of the one-way ANOVA analysis requires outliers to be excluded from the data, they were excluded for the analysis. Then, normally distributed data for all groups ($p > .05$) were obtained (see Appendix D, Table 28), and the homogeneity of variances in the data sets ($p > .05$) was observed (see Appendix D, Table 29). Table 7 shows descriptive statistics of each of the six treatment groups. The mean scores in the table reflect the quality of learning objects according to the LORI, which ranges from zero to 40.

The one-way ANOVA test (F (5, 191) = 10.303, $p < .001$) revealed that mean LORI scores for pre-service teachers' learning objects were statistically different for the feedback groups (see Table 8). Bonferroni correction was used for multiple comparisons and statistical significance was accepted at the $p < .0033$ level. The effect size calculated using omega squared was 0.19, indicating a large effect. Eta squared and partial eta squared also indicated large effect (partial $\eta^2 = .21$ and $\eta^2 = .27$). In other words, effect size estimates indicate that the quality of learning objects was largely effected by different types of feedback received during the LO development tutorials.

Table 7. Descriptive Statistics for LORI Score of Students Who Received Different Types of Feedback in the Tutorial

Groups	Mean	*St. Dev.*	n
Video (V)	24.50	2.60	28
Audio (A)	19.26	4.60	29
Text (T)	19.76	3.56	34
Video & Text (VT)	21.89	3.25	35
Video & Audio (VA)	18.70	4.69	20
Video + Audio & Text (VAT)	19.36	3.62	51
Total	20.53	4.13	197

Table 8. ANOVA Test for LORI Score of Students Who Received Different Types of Feedback in the Tutorial

Source	Type III Sum of Squares	*df*	Mean Square	*F*	*Sig.*
Between Groups	708.886	5	141.777	10.303	0.000
Within Groups	2628.21	191	13.76		
Total	3337.096	196			

In order to test which feedback groups' mean LORI scores were significantly different from each other, post hoc tests, Scheffe tests, were conducted. Scheffe's test is commonly described as the most conservative of all of the post-hoc analyses (Akbulut, 2010). It is used for unplanned comparisons, and it can be used when sample sizes are not equal. According to the tests (see Table 9), the V feedback group (M = 24.50, SD = 2.60) had significantly higher mean LORI scores than the A feedback group (M = 19.26, SD = 4.60), the T feedback group (M = 19.76, SD = 3.56), the VA feedback group (M = 18.70, SD = 4.69), and the VAT feedback group (M = 19.36, SD = 3.62). V feedback group (M = 24.50, SD = 2.60) had also higher mean LORI scores than the VT feedback group (M = 21.89, SD = 3.25) but not significantly.

Table 9. Multiple Comparisons of One-Way ANOVA for LORI Scores of Students Who Received Different Types of Feedback in the Tutorial

(I) Group	(J) Group	(I-J) Mean Difference	Std. Error	Sig.	95% Confidence Interval Difference	
					Lower Bound	Upper Bound
V	A	5.24*	.983	.000	1.94	8.55
	T	4.74*	.947	.000	1.55	7.92
	VT	2.61	.941	.178	-.548	5.78
	VA	5.80*	1.09	.000	2.15	9.45
	VAT	5.14*	.872	.000	2.20	8.07
A	T	-.506	.938	.998	-3.66	2.65
	VT	-2.63	.931	.164	-5.76	.505
	VA	.559	1.08	.998	-3.07	4.18
	VAT	-.104	.863	1.000	-3.01	2.80
T	VT	-2.12	.893	.347	-5.12	.883
	VA	1.06	1.05	.959	-2.45	4.58
	VAT	.402	.821	.999	-2.36	3.16
VT	VA	3.19	1.04	.100	-.311	6.68
	VAT	2.52	.814	.093	-.215	5.26
VA	VAT	-.663	.979	.993	-3.95	2.63

*. The mean difference is significant at the .003 level (Bonferroni Adjustment).

4.2 Research question 2

To what extent do different types of feedback presented by an LO development tutorial influence the feedback and adaptation quality of pre-service teachers' learning objects?

Prior to conducting a one-way ANOVA test, the normality of the data sets was assessed using Shapiro-Wilk's normality test for each cell of the design, and homogeneity of variances was assessed by Levene's test. Homogeneity of variances in the data sets ($p < .05$) was not observed, and the data was not normally distributed ($p < .05$). Therefore, a Kruskal-Wallis H test was conducted to examine the effects of different types of feedback on the feedback and adaptation (3rd) item scores in LORI scores of learning objects. Table 10 shows the mean rank and numbers for each of the six treatment groups.

Table 10. Ranks for Feedback & Adaptation Scores of Learning Objects Developed by Students Who Received Different Types of Feedback in the Tutorial

Groups	n	Mean Rank
V	28	147.98
A	32	122.86
T	34	92.46
VT	36	117.49
VA	20	70.15
VAT	52	70.23
Total	202	

Distributions of feedback and adaptation scores were not similar for all groups, as assessed by visual inspection of a boxplot (see Appendix D, Figure 19). A Kruskal-Wallis H test ($\chi 2$ (5) = 50.333, $p < .0001$) revealed that the mean ranks of feedback and adaptation scores for pre-service teachers' learning objects were statistically different for the feedback groups.

Further, pairwise comparisons were performed using Dunn's (1964) procedure with a Bonferroni correction for multiple comparisons. Adjusted p-values are presented (Table 11). This post hoc analysis revealed that the video feedback group (mean rank = 147.98) had significantly higher feedback and adaptation scores than the T group (mean rank = 92.46), the VA group (mean rank = 70.15), and the VAT (mean rank = 70.23) feedback groups. The result of the pairwise comparisons are ($p = .002$, $r = 0.49$), ($p < .001$, $r = 0.69$), and ($p < .001$, $r = 0.66$), respectively. Additionally, the audio feedback group (mean rank = 122.86) and VT feedback group (mean rank = 117.49) also scored significantly higher feedback and adaptation scores than the VA (mean rank = 70.15) and the VAT (mean rank = 70.23) feedback groups. The results of the pairwise comparisons are ($p = .014$, $r = 0.46$), ($p < .001$, $r = 0.46$) for the audio feedback group, and ($p = .036$, $r = 0.41$), ($p = .001$, $r = 0.42$) for the VT feedback group, respectively.

