South African Journal for Research in Sport, Physical Education and Recreation, 2015, 37(3): 113-122.
Suid-Afrikaanse Tydskrif vir Navorsing in Sport, Liggaamlike Opvoedkunde en Ontspanning, 2015, 37(3): 113-122.
ISBN: 0379-9069

EFFECT OF DIFFERENT INSTRUCTIONAL MEDIA ON ACQUISITION OF MARTIAL ARTS SKILLS BY ELEMENTARY SCHOOL STUDENTS

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ABSTRACT

This study investigated the effects of different instructional modes on teaching one of the popular martial arts, Baduanjin. The Grade-4 learners (N=81) that were recruited were assigned to one of three groups: picture-based instruction, video-based instruction and live-modelling instruction. All the students received four instruction sessions within two weeks. The measurements were a retention performance test conducted immediately after the students completed all the instruction sessions and another retention performance test conducted four weeks later. Through the analysis of one-way ANOVAs, significant differences were identified in the scores of the three groups. Students who received the picture-based instruction exhibited lower performance accuracy than those who received video-based and live-modelling instruction in both their retention and delayed retention tests. No significant difference was found between the video and the live-modelling groups. The implications of these results for the design of computer-assisted motor skills learning are discussed.

Key words: Elementary education; Physical education; Multimedia instruction; Martial arts.

INTRODUCTION

The integration of Information and Communication Technology (ICT) into physical education (PE) has been receiving increased attention over the last decade (Thomas & Stratton, 2006). The results from numerous studies have indicated the positive impacts of ICT on PE (Antoniou *et al.*, 2003; Golshani *et al.*, 2004), such as facilitating the learning of basketball rule violations (Antoniou *et al*., 2003), improving sailing and sport training knowledge (Leblanc *et al.*, 2001), and enhancing health-related knowledge (Siskos *et al*., 2005). In addition, ICT can be used to support the comparison and analysis of dance and human movement (Golshani *et al*., 2004), and basketball coaching skills (Papastergiou & Gerodimos, 2013).

Given the popularity of the Internet, the World Wide Web now plays an essential role in education. Researchers of educational technology have identified many advantages of Web-based instruction, including providing a sound forum for learning to occur anytime and anywhere (Liaw, 2008), allowing individual and collective publishing and sharing of images, audio and video (Bennett *et al.*, 2012), and supporting self-directed learning (Wang, 2011). In order to embrace the merits of Web-based instruction in improving PE, several researchers (Leijen *et al.*, 2009; Huang *et al.*, 2011), have sought to integrate the Internet into the enhancement of motor learning. For instance, the study of Huang *et al.* (2011) developed a Web-based learning platform for teaching motor skills, regulations and first-aid instruction to increase the effectiveness of PE courses and to promote motivation among learners.

To support the reflection process of dance students and learning from multiple perspectives, Leijen *et al.* (2009) utilised online video streaming as a way to help students describe their choreographic work and perform peer assessment of the recorded practice online. The results from both studies demonstrated the effectiveness of the implementations. Based on the above description, computer-assisted motor learning, especially that incorporates the approach of Web-based instruction, has become a growing trend in PE. This is happening not only because this instructional method provides the characteristics of convenience, flexibility and interaction, but also because it offers abundant opportunities for students to acquire the targeted knowledge or skills (Kooiman & Sheehan, 2014).

Demonstrating a motor skill in front of students is a fundamental and effective teaching approach (Lee *et al.*, 1991; Wulf *et al.*, 2005). According to some researchers (Bandura, 1986; Granados & Wulf, 2007), most people can acquire motor skills by observing a model. This acquisition process consists of several essential elements necessary for an observer to remember the model's behaviour to generate proper information to develop cognitive representation for regulating motion (Carroll & Bandura, 1990). In addition, the results of Carroll and Bandura (1990) have also suggested that the more one is exposed to the modelled motions, the more accurate one's cognitive representation and behavioural reproduction will be.

