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The effect of tutorial feedback type on the choice of feedback type in pre-service teachers' development of learning objects

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Abstract

This study investigates the effect of feedback types presented in learning object (LO) development tutorials on the quality of pre-service teachers' LOs and their choices of feedback types in authoring LOs. Results indicate that video feedback presented in the tutorials is the most effective feedback representation type, based on overall scores on the learning object review instrument and feedback quality of the LOs developed by the pre-service teachers. However, interaction between feedback types presented in the tutorial and pre-service teachers' actual use of feedback in authoring LOs was not meaningful. The implications are discussed.

Keywords: Pre-service teacher, learning object, authoring, feedback type, feedback preferences.

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1. Introduction

1.1. Feedback in Education

The concept of feedback has been studied extensively in education and psychology for many years because of its significant role in the learning process. In a meta-analysis by Kluger and Denisi (1996) feedback interventions were shown to contribute to performance improvement with a moderate effect (0.41). In an educational context, feedback may be defined simply as a message that follows a learner's response (Bationo, 1992). It also helps learners close the gap between their current understanding and the intended learning outcomes (Hattie & Timperley, 2010). Feedback informs learners about their mistakes so that they learn from them. It also allows teachers to monitor their students' learning progress and give specific feedback.

Numerous procedures can tell a learner whether a response is correct or not. Much research has been conducted on feedback types, including corrective feedback (Dempsey *et al*., 1993; Kulhavy & Stock, 1989), formative feedback (Shute, 2009) informative feedback (Hansen, 1974), immediate feedback, (Epstein, 1997), delayed feedback (Van der Kleij *et al*., 2015) and motivational feedback (Peyke, 2007).

In immediate feedback, information is presented subsequent to each test element or after the student performs a task (Dihoff, 2003). In delayed feedback, information is given to learners 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 and reported that immediate feedback contributed more to better performance than delayed feedback. They also determined that feedback given in delayed mode effectively allows students to 'practice' errors, which leads to faulty learning. Gibson (2000) also reported that delayed feedback may affect learning negatively in a dynamic environment. A meta-analysis by Azevedo and Bernard (1985) examined the effect of feedback in computer-based lessons and confirmed the result of Kulik and Kulik's (1988) meta-analysis.

1.2. Use of Feedback in Technology-Based Learning Settings

Feedback is one of the most important and frequently addressed elements in technology integration. Some of the research on the use of feedback in computer-based instruction (CBI) examines corrective feedback, informative feedback, immediate feedback and delayed feedback. Mason and Bruning (2001) grouped feedback commonly used in CBI into seven categories: knowledge-of-response (KR), knowledge-of-correct-response (KCR), answer-until-correct (where learners are asked to try again until they get the correct answer), bug-related (which provides common errors made by learners from 'bug libraries'), response-contingent (which checks the response and explains why the answer is correct or incorrect), topic-contingent (which checks the response and elaborates with general information), and attribute-isolation (which controls the answer and underlines key aspects of the targeted concept).

Adams (2006) examined 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 the effect of computer-assisted feedback strategies on both were identical. A similar study by Van der Kleij *et al*. (2012) examined the effect of written feedback. Each of the three groups in the study received different feedback types: immediate KCR with elaborated feedback (EF), delayed KCR with EF and delayed KR. There was no notable difference between feedback types on student achievement scores, although students found immediate KCR and EF combined to be more useful for learning than the other treatment.

In a meta-analysis by Azevedo and Bernard (1995), post-test data of 22 CBI studies with immediate feedback and 9 CBI studies with delayed feedback was examined: Effect sizes were 0.80 for immediate feedback and 0.35 for delayed feedback, indicating that students liked it more than delayed feedback, at least in CBI. In a similar meta-analysis, Van der Kleij *et al*. (2014) examined 40 studies with 70 effect sizes; the results suggested that immediate feedback is more advantageous than delayed feedback in a CBI for lower order learning tasks. On the other hand, EFwith effect size (0.49) was found to be more effective than knowledge of result (0.05) and knowledge of correct response (0.32).

