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CLINICAL RESEARCH:

Annualization of Fifth-Year Clinical Training in Dentistry: A Curricular Experience at the University of Costa Rica

Anualización de los cursos clínicos de quinto año de la carrera de Odontología: una experiencia curricular en la Universidad de Costa Rica

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ABSTRACT: The aim of this study was to determine the academic impact of converting fifth-year clinical courses at the Faculty of Dentistry of the University of Costa Rica from a semester-based to an annual format by comparing approval, failure, and academic delay outcomes between the two curricular models. An observational retrospective study with longitudinal follow-up was conducted using institutional academic records of 670 students from entry years 2007-2020, with follow-up through December 2024. Student records were analyzed considering variables such as gender, age, admission note, clinic approval rates, and academic delay. Approval rates between curricular formats were compared using chi-square tests and multivariate logistic regression models (OR, 95% CI). Academic delay was analyzed descriptively by clinical discipline and curricular format. Of the students included, 322 completed clinical courses under the semester-based system and 348 under the annual system. Statistically significant differences favoring the annual format were observed in Endodontics (79% *vs*. 64.3%; p<0.001) and Periodontics (91.4% *vs*. 83.5%; p=0.002), whereas Restorative Dentistry showed higher approval rates under the semester-based model (83.5% *vs*. 75.9%; p=0.014). No significant differences were found in Diagnosis, Oral Surgery and Exodontia, or Pediatric Dentistry and Orthodontics. Although a greater absolute number of students repeated courses under the semester-based format, failure in the annual format was associated with a longer mandatory academic delay (12 months vs. 6 months). The academic impact of annualization was heterogeneous across clinical disciplines, highlighting the importance of evaluating curricular reforms using objective indicators before consolidating permanent structural changes in dental clinical education.

KEYWORDS: Dental education; Curriculum; Clinical clerkship; Educational measurement; Curriculum reform; Longitudinal studies.

RESUMEN: El objetivo de este estudio fue determinar el impacto académico de convertir los cursos clínicos de quinto año en la Facultad de Odontología de la Universidad de Costa Rica de un formato semestral a uno anual, comparando los resultados de aprobación, fracaso y retraso académico entre ambos modelos curriculares. Se realizó un estudio observacional retrospectivo con seguimiento longitudinal utilizando los registros académicos institucionales de 670 estudiantes desde los años de ingreso 2007-2020, con seguimiento hasta diciembre de 2024. Se analizaron los registros de los estudiantes teniendo en cuenta variables como género, edad, nota de admisión, tasas de aprobación de clínicas y retraso académico. Se compararon las tasas de aprobación entre formatos curriculares utilizando pruebas de chi-cuadrado y modelos de regresión logística multivariante (OR, IC 95%). El retraso académico se analizó descriptivamente según la disciplina clínica y el formato curricular. De los estudiantes incluidos, 322 completaron cursos clínicos bajo el sistema semestral y 348 bajo el sistema anual. Se observaron diferencias estadísticamente significativas a favor del formato anual en Endodoncia (79% frente a 64,3%; p<0,001) y Periodoncia (91,4% frente a 83,5%; p=0,002), mientras que Odontología Restaurativa mostró tasas de aprobación más altas bajo el modelo basado en semestres (83,5% frente a 75,9%; p=0,014). No se encontraron diferencias significativas en Diagnóstico, Cirugía Oral y Exodoncia, ni en Odontopediatría y Ortodoncia. Aunque un mayor número absoluto de estudiantes repetía asignaturas bajo el formato semestral, el fracaso en el formato anual se asoció a un retraso académico obligatorio más largo (12 meses frente a 6 meses). El impacto académico de la anualización fue heterogéneo entre disciplinas clínicas, lo que pone de manifiesto la importancia de evaluar las reformas curriculares utilizando indicadores objetivos antes de consolidar los cambios estructurales permanentes en la educación clínica dental.

PALABRAS CLAVE: Educación odontológica; Currículo; Prácticas clínicas; Evaluación educativa; Reforma curricular; Estudios longitudinales.

