An “XL” Endodontics Intervention for Dental Students Required to Repeat the Course: Changing Frustration to Improved Grades and Attitudes

Marcela Alcota, DDS, MEd; Alejandra Fuenzalida, DDS; Claudia Barrientos, DDS; Mauricio Garrido, DDS; Pilar Ruiz de Gauna, PhD; Fermín E. González, DDS, MSc, PhD

Abstract: Given the psychological and financial costs involved with failing a clinical course, especially in developing countries, an alternative educational method was tested with students who had to repeat the year-long endodontic course at the University of Chile Faculty of Dentistry. The objectives of the intervention were to deepen theoretical knowledge and practical experiences, as well as to reinforce personal confidence in an endodontic clinical setting for students who failed the regular endodontic course. The aim of this study was to evaluate the success of this new model of educational intervention. In the study, 28 students who had failed the endodontic course repeated it with an alternative teaching method. The students attended patients immediately following practical competence exams, and they had access to simulated models that used rotary instruments and access cavities and had emergency care practice. Feedback sessions were held after each clinical session. Final grades were compared with those of other students who repeated the course without the intervention from 2007 to 2009. A survey was administered to understand the causes of initial failure and their opinions of the intervention. Students who participated in the alternative course did significantly better than their counterparts from previous years who did not receive the intervention (5.7±0.3 vs. 5.4±0.2; p<0.05). Their overall perception of the intervention was positive, and the main cause for previous course failure was personal insecurity and slow clinical care performance (54.2% of the students). The intervention course not only improved grades but also generated interest in endodontics, a contrasting perspective to the frustration students usually express after repeating the course. The results of this study support the introduction of similar interventions in endodontics and perhaps other courses.

Keywords: dental education, academic failure, educational intervention, endodontics, Chile

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Completing clinical requirements and the fear of failing a course are two of the main causes of stress for dental students. In addition, the psychological and financial costs brought on by academic failure in a medical course can be extremely high for both students and their families, especially in developing countries. Previous studies have reported that when students with academic difficulties receive appropriate support or remedial instruction, they can mitigate the negative costs of failure by successfully changing their perceptions of the course and then passing it. Previous studies have also examined the types of support systems and remedial approaches appropriate for students with academic problems in both didactic and clinical education. However, there is little evidence about how to successfully undertake and surmount course failure when it occurs. Even less evidence exists on how to confront and overcome students’ feelings of frustration and dismissal towards the course and/or dentistry in general after course failure.

At the Faculty of Dentistry of the University of Chile, the undergraduate dental program lasts six years, the same as for all dental schools in Chile. Students begin dental and related studies directly following secondary education, without other bachelor degree-level studies. During the first two years, students have to accrue sufficient credits in basic human-
istic, scientific, and dentistry-related courses. During the second and third years, students attend preclinical courses, and in the fourth year they begin clinical courses. In this context, endodontics is a year-long course taught to fourth-year students; it consists of a preclinical stage lasting three and a half months (approximately 42 hours), followed by a clinical stage with patient care that lasts approximately six months (approximately 66 hours). To successfully complete the clinical stage, students must independently pass cognitive and theoretical assessments, which include evaluations of each student’s clinical knowledge and professionalism. Changes to the endodontic course were implemented in 2007, with a competency-based program replacing an objectives-based program. Diverse and participative educational strategies were added, such as problem-based learning (PBL), presentation of clinical cases, work in small groups, and debates. In addition, assessment was modified to include tools such as objective structured clinical examinations (OSCEs) and modified clinical essays. Finally, thematic units for an appropriate teaching-learning process for endodontic concepts were revised and are updated every year.

Data from previous years showed that a significant number of students failed the course due to cognitive problems (15-20%). Given this, remedial educational techniques were designed and introduced for students who failed their first course evaluations, as detailed in a study published in 2011. With this educational intervention, the theoretical contents of the course were taught using methodologies adapted to varied learning styles. The conclusions of the previous study reinforced the permanent establishment of the 2007 curricular change that included educational methodologies for the endodontic course to appeal to varied learning styles. These strategies remain in use today and annually reduce the number of failing grades. These methodologies encourage students to think critically, versus mechanically, during patient treatment, thus deepening their experience and providing a better understanding of endodontic practice.