Three forms of immediate feedback were examined by Bation (1992) who used a computer-based tutorial in teaching a foreign language to identify the most beneficial feedback form (spoken feedback, written feedback or spoken and written feedback combined) for learning intellectual skills. The results showed that the group receiving a combination of immediate written and spoken feedback outperformed both the no-feedback group and the immediate-written-feedback group on post-test scores. However, there was no significant difference between the delayed versions of these feedback forms.

In a similar study, Ice *et al*. (2012) focused on students' preference for different feedback forms: text-based, audio-based and a combination of text- and audio-based feedback. They found that students
(*n* = 196) from three universities in the USA preferred a combination of text and audio feedback to stand-alone feedback (text or audio). Feedback presented as text was also preferred to audio feedback. In another study on feedback preferences, Cavanaugh and Song (2014) examined written feedback and audio feedback in an online course from the perspective of both instructors and students. They found that instructors preferred to use audio feedback for global issues (e.g., overall structure, topic of the paper) but written feedback was used more frequently for micro-level issues (e.g., grammar, spelling). Students, on the other hand, generally preferred audio feedback.

Lalley (1988) investigated the effect of video and text feedback on students' scores of knowledge and comprehension of biology content and their retention scores. Learners used two different sets of CBI materials in biology, which included characteristics of mammals and reptiles. In the video version, feedback was provided with video segments that included sound. The findings showed that the video feedback group had significantly higher learning scores (on both knowledge and comprehension) and higher retention scores than the text feedback group. A significant number of students indicated a preference for video feedback over text feedback.

1.3. Technology Integration

Beyond the question of the effectiveness of instructional materials in computer-based lessons is the issue of effective integration of technology-based materials into the learning process. Clark *et al*., (2015) emphasised the importance of teaching pre-service/candidate teachers how to use technology in a way that it will contribute to the learning process. Today, although teacher candidates take courses in technology integration, they may not intend to use the technology in their future teaching. Yet 72% of 15-year-old students in the Organization for Economic Cooperation and Development (OECD) countries reported that they use computers at school. In countries where teachers require their students to use the Internet for schoolwork, students' performance in reading, on average, declined (OECD, 2015). OECD data show that despite the availability of the ICT tools in schools, these technologies have not yet been widely adopted by teachers in formal education.

Teo (2009) examined factors that influence acceptance of technology and found that that attitudes towards computer use, anticipated usefulness and computer self-efficacy directly affect teacher candidates' intention to benefit from technology, whereas ease of use, facilitating conditions and technological complexity influence their intentions indirectly. Sadaf *et al.* (2007) investigated the beliefs of pre-service teachers and their intention to make use of Web 2.0 technologies in their future teaching. They used Ajzen's (1991) theory of planned behaviour, which consists of three constructs: attitude, subjective norms and perceived behavioural control. The findings indicated that prospective teachers' beliefs (behavioural, normative and control beliefs) influenced their stated intention to integrate Web 2.0 technology in their future teaching.

Sadaf *et al.*, (2016) conducted a study of prospective teachers' intentions to integrate the Web 2.0 tools in their future classrooms, aiming to explore whether their intentions transferred to actual behaviours. The findings revealed that anticipated usefulness, self-efficacy and student learning/expectation are the most powerful determinants of pre-service teacher intentions. A strong relationship was identified between their intentions and actual behaviours. In other words, intentions are consistent with actions, according to pre-service teacher self-reports.

1.4. Authoring Systems / Tools

Authoring systems are defined by Locatis *et al.* (1992) as tools that allow users to create CBI without having to do the programming. Authoring systems enable materials design by non-programmers, guiding the author and minimising the need for programming effort (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. Finally, they facilitate the transportability of courseware.