INTRODUCTION

Dentistry is a dynamic health profession that requires universities to continually adapt to scientific, technological, and social advances. This ongoing evolution drives curricular reforms aimed not only at ensuring knowledge acquisition but also at fostering clinical reasoning, professional skills, and the competencies necessary for decision-making in complex healthcare settings (1-3).

Within this context, clinical training represents a central pillar of dental education, as it integrates theoretical knowledge with practical experience and enables the progressive development of professional competencies (3). Students perceive this stage as the setting in which they consolidate their learning through real patient care experiences while simultaneously facing technical, organizational, and emotional demands (4). Innovative clinical learning environments have also been proposed as strategies to promote meaningful learning and professional autonomy (5).

The organization of clinical training varies across institutions, adopting semester-based, annual, rotational, or integrated models that directly influence students' experiences, the development of clinical competencies, and program completion efficiency (1,6). Over the past two decades, numerous curri-

cular reforms have reshaped dental curricula and redistributed clinical content (6). Studies based primarily on student perceptions have shown that such changes affect not only academic performance but also emotional well-being, integration into the clinical environment, and perceived educational quality (5,7). Furthermore, the format of clinical training has been associated with differences in student self-confidence and performance (8). In particular, annual models may promote continuity of patient care and comprehensive treatment planning, whereas fragmented structures can create pressure to meet clinical requirements within shorter timeframes (7).

From a broader structural perspective, studies in higher education have demonstrated that annual and semester-based evaluation systems may influence academic performance and patterns of student progression (9,10). Clinical audits of comprehensive care models have also assessed their impact on training quality and performance indicators (11). The transition from preclinical to clinical training has been described as a period of heightened vulnerability during which students must adapt to new clinical dynamics and professional expectations (12). Stress levels during this stage vary by dental discipline and are associated with curricular organization and teaching approaches (13). Therefore, optimizing the structure of clinical courses may have both academic and psychoeducational implications.

At the Faculty of Dentistry (FOd) of the University of Costa Rica, the curriculum has undergone several reforms in theoretical and preclinical courses. However, no substantial modifications were implemented in clinical courses until 2018, when fifth-year clinics transitioned from a semester-based to an annual format through an official university resolution (14). This reform aimed to strengthen clinical continuity, promote longitudinal patient relationships, and support the progressive integration of competencies. Despite its institutional relevance, the effects of this structural change on student performance have not been systematically evaluated using objective indicators.

Accordingly, the present study aims to comparatively analyze the distribution of enrolled, approved, and failed students in fifth-year clinical courses, as well as the academic delay associated with course failure, under the semester-based and annual models across 14 years of entry. This analysis seeks to determine whether the curricular modification was associated with changes in approval and failure patterns and in program duration among students who failed clinical courses, thereby providing empirical evidence to inform future academic decision-making in dental clinical education.

METHODOLOGY

PARTICIPANTS

An observational retrospective study with longitudinal follow-up was conducted using institutional academic records. This work represents a secondary analysis of a database previously used in studies examining terminal efficiency, course failure, and academic trajectories at the FOd of the University of Costa Rica (15,16); however, the analytical objective of the present study differed and specifically focused on comparing academic performance according to the curricular modality of fifth-year clinical courses.

Academic records of students enrolled in the Dentistry program who entered between 2007 and 2020 were included, with follow-up through December 2024.

Inclusion criteria comprised academic records with complete information available in the Student Applications System (Sistema de Aplicaciones Estudiantiles, SAE) and students who had enrolled at least once in fifth-year clinical courses.

Records with incomplete information and students exposed simultaneously to semester-based and annual formats in these courses were excluded to avoid classification bias.

The curricular modality (semester-based or annual) was determined according to the format actually completed by each student, regardless of year of entry.

DATA COLLECTION

Data were obtained from the SAE and included the following variables: sex (male or female), age at entry (years), admission note, approval or failure status of clinical courses, and number of repetitions per clinic.

The following semester-based clinical courses were analyzed: Pediatric Dentistry and Orthodontics I (O-0540), Pediatric Dentistry and Orthodontics II (O-0543), Diagnosis I (O-0240), Diagnosis II (O-0241), Restorative Dentistry I (O-0541), Restorative Dentistry II (O-0257), Endodontics I (O-0237), Endodontics II (O-0238), Oral Surgery and Exodontia I (O-0244), and Oral Surgery and Exodontia II (O-0245).