However, despite the implementation of these cognitive remedial measures for low-performing students before complete course failure, a notable percentage of students were still failing (approximately 10%). These failing grades were principally attributed to clinical performance. For this reason, we developed for this study a new educational intervention for students repeating the endodontic course after previous failure. Prior to this intervention, students who failed the endodontic course had to take it again the following year under the same conditions as the first time, a model currently applied to all courses.

The main aim of this study was to evaluate the success of this new educational intervention in three student cohorts who had failed the endodontic course due to non-completion of clinical course requirements. This study also aimed to compare the performance of these cohorts with cohorts under the previous model of course repetition (i.e., without further intervention). A survey was used to determine the students’ perceptions of the intervention and the reasons behind initial course failure, and final grades were compared with grades of students who repeated the course without intervention between 2007 and 2009.

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**Materials and Methods**

All study protocols were approved by the Ethics Committee of the Faculty of Dentistry of the University of Chile. All participants gave informed consent to the intervention. All identifying details and personal information were kept confidential.

**Educational Intervention**

An educational intervention was carried out in 2010, 2011, and 2012 with students who had failed the endodontic course due to non-fulfillment of the clinical program, which is comprised of five endodontic treatments. This intervention was based on the following educational concepts. First, students who have failed a clinical course, and are therefore obligated to repeat it, already have clinical skills and experience with patients that should be taken into account so as to fully take advantage of the intervention program. Second, there should be a deeper analysis of endodontic aspects using diverse and participative teaching strategies. In addition, new endodontic concepts that were not considered in the regular course should be incorporated, and clinical tutors with the highest experience in endodontic teaching and clinical monitoring of undergraduate students should be recruited.

We invited 28 students to take part in the intervention, and all accepted. The students had to meet the following requirements to be included: passed the cognitive and behavioral areas, did not quit the clinical area, and finished at least three endodontic treatments on patients. Of the 28 students, nine participated in 2010, eight in 2011, and 11 in 2012.
The alternative course ran in parallel to the regular course and kept the same timetable and number of course hours per week (three hours of clinical practice per week for a total of 108 hours during the entire course). In the initial meeting, the students were told what the intervention would be like. As a control group, grades from students who repeated the course in the three years preceding the intervention (2007 to 2009) were used.

Since the students failed only the clinical stage, the intervention was exclusive to this area. The theoretical half of the class was taken without modifications, and students were required to take exams for this portion together with the regular course. Additionally, the assessments for both the clinical and theoretical portions of the course were the same for the intervention and regular students. Moreover, the assessments for the study and control groups were consistent in terms of content, format, and grading.

At the beginning of the clinical program, the intervention students were not required to undertake the preclinical stage, which is mandatory for the regular course, but instead began attending patients immediately after passing a practical skills exam, which is also taken in the regular course after students finish preclinical studies. In this practical exam, students were required to complete an endodontic treatment on a simulated model of natural anterior teeth included in a dental model plaster, with assessment using a specifically designed rubric. The students had to show or explain to the examiner the access cavity, how they determined the working length, the instrumentation technique used, the sequence of instrumentation, the final apical diameter, the selection of the master gutta-percha point, spreaders, and accessory points, and the final x-ray of the filling. Besides this, the examiner evaluated whether the students met biosecurity requirements, maintained the order and cleanliness of working areas, and applied abundant irrigation during the treatment. A 90% pass percentage was required for students in both the intervention and regular groups.

Intervention students were asked to define the subjects that, in their opinion and according to previous experience, needed reinforcement in order to prepare them for the practical skill exam. Seminars, clinical case discussions, and personal study were used for the following subjects: endodontic anatomy, endodontic instruments, chemomechanical preparation, and root canal fillings.