In implementing Web-based instruction for motor learning, many researchers and educators are seeking the solution of replacing real live modelling with video demonstration. Examples of adopting this approach include using an online video-based learning environment to facilitate acquisition of ballet by college students (Leijen *et al.*, 2009), and developing computer-based instructional video lessons to help college students acquire the fundamental skills associated with golf swings (Huang, 2000). Similarly, basketball (Papastergiou & Gerodimos, 2013) and gymnastics skills (Lim & Koh, 2006), were also enhanced by using Web-based multimedia. Although the findings from both studies identified positive impacts on the learning of participants, it is still uncertain whether the same effects will appear in connection with implementing online video-based PE in an elementary school context.

Researchers of multimedia instruction (Mayer *et al.*, 2005) have proposed that static media (like pictures), offer the opportunity for better management of intrinsic processing; in which one cannot only control the pace and sequence of presentations, but also engage in deeper processing by mentally making inferences or connections with the pictures. Thus, in addition to online video-based instruction, this study also attempted to examine the effects of online picture-based instruction on students' acquisition of motor skills. Although the video-based and picture-based modes of instruction can be cost-effective and time-efficient, utilising these materials as alternatives to live instruction, especially for the motor acquisition of elementary school students, is unknown currently.

PURPOSE OF RESEARCH

The purpose of the present study was to determine whether different modes of instruction affect the learning of the martial art Baduanjin, as measured by a retention test of performance skills conducted immediately after the instruction sessions and again after 4 weeks. This study was intended to answer the research question: What were the effects of picture-based, video-based, and live-modelling instruction on the students' acquisition of the martial art? Since previous studies have pointed out that live modelling is an effective and efficient instructional approach for motor learning, this study was designed to assess whether video- or picture-based instruction can be as effective as live-modelling instruction.

METHODOLOGY

Ethical approval

After submitting the manuscript proposing the research to the Human Subject Committee of the National Taiwan Sport University, ethical clearance was approved. The results reported in this article were undertaken in compliance with the current laws of the country in which the experiments were performed. The authors accept full responsibility for the statements made.

Participants

Through convenience sampling, 3 classes in an elementary school of Northern Taiwan were recruited to participate in the present study. There were 81 fourth graders recruited in total. Of these students, 4 were excluded from analysis because they failed to take either the retention or the delayed retention test due to being injured or physically ill. The remaining 77 subjects were in the 3 classes and each class was assigned randomly to 1 of the 3 groups. These groups entailed the 'picture group' utilising pictures and text as the main instructional sources (11 males and 13 females); the 'video group' using video and text (12 males and 12 females); and the 'live demonstration' group, in which the students learned the motor skills face to face with a martial arts expert (16 males and 13 females). The participants were informed and everyone returned consent forms signed by their parents. The self-reported data showed that none of the students had ever learned this particular martial art before. In addition, the physical fitness of the participants was examined and no statistically significant differences were found in the scores for their body mass index ($F_{(2, 74)}$= 1.41; p>0.05), flexibility ($F_{(2, 74)}$= 2.10; p>0.05) or strength ($F_{(2, 74)}$= 0.01; p>0.05), suggesting that the physical ability of each group could be considered equal.

Experimental instrument

A Baduanjin learning system was developed by the researchers to facilitate the teaching of this popular Chinese martial art. Baduanjin consists of 8 sections: 1) Pressing up to the heavens with two hands; 2) Drawing the bow and letting the arrow fly; 3) Separating heaven and earth; 4) Wise owl gazing backward; 5) Big bear turning from side to side; 6) Punching with an angry gaze; 7) Touching the toes then bending backward; and 8) Shaking the body. Each section contains sub-motions numbered 9 to 18, which are listed in Table 1. Indicators of the levels of difficulty and duration of each section, suggested by the Baduanjin expert, are also provided. As shown, sections 2 and 3 have a high difficult level, while sections 1 and 8 have a low level of difficulty. The duration of the difficult sections tends to be longer than that of the less complex sections.