Authoring systems are constantly being improved by advancing technology. Current generations of authoring systems try to address previous deficiencies by (a) providing easier replication and modification of screen objects, (b) enabling the use of script languages, which makes it possible to extend the system capabilities, (c) serving programming templates and wizards for whatever the users might need to add (Locatis & Al-Nuaim, 1999). Authoring systems have on-screen tools such as icons, menus and prompts that make it easy to enter text, create graphics and modify them. The design and modification of interactive computer-based presentations by integrating graphics, audio, text and video is defined as multimedia authoring (Koegel & Jesse, 1993).

While the term 'authoring tools' is generally used as a near-synonym of authoring systems, Locatis and Al-Nauim (1999) maintain that authoring systems are a subset of authoring tools, which are products used for composing, editing and managing multimedia objects. 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 with familiar visual objects and metaphors (Berking, 2016).

In the present research, Articulate Storyline software was used as an authoring tool. It is a desktop-based e-learning development tool that is easy to use and has powerful features that allow users to create any interactive course or tutorial they can imagine. It is possible to create e-learning content such as product demonstrations, software simulations, branched scenarios, basic skills and compliance training, and 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 customisable characters as well as quizzes and interactive tests and exams, enabling the creation of comprehensive multimedia learning materials.

1.5. The Cognitive Theory of Multimedia Learning

The cognitive theory of multimedia learning (CTML) is built on three hypotheses: the dual channel, limited capacity and active processing hypotheses (Mayer, 2005). The dual channel hypothesis claims that there are two distinct channels to process information visually and auditory. Paivio's (1990) dual coding theory and Baddeley's (1986) theory of working memory also contribute to the concept of separated information processing. The second hypothesis predicts that processing information capacity in each channel at any given time is restricted. Chandley and Sweller's (1991) cognitive load theory and Baddeley's (1986) theory of working memory contribute to the concept of restricted capacity. According to the active processing hypothesis, humans actively take part in the learning process. This active cognitive process consists of three stages: selecting words and pictures, organising incoming information and combining it with prior knowledge. Figure 1 presents the CTML and its three stages.

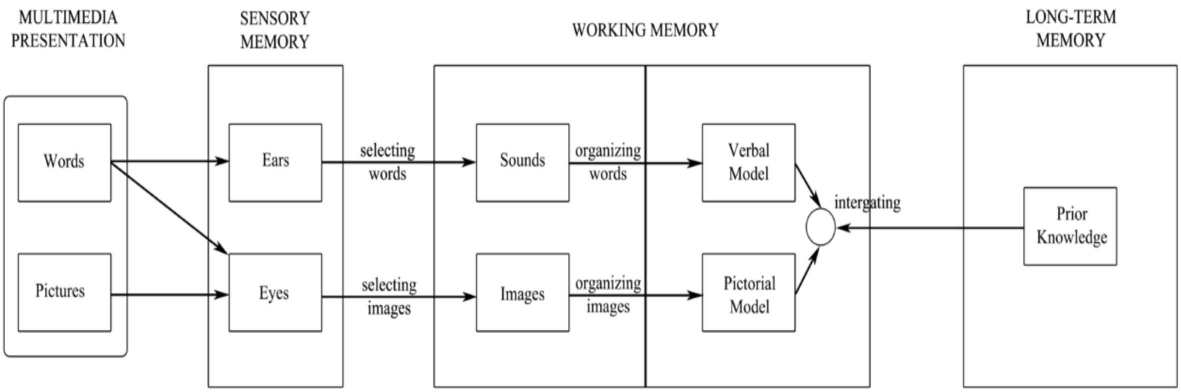

Figure 1. Cognitive theory of multimedia learning

The multimedia learning theory outlines 12 design principles under three main categories. These are reducing extraneous processing (coherence, signaling, redundancy, spatial contiguity, and the temporal contiguity principle), managing essential processing (segmenting, pre-training, modality principle) and fostering generative processing (multimedia, personalisation, voice, and image principle). In the present research, the principles of multimedia, modality and redundancy are considered.