After students took the practical skill exam, which was passed on the first attempt by all intervention students, the rest of the year took into account the students’ opinions. The following subjects were studied by the intervention students: pulp and periapical pathology diagnosis, intracanal medication, access cavities in molars, and endodontic emergencies. All of these topics were very similar to those of the regular course, but students in the intervention group had defined these as their weakest endodontic topics during the previous academic year. Therefore, these subjects were studied in greater depth through interactive educational methodologies such as seminars, small-group work, PBL, case discussions, and case presentations. Considering that the students in the intervention group started treating patients earlier than those in the regular course, the time spent using these methodologies in practical scenarios was greater than the time allotted for the regular course.

Moreover, new contents were added, such as NiTi rotary instrumentation and the presentation of two clinical cases per student. Students in the regular course only presented one clinical case per group of eight students. In this context, the intervention students carried out endodontic treatments using rotary instruments and access cavities in the molars of simulated models of natural molars included in a dental model plaster and in patients. They also attended emergency patients. Since previous studies have shown that, in terms of clinical confidence, it is very important for students to receive feedback and reinforce concepts, discussion meetings were held at the end of every clinical session in order to identify any problems during care and to clarify doubts (Table 1). Finally, attendance in the theoretical classes was optional, as is the standard for all regular courses of the university.

**Assessment**

After the intervention was finished, the grades of participating students from 2010 to 2012 (study group, n=28) were compared using a Student’s t-test to the grades of students from 2007 to 2009, who failed under the same conditions as the intervention group—i.e., only in the clinical area—but who did not receive any intervention (control group, n=22). Besides this, an anonymous, mixed survey was administered using open and closed questions in order to assess students’ perceptions of the intervention and the causes for initial course failure.

On the closed questions (1 to 9) on the survey, students were asked to select the alternative closest
to their opinion about the intervention from the following four alternatives: a) completely in agreement, b) partially in agreement, c) slightly in agreement, and d) in disagreement. On the open questions (10 to 13), the students were asked to identify the cause of their failure in the course the previous year, give their opinions about the intervention, and provide any additional comments.

Results

Table 2 shows a comparison between the average grades (scale 1 to 7, with 4=passing) of the students who received the intervention in 2010-12 and the control group of students who repeated the regular course in 2007-09. The students in the study group obtained a final grade average significantly higher than those of the control group (6.1±0.6 vs. 5.6±0.6, respectively), despite the fact that this topic was not covered in the intervention.

We also determined the frequency of the 24 students’ opinions and perceptions regarding the intervention (Table 3). Students’ perceptions of the intervention were positive in all cases. The students completely agreed that they felt accepted (95.8%) and that they had increased/improved their knowledge of endodontics (100%). An analysis of the open questions about the reasons for initial academic failure (Table 4) showed the principal causes to be insecurity, slowness in administering clinical care (54.2%), and difficulty in obtaining patients (37.5%). As for the question about what other subjects students would have liked to include, they preferred a deeper study and practice of the already included subjects rather than more subjects (Table 5). The students preferred carrying out more molar trepanations in patients (62.5%) and to deepen their knowledge of the rotary systems (33.3%). Other less frequently mentioned subjects for possible inclusion included complete endodontic treatments in molars (16.7%) and in young and/or impacted permanent teeth (8.3%) and the use of mineral trioxide aggregate material (4.7%). However, all of these subjects were exclusive to specialized postgraduate courses.
Finally, Table 6 reports the comments of the students about the intervention. Of these reactions, 100% were positive, highlighting the fact that most students (83.3%) felt they had gained a year instead of losing it. Some examples of the anonymous comments are as follows:

• “Not only the contents of the regular course, already internalized by the majority (as most of us failed the clinical part), were included. More complex and profound subjects were also studied. So, instead of having the feeling of losing one year, I felt I had gained one”;

• “It was an excellent experience. Better than doing the course for the second time, it was like doing an XL course that deepened interesting contents, such as when we were introduced to mechanized instrumentation”;