TABLE 1. **DESCRIPTION OF BADUANJIN SECTIONS**

Name	**Section 1**	**Section 2**	**Section 3**	**Section 4**	**Section 5**	**Section 6**	**Section 7**	**Section 8**
Num. of sub motions	12	18	15	12	15	18	15	9
Duration/ seconds	24	40	45	26	41	29	31	5
Level of difficulty	Low	High	High	Low	Medium	Medium	Medium	Low

The Baduanjin learning system used here was designed by, first, filming the demonstration of an expert who has been practising and coaching Baduanjin for more than 10 years. The video content was separated into 8 pieces corresponding to the 8 sections of Baduanjin. The narration of the expert was transcribed into text and the researchers examined the text information for the 3 groups to make sure that they were identical. Students in the video group could watch the video clip and read the text guidance. They could also pause and replay the clip if needed (Figure 1).

FIGURE 1. **INTERFACE OF LEARNING SYSTEM FOR VIDEO GROUP**

The illustrations used in the picture group were extracted from the key images of the video clip. The students could look at the images and read the text guidance located below the pictures (Figure 2). The text guidance was presented in Mandarin Chinese. The images could be enlarged by clicking on them. No specific learning sequence was imposed while using either the picture- or video-based instruction. That is, the participants were allowed to select which motion to learn first. Both systems conveyed the same information, but it was presented differently.

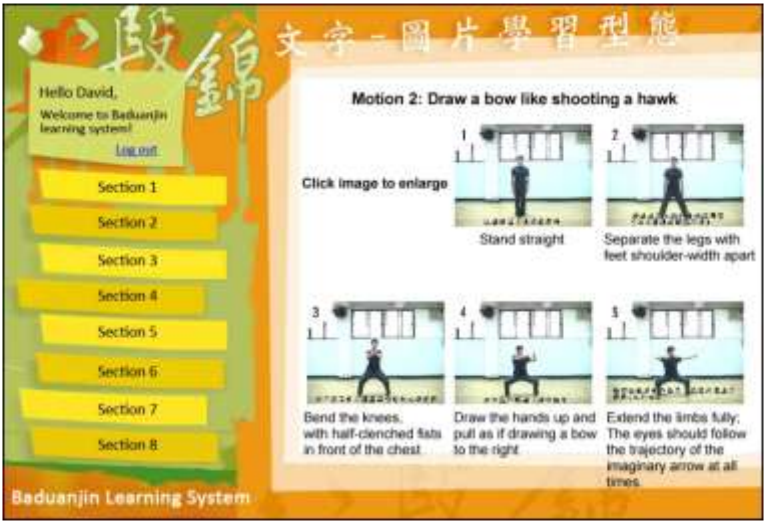

FIGURE 2. **INTERFACE OF LEARNING SYSTEM FOR PICTURE GROUP**

Procedure

The instruction sessions took place 4 times within 2 weeks (on every Monday and Thursday). Each session lasted 40 minutes. At the beginning of the first instruction session, the researcher offered a brief introduction of the research and its purposes to all the groups. All participants were aware that they would undergo an evaluation of their learning after completing the 4 instruction sessions.

The experiments for the 'picture' and 'video' groups were conducted in a computer lab. Each student worked individually at a computer and was asked to sit separately (with 1 empty seat on either side) to ensure sufficient space to practise. To start the instruction session, the students were given a code and password to log into the system, which allowed the researchers to track history of usage of the participants. They were told to remain silent during the activity and to raise their hands if they had any questions related to using the system. During each instruction session, the participants went through each section of the instructional media and practised Baduanjin at their own pace.

