Instructional Design Effects for Learning Motor Tasks

Peter Iserbyt
Katholieke Universiteit Leuven
Tervuursevest 101,B-3000 Leuven, Belgium
Peter.Iserbyt@faber.kuleuven.be

Abstract. This research introduces instructional design effects in the psychomotor area. Ninety university students learned Basic Life Support (BLS) individually and with task cards as the only source of information. Students were randomly divided into three groups, differing in the design of the task cards: (1) a text-only group, (2) a text + picture group, and (3) a picture with integrated text group. In doing so, two design effects previously defined by Mayer (2005), namely multimedia and spatial contiguity, were tested for learning Basic Life Support with task cards. Students were assessed before (baseline), immediately after (intervention), and three weeks later (retention). Additionally, transfer was tested. Repeated measures ANOVA revealed no differences between groups for total BLS scores. At intervention, significantly more students from the integrated group remembered and consequently performed all items from the BLS procedure compared to students from the text + picture group. For one of two transfer tests, the integrated group was significantly better than both other groups. Results from this lab study partly confirm previous multimedia research indicating better learning with the implementation of multimedia and spatial contiguity design principles.

Keywords: instructional design; multimedia; Basic Life Support; spatial contiguity

Introduction

Multimedia learning occurs when people build mental representations from words (such as spoken text or printed text) and pictures (such as illustrations, animations, photos, etc.). Multimedia refers to the presentation of words and pictures, whereas multimedia learning refers to the construction of knowledge (Mayer, 2005). Multimedia instructional tools are increasingly implemented in the domain of Physical Education. Many studies in this field report the use of 'static task cards' to guide student learning (Barrett, 2005; Iserbyt, Elen, & Behets, 2010). These task cards usually have the size of an A4 page, and combine a picture of the skill with written instruction about how to perform the skill. In Physical Education classes, these task cards are used to complement teacher instruction, to support student learning during practice, and to keep students on task. However, despite the widespread use of this instructional tool, specific research addressing its design is lacking in the psychomotor area. Therefore, the experiment described in this abstract is the first from a new line of research addressing multimedia design effects for learning psychomotor tasks. At first, the principles of multimedia and spatial contiguity are investigated. The multimedia principle states that people learn more deeply from words and pictures than from words alone. The spatial contiguity principle states that people learn more deeply when corresponding words and pictures are placed near to each other on the page or screen instead of far. Students in this study had to learn Basic Life Support (BLS) with task cards as the only source of information to learn the task. BLS consists of nine lifesaving actions to be performed in a specific order.

Methods

Participants, experimental procedures and groups

Ninety university students participated in this study. Prior to the experiment students received standardized instructions on a laptop computer, describing an emergency scenario. Students' actions were assessed as baseline. Following baseline assessment students were randomly divided in three groups to learn BLS in ten minutes with task cards. Groups differed in the design of the task cards: (1) text-only, (2) text + picture, and (3) picture with corresponding text placed near to each other (integrated text). In every group, eleven task cards were used to learn BLS and their content was developed according to the European Resuscitation Council 2005 guidelines (Handley et al., 2005). They comprised the instruction of nine BLS items: safe approach, check responsiveness by shaking gently and shouting loudly, shout for help, open airway, check for breathing, call 112, perform thirty chest compressions, perform two ventilations and continue the 30-2 sequence. The performance of chest compressions and ventilations were both instructed on two task cards because of the complexity of these skills. All task cards had an A4 format. Following the learning phase students were assessed on their BLS performance (intervention). Three weeks later, students were re-assessed on BLS performance (retention) and performed a transfer test to assess problem solving ability.

Assessment of BLS performance

All BLS assessments were videotaped and individually completed on a Laerdal AED Resusci Anne manikin connected to a laptop running the Laerdal PC-Skill Reporting system version 2.0 (Laerdal Medical, Vilvoorde, Belgium). This software recorded the following CPR variables: total number of compressions, average compression depth, average compression frequency, hand position, duty cycle, total number of ventilations, average ventilation volume and flow rate, and compression-ventilation ratio. In addition, qualitative assessment was made by two scientifically blinded researchers. These researchers were certified BLS instructors, naive to the purpose of this study. They evaluated the following variables from BLS videotape recordings: safe approach, check responsiveness by shaking gently and shouting loudly, shout for help, open airway, check for breathing, call 112, continue 30-2 sequence, performed all BLS skills and performed all BLS skills in correct order. To calculate the overall BLS performance, CPR data from the manikin and observational data were entered in a scoring system based on the Cardiff test (Whitfield, Newcomb, & Woollard, 2003). Total BLS scores could range between 18 and 73 points. At baseline, participants were given 2 min to act as best as possible. At intervention and retention, assessment was stopped after participants performed three compression-ventilation cycles.

Statistical methods

Total BLS scores at baseline, intervention, and retention were analysed using repeated measures ANOVA. Scheffé's test was conducted for post hoc analysis. Individual BLS items and transfer tests were analysed using one-way ANOVA. For all statistical testings a p value less than .05 was considered statistically significant.

Results

Repeated measures ANOVA found no differences in total BLS scores between groups. All groups demonstrated high learning gains, with significant differences for total BLS scores between baseline and intervention ($p < .01$) and between baseline and retention ($p < .01$). From intervention to retention, however, a significant drop in learning gains was revealed ($p < .01$). Analysis of individual BLS items at intervention revealed a significant effect for 'demonstrating all BLS items'. Significantly more students from the integrated group remembered and consequently performed all nine BLS items compared to students from the other groups.

For one of two transfer tests, the integrated group was significantly better than the text + pictures group ($p < .05$).

Discussion

Results from this lab study provide small proof for the beneficial effect of design principles in instructional tools like task cards, which is in contrast to previous multimedia research from Mayer (2005). No significant differences were found between groups for the total BLS scores. Only for one transfer test and the performance of all nine BLS items at intervention a significant difference was found. Two possible explanations are suggested to explain results in this study: time and cognitive load.

First, the time given to learn BLS with task cards in this lab study was 10 minutes. Maybe this time period was too long, resulting in no significant differences between groups. With enough time to learn, students working with poorly designed tools could catch up their counterparts working with better designed tools. Support for this statement can be found in previous research, indicating that design effects decrease with longer exposure times and control over tool use.

Secondly, implementation of design effects is believed to reduce cognitive load. Reducing cognitive load facilitates learning (Chandler & Sweller, 1991). However, it could be stated that the cognitive load for learning BLS within this target group of university students was not high enough to benefit from load reduction through design manipulation. Further research in this area is recommended.

References

Barrett, T.M. (2005). Effects of cooperative learning on performance of sixth grade physical education students. *Journal of Teaching in Physical Education*, *24*, 103-111.

Chandler, P., & Sweller, J. (1991). Cognitive load theory and the format of instruction. *Cognition and Instruction* , *8*, 293-332.

Handley, A.J., Koster, R., Monsieurs, K., Perkins, G.D., Davies, S., & Bossaert, L. (2005). European resuscitation council guidelines for resuscitation 2005: Section 2. Adult basic life support and use of automated external defibrillators. *Resuscitation, 67,* S7-S23.

Iserbyt, P., Elen, J., Behets, D. (2010). Instructional guidance in reciprocal peer tutoring with task cards. *Journal of Teaching in Physical Education, 29*(1), 38-53.

Mayer, R.E. (2005). *The Cambridge handbook of multimedia learning.* New York: Cambridge University Press.

Whitfield, R.H., Newcombe, R.G., & Woollard, M. (2003). Reliability of the Cardiff test of basic life support and automated external defibrillation version 3.1. *Resuscitation, 59*, 291-314