

Research Article

Effects of two different educational movie concepts regarding failure management on the acquisition of new manual abilities for dental students: A pilot study

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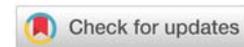
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Abstract

The main goal of this pilot study is to evaluate if two different educational movie concepts regarding the failure management provide a statistically significant difference in the acquisition of manual abilities (in this case bending of a triangular clasp) for dental students.

The participants of this study were dental students ($n=57$) from the 7th semester of the Goethe University Frankfurt/Main. Before the beginning of the study, the individual manual ability of the study participants has been assessed in the form of a pretest (Pret), based on the HAM-Man (with a scale from 0= very poor to 6= very good).

Based on these results, participants of this study were stratified, randomized and divided into two different groups. The two groups watched an educational movie with (study group 1) or without (study group 2) failure management. The individual acquisition of new manual abilities (regarding the bending of a triangular clasp) after the intervention was evaluated after three different criteria (length of each side, flatness and form of the triangle) and was measured in an overall grade (from 1 = very good to 6 = very bad). The differences, tested between the groups using a Wilcoxon-Mann-Whitney test, and p-values below 0.05 were considered significant. Between study group 1 (Pret=4.19, Post=2.67) and study group 2 (Pret=4.18, Post=2.50) no statistically significant difference in the overall grading of each triangular clasp ($p=0.68$) was found.

This finding leads to the conclusion that educational movies based on failure management have no statistically significant influence on the acquisition of new manual abilities.

Introduction

The education of dental students requires extensive resources, mainly regarding the teaching staff. Live demonstrations have mostly been the standard way to teach students new topics (in this publication regarding the bending of orthodontic figures). In an ideal setting, is a live

demonstration performed by a highly trained professional with decades of experience in their field of practice. In addition, a small group and several hours of training in a calm environment without much distraction have the advantage that the instructor directly addresses every student and their very own individual difficulties. Unfortunately, reality seems to differ. Growing numbers regarding the instructor-student



ratio and increasing shortages in many faculties lead to new problems, e.g. a detailed visualization of the procedure is often inadequate [1].

The production of educational movies has become much more accessible and inexpensive. Moreover, the growth of digital video platforms (e.g. YouTube, Vimeo or Dailymotion) allows a much faster approach to individual problem solving hence by downloading the particular app and searching for a suitable tutorial on one of the platforms. As Knösel [2], stated, YouTube and similar social media websites offer new educational possibilities that are currently both underdeveloped and underestimated in terms of their potential value. Each student can set their learning pace since learning videos liberate you from the confines of opening hours (regarding the library or working hours), the learning tempo of each group and the facility. Only an Internet connection is needed, and one can stop the video at any given time to fully understand the procedure.

Alqahtani stated that a procedural video is equally effective as a live demonstration, given that both the procedural video and the live instruction describe identical steps [3]. Aragon even stated that students performed significantly better than students without teaching aids [4].

Therefore, it can be stated that educational movies can be or are an aid in teaching dental students. Yet most of the studies focus on a comparison of the educational film against live instruction. Since most of these have identical content, students still want a live instruction since a member of the teaching staff can help each student when clarification is needed, as Thilakumara stated [5].

Dental education can highly profit by failure-based learning. Dentistry is a mostly practical profession, so it is common for every student to make and learn from their mistakes, especially in the beginning. Most of these beginner mistakes that the dental students make are mostly quite the same but they need to be addressed by the teaching staff in every course.

This study aimed to evaluate whether an educational movie with failure management (explanation of the most common beginner mistakes and how to avoid them) can help students achieve better results regarding the acquisition of new manual abilities than an educational movie without failure management.

Materials and methods

Study period and setting

This study was conducted on dental students of the winter semester 2017/2018 of the Goethe University Frankfurt/Main and took place on the October 18, 2017 and October 20, 2017. The total number of participants was 57 (68% female and 32% male).

The educational movie

For this study, two instructional videos (with/without failure management) explaining the bending of a triangular

clasp were produced. The following structure was used for the educational movie with failure management: key facts, the most common beginner mistakes, and step by step instruction with a checklist regarding the individual steps. The other instructional video without failure management contained the following structure: Theory, key facts, and step by step instruction.

The course materials

Each student had three different orthodontic pliers (which were already handed out by the teaching staff at the beginning of the semester), a pencil with soft lead and six pieces of 0.7mm thick steel wire. Using three of the steel wires for training purposes, the chief instructor of the teaching staff graded one piece of steel wire.

