Using computer animation for emergency medicine education

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Abstract: An experiment was conducted to investigate the effectiveness of animation for emergency medicine education. Two groups of participants were assessed on their ability to respond to three medical emergency situations in simulated test scenarios. The control group received instruction in traditional lecture/demo format, whereas the experimental group received instruction from a computer animation. Participants' knowledge of the medical emergencies response procedures was assessed according to speed and accuracy of the treatment, and ability to complete every step and execute the steps in the correct order. Results revealed no statistically significant difference in procedural knowledge between the control and experimental groups.

Keywords: animation-assisted education; computer animation; e-learning; educational technologies; emergency medicine; medical education; online training; technology-assisted learning.


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Tim McGraw received his PhD in Computer and Information Science and Engineering from the University of Florida. He is an Assistant Professor of Computer Graphics Technology. His areas of interests include biologically inspired graphics, medical image processing and visualisation. Specific projects include diffusion tensor MRI (DT-MRI) denoising and visualisation, and mesh processing. He was awarded four patents related to DT-MRI visualisation projects performed with Siemens Corporate Research. He has previous industry experience as a Mechanical Engineer and as a game developer (Electronic Arts, Schell Games, Rainbow Studios).

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1 Introduction

Previous studies have investigated the potential of animation technology for improving students’ ability to visualise bodily systems and structures. Research shows that animation technology can assist healthcare students in visualising the spatial features and interconnections of complex inner structures of the human body (Vernon and Peckham, 2002; Ruiz et al., 2009). However, the application of 3D animation in emergency medicine education remains almost completely unexplored. The study reported in the paper aimed to determine the efficacy of educational computer animations for healthcare students’ learning of three medical emergency procedures. In addition, the study investigated the students’ perception of computer animation as a learning tool for emergency medicine. The paper is organised as follows: in Section 2, we give an overview of medical emergencies, and we report prior research on the use of animation for education in general and for medical education in particular. In Section 3, we describe the study and present the findings. Discussion and conclusion are included in Section 4.

2 Background

2.1 Medical emergencies

A prospective observational study conducted at a university-affiliated tertiary referral hospital between July 2008 and December 2009 examined the role that time of response plays in emergency medical situations (Boniatti et al., 2014). Of the 1,481 emergency calls corresponding to 1,148 patients, 246 (21.4%) of the patients experienced delays in receiving care from an emergency medical team. In addition, mortality was higher among patients with delayed medical emergency team activation (152 [61.8%]) than among patients receiving timely medical emergency team activation. In other analyses, delayed or inadequate medical emergency response treatment remained significantly associated
with higher mortality (O’Shea, 2007). These findings reaffirm the urgent need for rapid response systems and the importance of effective medical emergency education.

A large variety of emergency situations are typically covered in medical emergency curricula. Three specific situations were selected for this study: choking, drowning and lower bone fracture. These particular emergencies were chosen because their treatments require relatively little time to administer and are neither too difficult to teach in a single class session nor so simple that they might be guessed by individuals with no medical training.

2.1.1 Drowning

According to the new definition adopted by the World Health Organisation (WHO) in 2002, “Drowning is the process of experiencing respiratory impairment from submersion/immersion in liquid.” Also according to the WHO, 0.7% of all deaths around the world (more than 5,00,000 deaths each year) occur because of unintentional drowning. However, this count may be low: “since some cases of fatal drowning are not classified as such according to the codes of the International Classification of Disease, this number underestimates the real figures, even for high-income countries, and does not include drowning that occurs as a result of floods, tsunamis, and boating accidents” (Szpilman et al., 2012).

2.1.2 Choking

Despite its frightening reputation, foreign-body airway obstruction (choking) is potentially the most reversible acute emergency imaginable (Kloeck, 2007). However, quick and adequate response is critical to administer life-saving care in the event of choking. Once the airway is totally blocked, progressive hypoxia develops immediately and is rapidly followed by unconsciousness and death unless immediate relief is provided. This medical emergency is particularly pernicious because it is difficult to predict. It can potentially happen to anyone at any time, regardless of that person’s health, physical condition, sex, or age. For this reason, it is beneficial for emergency medical procedures for treating choking to be well known by the general population.

