Original Article

Comparison of Outcomes of Recorded Lecture and Hands-on Course Education in Orthodontic Cast Analysis

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ABSTRACT

Purpose: The aim of this study was to compare recorded lecture education (RLE) and hands-on course education (HCE) via the test of orthodontic cast analysis lesson, which is prepared according to the Structure of the Observed Learning Outcomes (SOLO) taxonomy.

Methods: In our single-blinded, randomized, cross-sectional study, 87 students (45 female, 42 male) were divided into 2 groups. In the first group, HCE was used; the second group was given an RLE. One week later, 5 questions prepared by SOLO taxonomy were given to both groups. For scores of intergroup comparisons, the Mann-Whitney *U* test was used, and for intragroup comparisons, the Kruskal-Wallis test was used.

Results: There was no statistically significant difference between the groups' gender distribution ($p>0.05$). Examination scores of girls and boys did not differ significantly ($p>0.05$). There was a statistically significant difference in the comparison of average of scores in the HCE group ($p<0.05$). There was also a statistically significant difference in the average of scores of the RLE group. The averages of scores of the HCE group were found to be significantly higher than RLE group scores ($p<0.05$), excluding the first, fourth, and fifth questions.

Conclusion: Hands-on course education, to which the students are accustomed and with which students are more comfortable asking questions in the classroom and expressing their opinions easily, have higher success rates when compared with RLE. (*Turkish J Orthod* 2015;28:13–18)

KEY WORDS: Hands-on course education, Orthodontic cast analysis, Recorded lecture education, SOLO taxonomy

INTRODUCTION

At the end of dental education, the goal is to have students achieve critical thinking skills, create their own opinions related to a topic, gather data together, make logical conclusions from what they understand from the topic, realize their limits, and be skeptical and formulate their own independent judgments.[1] For that purpose, deep learning, which has a positive influence on persistence of information, is more effective for the success of students when compared with superficial learning.[2–4] Therefore, the learning process should be based on deep learning in order to achieve retention and high-level education. Together with the developing technology, distance education is becoming more popular. As a method used since the 1980s in light of students' demands, distance education started to replace traditional methods by reducing the time spent in faculties and expenses of faculties. Distance education is as efficient as any other learning program, since it provides an environment in which students can study wherever and whenever they are ready, easily access information, and make repetitive reviews of the topics. There is much research comparing the effects of distance education with hands-on course education (HCE) that points out significant benefits of distance education along with its unwanted effects.[5–8]

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Taxonomies can be used to evaluate the perception level of education with various teaching methods. The Structure of the Observed Learning Outcomes (SOLO), which is often preferred for preparation of questions and evaluation of answers, was developed as a general cognitive development model by John Biggs and Kevin Collis. With the help of this taxonomy, according to verbal or written answers of individuals related to a specific duty, it is possible to define the level of thinking related to required information and skills for that duty.[9] When the answers of the students were evaluated using SOLO taxonomy, as the level of learning reached higher levels, consistency and correlation increased, and thinking in multiple ways was seen. Most of the studies that used SOLO taxonomy had the same methodology, which is a summative assessment of the knowledge.[10–12] The student should answer the 5 questions, which are prepared by SOLO taxonomy, and the answers should include the basic knowledge about the subject, describe the subject, make an algorithm, list and explain the reasons, associate the steps, classify, compare and make analysis, predict the result, evaluate, relate with other situations, and build a hypothesis.

For this purpose, this taxonomy serves as a strong tool in evaluating the level of students in understanding terms and their ability to solve problems.[13,14] In our study, the efficacy of recorded lecture education (RLE), which is a way to deliver distance education, and HCE given in an orthodontic cast analysis lesson will be compared based on questions prepared according to SOLO taxonomy, with the aim of determining the difference in level of learning created with both teaching methods.