Table 11. Pairwise Comparison Using Dunn's (1964) Procedure with a Bonferroni Adjustment for F&A Scores of Students Who Received Different Types of Feedback in the Tutorial

Sample1-Sample2	Test Statistic	Std. Error	Std. Test Statistic	Sig.	Adj. Sig.*
V-A	25.123	14.479	1.735	.083	1.000
V-T	55.526	14.279	3.889	.000	.002
V-VT	30.496	14.099	2.163	.031	.458
V-VA	77.832	16.381	4.751	.000	.000
V-VAT	77.751	13.115	5.928	.000	.000
A-T	30.403	13.781	2.206	.027	.411
A-VT	5.373	13.594	.395	.693	1.000
A-VA	52.709	15.949	3.305	.001	.014
A-VAT	52.629	12.571	4.186	.000	.000
T-VT	-25.030	13.381	-1.871	.061	.921
T-VA	22.306	15.767	1.415	.157	1.000
T-VAT	22.225	12.340	1.801	.072	1.000
VT-VA	47.336	15.604	3.034	.002	.036
VT-VAT	47.255	12.131	3.895	.000	.001
VA-VAT	-.081	14.722	-.005	.996	1.000

*Adjusted p-values with Bonferroni correction

4.3 Research question 3

4.3.1 Research question 3a (for 6 groups)

Is there a meaningful interaction between the types of feedback presented in the LO development tutorial and the type of feedback used by pre-service teachers authoring LOs?

To examine the relationship between different types of feedback received during LO development tutorials (TF) and the type of feedback used in authoring (UF), a chi-square test of independence was performed. The interaction between these variables was not significant (X^2 (25, N = 193) = 11,684, p = .929). Table 12 shows a typical cross-tabulation table comparing the two hypothetical variables TF and UF. The detailed information of the cross tabulation is given in Appendix D, Table 30.

One assumption of the Chi-square test is that no more than 20% of a cell can have values lower than five (Büyüköztürk, 2013), but notice that 30 cells (83.3%) have an expected count of less than five in the data (see Table 12). That is to say, the supposition required for the standard asymptotic calculation of the significance level for this test was not confirmed. Thus, the exact method was applied due to the fact that when the suppositions of the asymptotic method cannot be confirmed, the results may be inaccurate (Mehta & Patel, 1989). The analysis for TF and UF revealed that the exact p value based on Pearson's statistics was .929, compared to .703 for the asymptotic value. In spite of the exact p value, the null hypothesis was not discredited at the .05 significance level, and it can be inferred that there is no evidence for possible interaction between different types of feedback received in LO development tutorial and the type of feedback used in authoring LO; the statistics are shown in Table 13.

Table 12. TF * UF Cross-tabulation

TF	UF					
	V	A	T	VT	VA	VAT
V	0	0	28	0	0	0
A	0	0	31	1	0	0
T	0	0	34	0	0	0
VT	0	0	36	0	0	0
VA	0	0	18	0	0	0
VAT	0	1	43	0	0	1

Table 13. Exact Results of Pearson Chi-Square Test for Interaction between TF and UF

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	11.684	25	.703	.929		
Likelihood Ratio	9.493	25	.850	.929		
Fisher's Exact Test	14.856			.929		
Linear-by-Linear Association	0.298	1	.585	.667	.351	.052
N of Valid Cases	193					

30 cells (83.3%) have an expected count of less than five. The minimum expected count is .09.

4.3.2 Research question 3b (for 3 groups)

Is there a meaningful interaction between types of feedback studied in the LO development tutorial and the type of feedback used by pre-service teachers authoring LOs?

To examine the relationship between different types of feedback received during LO development tutorials (TF) and the type of feedback used in authoring

(UF), a chi-square test of independence was performed. The interaction between these variables was not significant (X^2 (4, N = 193) = 0,441, p = 1.00). Table 14 shows a typical cross-tabulation table comparing the two hypothetical variables TF and UF. The detailed information of the cross tabulation is given in Appendix D, Table 31.

Table 14. TF * UF Cross-tabulation

TF	UF		
	Visual	Verbal	Visual & Verbal
Visual	0	28	0
Verbal	0	65	1
Visual & Verbal	0	98	1

The assumption of the Chi-square test was not met. Thus, the exact method was applied instead of the asymptotic method. The analysis for TF and UF revealed that the exact p value based on Pearson's statistics was 1.00, compared to .802 for the asymptotic value. In spite of the exact p value, the null hypothesis was not discredited at the .05 significance level, and it can be inferred that there is no evidence for possible interaction between different types of feedback received in the LO development tutorial and the type of feedback used in authoring the LO; the statistics are shown in Table 15.

Table 15. Exact Results of Pearson Chi-Square Test for Interaction between TF and UF

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	0.441	4	.802	1.000		
Likelihood Ratio	0.713	4	.700	1.000		
Fisher's Exact Test	0.714			1.000		
Linear-by-Linear Association	0.067	1	.796	1.000	.614	.353
N of Valid Cases	193					

6 cells (66.7%) have an expected count of less than five. The minimum expected count is .29.

4.4 Research question 4

4.4.1 Research question 4a (for 6 groups)

Is there a meaningful interaction between pre-service teachers' intended use of feedback type and their usage of feedback type in authoring LOs?

To examine the relationship between students' intended use of feedback type (IF) and feedback they used in authoring LO (UF), a chi-square test of independence was performed. The interaction between these variables was not significant (X^2 (25, *N* = 185) = 20,114, *p* = .201). Table 16 shows a typical cross-tabulation table comparing the two hypothetical variables IF and UF. Detailed information of the cross tabulation is given in Appendix D, Table 32.

Table 16. IF * UF Cross-tabulation

IF	UF					
	V	A	T	VT	VA	VAT
V	0	0	28	0	0	0
A	0	0	31	1	0	0
T	0	0	34	0	0	0
VT	0	0	36	0	0	0
VA	0	0	18	0	0	0
VAT	0	1	43	0	0	1

The assumption of the Chi-square test was not met. Thus, the exact method was applied instead of the asymptotic method. The analysis for IF & UF revealed that the exact p value based on Pearson's statistic is .201, compared to .168 for the asymptotic value. Accordingly, the null hypothesis was not discredited at the .05 significance level, and it can be inferred that there is no evidence to show the interaction between students' intended use of feedback type and feedback type they used in authoring LOs; the statistics are shown in Table 17.

Table 17. Exact Results of Pearson Chi-Square Test

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	20.114	25	.168	.201		
Likelihood Ratio	9.194	25	.867	.350		
Fisher's Exact Test	23.474			.350		
Linear-by-Linear Association	3.109	1	.078	.071	.013	.011
N of Valid Cases	185					

31 cells (86.1%) have an expected count of less than five. The minimum expected count is .01.

4.4.2 Research question 4b (for 3 groups)

Is there a meaningful interaction between pre-service teachers' intended use of feedback type and their usage of feedback type in authoring LOs?