The following orthodontic pliers were used: Side Cutter, Pointed Beak Pliers, Universal Wire Bending Pliers (all of those: Dentaureum GmbH, Ispringen, Germany). The 0.7mm thick steel wire was also a product of Dentaureum GmbH, Ispringen, Germany. Several different companies produce pencils with soft lead, but most students used, Faber Castell 9000 2B, Faber Castell AG, Stein, Germany.

Educational movie A (with failure management) hosted under the following link on YouTube: <https://youtu.be/WGSorjJiHV8>.

Educational movie B (without failure management) hosted under this following link on YouTube: <https://youtu.be/pdcoHwkcKTY>.

Spare headphones – JBL T160 (Harman Germany GmbH, Garching, Germany) – were provided to the participants of the study who did not have any before the main test.

Pretest (October 18, 2017)

The individual manual abilities of every student were evaluated with the help of the evidence-based HAM-Man (entry-level test for aspiring dental students in Hamburg/Germany). The Pretest had a duration of 45 min, and each wire figure was graded after the checklist criteria of the HAM-Man. According to these results, two groups separated the students in a randomized manner.

Posttest (October 20, 2017)

Every student had a handout with their number (for the further evaluation of individual performance) and a QR Code that linked to the educational movie regarding the group they belonged to. It was ensured that every student could adequately open the link on their smartphone/tablet device. Students were informed after the pretest to bring such an electronic device to the main test so that they could open the dedicated movie of their group on YouTube. The videos were set from private to public at the beginning of the test at 10am. The authors of the study made sure that every student had the mentioned course materials and headphones.

Therefore, every participant of the study could watch the educational movie silently in an exam-like atmosphere. The



whole duration of the main test was 30 minutes: 15 minutes dedicated to watching the educational movie without bending and 15 minutes for the bending of the triangular clasp. At the end of those 30 minutes, the teaching staff collected each triangular clasp to rate them. The teaching staff made sure that each clasp was linked to the specific number of the student.

Data security

Every questionnaire evaluated the students' individual opinion anonymously for overall objectivity in collecting data for the evaluation.

Every individual triangular clasp, which should be graded by the chief instructor of the teaching staff, had a certain number dedicated to the individual participant of the study so that the results linked to the participant of the study in a pseudonymized manner.

The teaching staff and grading

The chief instructor of the teaching staff was responsible for the rating of each triangular clasp. Every triangular clasp was graded with the following criteria: length of side, flatness and triangular form. Using the grading known from German schools (from 1=very good to 6=very bad for the criteria length of the side and triangular shape) and for the criteria flatness (1= yes, 0=no), the overall performance for every triangular clasp regarding these three criteria were able to be evaluated.

The grading team consisted of the chief instructor and head technician of the orthodontic lab of the department of orthodontics, who has over 30 years of experience in the teaching of students. Every result from the grading of the orthodontic figures of the pretest or the triangular clasp in the main-test was documented by the author of this study, while the rating took place.

Results

Response rate

57 of the 59 students (32% male, 68% female) from the 7th semester 2017/2018 participated in this study. The results are shown in Tables 1-4.

Questionnaire

After the test, the students were requested to fill out a questionnaire (Tables 5,6) regarding their individual learning preferences, the usage of educational movies and their own feedback on the educational film.

Data security

Every questionnaire evaluated the students' individual opinion anonymously for overall objectivity in collecting data for the evaluation.

Every individual triangular clasp, which should be graded by the chief instructor of the teaching staff, had a certain number dedicated to each participant of the study so that the results

Table 1: Values of the parameter "length of side" (from 1=very good to 6=very bad) in group 1 and 2 with their corresponding data (SD=Standard Deviation, Min=minimum, Max=maximum).

Number	Group	Mean	Median	SD	Min	Max	Significant to number
1	study 1	2.83	3	1.83	1	6	no
2	study 2	2.39	1	1.71	1	6	no

Table 2: Values of the parameter "flatness" (1=yes, 0=no) in group 1 and 2 with their corresponding data (SD=Standard Deviation, Min=minimum, Max=maximum).

Number	Group	Mean	Median	SD	Min	Max	Significant to number
1	study 1	1.10	1	0.56	1	4	no
2	study 2	1.00	1	0.00	1	1	no

Table 3: Values of the parameter "triangular form" (from 1=very good to 6=very bad) in group 1 and 2 with their corresponding data (SD=Standard Deviation, Min=Minimum, Max=Maximum).