METHOD

This study protocol was in accordance with the Helsinki Declaration of Human Rights and was approved by Ethical Committee of Yeditepe University under registration No. 403/2014. In our study, a junior class of 87 students (45 female, 42 male) was randomly divided into 2 groups. An orthodontic cast analysis lecture, which enables students to figure out the possible discrepancies between the arch length and tooth size in the mixed and the permanent dentition, was chosen as the subject to be taught. With the help of this lecture, students can perform model analysis by applying every step of this method in sample case presentation and determine whether lack of space or excessive space exists. In the first group, an HCE was used as the educational method, and the students were given a lecture on orthodontic model analysis. Research assistants, who were assigned to every 5 students of this 45-student group, explained the indications and method for Hays-Nance model analysis by demonstrating on stone casts. No oral lecture was given to the second group. The oral lecture and practical presentation given to the first group of students were recorded as a full-length video, which was distributed to the second group by loading the video to a CD. The groups were instructed not to share data with each other. One week later, a pop quiz that included 5 questions prepared with the help of SOLO taxonomy were given to both groups. SOLO taxonomy was used to evaluate the level of learning of the students. To carry out the study as a single-blinded one, the students were told to write down the numbers assigned to them on their examination paper instead of their names.

In the answers to the 5 questions prepared with the help of SOLO taxonomy, the following were requested from the students:

1. Explain the basic information that measures the level of knowledge related to the subject.
2. Make an explanation.
3. Make and algorithm, listing and explaining it.
4. Define the causes, correlate, classify, and compare and analyze the steps.
5. Predict and evaluate the outcome, making connections with cases, and constitute the hypothesis.

Examination papers were evaluated objectively by a teaching assistant, who had no information about the distribution of the working groups, by rating with predetermined scores for each answer.

The Statistical Package for Social Sciences (SPSS, version 17.0, SPSS Inc, Chicago, IL, USA) was used for statistical tests. For descriptive statistics of the continuous data, mean $\pm$ standard deviation was used; frequency and percentiles were used for countable data. The values achieved from the variables that did not fit to normal distribution were tested by Mann-Whitney *U* test to test the difference in terms of scoring average between HCE and RLE groups. Kruskal-Wallis test was used in the intragroup comparison of the average scores obtained from the questions. Mann-Whitney *U* test was used for pairwise comparisons. The results were evaluated at the $p < 0.05$ significance level.

Table 1. Intragroup comparison of examination scores according to gender

Gender	Girls (n = 19) Mean (±SD)	Boys (n = 21) Mean (±SD)	*p*
Hands-on course education group			
Question 1	2.96 (±2.05)	3.82 (±1.94)	0.843
Question 2	3.50 (±1.69)	4.27 (±2.10)	0.548
Question 3	1.79 (±2.94)	3.09 (±3.58)	0.403
Question 4	4.58 (±6.05)	5.09 (±6.47)	0.633
Question 5	1.71 (±1.39)	1.09 (±1.57)	0.447
Total score	14.54 (±11.62)	17.36 (±8.03)	0.657
Recorded lecture education group			
Question 1	2.48 (±1.47)	2.57 (±1.39)	0.664
Question 2	1.95 (±1.93)	1.76 (±1.57)	0.918
Question 3	0.86 (±1.82)	0.38 (±1.07)	0.409
Question 4	2.52 (±4.17)	3.24 (±4.96)	0.604
Question 5	1.52 (±1.56)	0.81 (±1.16)	0.214
Total score	9.38 (±7.60)	8.81 (±6.73)	0.889

* $p < 0.05$, significance level, SD, Standard Deviation.

RESULTS

There was no statistically significant difference between the distribution of 2 genders in both groups (data not shown) and examination scores according to gender ($p>0.05$; Table 1).

Intragroup Comparison of Scores

Intragroup comparison of mean values of the HCE scores showed a statistically significant difference ($p<0.05$; Table 2).