2.1.3 Bone fracture

Every year roughly 2 million people are admitted to emergency rooms (ERs) in the US with long-bone fractures (LBF). Most of the patients present moderate to severe pain as result of the fracture. In a study by Minick et al. (2012), which included 218 patients admitted to the ER with LBF, 36% of the patients received inadequate care and pain management while in the ER. Patients who received adequate care and pain medication (n = 126) waited for 1.76 h (±1.47).

2.2 Computer animations and students’ learning

Researchers have studied the influence of computer animations on students’ learning through various experiments and have achieved conflicting results. Although some experiments demonstrate the efficacy of animation as a learning tool (Dooley et al., 2000; English and Rainwater, 2006; Wilson and Dwyer, 2001; Nilforooshan et al., 2013), other
studies suggest that animations can be distracting with little or no positive effect on learning (McGregor et al., 2003; Park and Hopkins, 1993).

Those researchers who believe computer animation is an effective instructional device argue that the main strength of animation is the fact that it can represent information in different modalities: images, words (text or narration) and motion (Tversky et al., 2002), and several modalities are more beneficial than one for learning. Moving graphics can attract the viewers and attain audience motivation (Sirikasem and Shebilske, 1991), and animation can play an effective instructional role by engaging the viewer, guiding attention, representing motion-related knowledge and explaining complex concepts in simple steps (Park, 1998). Another benefit of animation is its ability to explain a dynamic and changing process. Through animations, students can develop better mental pictures of a system, activity or procedure that leads to a higher understanding of complex concepts (Tversky et al., 2003; Taylor et al., 2008; Wu and Shah, 2004; Xiao, 2013).

Researchers who are skeptical about the potential of educational animations include Gerjets and Scheiter (2003) and Paas et al. (2007) who argue that 3D animations lead to a cognitive overload and, subsequently, a decrease in learning. Tversky et al. (2002) state that animations may be ineffective because they violate the second principle of good graphics, the Apprehension Principle, according to which graphics should be accurately perceived and appropriately conceived. “Animations can be too complex or too fast to be accurately perceived. …Animations may be more effective than comparable static graphics in situations other than conveying complex systems, for example, for real time reorientations in time and space.”

In summary, the literature shows no consensus on the potential benefits and drawbacks of digital animation for teaching and learning. Furthermore, many experiments that investigated the educational efficacy of animation have caveats. Some studies did not compare animations with equivalent information conveyed in static graphics; therefore, it was not possible to determine if the difference in learning was due to the use of images or the use of moving images. Other studies have not used equivalent procedures; for instance, the animation condition allowed interactivity whereas the static condition did not, so that benefits may be due to interactivity rather than animation (Schnotz and Grzondziel, 1999). In some experiments, the successes of animation seem to be due to advantages in extra information conveyed or additional procedures, rather than the animation of the information per se.

The study reported in the paper attempts to overcome many of the limitations of previous studies and shed light on the educational potential of digital animations for students’ learning of medical emergencies.

2.2.1 Computer animations for medical education

In recent years, 3D visualisation and animation technologies have been increasingly applied to the field of medicine not only in research and clinical roles but also educational ones (Tait et al., 2012). A few examples of application of animation to medical education can be found in the literature; however, few studies that compare the effectiveness of animation to other pedagogical approaches have been published, and the evidence is inconclusive (Ruiz et al., 2009).

Vernon and Peckham (2002) have explored the value of using computers and specialised software to create 3D anatomical and biological models as well as their
possible influence in facilitating medical education. The study concludes that 3D models, though expensive to produce, are easy to share electronically and have the potential to give students the opportunity to gain surgical experience without any danger to patients via simulated surgical environments. The study’s conclusions also note that application of 3D modelling and animation allows for visualising subjects and scenes that could never be captured on film.