The instruction sessions for the live-modelling group took place in the gym. The students learned Baduanjin from an experienced instructor whose teaching guidance was identical to the content being viewed by the picture and video groups. The teacher spent 10 minutes on demonstration and the remaining 30 minutes on observing the practise of the students. During the practise, no discussion among the students was allowed and the instructor gave no feedback on their performance. This was to maintain the balance of the research design since immediate feedback is less likely to be given when self-learning motor skills through an online learning system.

Evaluation measurement

An immediate and a 4-week delayed retention test were conducted to evaluate the motor performance of the students after the instruction sessions had concluded. Each group was divided into 3 subgroups. When 1 subgroup was receiving a test, the other 2 were in a separate room watching a movie that was unrelated to the targeted content of the present study. To prevent the students of the subgroup from being able to imitate one another during the test, the researcher had each participant pick up a card printed with a sequence of codes (from 1 to 8, representing the 8 sections of Baduanjin), where each sequence had a different initial number. Thus, every student worked through the 8 sections of Baduanjin in a different sequence. In addition, 2 video cameras were set up to record the performance of the students from the front and front-right views. The researcher separated the video clips of the performance and named them according to the ID numbers of the students.

Two qualified PE teachers were invited to grade the student clips using an evaluation form designed by the Baduanjin expert. Both teachers had been learning Baduanjin for 2 years. Each section of Baduanjin was measured at 3 stages: preparation; pre-motion; and post-motion. During these stages, every student was graded in terms of their eyes (whether he or she was looking at the designated spot), body, limbs, footsteps and conformance with rules (whether the motion was performed at the appropriate pace). Due to the different complexities of the 8 sections of Baduanjin, each section was evaluated based on 8 to 13 criteria using a 5-point Likert scale (where “1” = inaccurate and unskilful, and “5” = accurate and skilful). The full scores for each section, ranging from 40 to 65, were converted into percentages. A person’s overall performance was captured by the average of the scores on the 8 sections. The tester reliability of the 2 graders reached Cronbach’s α-value of 0.88 (suggested adequate value >0.70), indicating good internal consistency (Allen & Yen, 2002). A 4-week delayed retention test was conducted following the same process as that of the first retention test.

Data analysis

A series of one-way analysis of variance (ANOVA) was employed in this study to examine differences in the retention and delayed retention scores of the students. Following ANOVA, Scheffe analyses were performed to identify differences among groups. All statistical analyses were conducted and significance awarded at the level of $p<0.05$.

RESULTS

ANOVA analyses were applied to compare the participants’ scores on the immediate and the delayed retention tests. Once a significant F-value was identified in the analysis, post hoc tests were used to examine the significance of all possible pair-wise comparisons among groups. Table 2 shows the performance of the students on the retention and delayed retention tests. As shown, the students in the ‘live-modelling’ group had the highest accuracy rate in the retention (68.83±14.96%) and delayed retention test (63.27±10.42%), whereas those in the ‘picture-based’ group had the lowest accuracy rate in the retention (50.48±17.28%) and delayed retention test (43.83±14.30%).

Meanwhile, statistically significant differences were identified in the retention ($F_{(2, 74)}$= 9.62;

p<0.01) and delayed retention scores ($F_{(2, 74)}$= 15.71; p<0.001), of the participants. Furthermore, a series of post hoc tests (Scheffe tests) were performed to compare further the differences among the groups. The results indicate that students in both the 'video' and 'live-modelling' groups scored significantly higher than those in the 'picture group' did in both the retention and delayed retention tests.