• “Before the intervention, I felt frustrated about repeating a course. However, once the course began, this feeling changed, and I felt privileged to have repeated the year. This was because of the high level of the course”;

• “I would like to express my gratitude for having the possibility to take part in this intervention. I was able to improve my clinical skills and perform new and important procedures for my future professional practice”;

• “This educational intervention is a procedure that should be repeated for other courses too, as one learns much more and it prevents you from loathing the course”;

• “I only wish to express my gratitude for the professors in charge [of the intervention]. They made this intervention possible, which positively changed my perception of endodontics”; and

• “Subjects that were superficially treated in the first course were deepened. This is because we started the course with a basis, and the time was better invested in reinforcing contents and deepening them instead of starting with the basics. The intervention also gave me confidence to carry out an endodontic treatment alone in the future. The course helped me find the enthusiasm for endodontics and even consider it as an area of specialization in the future.”

Discussion

In this study, an educational intervention took place for students repeating the endodontics course in 2010-12 due to previous non-fulfillment of clinical course requirements. This intervention included a total of 28 students and mainly consisted of increasing the clinical attention to patients, deepening regularly taught contents, and introducing new contents not regularly given in the undergraduate course on endodontics. When we compared the grades of intervention students with those of students who repeated the course in the previous years without intervention, the study group showed significantly higher grades than the control group. Also, when the grades were divided
for students with low performance during a course significantly improved their perception of the discipline/specialty. Interestingly, the highest scores of the study group in comparison with the control group were obtained in the area of behavior/professionalism. It is interesting that while the intervention did not touch on professionalism, but focused only on the clinical area through the use of methodological strategies,

| Table 4. Students' perceived causes of their initial academic failure (n=24) |
|--------------------------|------------------|
| Cause of Failure | Number (Percentage) |
| Insecurity and slowness in caring for patients (poor time management) | 13 (54.2%) |
| Difficulty in getting patients | 9 (37.5%) |
| Patients missed the appointment and/or lack of patient commitment | 7 (29.2%) |
| Fear and/or little support from clinical tutor | 4 (16.7%) |
| Lack of integrating theory with clinical practice | 3 (12.5%) |
| The course did not interest me | 1 (4.7%) |
| Personal problems | 1 (4.7%) |
| Immaturity | 1 (4.7%) |
| Excessive academic load | 1 (4.7%) |

Note: Students could attribute their failure to more than one cause.

| Table 5. Topics students would have liked to be included or have increased time on during the intervention (n=24) |
|--------------------------|------------------|
| Topic | Number (Percentage) |
| More practice with a higher number of molar trepanations in patients | 15 (62.5%) |
| More extensive information on the rotary systems | 8 (33.3%) |
| Carry out treatments on patients using rotary instruments | 4 (16.7%) |
| Attend a higher number of endodontic emergencies | 4 (16.7%) |
| Perform treatments in molars | 4 (16.7%) |
| Carry out some treatments on young and/or traumatized permanent teeth | 2 (8.3%) |
| Learn to use mineral trioxide aggregate (MTA) | 1 (4.7%) |
| Apply intracoronal bleaching | 1 (4.7%) |

Note: Students could name more than one topic.

| Table 6. Students' open comments about the intervention (n=24) |
|--------------------------|------------------|
| Comment | Number (Percentage) |
| More complete learning, integrated, with new topics, and no repetition or stagnation. Very productive. | 21 (87.5%) |
| Gratitude for the intervention, that it was a great experience, and that it felt as if a year was won. | 20 (83.3%) |
| It provided confidence, assurance, independence, and rapidness needed in clinical care. It taught skills for successful treatment. | 14 (58.3%) |
| Great team of professors who were trained, welcoming, understanding, and able to value differences among the students. | 9 (37.5%) |
| Positively changed my vision of the course and the endodontics specialty. | 9 (37.5%) |
| Hopefully, the intervention will be applied in other courses. | 7 (29.2%) |

Note: Students’ comments could fall into more than one area.