A recent study investigated the effect of 3D animation on the increase and recall of knowledge on periodontitis by patients affected by this condition (Cleeren et al., 2014). The study conducted a comparison between the effects of a 3D animation (experimental group) and narration and drawing (control group). The experiment consisted of four steps:

1. a pre-test (to assess baseline knowledge)
2. each patient receiving one type of education (3D animation or control video)
3. a post-test (to assess knowledge immediately after viewing the animation)
4. a follow-up test (to assess knowledge recall after 2 weeks).

Findings from the study show that 3D animations are more effective than real-time drawings for knowledge recall. Thus, 3D animations may be a powerful tool for assisting in student information retention.

Another recent study compared the skill retention of an intervention group to a control group in a single-blind randomised controlled trial (Choa et al., 2009). Participants were randomised into two groups: the AA-CPRII group (n = 42) and the control group (n = 38). Both groups were asked to perform three cycles of CardioPulmonary Resuscitation (CPR) though their performances were recorded on video. Each group was composed of laypeople (non-medical professionals) who had had their most recent CPR training at least six months before the experiment. The intervention group was given animation-assisted CPR (AA-CPRII) instruction on their cellular phones, whereas the control group relied on whatever they could recall from their previous training. A checklist was used by three evaluators to assess the educational animations. The psychomotor skills of participants were also evaluated.

The results of this study show that the experimental group had a significantly better score than the control group ($p < 0.001$). In terms of psychomotor skills, the experimental group demonstrated better performance in hand positioning ($p = 0.025$), compression depth ($p = 0.035$) and compression rate ($p < 0.001$) than the control group. The researchers note with optimism that “animation-assisted CPR could be used as a review tool for achieving effective one-person-CPR performance”.

Despite these few studies, existing medical education research does little to inform the use of animations (Ruiz et al., 2009). Additional research is needed to reveal the true potential of animation and ascertain when to use animations and how to use them effectively.
3 Description of the study

The objective of the study reported in the paper was to determine whether computer animation is as effective (and therefore could replace) as traditional instruction for healthcare students’ learning of emergency medical care response procedures. More specifically, the study compared two educational approaches: lecture based and animation based. The study used an ex post facto experimental design. It included both treatment group and control group and collected data both before and after the two groups were exposed to the educational interventions.

The dependent variables of the experiment were the students’ performance scores, e.g. accuracy score, completion score, speed score, order score and total score (sum of the four separate scores). Accuracy refers to how accurately the students were able to perform the procedure compared with the literature practices (for instance, whether they touched the right position on the victim’s body). Speed refers to how quickly the students performed the treatment and also whether they used proper rhythm for chest compression and face-to-face breaths: in general, prompt and quick emergency medical care is crucial for patient survival in medical emergencies, though the rhythm for the specific activities mentioned cannot be too quick or it can cause harm to the patient. Completion refers to whether the students were able to finish the treatment without omitting any important procedures. Order refers to whether the steps of the medical treatment are administered in the proper order - some actions used for emergency medical care may waste time or cause harm if they are not performed in the correct sequence.

In addition, the subjective comments of the participants on their perception of the animation were recorded and are discussed in Section 3.7.

The study aimed to answer the research question of whether watching the educational 3D animation of medical emergency response (which we call DCF animation - drowning, choking, fracture) lead to learning gains that are equivalent to receiving traditional instruction (e.g. instructor’s lecture + demo). In addition, the study investigated whether there is an interaction between gender and learning gains.

To answer the research questions, the following alternative hypotheses were considered (five for male participants and the same five for female participants):

- $H_{11}$: Watching the DCF animation leads to male participants’ ‘accuracy scores’ that are equivalent to receiving traditional instruction.
- $H_{21}$: Watching the DCF animation leads to male participants’ ‘speed scores’ that are equivalent to receiving traditional instruction.
- $H_{31}$: Watching the DCF animation leads to male participants’ ‘completion scores’ that are equivalent to receiving traditional instruction.
- $H_{41}$: Watching the DCF animation leads to male participants’ ‘order scores’ that are equivalent to receiving traditional instruction.
- $H_{51}$: Watching the DCF animation leads to male participants’ ‘total scores’ that are equivalent to receiving traditional instruction.