To examine the relationship between students' intended use of feedback type (IF) and the feedback they used in authoring LO (UF), a chi-square test of independence was performed. The interaction between these variables was not significant (X^2 (4, N = 185) = 0,489, p = 1.000). Table 18 shows a typical cross-tabulation table comparing the two hypothetical variables IF and UF. Detailed information of the cross tabulation is given in Appendix D, Table 33.

Table 18. IF * UF Cross-tabulation

IF	UF		
	Visual	Verbal	Visual & Verbal
Visual	0	2	0
Verbal	0	34	0
Visual & Verbal	0	147	2

The assumption of the Chi-square test was not met. Thus, the exact method was applied instead of the asymptotic method. The analysis for IF & UF revealed that the exact p value based on Pearson's statistic is 1.000, compared to .783 for the asymptotic value. Accordingly, the null hypothesis was not discredited at the .05 significance level, and it can be inferred that there is no evidence to show the interaction between students' intended use of feedback type and the feedback type they used in authoring LOs; the statistics are shown in Table 19.

Table 19. Exact Results of Pearson Chi-Square Test

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	0.489	4	.783	1.000		
Likelihood Ratio	0.871	4	.647	1.000		
Fisher's Exact Test	2.266			1.000		
Linear-by-Linear Association	0.459	1	.498	1.000	.648	.648
N of Valid Cases	185					

7 cells (77.7%) have an expected count of less than five. The minimum expected count is .02.

4.5 Research question 5

4.5.1 Research question 5a (for 6 groups)

Is there a meaningful interaction between pre-service teachers' intended use of feedback type and their recommended type of feedback?

To examine the relationship between intend to use feedback type (IF) and the type of feedback recommended by participants (RF), a chi-square test of independence was performed. Table 20 shows a typical cross-tabulation table comparing the two hypothetical variables IF and RF. Detailed information of the cross tabulation is presented in Appendix D, Table 34.

Table 20. RF * IF Cross-tabulation

RF	IF					
	V	A	T	VT	VA	VAT
V	0	0	0	2	4	4
A	0	3	2	4	1	7
T	1	0	13	6	2	14
VT	0	1	5	20	3	5
VA	0	0	0	3	5	4
VAT	1	6	5	14	4	51

Although the interaction between these variables was significant (X^2 (25, N = 190) = 87,007, $p < .001$) (see Table 21), the result may not be reliable because one assumption of the Chi-square test is no more than 20% of a cell can have values lower than five, and was not met. For this reason, the analysis for research question 5b was applied.

Table 21. Results of Pearson Chi-Square Test

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	87.007[a]	25	.000
Likelihood Ratio	77.356	25	.000
Linear-by-Linear Association	4.991	1	.025
N of Valid Cases	190		

26 cells (72.2%) have an expected count of less than five. The minimum expected count is .11.

4.5.2 Research question 5b (for 3 groups)

Is there a meaningful interaction between pre-service teachers' intended use of feedback type and their recommended type of feedback?

To examine the relationship between intend to use feedback type (IF) and the type of feedback recommended by participants (RF), a chi-square test of independence was performed. The interaction between these variables was significant (X^2 (4, N = 190) = 13,759, p = .012). Table 22 shows a typical cross-tabulation table comparing the two hypothetical variables IF and RF. Detailed information of the cross tabulation is presented in Appendix D, Table 35.

Table 22. RF * IF Cross-tabulation

RF	IF		
	Visual	Verbal	Visual & Verbal
Visual	0	0	10
Verbal	1	18	34
Visual & Verbal	1	17	109

The assumption of the Chi-square test was not met. Thus, the exact method was applied instead of the asymptotic method. The analysis for RF & IF revealed that the exact p value based on Pearson's statistic is .012, compared to .008 for the asymptotic value. Accordingly, the null hypothesis was discredited at the .05 significance level, and it can be inferred that there is an evidence to show interaction between students' intended use of feedback type and recommended type of feedback; the statistics are shown in Table 23.

Table 23. Exact Results of Pearson Chi-Square Test

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	13.759	4	.008	.012		
Likelihood Ratio	14.523	4	.006	.004		
Fisher's Exact Test	13.384			.005		
Linear-by-Linear Association	2.092	1	.148	.151	.100	.039
N of Valid Cases	190					

4 cells (44.4%) have an expected count of less than five. The minimum expected count is .11.

4.6 Research question 6

4.6.1 Research question 6a (for 6 groups)

Is there a meaningful relationship between type of feedback used by pre-service teachers authoring LOs and their recommended type of feedback?

To examine the interaction between the feedback type students used in authoring LOs (UF) and recommended type of feedback (RF), a chi-square test of independence was performed. The interaction between these variables was not significant (X^2 (4, N = 185) = 2,089, p = 1.000). Table 24 shows a typical cross-tabulation table comparing the two hypothetical variables UF and RF. Further detailed information of the cross tabulation is presented in Appendix D; Table 36.

Table 24. RF * IF Cross-tabulation

RF	IF					
	V	A	T	VT	VA	VAT
V	0	0	9	0	0	0
A	0	0	17	0	0	0
T	0	0	35	0	0	0
VT	0	0	32	1	0	0
VA	0	0	12	0	0	0
VAT	0	1	77	0	0	1

One assumption of Chi-square test is that no more than 20% of cell can have values lower than five, but notice that six cells (66.7%) have an expected count of less than five in the data (Table 24). That is to say, the supposition required for the standard asymptotic calculation of the significance level for this test was not conformed. Thus, the exact method was applied due to the fact that when the suppositions of the asymptotic method cannot be conformed, the results may be inaccurate (Mehta & Patel, 1989). The exact p value based on Pearson's statistic is 1.000, compared to .719 for the asymptotic value. In spite of the exact p value, the null hypothesis was not discredited at the .05 significance level, and it can be inferred that there is no evidence to show the interaction between feedback type students used in authoring LOs and recommended type of feedback; the statistics are shown in Table 25.

Table 25. Exact Results of Pearson Chi-Square Test

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	7.322	25	.948	.820		
Likelihood Ratio	6.884	25	.961	.820		
Fisher's Exact Test	16.514			.820		
Linear-by-Linear Association	0.273	1	.601	.720	.394	.063
N of Valid Cases	185					

30 cells (83.3%) have an expected count of less than five. The minimum expected count is .05.

4.6.2 Research question 6b (for 3 groups)

Is there a meaningful relationship between the type of feedback used by pre-service teachers authoring LOs and their recommended type of feedback?

To examine the interaction between the feedback type students used in authoring LOs (UF) and the recommended type of feedback (RF), a chi-square test of independence was performed. The interaction between these variables was not significant (X^2 (4, N = 185) = 0.995, p = 0.621). Table 26 shows a typical cross-tabulation table comparing the two hypothetical variables UF and RF. Further detailed information of the cross tabulation is presented in Appendix D, Table 37.