According to a common-sense view of multimedia learning, providing information using words is equivalent to providing information using pictures. For this reason, presenting information using both words and pictures is seen as creating redundancy. On the other hand, the CTML Mayer (2011) and the dual coding theory (Clark & Paivio, 1991) claim that people learn more thoroughly when presented with information using both words and images, rather than only words, because visuals support words in mental coding. Many studies support this claim (Butcher, 2006; Mayer & Anderson, 1991; Moreno & Valdez, 2005; Pawar, 2011).

With respect to the modality principle, there should be no difference between narration and on-screen text because they are equivalent information. However, CTML claims that people learn more thoroughly when information is presented through narration than with on-screen text. Numerous studies have tested the modality principle. Results have shown that presenting pictures with narration rather than pictures with on-screen text is more beneficial for learning (Fiorella *et al*., 2012; Harskamp *et al*., 2007). According to the redundancy principle, it is better to present the same words in two formats – on-screen text and narration – so that learners can choose the format that better suits them. CTML, by contrast, claims that people acquire knowledge better from animation with narration as opposed to animation with narration and on-screen text, because learners are said to divide their attention when studying information with narration, animation and on-screen text. Findings of various studies are also in line with the redundancy principle (Lyles, 2010; Mayer & Johnson, 2008; Schar & Kaiser, 2006).

Taking all these issues into consideration, the present study was designed to answer the following research questions:

i.To what extent do different types of feedback presented in a tutorial on developing a learning object (LO) influence

a) The overall quality of the LO that is developed?

b) The quality of both feedback and adaptability of the LO that is developed?

ii. To what extent do different types of feedback presented in a tutorial on developing a learning object (LO) influence

a) Is there a meaningful interaction between types of feedback used in the tutorial and the type of feedback used in the LO that is developed?

b) Is there a meaningful interaction between the tutee's intention to a particular feedback type and the actual feedback type used in the LO that is developed?

c) Is there a meaningful interaction between the tutees' intended use of feedback type and their recommended type of feedback?

d) Is there a meaningful relationship between the type of feedback used in the LO that is developed and the tutees' recommended type of feedback?

2. Method

2.1. Research Design

A post-test-only quasi-experimental design was used in this study. There were six treatment groups, each of which received a particular feedback type: text (T), audio (A), video (V), video with text (VT), video with audio (VA) and video with audio-plus-text (VAT). The same researcher gave the same lecture using Articulate Storyline software with all groups, but interventions were different. The tutorials were intended to teach how to use the components and functions of the Articulate Storyline software to develop an LO.

2.2. Participants

Convenience sampling was used. The original sample of the study consisted of 204 pre-service teachers from four departments in the faculty of education at a state university: Educational Sciences (ED), Primary Education (PRED), Mathematics and Science Education (SCED) and Foreign Language Education (FLED). A technology skill questionnaire was administered to assess the level of the participants' technology skills. Only two had a high level of technology skills, so these were excluded from the sample, resulting in a final sample of 202 students. All students were enrolled in a required course in instructional technologies and materials development. None had taken an instructional materials development course before the study. The departmental distribution and demographic information of the sample is shown in Table 1.

Table 1. Demographic information of sample

Treatment groups	Average age	Gender		Department				Total
		Male	Female	PRED	SCED	ED	FLED	
Video (V)	21.7	4	24	3	11	5	9	28
Audio (A)	22.0	1	31	15	2	11	4	32
Text (T)	21.9	7	27	6	7	18	3	34
Video with text (VT)	22.0	3	33	15	12	5	4	36
Video with audio (VA)	22.6	6	14	2	11	5	2	20
Video with audio-plus-text (VAT)	21.4	4	48	15	3	8	26	52
Total	21.9	25	177	56	46	52	48	202

2.3. Instrumentation

2.3.1. The Questionnaire on Feedback Preferences

Students responded to a questionnaire on feedback preferences before treatment, using a web-based form. The questionnaire was designed to determine their intended use of feedback type in and their recommendations of use of feedback type in authoring LO. This information was used to compare the intended and recommended feedback types with what they actually used in the LO they developed.