The same five hypotheses were considered for the female participants.
3.1 Procedure

Each participant in the study progressed through four steps: pre-test, group assignment, educational intervention and post-test. The experiment began with a pre-test for all the participants that was designed to determine the subjects’ knowledge of medical emergency procedures. The pre-test required each student to respond to three medical emergencies (e.g., drowning, choking and bone fracture) and to provide appropriate treatment. For drowning, a medical model of a human body was provided, and the student was asked to do what he/she knew about drowning treatment. For choking, a teacher of the department pretended to be choking, and the student was asked to deal with the situation. For lower bone fracture, each student was asked to help a person lying on the ground pretending to have a bone fracture. The participants’ performances were recorded and evaluated by a medical expert.

After the pre-test, the participants were divided into two groups of 34 students each. A randomised complete block design was used to divide the subjects into two groups with similar pre-knowledge. In other words, we used the pre-test scores to group individuals in terms of pre-knowledge and then made sure these groups of individuals were equally assigned to the two intervention groups, e.g., group A (experimental group) and group B (control group). A randomised complete block design ensures that the two sample groups are well balanced and comparable.

The control group attended a 20 min lecture and demo on medical emergency response delivered by one of the instructors, whereas the experimental group went to the lab and watched the DCF animation four times (for a total time of approximately 20 min).

After the educational interventions, all participants completed the post-test, which was identical to the pre-test. The participants’ performance, which required the subjects to act out their response by interacting with a volunteer or medical model, was recorded and evaluated by a medical expert. Comparing participant performance on the post-test with the pre-test allowed for an assessment of learning gain.

3.2 Participants

The experiment was conducted at a medical school in China. All of the participants were first-year nursing students who had no or very little background in emergency medicine (with the exception of those who may have achieved some knowledge of emergency medicine through their own extracurricular efforts). The participants were randomly selected among first-year students, they had similar grades, learning ability and level of background knowledge relating to medical emergencies.

3.3 Stimuli

Stimuli included a lecture and a demo on medical emergencies delivered by an instructor (for the control group) and the DCF animation (for the experimental group). The lecture provided the students with background knowledge on medical emergencies, medical terminology, anatomical terms and body systems, whereas the demo was a hands-on demonstration of the treatment procedures performed by the instructor. Figure 1 shows two photos taken during the lecture and demonstration.
Using computer animation for emergency medicine education

**Figure 1** Photos of traditional lecture (left) and demo (right) (see online version for colours)

The DCF animation was created in Autodesk Maya and Adobe After Effects. It included three 3D sequences illustrating the treatment procedures for drowning, choking and bone fracture, explanatory text and 2D diagrams. The explanatory text was written by an expert in medical emergencies, who also contributed to the design of the sequences and diagrams. The total length of the animation was 4 min and 30 s. Figure 2 shows four frames extracted from the DCF animation.

**Figure 2** Four frames extracted from the animation: drowning treatment (top); bone fracture treatment (bottom left); choking treatment (bottom right) (see online version for colours)

The design of the animation was guided by several of the principles for effective use of animation in multimedia learning developed by Mayer and Moreno (2002) and Mayer (2008, 2009). In particular, the principles that informed the design of the animation include
− *Multimedia Principle* - People achieve greater learning when they receive information from more than one media source at the same time. In the DCF animation, information is presented concurrently in different media formats: moving images, diagrams and text.

− *Spatial Contiguity and Temporal Contiguity Principles* - Learning is increased when corresponding words and pictures are presented near rather than far from each other on the screen and simultaneously rather than successively. In the DCF animation text, 3D images and 2D diagrams are presented concurrently and next to each other (see Figure 2).