Table 26. RF * UF Cross-tabulation

RF	UF		
	Visual	Verbal	Visual & Verbal
Visual	0	9	0
Verbal	0	52	0
Visual & Verbal	0	122	2

The assumption of the Chi-square test was not met. Thus, the exact method was applied instead of the asymptotic method. The exact p value based on Pearson's statistic is .621, compared to .608 for the asymptotic value. In spite of the exact p value, the null hypothesis was not discredited at the .05 significance level, and it can be inferred that there is no evidence to show the interaction between the feedback type students used in authoring LOs and the recommended type of feedback; the statistics are shown in Table 27.

Table 27. Exact Results of Pearson Chi-Square Test

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)	Point Probability
Pearson Chi-Square	0.995	4	.608	.621		
Likelihood Ratio	1.611	4	.447	.621		
Fisher's Exact Test	1.258			1.000		
Linear-by-Linear Association	0.866	1	.352	.621	.448	.448
N of Valid Cases	185					

6 cells (66.7%) have an expected count of less than five. The minimum expected count is .10.

CHAPTER 5

DISCUSSION

This section focuses on discussions of (a) the role of different presentation types of feedback (b) pre-service teachers' feedback preferences, (c) limitations of the study, and (d) recommendations for future research.

5.1 The role of different presentation types of feedback

One of two main questions of the study was to what extent different types of feedback presented by the LO development tutorial influence the quality of learning objects developed by pre-service teachers. This question was examined in terms of two different aspects: feedback quality scores and the overall scores of LO developed by the pre-service teachers. The findings revealed that the feedback presented in video was the most effective feedback representation type, based on both overall scores and feedback quality scores of learning objects developed by the pre-services teachers. Specifically, the video feedback group had significantly higher overall mean LORI scores than the others, except for the VT feedback group. In line with the overall LORI scores, the video feedback group also had significantly higher feedback and adaptation scores than the T, VA, and VAT feedback groups. Additionally, the A and VT groups had significantly higher feedback and adaptation scores than the VA and VAT feedback groups.

For example, the studies in the literature have similarities to and differences from this research. Lalley (1998) found that a video feedback group scored higher than a textual feedback group on learning scores. The current study confirmed Lalley's study and extended it at the application level. There is also some research that compares spoken and written feedback in different ways (Bationo, 1992; Fiorella, Vogel-Walcutt, & Schatz, 2012). Bationo's study (1992) showed that a combination of written and spoken feedback group is superior to written feedback on intellectual skill learning, but there was no significant difference between written and spoken feedback groups. On the contrary, Fiorella et al. (2012) found that a spoken feedback group had higher scores than a written feedback group on decision-making in training and the assessment process. The current study confirmed Bationo's study (1992) but failed to confirm the study conducted by Fiorella et al. (2012). This contradiction may be caused by using real-time feedback that does not interrupt the contextual timeline instead of near-real time feedback presented after the completion of a task. Moreover, Fiorella et al. (2012) concluded that real-time feedback intervention is more effective in the acquisition and application of higher-order cognitive skills as opposed to lower-level skills.

In the current study, the feedback process consisted of two stages. First, a response is given to students indicating their answer as correct or incorrect. Then, instructional content was presented to the learner in different representations. For this reason, it is important to discuss the findings from the perspective of three principles of multimedia design: multimedia, modality, and redundancy.

The Dual Coding Theory of Paivio (1990) asserted that humans have two distinct information process systems—verbal and visual—and these construct referential connections between the two. It is also claimed that people should learn more deeply when presenting information using both words and pictures versus words alone because they are connected mentally, according to multimedia principle (Mayer, 2001). Therefore, it was expected that the VA feedback group would learn the LO development tool better than the other groups, considering multimedia learning principles. Theoretically, if the VA feedback group learned LO developmental tool the best, this would also reflect the quality of pre-service teachers' learning objects. That means that the VA feedback group should have higher overall LORI scores than others. However, the results showed that the VA feedback group had the lowest overall and feedback quality scores. These findings of the current study are inconsistent with prior research in the field of multimedia learning for the reasons described below.

Firstly, most previous research was conducted with basic and short learning material (e.g. Butcher, 2006; Harskamp et al., 2007; Mayer & Anderson, 1991; Mayer & Moreno, 1998) and was measured with paper and pencil based retention, recall, and transfer tests immediately after delivering the learning material (e.g. Mayer et al., 2001; Mayer & Johnson, 2008; Moreno & Valdez, 2005). On the other hand, in the current study, how well pre-service teachers learned the LO development tutorial was not measured directly; it only assessed their learning object quality. Therefore, it is difficult to conclude that one group learns better from different representation of feedback than another by comparing just the quality scores of the learning objects. Secondly, there was a time interval between the usage of the LO development tool and submission of LOs developed by pre-servicers. In this process, other material can also be used by pre-service teachers.

To sum up, this study makes a significant contribution to the literature: most prior studies compared two or three feedback representation types. In the current study, however, the effect of feedback representation types on the quality of learning objects and feedback was examined by using six representation types. It is thought that in the light of the results of the study, courseware designers have the opportunity to use the most effective feedback representation type in developing learning objects.

Nevertheless, the current study failed to extend past studies about multimedia learning principles with complex subject matter and skill-based performance scores.

5.2 Feedback preferences

The second main question of this research was to what extent different types of feedback presented in LO development tutorials influence the feedback type preferences of pre-service teachers for developing learning objects. Pre-service teachers' feedback preferences were examined in terms of three different aspects: actual, intended, and recommended use of feedback types in authoring LOs. The findings revealed that the feedback type used by pre-service teachers in authoring LOs did not interact with either their intended or recommended type of feedback, whereas a meaningful interaction was observed between their intended and recommended feedback types. Additionally, there was no meaningful interaction between feedback types presented by LO development tutorials and pre-service teachers' actual use of feedback in authoring LOs.

Lalley (1998) examined the students' feedback preferences in a computer assisted environment in terms of two feedback types: text and video feedback. The results showed that students preferred video feedback to text feedback, indicating that video was more interesting. However, in the current study, video feedback was the least preferred feedback type in feedback questionnaires in terms of pre-servicers' intentions and recommendations of feedback usage.

A different study conducted by Ice et al. (2010) focused on feedback preferences among three feedback types provided by the instructor: textual, audial and a combination of the two. In the study, instructors provided feedback using the Adobe Acrobat Pro tool by inserting textual or/and audial comments. Findings indicated that the combined version was preferred the most by students, and textual feedback was preferred to audial feedback. In a similar study in an online course, Cavanaugh and Song (2014) found different results under different conditions: Instructors preferred to provide audio feedback when giving feedback on the overall structure or the topic of the paper, whereas textual feedback was preferred in micro-level issues such as grammar and spelling. Additionally, in general students preferred audio feedback. In the current study, although students did not prefer text feedback the most, it (13%) was rated higher than audio feedback (%5). In other words, the current findings are similar to those of Ice et al.