2.3.2. The Technology Skill Questionnaire

Students completed a technology skill questionnaire online before the treatment, using a web-based form. The questionnaire consisted of 22 items. The first six items were about personal information, including name, age, gender and department. The remaining 16 items assessed technology skills. The maximum possible score was 115 points. Students scoring under 70 were regarded as having low technology skills, while those who scored above 69 were regarded as having high technology skills.

2.3.3. The Learning Object Review Instrument

To measure the quality of the LOs developed by the students, a learning object review instrument (LORI) was used. The first version of LORI was developed in Vargo (2003) and improved in Nesbit (2007). It comprises nine items—content quality, learning goal alignment, feedback and adaptation, motivation, presentation design, interaction usability, accessibility, reusability and standards compliance—each with descriptive rubrics. The standards compliance item measures whether the LO meets international technical standards, but because this sort of technical content is not covered in any of the courses taken by the pre-service teachers, the standard compliance item was excluded from the evaluation process.

2.3.4. The LO Development Tutorial

The study took place in a computer lab where each student had access to a computer. The LO development tutorial was designed especially for this study. There were six versions of the tutorial. Two domains and two hosting services were used for publishing the tutorial, even though there was a single database to be saved. In the introductory screen, users were asked to enter their personal information, which was needed to save their actions, such as finishing a module.

In the module selection screen of the tutorial, users were to select the module they wanted to work on. Each module consisted of five or six sub-topics. The aim of dividing modules into sub-topics was to prevent cognitive overload. In the selected task of the tutorial, it was expected that the user would explore ways to accomplish the task, by trial and error. If they clicked in the wrong place, a feedback screen appeared, offering two choices: 'Try again' and 'Learn'. If a user chose the 'Learn' button, a feedback representation was shown on the screen. In the video version, the users were shown a video that demonstrated the steps of a given task. For example, in order to insert a text box, the video showed a mouse cursor moving to the insert button and clicking on it. In the audio version of the tutorial, the users were given narrative feedback. For example, in order to insert a text box, users heard the instruction 'Click the insert button.' In the text version of the tutorial, feedback was presented in written form (Click the insert button). The information in the text version was identical to the narration in the audio version. In the video-with-text version, the video was identical to the one in the video version, but with a caption that displayed simultaneously. As for the video-with-audio version, the same video was displayed simultaneously with an audio narration of the text, corresponding to the information in the video. Finally, in the video-with-audio-and-text version, feedback was given via video with a simultaneous text display and corresponding audio (Figure 2). When users completed the module, all traces and related information were saved in the database.

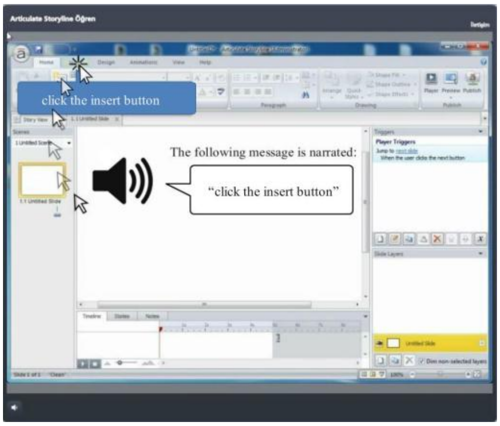

Figure 2. Feedback screen of selected task for VAT version

2.4. Procedures

The feedback preference and technology skill questionnaires were administered using web-based forms. There were six hyperlinks on an LMS to access webpages of the tutorials, one for each version of the tutorial. Each group of students used a different link, assigned randomly before starting the treatment. The researcher then introduced the tutorial and explained how it worked. The researcher also informed the students how they would be assessed. By tracking their activity in database records, the researcher was able to ensure that the students finished the weekly tutorial modules before coming to class. The researcher gave the same weekly lecture to all treatment groups. The students used the Articulate Storyline program. The treatment lasted seven weeks, with the students finishing three or four modules each week. After seven weeks, each student submitted an LO as their final project for the course. These projects were evaluated by two experts, using a rubric.