− *Segmenting* - Learning is promoted when instructional materials are broken down in small segments and learners have control over the pace of presentation. Students may become confused with continuous presentations, since they must make mental connections to integrate information from presented multimedia (Schnotz and Bannert, 2003). Although segmentation in the DCF animation is not under the learners’ control, the content of the animation has been segmented into three parts, and for each medical emergency, the response procedure has been further segmented into fundamental steps.

− *Signalling* - People learn better when cues that emphasise the structure and organisation of the conceptual message are added in key locations. In the DCF animation diagrams and graphics (e.g. arrows) are added throughout the animation to clarify the explanations and highlight certain points.

− *Personalisation Principle* - People learn better from multimedia lessons when words are in conversational style rather than formal style. In the DCF animation, all textual explanations are written in a non-technical style.

### 3.4 Evaluation instruments

The performances of each student in both pre-test and post-test were graded by an expert from the Department of Nursing who was either a teacher of an emergency medicine class or a nurse in a Hospital’s Department of Emergency Medicine. The experts evaluated the students’ performances using a scoring sheet that included four criteria: accuracy, speed, completion and order. All four criteria were rated from 1 to 5, with 1 standing for poor knowledge and inadequate performance and 5 standing for excellent knowledge and perfect performance.

After the post-test, the participants in the experimental group were asked to take a brief survey. The survey included questions regarding the subjects’ attitudes/perceptions towards computer animation and suggestions for improvement. The questions included in the survey are reported below:

1. Compared to lecture-based education, what advantages and disadvantages do you think animation-assisted instruction has?
2. Did you find the animation useful and informative? Was any part of the animation confusing to you?
3. From your perspective as a healthcare student, do you have any suggestions for improving the animation?
4 Drowning, choking and bone fracture were chosen for this animation because their causes and the procedures for their treatment are easily representable via animation. As a healthcare student, what other medical issues do you think could be taught using computer animation?

3.5 Statistical data analysis

For the statistical analysis, we used the following notation:

- Group A = experimental group; group B = control group; MA, FA = male students, female students in group A, respectively; MB, FB = male students, female students in group B, respectively. In addition, for each group, FC = female participant’s completion score; FS = female participant’s speed score; FA = female participant’s accuracy score; FO = female participant’s order score; FT = female participant’s total score. The same notation was used for male participants, e.g. MC = male participant’s completion score, MS = Male participant’s speed score, etc. To test the hypotheses, 10 T-tests were performed: AFC vs. BFC; AFS vs. BFS; AFO vs. BFO; AFC vs. BFC; AFT vs. BFT, AMC vs. BMC; AMS vs. BMS; AMO vs. BMO; AMC vs. BMC; AMT vs. BMT.

In general, a comparison of P-values and the type I error $\alpha$, which is set as 5% in this study, would show whether the differences in learning gains between the two groups are statistically significant. However, in this study, the Holm-Bonferroni method was used to account for multiple comparisons. This method is designed to control the overall type I error and provide a simple test more powerful than the Bonferroni correction.

3.6 Results

All subjects increased their content learning as a result of the educational interventions. In particular, students in the control group increased their procedural knowledge by 37% whereas students in the experimental group increased their procedural knowledge by 35%.

To determine whether the differences in learning between the two groups were significant, a statistical analysis was performed using the R language and software. R is a programming language and software environment for statistical computing and graphics supported by the R Foundation for Statistical Computing (Ihaka, 1998). Before performing the statistical analysis, the raw data were edited into a format that is readable for R language and software and easily programed. Table 1 shows how the data were edited and saved to be processed by the statistical analysis software (only the data for 6 out of 68 subjects is shown). Each row contains the data for one subject. The p-values and the adjusted type I errors for all T-tests are reported in Table 2; the mean and median values for each scoring criterion and the total mean and median values are reported in Table 3.
Table 1  Subjects’ data formatted for statistical analysis software; only data for six subjects are shown