The difference was from the scores of the third (making algorithm, listing and explaining of the algorithm) and the fifth (predict and evaluate the outcome, making connection with cases, and constituting hypothesis), the third and the second (make explanation), the third and the first (basic information), the fourth (defining the causes, correlating the steps, classification, comparison and analysis), and the second, fourth, and first questions. The mean value of the scores of the third question was lower than the mean values of the first, second, and fifth question scores ($p<0.05$; Table 3). The mean value of the scores of the fourth question was lower than the mean values of the second and the first question scores. The mean values of the scores of the first and second, first and fifth questions did not show a statistically significant difference ($p>0.05$), as did neither the mean values of the scores of the second and the fifth, the third and the fourth, and the fourth and the fifth questions.

The intragroup comparison of the mean values of the RLE scores showed a statistically significant difference ($p<0.05$; Table 4).

A statistically significant difference was observed between the scores of the third and the fifth, the third and the second, the third and the first, and the fourth and the first questions ($p<0.05$; Table 5). The mean value of the scores of the first question was higher

Table 2. Intragroup comparison of mean values for the scores of questions in the hands-on course education (HCE) group

HCE	Mean ± SD
Question 1	42.85 ± 28.40^{c}
Question 2	41.94 ± 24.15^{c}
Question 3	17.77 ± 26.78^{a}
Question 4	20.66 ± 28.07^{ab}
Question 5	39.44 ± 35.14^{bc}
p	0.000*

* $p < 0.05$, significance level.
^{a,b} Same superscript letters indicate no significant difference.

Table 3. Intragroup comparison of the mean values for the scores of questions in the recorded lecture education (RLE) group

RLE	Mean ± SD
Question 1	36.05 ± 20.26^{c}
Question 2	23.21 ± 21.83^{bc}
Question 3	5.62 ± 13.61^{a}
Question 4	14.40 ± 22.74^{ab}
Question 5	29.16 ± 35.31^{bc}
p	0.000*

* $p < 0.05$, significance level.
^{a,b} Same superscript letters indicate no significant difference.

Table 4. Intergroup comparison of mean values of the group scores[a]

RLE/HCE	HCE Mean	RLE Mean	*p*
Question 1	3.00	2.52	0.325
Question 2	3.36	1.86	0.000*
Question 3	1.96	0.62	0.003*
Question 4	4.13	2.88	0.151
Question 5	1.58	1.17	0.113
Total score	11.56	5.80	0.002*

[a] HCE, hands-on course education; RLE, recorded lecture education.
* $p < 0.05$, significance level.

than the scores of the third and the fourth questions. The mean values of the scores of the second and the fifth questions were higher than the scores of the third question. The difference between the mean values of the scores of the first and the second, the first and the fifth, the second and the fourth, the second and the fifth, the third and the fourth, and the fourth and the fifth questions were not statistically significant.

Intergroup Comparison of Scores of Groups

Except for the first, fourth, and fifth question, there was a statistically significant difference between the 2 groups ($p<0.05$). The mean values of the scores of the HCE group were higher than those of the RLE group (Table 6).

DISCUSSION

There are studies carried out on students regarding how to achieve persistency of the knowledge given during lectures, how to keep the students fully attracted to lectures, and how to enable the correlation and interpretation of the information and use it in problem solving, which overall leads to an increase in success rates.[3,9–15]

The reason why we chose SOLO taxonomy to evaluate education quality over other taxonomies that determine cognitive structure is that it shows the difference between different levels of learning and its ease of application. Also, it is a common model for different learning methods, and it has not been previously used for the assessment of orthodontic education. While scoring the answers of the students, the teaching assistant was not informed to which group the paper she was evaluating belonged. This provided objectivity and prevented bias.