Schär and Kaiser (2006) provided seven different combinations of feedback to students with a learning material and surveyed their preferences. The results showed that textual feedback was the most preferred, whereas video was the least preferred. However, in the current study, video, audio and text combination feedback (45%) type were the most highly rated, and that was followed by video, with text feedback (%26) in intended feedback preferences, whereas video was again preferred the least. Moreover, the results revealed that there was an interaction between students' recommendations and intentions of feedback types; percentages of recommended feedback types are as follows: VAT (41%), T (18%), VT (17%), VA (10%), A (9%) and V (5%).

According to responses to the questionnaires conducted before the study, the majority of students intended to use the VAT version of feedback, and 98% of all students used textual feedback when authoring their own learning objects. The results also revealed that pre-service teachers' use of feedback types in authoring an LO did not interact with either their feedback intentions or feedback recommendations, showing that pre-service teachers' intentions did not transfer to actual behaviors. However, Sadaf et al. (2016) found that there was an interaction between pre-service teachers' intentions and actual behaviors with regard to the integration of Web 2.0 tools in their future lessons. They also argued that perceived usefulness, self-efficacy, and students/learning expectations had an important role in transferring intentions into actions. In addition to the factors listed above, in the current study, students may prefer a ready-to-use feedback template to finish their final projects in their courses. According to responses to one survey item ("I can use the feedback templates served by Articulate Storyline program"), video feedback was the least preferred feedback type because it is hardest to implement, although the video feedback group scored significantly higher than other groups on overall LORI scores, and 76% of all students intended to use the feedback template. Additionally, 84% of students did not use the feedback type they intended to use before the study. This percentage rises to 99% when excluding textual group data because a ready-to-use feedback template is textual. It may stem from the fact that the feedback template provided by Articulate Storyline program was textual. The participants are students, and they had to finish their design of learning materials by a deadline. Therefore, this may have led to an increase in a tendency to prefer a ready-to-use feedback template. As a result, pre-service teachers' usages were not affected by feedback types provided by the learning object development tool.

5.3 Limitations of the study

The generalizability of the findings of this study is limited because of its use of a convenient sample of pre-service teachers from a state university. It was, though, conducted in a real school setting. In addition, the sample size of the research was not adequate for each feedback group because some students dropped out or did not submit the final project of the course. Another limitation was the time interval. The treatments lasted seven weeks, a period in which participants were able to use or benefit from other material: the study was not able to keep the sample away from intervening variables. It was not possible to control this condition because of conducting the study in a real school setting.

5.4 Recommendations and suggestions for further research

The current study should be replicated by using true experimental design in order to increase generalizability, and findings can be extended by investigating treatments on professional teachers and pre-service teachers from universities located in different regions. Additionally, further research may examine the effect of different types of feedback on overall learning object quality scores of individuals with different levels of technology skill. To understand the full impact of three multimedia learning principles— multimedia, modality and redundancy on learning—future investigations need to study with learning material which is complex and covers a whole unit. Moreover, the learning scores of the LO developmental tool can be measured for exploring both the effects of multimedia learning principles more accurately, and the relationship with quality scores of learning objects designed by pre-service teachers. To control external conditions, the process of treatment may be shortened by using a lab setting and can be conducted with different LO developmental tools without a ready-to-use feedback template in order to obtain more accurate results.

APPENDIX A

QUESTIONNAIRE ON FEEDBACK PREFERENCES

*Required

Name *

Surname *

1) What type of feedback representations do you prefer to use when developing learning material? *

Choose one of them

- ( ) Text feedback
- ( ) Audio feedback
- ( ) Video feedback
- ( ) Video + Text feedback
- ( ) Video + Audio feedback
- (•) Video + Audio + Text feedback

2.1) Is a single type of feedback representation enough for designing learning material the needs higher order thinking skills? *

- ( ) Yes
- (•) No

2.2) If "No", please explain why

3) What type of feedback representations are more appropriate for the following departments? *

Please select one for each department.

	Text	Audio	Video	Video + Text	Video + Audio	Video + Audio + Text
CET	○	○	○	○	○	○
PRED	○	○	○	○	○	○
FLED	○	○	○	○	○	○
MATH	○	○	○	○	○	○
GUID	○	○	○	○	○	○
PHIL	○	○	○	○	○	○
PHYS	○	○	○	○	○	○
CHEM	○	○	○	○	○	○
SCED	○	○	○	○	○	○

4) I can use the feedback templates served by Articulate Storyline program. *

Please select one.

- ○ Strongly disagree
- ○ Disagree
- ◉ Neutral
- ○ Agree
- ○ Strongly agree

5) Which of the following types of feedback should be given higher priority? *

Please select one.

- (•) Knowledge-of-response (Just saying correct or incorrect)
- ( ) Knowledge-of-correct-response (giving correct response)
- ( ) Elaborated feedback

6) Is technology such as Articulate and Office efficient for the inclusion of feedback types in creating learning materials? *

If "Yes", how much?

- ( ) Not at all
- ( ) To a small extent
- ( ) To some extent
- ( ) To a moderate extent
- ( ) To a large extent

APPENDIX B

QUESTIONNAIRE ON TECHNOLOGY SKILL

Required
1) Name *

2) Surname *

3) Gender *

- Male
- Female

4) Department *

5) Age *

6) Grade *

7) Have you ever developed a web site? *

- Yes
- No

8.1) Do you have a personal web page? *

- Yes
- No

8.2) If "Yes", please write down address of your web page

9) Please write down web site development tools that you use.

10) Which of the following applications do you use?

- [x] Facebook
- [ ] Twitter
- [ ] Instagram
- [ ] LinkedIn
- [ ] Foursquare

11.1) Do you have a personal blog? *

- ○ Yes
- ○ No

11.2) If "Yes", please write its address below.

[ ]

12) How often do you use the following programs? *

	Everyday	Once a week	Once a month	Rarely	Never
MS PowerPoint	○	○	○	○	○
MS Word	○	○	○	○	○
MS Excel	○	○	○	○	○
MS Access	○	○	○	○	○
Google Docs	○	○	○	○	○
Apple Keynote	○	○	○	○	○
Apple Pages	○	○	○	○	○
Apple Numbers	○	○	○	○	○

13) Can you add a new slide to a presentation using tools like MS PowerPoint? *

- ○ Yes
- ○ No

14) Can you add pictures, sounds, and links into a web site using tool like Adobe Dreamweaver, MS Word, etc. *

- ○ Yes
- ○ No

15) Have you ever created an audio file by using any program? *

- ○ Yes
- ○ No

16) Please write down program(s) that you use(s) to edit images.