Number	Group	Mean	Median	SD	Min	Max	Significant to number
1	study 1	4.00	4	1.85	1	6	no
2	study 2	4.11	5	1.75	1	6	no

Table 4: Values of the parameter "overall grade" (from 1=very good to 6=very bad) in group 1 and 2 with their corresponding data (SD=Standard Deviation, Min=Minimum, Max=Maximum).

Number	Group	Mean	Median	SD	Min	Max	Significant to number
1	study 1	2.67	2.33	1.04	1	4.33	no
2	study 2	2.50	2.67	0.88	1	4.33	no

linked to the participant of the study in a pseudonymized manner.

Free text information for evaluation

In addition to the assessment of the shown educational movie, the students had the chance to give individual feedback.

The students of group 1(with failure management) had experience with educational movies using the E-Learning platform OLAT from the Goethe University of Frankfurt. They complained that the labeling of each step should needs optimization, and the bending should, in general, be bigger in order to understand the steps better. If possible animation of the bending of the triangular clasp should be used for every step layered over the shown clasp, but most importantly, the students want two versions regarding right- or left-handed bending.

Students of group 2(without failure management) had comparable ideas for improvement: two versions for right- and left-handed bending, optimization of the labeling of each step and an explanation of the used pliers. Furthermore, the students of group B found that live instruction helps them more to understand the step by step procedure since the instructor can stop each step and can explain the bending process in a



Table 5: Evaluation of the questionnaire of group 1 (0=disagree, 1=partly agree, 2=agree, 3=highly agree) with their corresponding data (SD=Standard Deviation, Min=Minimum, Max=Maximum).

Study 1	Factors to be evaluated	Mean	Median	SD	Min	Max
1.	Had you previously seen educational movies regarding orthodontic bending?	0.74	1.00	0.64	0	3
2.	aplatforms, e.g. YouTube?	1.61	1.00	0.58	0	3
3.	Did you like the shown educational movie?	2.24	2.00	0.60	1	3
4.	Has orthodontic bending become more accessible to you after seeing this educational movie?	1.66	1.50	0.65	0	3
5.	Would the implementation of educational movies of this kind help you acquire new manual abilities faster?	2.39	2.00	0.49	1	3
6.	Would you use educational movies of this kind regularly?	2.52	2.50	0.50	1	3

Table 6: Evaluation of the questionnaire (0=disagree, 1=partly agree, 2=agree, 3=highly agree) of group 2 with their corresponding data (SD=Standard Deviation, Min=minimum, Max=maximum).

Study 2	Factors to be evaluated	Mean	Median	SD	Min	Max
1.	Had you previously seen educational movies regarding orthodontic bending?	0.77	0.50	0.95	0	3
2.	Do you use educational movies hosted on platforms, e.g. YouTube?	1.84	2.00	0.81	0	3
3.	Did you like the shown educational movie?	1.80	2.00	0.60	0	3
4.	Has orthodontic bending become more accessible to you after seeing this educational movie?	1.27	1.00	0.45	0	3
5.	Would the implementation of educational movies of this kind help you acquire new manual abilities faster?	2.22	2.00	0.41	1	3
6.	Would you use educational movies of this kind regularly?	2.41	2.00	0.49	1	3

three-dimensional manner, which the movie cannot provide. Still, before or after having instruction, educational videos were a great learning aid to repeat or understand the step by step procedure.

Answering the main research question

This study has shown that educational movies based on failure management do not have a measurable impact on the individual learning capabilities of new manual skills. An educational film based on a concept regarding theory, practice, the most common beginner mistakes and a step by step explanation can provide a learning experience that enables students to pass with average results.

Discussion

The educational movies were compared to the known live instructions from the teaching staff. Instruction from the teaching staff is around 30minutes long. It consists of the following parts in chronological order: an explanation of the theory regarding the shown topic, a practical demonstration

in a step by step concept and free time, e.g. practice/individual feedback. The difference between both educational movies lies in the form of transportation of the failure management: group 1 had an educational film where a checklist highlighted the most common mistakes at the end of every step. Group 2 had an educational movie, where the most common beginner mistakes regarding the topic of bending a triangular clasp appeared before the step by step explanation.