It was determined that superficial learning was predominant in both groups. In the HCE group, answers to basic information questions had higher scores compared with those given to multistructural and relational questions, and overall, the scores were higher than the RLE group. The designing algorithm, analysis, and hypothesis were expected as answers of the multistructural and relational questions. Since the first 2 questions did not require any interpretation from the student and because they investigated basic information based on memorization, better answers were received when compared with the latter questions. The highest average scores in the RLE group were with the first and second questions. This group of students answered the first question better than the third and fourth questions. When the success rates of the 2 groups were compared, the average scores of the HCE group were higher than those of the RLE group, except for the second and the third questions (Table 6). Similar scores were received from both groups for the third question, from which making the algorithm, listing, and explaining of the algorithm were expected. The HCE group explained basic information and gave better answers in defining the causes, correlating the steps, classification, comparison, and analysis than the RLE group did, and better answers were given in the HCE group in terms of explaining the reasons with the help of the information and correlating steps. The HCE group received higher scores than the RLE group in predicting the outcome and generating a hypothesis. In the superficial learning phase, both groups showed similar success rates, while HCE was more effective at deep learning. It can be speculated that the HCE group scored at a higher level than the RLE group, mainly because of the interactive character of the lesson, which enabled the students to better relate didactic information with clinical relevance. Another reason might be the close proximity of the students in the HCE group to the models, enabling them to handle them when necessary, which was not the case for the RLE group, in which students were able to view the teaching material only visually.

Different results were observed in studies similar to the present study. Rosenberg *et al*.[8] compared distance education and didactic education methods in a course on dental and facial functional, panoramic, and cephalometric analysis and classification of malocclusions in a group of 90 fourth- and fifth-grade students. The didactic method was found to be more effective[8]; however, the authors stated that

they had hesitations as to the possibility that distance education can take over didactic education. Clark *et al*.[6] explained cephalometric analysis and simple superimposition techniques with distance education and traditional methods to first-year students and found no difference between the 2 methods. Irvine and Moore[16] reported that the distance education group received higher scores compared with the traditional education group, for an analysis lecture course in which basic information, terms, and different treatment methods on mixed dentition were explained. In a cross-sectional study, Luffingham[7] found distance education to be more efficient when testing 60 first-grade students and drew attention to the students' positive opinions about distance education. Different outcomes of studies that compare RLE and HCE might be due to nonstandard testing methods that measure education, differences in students' ages and stage of education,[8] and numbers of subjects included in the study.[6] Even though there are no studies in the literature indicating that RLE might be preferred over HCE, the usefulness of RLE is a matter of discussion. Besides, there is only 1 study that compares the advantages of each method against each other based on objective and subjective outcome.[17] In the aforementioned study, there was a small group of students of different grades, and multiple-choice questions were used to evaluate the student outcomes, which is structurally different from our study. Instead of a subject that can be shown practically, such as cast analysis, as we preferred in our study, the choice of a more didactic topic might not reveal any difference in education level in either explaining methods.

Blended learning, in which both HCE and RLE are carried out together supporting each other, has been found to be an effective learning style.[18–20] Kavadella *et al*.[20] evaluated the educational effectiveness of blended lessons with conventional lessons. They found that blended learning is well evaluated by undergraduate students. In another study by Bains *et al*.,[19] blended learning was more effective and accepted compared with RLE or face-to-face learning alone. The blended curriculum with student-focused learning to create didactic and laboratory skills was approved at the end of the study of Faraone *et al*.,[18] in which a preclinical complete denture prosthodontics lesson was tested. Future studies are needed in which the blended, HCE, and RLE methods are compared for deep learning in orthodontics, both in practical work and in diagnosing clinical situations.

It should be kept in mind that the reason HCE is more efficient than RLE might be because the students might not be ready for computer-based self-paced education. Even though RLE is preferred to HCE because of its advantages, it can be used as a supportive and retaining method to HCE. The effects of HCE and RLE on education need further long-term research with an increased number of students and different types of subjects and different cultures. Future studies based on comparison of the scores received from the questions prepared using SOLO taxonomy with students' overall grades in school or with orthodontic grades from previous years would be advantageous. Especially in practical lessons, integrating RLE into an HCE program could increase student outcomes. In addition, a remote, time-independent method such as RLE would contribute to improvement of the education when taken together with reinforcing lectures at school.

CONCLUSION

The students are familiar with HCE, which allows students to ask questions in the classroom and express their opinions easily. Therefore, HCE had higher success rates when compared with RLE.

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