17.1) Do you know any program(s) that you use to take and to save screenshot? *

- ○ Yes
- ○ No

17.2) If "Yes", please write down their names.

18.1) Do you know any program(s) that you use to edit videos? *

- ○ Yes
- ○ No

18.2) If "Yes", please write down their names.

19.1) Do you know any program(s) that you use to record interaction between a user and a software? *

- ○ Yes
- ○ No

19.2) If "Yes", please write down their names.

20.1) Have you ever created a survey on the Web? *

- ○ Yes
- ● No

20.2) If "Yes", please write down names of the programs.

21.1) Have you ever developed an animation? *

- ● Yes
- ○ No
- ○

21.2) If "Yes", please write down names of the programs.

22.1) Have you ever developed an interactive application? *

- Yes
- No

22.2) If "Yes", please write down names of the programs.

APPENDIX C

SCORING SHEET FOR THE LEARNING OBJECT REVIEW

Learning Object ______________________________ Reviewer ____________________

General Remarks

Criterion (Low → High)	★	★★	★★★	★★★★	★★★★★	
1. Content Quality: Veracity, accuracy, balanced presentation of ideas, and appropriate level of detail	1	2	3	4	5	NA
2. Learning Goal Alignment: Alignment among learning goals, activities, assessments, and learner characteristics	1	2	3	4	5	NA
3. Feedback and Adaptation: Adaptive content or feedback driven by differential learner input or learner modeling	1	2	3	4	5	NA
4. Motivation: Ability to motivate and interest an identified population of learners	1	2	3	4	5	NA
5. Presentation Design: Design of visual and auditory information for enhanced learning and efficient mental processing	1	2	3	4	5	NA
6. Interaction Usability: Ease of navigation, predictability of the user interface, and quality of the interface help features	1	2	3	4	5	NA
7. Accessibility: Design of controls and presentation formats to accommodate disabled and mobile learners	1	2	3	4	5	NA
8. Reusability: Ability to use in varying learning contexts and with learners from differing backgrounds	1	2	3	4	5	NA
9. Standards Compliance: Adherence to international standards and specifications	1	2	3	4	5	NA

APPENDIX D

DETAILED ANALYSIS TABLES

Table 28. Normality Tests for the LORI Scores of Students Who Received Different Types of Feedback in the Tutorial

Groups	Kolmogorov-Smirnov			Shapiro-Wilk		
	Statistic	*df*	*Sig.*	Statistic	*df*	*Sig.*
V	.114	28	.200*	.972	28	.627
A	.100	29	.200*	.971	29	.595
T	.086	34	.200*	.981	34	.799
VT	.120	35	.200*	.978	35	.704
VA	.138	20	.200*	.942	20	.266
VAT	.102	51	.200*	.965	51	.139

*. This is a lower bound of the true significance.

Table 29. Homogeneity of Variance Tests for the LORI Scores of Students Who Received Different Types of Feedback in the Tutorial

		Levene Statistic	*df1*	*df2*	*Sig.*
LORI Scores	Based on Mean	2.150	5	191	.061
	Based on Median	1.898	5	191	.097
	Based on Median and with adjusted df	1.898	5	165.82	.097
	Based on trimmed mean	2.122	5	191	.065

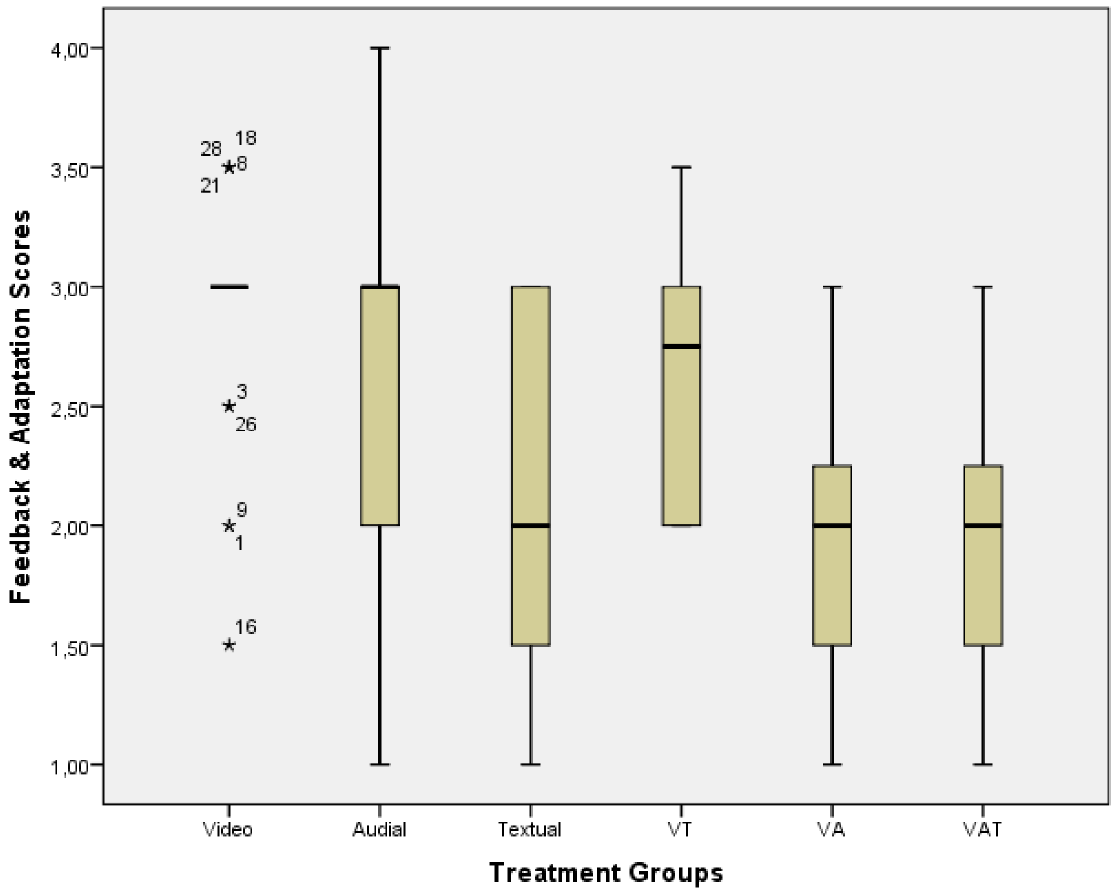

Figure 19 Boxplot of feedback and adaptation scores of students who received different types of feedback in the tutorial