Since dentistry is a field of practical work, beginner mistakes do not differ that much from each student and they repeat themselves every semester again and again. It does not matter if the topic is the bending of a triangular clasp, the proper scaling of a tooth or implantation. Every procedure has its difficulties, and a specific step by step approach can avoid those mistakes and in most cases reach good to excellent results. It does not matter if the teaching staff or an educational movie shows the procedure in the mentioned manner in a demonstration [5]. Bazyk [6], already conducted a study regarding the effectiveness of videotaped vs live instruction regarding the evaluation skills of students. He stated that even if there is no difference in the effectiveness of each form of demonstration, the students prefer the live instruction because an instructor of the teaching staff provides individual feedback but a video just cannot do that. Mir [7], confirmed the results of Bazyk wherein their study groups achieved no significant difference in the scores. According to these results, Mir finally stated that videotaped demonstrations could be as practical as the personal teaching of clinical methods. Packer [8], concluded in his study that both teaching methods (a videotaped demonstration or a live demonstration) developed a similar level of understanding of the principles behind the exercises, although students preferred the live demonstration. However, Clark [9], stated that students performed significantly better in the combination of video and faculty-led hands-on-instruction than video or instruction alone regarding oral and pharyngeal cancer examination. Weber [10], concluded that video-based instruction is a more effective teaching method than conventional instruction for learning surgical hand disinfection.

Regarding the experience gathered in this study field, it appears that the educational movie can be a teaching aid. The learning experience of each student is supported, but especially in dentistry, it can not replace an instructor. The own feedback for every student from the instructor seems to be important: Ramlogan [11], concluded that students had a preference for video and would like it integrated into the lecture rather than act as a substitute for the lecture. Nikzad [12], stated that supplementary teaching aids such as a VCD (instructional video CD) and a study guide might improve the clinical performance of dental students to some extent, but students still prefer the live demonstration. Therefore, using educational movies as a tool for learning or recapitulating clinical demonstrations is possible, but not considered to replace live clinical demonstrations [13].

As a limitation of our study, it needs to be mentioned,



that it is common for students to gather a certain amount of knowledge before being officially introduced to new topics. Therefore, it can not be guaranteed over the whole timespan of the study that students consult the teaching staff for advice regarding orthodontic bending.

The gained experience from this pilot study and its design help tremendously in the execution of the following studies in this field of research.

One advantage of our study setup is the separation of participating students in a randomized controlled manner. The individual performance of each participant can be measured and evaluated after comparing the results of the pretest with the main-test. By executing the study during one day, in one room, with two groups and pretest following the main-test, the limitations can be reduced.

Concluding the results of the questionnaire the majority of the students of both study groups confirm the results: 53% of group 1 (the educational movie with failure management) partly agree that bending the triangular clasp with the educational film was easier.

48% agree that an implementation of this kind of learning aid would help the learning of new manual abilities. 45% agree that they would use educational movies regularly. 75% of group 2 (educational video without failure management) partly agreed that the bending of the triangular clasp after help of the tutorial movie was easier.

68% agree that implementation as a learning aid would help the learning of new manual abilities. 57% agree that they would use these educational movies regularly. Both study groups partly agree that they have seen educational videos on platforms, e.g. YouTube (group 1 35% and group 2 44%), but disagree (group 1 55% and group 2 61%) that they have seen particular educational movies regarding the topic of orthodontic bending.

Regarding the individual feedback, both groups want an educational movie regarding left- or right-handed bending and a better explanation of step 7. Animation could help to fulfill this demand since it is challenging to film this three-dimensional step. Even more considerable effort is required to train teaching staff to bend a triangular clasp in a step by step method left- or right-handed. However, an animation is more challenging to produce and its effectiveness in orthodontic educational movies should be the topic of further studies.

Schorn-Borgmann [14], already stated that factors other than e-Learning might have a higher impact on manual skills and further studies should investigate this. Since we have the technical possibilities, but they are still expensive (e.g. virtual reality animation), further studies should research the following questions: Which form of hosting (e.g. YouTube or a dedicated faculty-own server with an app for iOS and Android) performs best? Which type of presentation (educational movie or animation with a multiple-choice questionnaire) supports

the teaching staff the most? Which form of newer technology (virtual reality, augmented reality) provides the best learning experience before or after the live instruction? Where and when does individual feedback help the most in order to fully understand the specific topic?

Educational movies should have a structure that stands in unison with the instruction from the teaching staff. They should (regarding orthodontic courses) consider left- and right-handed demonstrations and find e.g. animations of the step by step procedure for a better understanding of three-dimensional presentations. Still, educational movies cannot replace instructional staff, but they can help as a teaching aid for instructors. They allow the teaching staff to focus more on individual feedback. Finally, the educational movie is not limited to specific parameters such as time or group sizes, which would help solve two big problems, which the teaching staff is facing nowadays.

Conclusion

Failure management in orthodontic educational movies does not have a significant difference in the learning of new manual abilities.

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