Teacher-centred vs. practical learning in image-guided surgery - A study

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Abstract In general, vocational education is crucial for a successful future career. We studied the impact of different teaching strategies and techniques on the learning success for students in computer-assisted surgery. Frontal teaching, practical learning, and a mixture of both are investigated to find the most effective way. The success of learning is measured quantitatively with an exam and questionnaire, and analyzed statistically.

Keywords. Image-guided surgery, Computer-assisted surgery education, simulation and training, Interactive learning

Introduction

Computer-assisted surgery (CAS) represents a surgical concept and set of methods that use natural science in combination with computer technology to perform preoperative planning and intraoperative surgical intervention [1]. This highly complex setting demands for the best teaching techniques. Simulation and participatory learning can ultimately steepen the learning curve and prepare students and surgeons to the field, and thereby, improve the intraoperative use of navigational technology.

1. Methods

In order to test the superiority of practical training in image-guided surgery over other approaches we performed a study with 30 medical students at the Innsbruck Medical University. The participants were assigned randomly into three groups. Each group consisted of ten participants and was instructed on the same CAS topics in a one hour period: 3D-navigation in surgery, components of image-guided surgery navigation systems, pivot calibration, registration, registration errors, tracking systems, patient tracking, pointer tool, dynamic reference frame, and clinical workflow. Navigation is done with the IGI-simulator [2] via the computers' webcam, which can track optical markers, a LEGO phantom and a CT-scan of the phantom [3] on off-the-shelf laptops.

Group one received a traditional lecture covering all pertinent aspects. Group two worked entirely with the IGI-simulator. Group three had both theoretical instruction and practical work. Groups of three students in groups two and three worked on one laptop.

Four days after the teaching session the effect of the different teaching approaches was assessed with a multiple choice test and a questionnaire. The test consisted of 21 questions (14 multiple choice and 7 theoretical questions to be answered in free-text, "f-questions") and a questionnaire with 13 statements on personal feedback ("p-questions"). Examples of p-questions are: "I have used a navigation system before; I now know what a navigation system is; the simulator contains essential components of a navigation system; the simulator helped me to understand navigation systems, I will continue to occupy myself with image-guided surgery." Answers were given on a 3-point Likert scale (agree, partially agree or disagree). Theoretical questions were weighted to account for potential correct random multiple choice answers (max 8 vs. 4 points). Test duration was 45 minutes. Data analysis was done with SPSS 22, confidence level $p < 0.05$.

2. Results

Data were normal distributed (Kolmogorov-Smirnov-Test). No statistically significant differences were found between the three groups concerning f-questions (Kruskal-Wallis-Test) for individual questions and for the overall sum of points. The overall sum of answers for p-questions showed a statistically significant difference between group one and groups two and three, respectively (χ^2-Test). Groups two and three provided virtually identical answers to the f- and p-questions. There is no statistically significant difference in the answers of three groups with respect to gender, age and semesters. The scatter of p- and f- answers in group one was much smaller than in groups two and three, respectively.

3. Discussion

The data show that neither form of teaching is statistically superior to the other. However, if personal satisfaction and motivation triggered by teaching comes into play, classical frontal teaching performs weakest. The evaluation results of the p-questions with the above analysis show that active involvement in computer-assisted surgery has positively influences learning, boosts motivation, and positively affects the learning attitude towards a new subject. In summary, the setting of CAS provides an ideal, controlled, testbed to assess different forms of teaching / learning.

References

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