TABLE 2. **ANALYSIS OF PERFORMANCE OF STUDENTS ON RETENTION AND DELAYED RETENTION TESTS**

Group	**Retention** Mean±SD	**Delayed retention** Mean±SD
(1) Picture group (n=24)	50.48±17.28	43.83±14.30
(2) Video group (n=24)	62.32±13.34	54.90±13.11
(3) Live modelling group (n=29)	68.83±14.96	63.27±10.42
F (ANOVA)	9.62***	15.71***
Post hoc tests	(2)>(1), (3)>(1)	(2)>(1), (3)>(1)

*** p <0.001

DISCUSSION

While the integration of technology into motor learning has seen an increasing trend in the last decade (Hergüner, 2011; Kizilet, 2011), there is still a lack of studies on implementing technology, particularly the Internet, in PE in the elementary school context. The present study was conducted to examine the effects of the 'picture-based', 'video-based' and 'live-modelling' modes of instruction on the acquisition of Baduanjin skills by fourth graders. The results of the immediate and the delayed retention tests indicate that the 'video' and 'live-modelling' modes of instruction were more effective than the 'picture-based' instruction. That is, learners in the 'picture-based' group tended to make a greater number of errors than those who received the 'video-based' and 'live-modelling' instruction. This finding is indicative of the results of Reo and Mercer (2004), where the effect of using live modelling, videotape, and hand-outs (containing pictures and text), on learning an exercise programme was compared. They found that students who received 'live-modelling' or 'video' instruction outperformed those who learned from 'reading the hand-out materials' on both the immediate and delayed retention tests.

According to Shea *et al.* (2000), novice learners tend to benefit greatly from direct observation of demonstrations together with physical practise as they can extract relevant information regarding proper coordination patterns and evaluate strategies. This may be a factor contributing to the positive impacts of both 'video-based' and 'live-modelling' instruction in this study. 'Picture-based' instruction, despite offering the key pictures of each movement, does not seem to provide sufficient information for learners to perceive the coordination and in-between actions of the complex Baduanjin movements. Based on findings of the present study and previous research, it is preferable to utilise 'video' content rather than 'static pictures' when designing digital learning materials for motor learning.

Many studies have indicated that immediate feedback plays a critical role in the learning of motor skills (Newell, 1991; Winstein *et al.*, 1996). However, immediate feedback was controlled in the present study because it remains challenging to provide it through either online 'picture-based' or 'video-based' instruction. Thus, to maintain the balance of the experimental design, immediate feedback was not provided to the live-modelling group. Although the results show that online 'video-based' instruction can be as effective as 'live-modelling' instruction, future research should develop ways to improve online video-based instruction. Some suggestions include, to begin with integrating cooperative learning into teaching (Granados & Wulf, 2007); that is, having students practise 'video-based' motor learning activities online in dyads to allow them to conduct observations and do peer assessments on each other.

Studies have found that watching novice demonstrations can also promote the acquisition of the motor skills of students (Lee & White, 1990; Rohbanfard & Proteau, 2011). This is not only because an unskilled model can provide valuable information for improving the task, but also because the observer can be engaged in the problem-solving process involved in motor acquisition (Adams, 1986). Thus, the second approach to improve online 'video-based' instruction is to provide a pool of video clips of demonstrations not only by an expert model, but also by a novice model for learners to observe. An interesting topic drawn from this discussion is whether there is any difference in the effectiveness of first presenting a novice demonstration or an expert demonstration. Another suggestion for future studies is to examine the impact of the ages of participants on the learning outcomes. It is likely that Grade 4 learners might learn differently from older or younger grades. In addition, the sample size of this study was small and the participants were from one school thus, the results could not be generalised. Future studies should avoid these issues.

CONCLUSION

To summarise, this study found that 'video-based' and 'live-modelling' instruction are more effective than 'picture-based' instruction in this group of children. Particularly, when there is no live model to imitate, video and text can be an effective learning tool to facilitate motor acquisition. The prevalence of child obesity is increasing rapidly worldwide (Han *et al*., 2010). Offering alternative approaches to motivate participation in physical activities anytime and anywhere has thus become of great importance. Online 'video-based' instruction can be an ideal option. Further research is needed to examine how different modes of instruction can promote the motivation of the learner to participate in activities or to perform motor skills that are more complex. In addition, since the age of the participants might play an essential role in the results, further research should also address the effects of these instructional media on participants of different ages.

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(Subject Editor: Dr Dorita du Toit)