2.5. Scoring the LOs

Two reviewers evaluated the student-developed LOs using LORI. One of the reviewers was the researcher himself and the other was an educational technologist working as a research assistant in the Computer Education and Educational Technology Department at the same university. The quality of the LOs was rated using eight dimensions of LORI because the item named 'Standards Compliance' was excluded, and each of which had a 5-level rating scale. The reviewer could select the 'not applicable' option on any level, depending on the situation. In the rating process, if the difference between the scores of the two reviewers for a given item was zero or one, the final score for the particular item was the average of the two scores. If there was a difference of two points or more, the evaluators negotiated the score.

The feedback and adaptation item of LORI addresses 'adaptive content or feedback driven by differential learner input or learner modeling' (Nesbit et al., 2007). To get the highest rating (five points), an LO had to include EF that was adaptive to the needs and characteristics of the students. For example, one student's LO received a score of four points instead of five on the feedback and adaptation item because she used an EF that was not sufficiently adaptive. Another LO received only one point because the student used a feedback type that simply informed users whether their response was right or wrong.

3. Results

3.1. Research Question 1

A one-way ANOVA test was conducted to test the following question: 'To what extent do different types of feedback presented in an LO development tutorial influence the overall LORI scores of pre-service teachers' LOs?' A one-way ANOVA (F (5, 191) = 10.303, p < 0.001) revealed that mean LORI scores for the LOs of the different groups were statistically different. A Bonferroni correction was used for multiple comparisons and statistical significance was accepted at the p < 0.0033 level. The effect size calculated using omega squared was 0.19, indicating a large effect. Eta squared and partial eta squared also indicated a large effect (partial η^2 = .21 and η^2 = .27). In other words, the effect size estimates indicated that the type of feedback received in the LO development tutorials affected the quality of LOs.

In order to determine which groups' mean LORI scores were significantly different from the others, post hoc tests such as Scheffe tests were conducted. These tests revealed that 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). The V feedback group (M = 24.50, SD = 2.60) also had higher mean LORI scores than the VT feedback group (M = 21.89, SD = 3.25), but the differences were not statically significant.

3.2. Research Question 2

The Kruskal-Wallis H test answered the second question: 'To what extent do different types of feedback used in the LO development tutorial influence pre-service teachers' quality of feedback and quality of adaptability in their LOs?' The Kruskal-Wallis H test (χ^2 (5) = 50.333, p < 0.0001) revealed that the mean ranks of feedback and adaptation scores for the pre-service teachers' LOs were statistically different for the different groups. Further, pairwise comparisons were performed using Dunn's (1964 procedure with a Bonferroni correction for multiple comparisons. 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 results of the pairwise comparisons were (p = 0.002, r = 0.49), (p < 0.001, r = 0.69), and (p < 0.001, r = 0.66), respectively. Additionally, the audio feedback group (mean rank = 122.86) and VT feedback group (mean rank = 117.49) had 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 were (p = 0.014, r = 0.46), (p < 0.001, r = 0.46) for the audio feedback group and (p = 0.036, r = 0.41), (p = 0.001, r = 0.42) for the VT feedback group.

3.3. Research Question 3

Using a chi-squared test of independence, we tested the interaction between the types of feedback used in the LO tutorial and the type of feedback used by the pre-service teachers in authoring their own LOs. We found that the interaction between these variables was not significant (X^2 (25, N = 193) = 11,684, p = 0.929). 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 revealed that the exact p value based on Pearson's statistics was 0.929, compared to 0.703 for the asymptotic value. In spite of the exact p value, the null hypothesis was not discredited at the 0.05 significance level, and we inferred that there was no evidence for possible interaction between the different types of feedback used in the LO tutorial and the type of feedback used in authoring the LOs.