and compared by area (theoretical and clinical), the intervention students had significantly higher grades in all areas. These results could be attributed to the fact that the study group was more motivated and interested in the course as compared to the students of the control group. In regards to this, no previous studies were found with a similar intervention method for students who had failed a course. However, two studies found that the use of remedial techniques,
new contents, and student motivation, it nevertheless contributed to the improvement of professional behavior in the students. This is particularly relevant and important as a current agreement between organizations and institutions of higher education in Latin America, North America, and Europe focuses on the importance of training and developing professionalism in future dentists.\textsuperscript{17-20} This aspect is so important that some authors have stated that only in the context of professionalism can the specialized knowledge and technical experience of a dentist benefit the community.\textsuperscript{20,21}

When we analyzed the students’ perceptions of the intervention, 100\% of them agreed that it had increased and improved their knowledge in endodontics and that the experience offered new contributions to their learning. This result could be because the students felt that they were not repeating the same topics as the previous year, but rather that the subjects were deepened. The introduction of topics that were not studied in the original course also offered new study material and new challenges, which could have influenced their perception of these aspects.

Moreover, it is important to underscore that all participants agreed that the professors in charge were appropriately trained. The professors who participated in the intervention not only had professional knowledge in clinical endodontics, but also had pedagogical training in university teaching and several years of experience and direct clinical work with students. According to the students, these attributes allowed for more interaction, communication, and confidence in the student-professor relationship. This result is consistent with previous studies that defined the pedagogical preparation of the professor as an important requirement for learning in dental education.\textsuperscript{1,2,22,23}

Based on the surveys, 95\% of the students felt accepted and understood and that the experience should be repeated in the following years. More than 90\% of them reported that the intervention improved their approach with handling patients and that it helped them to develop more confidence in the execution of endodontic procedures. A previous study found endodontics to be a difficult subject for students, many of whom believed that, in order to develop clinical experience, more clinical time and patient cases were required than were included in regular courses.\textsuperscript{12} In this regard, our intervention in this study did not include the preclinical stage since the students had already treated patients and, under a pedagogical vision, it is not logical to repeat practice in simulated models. Thus, students were allowed to spend more hours with patients. Furthermore, the methodologies used by the participating professors, such as presentation of personal clinical cases, PBL, and group discussions at the end of every clinical session to discuss mistakes, complications, and doubts, gave the students important feedback and reinforced concepts by giving them more clinical confidence, similar to that reported in previous studies.\textsuperscript{12,16}

Of the students who participated in the intervention, 75\% said that the intervention had totally and positively changed their vision of endodontics, and some were even considering this specialty as a future possibility. Overcoming their frustration with and aversion towards a discipline, as can happen in the face of academic failure, and producing positive perspectives are important overall achievements of the intervention.

Regarding the 58\% of the students who reported that the intervention helped them improve in other disciplines, this finding could indicate that the students better understood the importance of endodontics as a basis for other dental treatments and procedures in other clinical disciplines. This is particularly important given the curricular structure of the Faculty of Dentistry at the University of Chile, where in the fourth year of study all of the clinical courses work separately, each with an individual clinical program to fulfill, so that integration with other disciplines is difficult. Only in the fifth and sixth years of study do the students treat the patients integrally. This curricular weakness will be modified through the implementation of a new curriculum launched in 2014 that will include, among other changes, complete clinical integration and an earlier introduction of students to patients. Implementing the type of intervention noted in our study would additionally help in the establishment of this new curriculum.

Our analysis of the open-ended survey questions showed that the reasons for previous failure were varied, as has been found in previous studies.\textsuperscript{6,7} However, the principal reasons expressed by the students were their insecurity and slowness in treating patients, which included poor time management and difficulties with obtaining patients, patient non-attendance, or repeated late arrival to the appointment. These difficulties have also been reported in other teaching experiences, in both endodontics and in other health disciplines dealing with patient care.\textsuperscript{12,13} Keeping this in mind, it is important to note that Chile currently has 39 dental schools. This
quantity is extremely disproportionate in relation to the country’s population (~17 million people), and many of these schools lack accreditation for the quality of education provided. This problem has caused a progressive decline in the number of patients visiting the University of Chile for dental care, generating a challenge that needs to be faced, possibly with adaptations to course requirements given the new reality of few patients.