Table 30. TF * UF Cross-tabulation

Tutorial Feedback Presented by LO Development Tutorial (TF)		Used Feedback Types in LO (UF)						
		V	A	T	VT	VA	VAT	Total
V	Count	0	0	28	0	0	0	28
	Expected Count	0	0.1	27.6	0.1	0	0.1	28
	% within TF	0	0	100	0	0	0	100
	% within UF	0	0	14.7	0	0	0	14.5
	% Total	0	0	14.5	0	0	0	14.5
A	Count	0	0	31	0	0	0	32
	Expected Count	0	0.2	31.5	0.2	0	0.2	32
	% within TF	0	0	96.9	0	0	0	100
	% within UF	0	0	16.3	0	0	0	16.6
	% Total	0	0	16.1	0	0	0	16.6
T	Count	0	0	34	0	0	0	34
	Expected Count	0	0.2	33.5	0	0	0.2	34
	% within TF	0	0	100	0	0	0	100
	% within UF	0	0	17.9	0	0	0	17.6
	% Total	0	0	17.6	0	0	0	17.6
VT	Count	0	0	36	0	0	0	36
	Expected Count	0	0.2	35.4	0.2	0	0.2	36
	% within TF	0	0	100	0	0	0	100
	% within UF	0	0	18.9	0	0	0	18.7
	% Total	0	0	18.7	0	0	0	18.7
VA	Count	0	0	18	0	0	0	18
	Expected Count	0	0.1	17.7	0.2	0	0.2	18
	% within TF	0	0	100	0	0	0	100
	% within UF	0	0	9.5	0	0	0	9.3
	% Total	0	0	9.3	0	0	0	9.3
VAT	Count	0	1	43	0	0	0	45
	Expected Count	0	0.2	44.3	0.2	0	0.2	45
	% within TF	0	2.2	95.6	0	0	0	100
	% within UF	0	100	22.6	0	0	0	23.3
	% Total	0	0.5	22.3	0	0	0	23.3
Total	Count	0	1	190	1	0	1	193
	Expected Count	0	1	190	1	0	1	193
	% within TF	0	0.5	98.4	0.5	0	0.5	100
	% within UF	0	100	100	100	0	100	100
	% Total	0	0.5	98.4	0.5	0	0.5	100

Table 31. TF * UF Cross-tabulation

Tutorial Feedback Presented by LO Development Tutorial (TF)		Used Feedback Types in LO (UF)			
		Visual	Verbal	Visual & Verbal	Total
Visual	Count	0	27	0	28
	Expected Count	0	27.7	0.3	28
	% within TF	0	100	0	100
	% within UF	0	14.7	0	14.5
	% Total	0	14.5	0	14.5
Verbal	Count	0	65	1	66
	Expected Count	0	65.3	0.7	66
	% within TF	0	98.5	1.5	100
	% within UF	0	34	50	34.2
	% Total	0	33.7	0.5	34.2
Visual & Verbal	Count	0	98	1	99
	Expected Count	0	98	1	99
	% within TF	0	99	1.0	100
	% within UF	0	51.3	50	51.3
	% Total	0	50.8	0.5	51.3
Total	Count	0	191	2	193
	Expected Count	0	191	2	193
	% within TF	0	99	1	100
	% within UF	0	100	100	100
	% Total	0	99	1	100

Table 32. IF * UF Cross-tabulation

Intend to Use Feedback Type (IF)		Used Feedback Types in LO (UF)						
		V	A	T	VT	VA	VAT	Total
V	Count	0	0	2	0	0	0	2
	Expected Count	0	0	2	0	0	0	2
	% within TF	0	0	100	0	0	0	100
	% within UF	0	0	1.1	0	0	0	1.1
	% Total	0	0	1.1	0	0	0	1.1
A	Count	0	1	31	0	0	0	10
	Expected Count	0	0.1	9.8	0.1	0	0.1	10
	% within TF	0	10	90	0	0	0	100
	% within UF	0	100	4.9	0	0	0	5.4
	% Total	0	0.5	4.9	0	0	0	5.4
T	Count	0	0	24	0	0	0	24
	Expected Count	0	0.1	23.6	0.1	0	0.1	24
	% within TF	0	0	100	0	0	0	100
	% within UF	0	0	13.2	0	0	0	13
	% Total	0	0	13	0	0	0	13
VT	Count	0	0	49	0	0	0	49
	Expected Count	0	0.3	48.2	0.3	0	0.3	49
	% within TF	0	0	100	0	0	0	100
	% within UF	0	0	26.9	0	0	0	26.5
	% Total	0	0	26.5	0	0	0	26.5
VA	Count	0	0	18	0	0	0	18
	Expected Count	0	0.1	17.7	0.1	0	0.1	18
	% within TF	0	0	100	0	0	0	100
	% within UF	0	0	9.9	0	0	0	9.7
	% Total	0	0	9.7	0	0	0	9.7
VAT	Count	0	1	80	1	0	1	82
	Expected Count	0	0.4	80.7	0.4	0	0.4	82
	% within TF	0	0	97.6	1.2	0	1.2	100
	% within UF	0	0	44.0	100	0	100	44.3
	% Total	0	0	43.2	0.5	0	0.5	44.3
Total	Count	0	1	182	1	0	1	185
	Expected Count	0	1	182	1	0	1	185
	% within TF	0	0.5	98.4	0.5	0	0.5	100
	% within UF	0	100	100	100	0	100	100
	% Total	0	0.5	98.4	0.5	0	0.5	100

Table 33. IF * UF Cross-tabulation

Intend to Use Feedback Type (IF)		Used Feedback Types in LO (UF)			
		Visual	Verbal	Visual & Verbal	Total
Visual	Count	0	2	0	2
	Expected Count	0	2	0	2
	% within TF	0	100	0	100
	% within UF	0	1.1	0	1.1
	% Total	0	1.1	0	1.1
Verbal	Count	0	34	0	34
	Expected Count	0	33.6	0.4	34
	% within TF	0	100	0	100
	% within UF	0	18.6	0	18.4
	% Total	0	18.4	0	18.4
Visual & Verbal	Count	0	147	2	149
	Expected Count	0	147.4	1.6	149
	% within TF	0	98.7	1.3	100
	% within UF	0	80.3	100	80.5
	% Total	0	79.5	1.1	80.5
Total	Count	0	183	2	185
	Expected Count	0	183	2	185
	% within TF	0	98.9	1.1	100
	% within UF	0	100	100	100
	% Total	0	98.9	1.1	100