3.4. Research Question 4

The interaction between pre-service teachers' intended use of feedback type and the type of feedback they used in authoring their LOs was tested by a chi-squared test of independence. It showed that the interaction between these variables was not significant (χ^2 (25, *N* = 185) = 20,114, *p* = 0.201). However, the assumption of the chi-squared test was not met. The exact method was therefore applied instead of the asymptotic method. The analysis revealed that the exact p value based on Pearson's statistic was 0.201, compared to 0.168 for the asymptotic value. Accordingly, the null hypothesis was not discredited at the 0.05 significance level, and we inferred that there was no evidence to show the interaction between students' intended use of feedback type and feedback type they used in authoring their LOs.

3.5. Research Question 5

A chi-squared test of independence was used to determine meaningful interaction between pre-service teachers' intended use of feedback type and their recommended type of feedback. The test showed that interaction between these variables was significant (χ^2 (25, *N* = 190) = 87,007, $p < 0.001$). The null hypothesis was discredited at the 0.05 significance level, and we inferred that there was evidence that indicated interaction between students' intended use of feedback type and recommended type of feedback.

3.6. Research Question 6

The relationship between the type of feedback used by pre-service teachers in authoring their LOs and their recommended type of feedback was tested by a chi-squared test of independence. The test showed that the interaction between these variables was not significant (χ^2 (4, *N* = 185) = 2,089, *p* = 1.000). Therefore, the exact method was applied. The exact p value based on Pearson's statistic was 1.000, compared to 0.719 for the asymptotic value. In spite of the exact p value, the null hypothesis was not discredited at the 0.05 significance level.

4. Discussion and Conclusion

4.1. The Role of Different Types of Feedback Presentation

One of the two main questions of the study was to what extent feedback types used in the LO development tutorial influenced the quality of LOs developed by pre-service teachers. This question was answered based on feedback quality scores and LORI scores of the LOs developed by the pre-service teachers. The findings suggest that video feedback is the most effective feedback representation type, based on both LORI scores and feedback quality scores. The V feedback group had significantly higher overall mean LORI scores than the others, but the difference was not statistically significant for the VT feedback group. As with its overall LORI scores, the video feedback group also had significantly higher feedback and adaptation scores than the T, VA and VAT feedback groups. The A and VT groups had significantly higher feedback and adaptation scores than the VA and VAT feedback groups.

The literature includes studies that both support and contradict this research. Lalley's (1988) video feedback group had higher learning scores than his textual feedback group. The current study confirmed Lalley's results and extended them at the application level. There is also other research that compares spoken and written feedback (Bationo, 1992; Fiorella *et al.*, 2012). Bationo's study (1992) showed that a combination of written and spoken feedback is superior to written feedback on intellectual skill learning, but unlike our study, there was no significant difference between his written and spoken feedback groups. By contrast, Fiorella *et al.* (2012) found that a spoken feedback group had higher scores than a written feedback group on decision-making in training and in the assessment process. The current study confirmed Bationo's study (1992) but failed to confirm that of Fiorella and his colleagues (2012). This contradiction may be due to the fact that it is used real-time feedback that did not interrupt the contextual timeline instead of near-real time feedback presented after the completion of a task (Fiorella et al., 2012). Moreover, in Fiorella *et al*. (2012) it is concluded that real-time feedback intervention is more effective for the acquisition and application of higher order cognitive skills than lower level skills.

In the current study, students received feedback from tutorial in two stages. First, information was given to students indicating whether their answer was correct or incorrect. Then, instructional content was presented to the students 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.

Paivio's (1990) dual coding theory asserted that humans have two distinct information processing systems—verbal and visual—and that these systems are connected. Also, according to the multimedia principle (Mayer, 2001) people learn more deeply when presented with information in a form that uses both words and pictures versus words alone, because the learner mentally associates the pictures and the accompanying words. It was therefore expected that the VA feedback group would learn how to use the LO authoring tool better than the other groups, considering the multimedia learning principles. Theoretically, if the VA feedback group learned how to use the LO authoring tool the best, this would be reflected in the quality of their LOs. That would suggest that the VA feedback group would receive higher LORI scores than the other groups. 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, possible reasons for which are described below.