<table>
<thead>
<tr>
<th>Subject</th>
<th>Group</th>
<th>Gender</th>
<th>Accuracy score</th>
<th>Speed score</th>
<th>Completion score</th>
<th>Order score</th>
<th>Total score</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>A</td>
<td>M</td>
<td>3</td>
<td>4</td>
<td>3</td>
<td>3</td>
<td>13</td>
</tr>
<tr>
<td>2</td>
<td>A</td>
<td>F</td>
<td>4</td>
<td>5</td>
<td>4</td>
<td>4</td>
<td>17</td>
</tr>
<tr>
<td>3</td>
<td>A</td>
<td>F</td>
<td>4</td>
<td>5</td>
<td>5</td>
<td>4</td>
<td>18</td>
</tr>
<tr>
<td>4</td>
<td>B</td>
<td>M</td>
<td>4</td>
<td>5</td>
<td>4</td>
<td>5</td>
<td>18</td>
</tr>
<tr>
<td>5</td>
<td>A</td>
<td>M</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>10</td>
</tr>
<tr>
<td>6</td>
<td>B</td>
<td>F</td>
<td>4</td>
<td>4</td>
<td>5</td>
<td>5</td>
<td>18</td>
</tr>
</tbody>
</table>

Table 2  Results of the 10 T-tests: P-values and adjusted type I errors

<table>
<thead>
<tr>
<th>T-test</th>
<th>P-value</th>
<th>Adjusted type I error</th>
</tr>
</thead>
<tbody>
<tr>
<td>FC</td>
<td>0.000296</td>
<td>0.005</td>
</tr>
<tr>
<td>FS</td>
<td>0.236459</td>
<td>0.025</td>
</tr>
<tr>
<td>FO</td>
<td>0.014147</td>
<td>0.00625</td>
</tr>
<tr>
<td>FA</td>
<td>0.053598</td>
<td>0.00833</td>
</tr>
<tr>
<td>FT</td>
<td>0.008096</td>
<td>0.00555</td>
</tr>
<tr>
<td>MC</td>
<td>0.133405</td>
<td>0.0125</td>
</tr>
<tr>
<td>MS</td>
<td>0.350617</td>
<td>0.05</td>
</tr>
<tr>
<td>MO</td>
<td>0.101939</td>
<td>0.01</td>
</tr>
<tr>
<td>MA</td>
<td>0.210575</td>
<td>0.0166</td>
</tr>
<tr>
<td>MT</td>
<td>0.0186603</td>
<td>0.00714</td>
</tr>
</tbody>
</table>

Table 3  Mean and median values for all groups of subjects for each scoring criterion

<table>
<thead>
<tr>
<th>Group</th>
<th>A Mean</th>
<th>A Mdn</th>
<th>C Mean</th>
<th>C Mdn</th>
<th>S Mean</th>
<th>S Mdn</th>
<th>0 Mean</th>
<th>0 Mdn</th>
<th>T Mean</th>
<th>T Mdn</th>
</tr>
</thead>
<tbody>
<tr>
<td>AF</td>
<td>3.074</td>
<td>3</td>
<td>3.555</td>
<td>4</td>
<td>3.592</td>
<td>3</td>
<td>3.555</td>
<td>3</td>
<td>13.776</td>
<td>13</td>
</tr>
<tr>
<td>AM</td>
<td>4.166</td>
<td>4</td>
<td>4.166</td>
<td>4</td>
<td>5</td>
<td>5</td>
<td>4.33</td>
<td>4</td>
<td>17.662</td>
<td>17</td>
</tr>
<tr>
<td>BF</td>
<td>3.592</td>
<td>3</td>
<td>4.37</td>
<td>4</td>
<td>3.95</td>
<td>4</td>
<td>4.259</td>
<td>4</td>
<td>16.171</td>
<td>15</td>
</tr>
<tr>
<td>BM</td>
<td>4.532</td>
<td>4</td>
<td>4.75</td>
<td>5</td>
<td>4.875</td>
<td>5</td>
<td>4.259</td>
<td>4</td>
<td>18.416</td>
<td>18</td>
</tr>
</tbody>
</table>