The annual courses included: Pediatric Dentistry and Orthodontics (O-0263), Diagnosis (O-0268), Restorative Dentistry (O-0265), Endodontics (O-0264), and Oral Surgery and Exodontia (O-0266).

Approval on the first attempt was defined as obtaining a grade ≥7 on the first enrollment. Final approval corresponded to the academic status of "approved," regardless of the number of attempts required. Failure was defined as a final grade <7, in accordance with the Academic Regulations of the University of Costa Rica (17). For the semester-based format, overall clinic approval was defined as successful completion of both Component I and Component II, which were equivalent in content to the corresponding annual clinic.

STATISTICAL ANALYSIS

Data were entered into a Microsoft Excel database (Microsoft Inc., Redmond, WA, USA) and carefully reviewed to correct inconsistencies prior to analysis.

Descriptive analyses were conducted using absolute and relative frequencies for categorical variables. Approval rates between curricular modalities were compared using the chi-square test, with statistical significance set at $p<0.05$.

Multivariable logistic regression models were constructed to estimate associations between curricular modality and course approval, adjusting for sex, age at entry, and admission note. Results were expressed as odds ratios (ORs) with 95% confidence intervals (CIs). Academic delay was presented descriptively according to clinical discipline and curricular modality.

All statistical analyses were performed using SPSS version 23.0 (SPSS Inc., Chicago, IL, USA).

ETHICAL CONSIDERATIONS

The study was approved by the Scientific-Ethical Committee of the University of Costa Rica (CEC-84-2022). Only anonymized academic data were used, ensuring confidentiality and data protection.

RESULTS

Of the 696 academic records corresponding to entry between 2007 and 2020, 670 met the inclusion criteria and were included in the analysis. The mean admission note was 604.09 points, and the mean age at entry was 17.5 years. The majority

were female (76%). Of the total sample, 322 students completed the clinics under the semester-based model and 348 under the annual model.

Under the semester-based format, lower approval rates were observed in the first component of the clinics, with statistically significant differences between Components I and II in Endodontics, Pediatric Dentistry and Orthodontics, Periodontics, and Restorative Dentistry (Table 1).

When comparing overall approval rates between curricular modalities, statistically significant differences were identified in specific disciplines. In Endodontics, the annual model showed a higher approval rate than the semester-based model (79% *vs*. 64.3%; p<0.001). Similarly, Periodontics demonstrated higher approval under the annual model (91.4% *vs*. 83.5%; p=0.002). In contrast, Restorative Dentistry showed higher approval under the semester-based structure (83.5% *vs*. 75.9%; p=0.014). No significant differences between modalities were observed in Diagnosis (p=0.355), Oral Surgery and Exodontia (p=0.981), or Pediatric Dentistry and Orthodontics (p=0.082) (Table 2).

Table 1. Approval rates of clinical courses under the semester-based model (n=322).

Clinic	Clinic I	Clinic II	Chi-square
Diagnosis	321 (99.7%)	321 (99.7%)	1.0
Endodontics	223 (69.2%)	303 (94.1%)	<0.001
Oral Surgery and Exodontia	314 (97.5%)	316 (98.1%)	0.589
Pediatric Dentistry and Orthodontics	211 (65.5%)	292 (90.7%)	<0.001
Periodontics	275 (85.4%)	315 (97.8%)	<0.001
Restorative Dentistry	274 (85.1%)	313 (97.2%)	<0.001

Table 2. Comparison of approval rates between semester-based and annual models (N=670).

Clinic	Semester-based (n=322)	Annual (n=348)	Chi-square
Diagnosis	321 (99.7%)	345 (99.1%)	0.355
Endodontics	207 (64.3%)	275 (79%)	<0.001
Oral Surgery and Exodontia	308 (95.6%)	333 (97.9%)	0.981
Pediatric Dentistry and Orthodontics	189 (58.7%)	227 (65.2%)	0.082
Periodontics	269 (83.5%)	318 (91.4%)	0.002
Restorative Dentistry	269 (83.5%)	264 (75.9%)	0.014