First, most previous research was conducted with basic learning materials that had narrow content (Butcher, 2006; Harskamp *et al*., 2007; Mayer & Anderson 1991; Mayer & Moreno, 1998) and these learning materials were measured by retention, recall and transfer tests administered immediately after delivering the learning material. In the current study, how well pre-service teachers learned from the LO development tutorial was not measured directly; it was their LO quality that was assessed. It is therefore difficult to conclude that one group learned better from different representations of feedback than another, by comparing only the quality scores of the LOs. Second, there was a time interval between the usage of the LO development tutorial and the submission of the LOs. In this interval, the participants may have used other material.

Most prior studies compare two or three feedback representation types. The unique contribution of the current study is that six representation types were used to examine the effect of feedback representation types on the quality of LOs. In the light of our results, courseware designers can use the most effective feedback representation type in developing LOs. The current study, however, should be extended to confirm and extend past studies, using more complex subject matter and skill-based performance assessment.

4.2. The Role of Different Types of Feedback Presentation

The second main aim of this research was to determine to what extent different types of feedback presented in LO development tutorials influenced pre-service teachers' preferences for feedback type in developing their own LOs. Their 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 in the LO development tutorials and the type of feedback pre-service teachers used in authoring their LOs.

Lalley (1988) examined student preference for text of video feedback in a computer-assisted environment. The results showed they preferred video feedback. By contrast, in the current study, video feedback was the least preferred feedback type in terms of pre-servicers' intentions and recommendations of feedback usage.

Ice *et al.* (2010) also focused on preferences for feedback type: textual, audial and a combination of the two. Findings indicated that the combined version was preferred by most students, and textual feedback was preferred to audial feedback. In a study on 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 on the topic of the paper, but they preferred to give textual feedback for micro-level issues such as grammar and spelling. Students, however, preferred audial feedback. In the current study, although textual feedback was not the students' top preference (only 13%), it was rated higher than audial feedback (5%). In this respect, the findings of the current study are similar to those of Ice *et al.* (2010).

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

In the questionnaire on feedback preferences administered prior to our study, the majority of students expressed an intention to use VAT-type feedback, but 98% incorporated textual feedback when authoring their own LOs. The results of the study also revealed that the various feedback types the pre-service teachers used in authoring their LO interact neither with their feedback intentions nor their feedback recommendations, showing that pre-service teachers' intentions did not transfer into actual behaviours. Sadaf *et al.*(2016), however, did find an interaction between intentions and actual behaviours 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 converting intentions into actions.

In the current study, in addition to the factors listed above, students preferred a ready-to-use feedback template that is textual. According to the responses to one item on the questionnaire on feedback preferences, video feedback was the least preferred feedback type because it is the hardest to implement, although the video feedback group had significantly higher overall LORI scores than other groups, and 76% of all students intended to use the feedback template. Additionally, 84% of students did not use the feedback type they expected to use prior to the treatment. This percentage rises to 99% when excluding textual group data because the ready-to-use feedback template was textual. The increase to 99% may stem from the fact that the feedback template provided by the Articulate Storyline program was textual. Furthermore, the participants were students, and they had a deadline for finishing their learning materials design project. The time constraint may have led to an increased tendency to prefer a ready-to-use feedback template. In the final analysis, the feedback type pre-service teachers used in authoring their LOs was not affected by feedback types presented in the LO development tutorial.

4.3. Limitations of the Study

Although it was conducted in a real school setting, the generalisability of the findings of this study is limited, largely because of its convenience sampling. Furthermore, the sample size of each group was not adequate; some students dropped out or failed to submit the final project. Another limitation is related to duration. The treatments lasted seven weeks, during which time students were able to use other material: it was not possible to avoid the sample from intervening variables because the study was conducted in a real school setting.

4.4. Recommendations for Further Research

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

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