Table 34. RF * IF Cross-tabulation

Recommended Feedback Type by Participants (RF)		Intend to Use Feedback Type (IF)						
		V	A	T	VT	VA	VAT	Total
V	Count	0	0	0	2	4	4	10
	Expected Count	0.1	0.5	1.3	2.6	1	4.5	10
	% within TF	0	0	0	20	40	40	100
	% within UF	0	0	0	4.1	21.1	4.7	5.3
	% Total	0	0	0	1.1	2.1	2.1	5.3
A	Count	0	3	2	4	1	7	17
	Expected Count	0.2	0.9	2.2	4.4	1.7	7.6	17
	% within TF	0	18	11.8	23.5	6	41.2	100
	% within UF	0	30	8	8.2	5.3	8.2	8.9
	% Total	0	1.6	1.1	2.1	0.5	3.7	8.9
T	Count	1	0	13	6	2	14.0	36
	Expected Count	0.4	1.9	4.7	9.3	3,6	16.1	36
	% within TF	2.8	0	36.1	16.7	5.6	38.9	100
	% within UF	50	0	52	12.2	10.5	16.5	18.9
	% Total	0.5	0	6.8	3.2	1.1	7.4	18.9
VT	Count	0	1	5	20	3	5	34
	Expected Count	0.4	1.8	4.5	8.8	3	15.2	34
	% within TF	0	2.9	14.7	59	9	14.7	100
	% within UF	0	10	20	40.8	15.8	5.9	17.9
	% Total	0	0.5	2.6	10.5	1.6	2.6	17.9
VA	Count	0	0	0	3	5	4	12
	Expected Count	0.1	0.6	1.6	3.1	1.2	5.4	12
	% within TF	0	0	0	25	41.7	33.3	100
	% within UF	0	0	0	6.1	26.3	4.7	6.3
	% Total	0	0	0	1.6	2.6	2.1	6.3
VAT	Count	1	6	5	14	4	51	81
	Expected Count	0.9	4.3	10.7	20.9	8.1	36.2	81
	% within TF	1.2	7.4	6.2	17.3	4.9	63	100
	% within UF	50	60	20	28.6	21.1	60	42.6
	% Total	0.5	3.2	2.6	7.4	2.1	26.8	42.6
Total	Count	2	10	25	49	19	85	190
	Expected Count	2	10	25	49	19	85	190
	% within TF	1	5.3	13.2	25.8	10	44.7	100
	% within UF	100	100	100	100	100	100	100
	% Total	1,1	5.3	13.2	25.8	10	44.7	100

Table 35. RF * IF Cross-tabulation

Recommended Feedback Type by Participants (RF)		Intend to Use Feedback Type (IF)			
		Visual	Verbal	Visual & Verbal	Total
Visual	Count	0	0	10	10
	Expected Count	0.1	1.8	8.1	10
	% within TF	0	0	100	100
	% within UF	0	0	6.5	5.3
	% Total	0	0	5.3	5.3
Verbal	Count	1	18	34	53
	Expected Count	0.6	9.8	42.7	53
	% within TF	1.9	34	64.2	100
	% within UF	50	51.4	22.2	27.9
	% Total	0.5	9.5	17.9	27.9
Visual & Verbal	Count	1	17	109	127
	Expected Count	1.3	23.4	102.3	127
	% within TF	0.8	13.4	85.8	100
	% within UF	50	48.6	71.2	66.8
	% Total	0.5	8.9	57.4	66.8
Total	Count	2	35	153	190
	Expected Count	2	35	153	190
	% within TF	1.1	18,4	80.5	100
	% within UF	100	100	100	100
	% Total	1.1	18.4	80.5	100

Table 36. RF * UF Cross-tabulation

Recommended Feedback Type by Participants (RF)		Used Feedback Type in LO (UF) V	A	T	VT	VA	VAT	Total
V	Count	0	0	9	0	0	0	9
	Expected Count	0	0	8.9	0	0	0	9
	% within TF	0	0	100	0	0	0	100
	% within UF	0	0	4.9	0	0	0	4.9
	% Total	0	0	4.9	0	0	0	4.9
A	Count	0	0	17	0	0	0	17
	Expected Count	0	0.1	16.7	0.1	0	0.1	17
	% within TF	0	0	100	0	0	0	100
	% within UF	0	0	9.3	0	0	0	9.2
	% Total	0	0	9.2	0	0	0	9.2
T	Count	0	0	35	0	0	0	35
	Expected Count	0	0.2	34.4	0.2	0	0.2	35
	% within TF	0	0	100	0	0	0	100
	% within UF	0	0	19.2	0	0	0	18.9
	% Total	0	0	18.9	0	0	0	18.9
VT	Count	0	0	32	1	0	0	33
	Expected Count	0	0.2	32.5	0.2	0	0.2	33
	% within TF	0	0	97	3	0	0	100
	% within UF	0	0	17.6	100	0	0	17.8
	% Total	0	0	17.3	0.5	0	0	17.8
VA	Count	0	0	12	0	0	0	12
	Expected Count	0	0.1	11.8	0.1	0	0.1	12
	% within TF	0	0	100	0	0	0	100
	% within UF	0	0	6.6	0	0	0	6.5
	% Total	0	0	6,5	0	0	0	6.5
VAT	Count	0	1	77	0	0	1	79
	Expected Count	0	0.4	77.7	0.4	0	0.4	79
	% within TF	0	1.3	97.5	0	0	1.3	100
	% within UF	0	100	42.3	0	0	100	42.7
	% Total	0	0.5	41.6	0	0	0.5	42.7
Total	Count	0	1	182	1	0	1	185
	Expected Count	0	1	182	1	0	1	185
	% within TF	0	0.5	98.4	0.5	0	0.5	100
	% within UF	0	100	100	100	0	100	100
	% Total	0	0.5	98.4	0.5	0	0.5	100

Table 37. RF * UF Cross-tabulation

Recommended Feedback Type by Participants (RF)		Used Feedback Type in LO (UF)			
		Visual	Verbal	Visual & Verbal	Total
Visual	Count	0	9	0	9
	Expected Count	0	8.9	.1	9
	% within TF	0	100	0	100
	% within UF	0	4.9	0	4.9
	% Total	0	4.9	0	4.9
Verbal	Count	0	52	0	52
	Expected Count	0	51.4	.6	52
	% within TF	0	100	0	100
	% within UF	0	28.4	0	28.1
	% Total	0	28.1	0	28.1
Visual & Verbal	Count	0	122	2	124
	Expected Count	0	122.7	1.3	124
	% within TF	0	98.4	1.6	100
	% within UF	0	66.7	100	67
	% Total	0	65.9	1.1	67
Total	Count	0	183	2	185
	Expected Count	0	183	2	185
	% within TF	0	98.9	1.1	100
	% within UF	0	100	100	100
	% Total	0	98.9	1.1	100

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