As evidenced by Table 2, only the comparison of the Completion scores of female subjects (FC) indicates a statistically significant difference between the two groups. Female participants in the control group scored significantly higher than female participants in the experimental group in regard to ‘completion’. Results of the other T-tests show that there are no statistically significant differences between the two groups’ scores. Table 3 shows that, overall, students in the control group scored higher than students in the experimental group and male students scored higher than female students across both groups; however, these differences are not statistically significant. Based on these results, 9 of the 10 alternative hypotheses can be accepted.
3.7 Findings from the questionnaire

The majority of the students showed a positive attitude towards the animation and looked forward to its improvement. In regard to questions 1 and 2 (e.g. ‘What are the advantages and disadvantages of animation-assisted instruction?’ and ‘Did you find the animation useful and informative?’ ‘Was any part of the animation confusing to you?’), the students’ answers are summarised below:

− The main advantage of the animation is that it offers the possibility to watch the sequence of steps as many times as needed.
− The animation helps us to understand what is happening inside the body while performing the treatment. This is a main advantage of animation versus instructor’s demo.
− The graphics are interesting and convey the concepts clearly.
− It is difficult, at times, to understand exactly how to perform the procedure because of occlusion problems and because the camera is too far from the hands of the person.
− The animation is useful but should not replace the instructor’s lecture and demo; it could be used as an additional learning tool.

The students’ answers to question 2 (e.g. ‘From your perspective as a healthcare student, do you have any suggestions for improving the animation?’) are summarised below:

− An interactive application that allows for changing the point of view and for zooming in/out on the hands and details would be more helpful.
− More detailed information/visualisation of what is happening inside the body would make the animation more beneficial to students.
− An interactive educational game would be more interesting and engaging than a simple animation sequence.

In regard to question 4 (e.g. ‘As a healthcare student, what other medical issues do you think could be taught using computer animation?’) students’ suggestions included: asthma and epilepsy, heatstroke, internal bleeding and burns.

4 Discussion and conclusion

In this paper, we have reported an experiment in which objective was to investigate the influence of computer animation on students’ learning of medical emergency response procedures. Findings from the experimental study provided preliminary evidence of the efficacy of animation as a learning tool. Overall, watching the animation led to an increase in subjects’ procedural knowledge. Compared with traditional learning methods (e.g. lecture and demo), watching the animation led to slightly lower procedural knowledge gains; however, except for the female participants’ completion scores, the differences were not statistically significant. Responses to a survey on the participants’ perceptions of the animation revealed a positive and enthusiastic attitude towards the technology.
The results of the study are important because they add to the growing body of evidence that supports the educational efficacy of computer animation. More specifically, findings suggest that animation can be an effective learning tool for medical emergency response training and could replace the traditional ‘in-the-classroom’ lecture and demo. Hence, results from the experiment point to the potential of animation technology for making medical emergency education and training available online anywhere, anytime, at a more affordable cost, with the prospect of reaching a broad audience, including underrepresented groups.

However, although several experimental studies (including the one reported in the paper) support the educational potential of animation, further research will need to be conducted to answer important questions such as: how can animations be designed to reduce extraneous cognitive load and enhance germane load? Are some school subjects better suited for animation than others? When should we use 3D animations versus 2D animations versus static images? How should evaluation studies on the impact of animation in education be conducted? What are the cost/benefits of educational animations versus less expensive alternatives? Furthermore, as Ruiz et al. (2009) point out, medical education differs from other fields; hence, findings on the pedagogical efficacy of animation in certain disciplines may not generalise to medical education.

In future work, to continue to advance knowledge on the potential of computer animation for medical education, we plan to conduct additional comparative studies using different animation designs, different learner groups, different subject matters and different settings.

References


Using computer animation for emergency medicine education