Another cause for failure mentioned by some students (16.7%) was fear of and/or little support from the clinical tutor. This opinion has been noted in other studies in which the students assigned great importance to the technical experience of their professor and held the belief that a good student-professor relationship is fundamental for student performance.22,24 Pedagogical training for teachers enables them to evaluate students using various strategies, which is of vital importance for establishing a successful teaching-learning process,25,26 especially when students learn in an environment of high stress, such as exists when providing clinical care to patients.5,13,27-30

Students also mentioned the lack of integration between theory and clinical practice as a reason for failure. Students better assimilate knowledge through its application. This is why great importance was given to clinical and practical learning, as students feel they are nearer to a real situation, thus making assimilation of the knowledge easier.12,14,16,22 We hope that this situation will be partially solved with the wider implementation of the intervention.

It is important to highlight that when these students were asked about including more topics in the intervention, many preferred instead to gain more experience in patient care with the already included new subjects in the intervention, which were molar trepanation, rotary instrumentation, and emergency care. This finding coincides with that of other studies in which students expressed their wish to start practical work and acquire as much clinical experience as possible.12,14,16,22,31 For the intervention students in our study to pass the course, they were required to carry out the same number of treatments as the students in the regular course: four endodontic treatments in anterior teeth (incisors and canines) and one treatment of a premolar.

Most of the intervention students ended the clinical program approximately one month before the rest of the course. While many had the enthusiasm to continue treating more patients, this only happened in a few situations. Due to a shortage of patients and in order not to disadvantage students in the regular course, these treatments were carried out on patients who were already in treatment with the students who participated in the intervention. Still, this was an opportunity not afforded to students in the regular course.

Finally, regarding the opinions of the students expressed in response to the open-ended questions, most of them thought that the intervention was a great experience in which they felt they had gained one year, deepened their knowledge, acquired more experience, and learned new contents. The students emphasized the quality of the professors and strongly suggested the program continue not only in endodontics but also in other clinical courses.

Since this intervention was applied in only one clinical course, our sample size was small. Given this, any limitations of this study are probably related to the practical significance of the statistical differences between student groups. Despite being significant, a difference of 0.3 points in overall final grade could be considered irrelevant in improving the performance of the intervention students in the evaluated areas. However, the effect of this intervention on the students’ perception of the course and on the endodontic specialty is, in our opinion, sufficient to suggest the value of such intervention programs in dental curricula as a way to improve benefits for students who have failed a clinical course.

In addition to using the results of this study for future improvements in our school, we recommend that this type of intervention be added to other undergraduate dental programs of universities in Chile and perhaps elsewhere. However, considerations should be made given that undergraduate endodontic programs may vary among dental schools even in the same country.32,33 Each dental school should apply its own model specific to its own reality, using the educational concepts presented by our intervention as a basis, therefore ensuring the best scenario for students who have to repeat a clinical course. Through this, a negative experience can be transformed into a positive one.

**Conclusion**

This study found that the educational intervention given to fourth-year dental students who had previously failed the endodontics course significantly improved their grades when compared with those who retook the course without modifications. Besides this, the intervention generated an interest in the
specialty that counteracted frustration and the perception of having lost a year when repeating the course. These results indicate the necessity of redefining the teaching methods used with dental students repeating a clinical course, in which the aim should be taking a difficult situation and making it into a positive opportunity that encourages them to improve in this field and motivates their future progress. Finally, the results of this study support the implementation and further evaluation of similar interventions in other areas of teaching and learning in clinical dentistry at our school. In the future, this could be even easier to apply considering the integration of different clinical areas planned in the new curriculum of our dental school.

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Disclosure

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