Multivariable analysis was performed for clinics showing statistically significant differences in approval rates and for Pediatric Dentistry and Orthodontics, given its high failure frequency. Using the semester-based model as the reference category, logistic regression revealed that students in the semester-based format had a 54% lower probability of approval in Endodontics compared with those in the annual model (OR=0.46; 95% CI: 0.32-0.66; p<0.001) and a 48% lower probability of approval in Periodontics (OR=0.52; 95% CI: 0.32-0.86; p<0.001). Conversely, in Restorative Dentistry, the semester-based format was associated with a 66% higher probability of approval compared with the annual format (OR=1.66; 95% CI: 1.12-2.46; p<0.05). No statistically significant association between modality and approval was observed in Pediatric Dentistry and Orthodontics (OR=0.77; 95% CI: 0.56-1.06; p=0.110).

Regarding sex, only in Pediatric Dentistry and Orthodontics did female students show a higher probability of approval compared with males (OR=1.49; 95% CI: 1.05-2.11; p<0.05). No statistically significant associations were identified for age at entry or admission note (Table 3).

Regarding academic delay, a greater absolute number of students experienced delay under the semester-based model (389 students) compared with the annual model (267 students). However, the duration of delay was longer when failure occurred under the annual format, reaching 12 months compared with 6 months under the semester-based model. The clinics with the highest repetition frequency in both modalities were Pediatric Dentistry and Orthodontics and Endodontics. In Restorative Dentistry, a higher frequency of delay was observed under the annual model (Table 4).

Of the total records analyzed, 3.7% (25 students) experienced academic delay attributable exclusively to failure in clinical courses, with this situation being more frequent under the semester-based model (Table 5).

Table 3. Association between curricular modality and approval of clinical courses and independent variables.

Variables	Endodontics		Pediatric Dentistry and Orthodontics		Periodontics		Restorative Dentistry	
	OR	95%IC	OR	95%IC	OR	95%IC	OR	95%IC
Modality								
Semester-based (Ref)	---	---	---	---	---	---	---	---
Annual	0,46**	0,32-0,66	0,77	0,56-1,06	0,52**	0,32-0,86	1,66*	1,12-2,46
Sex								
Male (Ref)	---	---	---	---	---	---	---	---
Female	1,17	0,80-1,71	1,49*	1,05-2,11	1,28	0,76-2,16	1,11	0,72-1,69
Age (per year)	0,94	0,84-1,05	1,03	0,92-1,15	1,01	0,85-1,20	1,06	0,92-1,21
Admission note (per point)	1,00	0,99-1,01	1,00	0,99-1,01	1,00	0,99-1,01	1,00	0,99-1,01

OR=Odds Ratio; 95% CI=95% Confidence Interval. Ref = Reference category.
* p<0.05; ** p≤0.001.

Table 4. Number of students who repeated each clinical course at least once and corresponding delay in graduation.

Clinic	Semester-based (n=389)		Annual (n=267)	
	Students	Delay	Students	Delay
Diagnosis	1	6 months	3	12 months
Endodontics	120	6 months	57	12 months
Oral Surgery and Exodontia	14	6 months	15	12 months
Pediatric Dentistry and Orthodontics	144	6 months	99	12 months
Periodontics	50	6 months	27	12 months
Restorative Dentistry	60	6 months	66	12 months

Table 5. Students who failed only clinical courses (n=25).

Semester-based students	Annual students	Academic delay
15	0	6 months
4	4	12 months
2	0	18 months
0	0	24 months

DISCUSSION

The transition from a semester-based to an annual format produced differential outcomes. No homogeneous improvement was observed across all clinics in terms of approval rates or graduation delay. The curricular modification was implemented to optimize academic performance during students' transition into the clinical environment, a stage described as critical in dental education because it requires the strengthening of competencies related to patient care as well as the development of emotional and communication skills (18). In this regard, García-Huidobro (19) emphasizes that the transition to clinical practice constitutes a highly demanding phase in which students must integrate previously acquired knowledge and skills to function effectively in healthcare settings and deliver high-quality treatment.

Previous research conducted at the FOd (16,20) identified Diagnosis and Oral Surgery and Exodontia as the clinics with the highest approval rates. These findings are consistent with the present results, as both clinics maintained approval rates above 95% under both semester-based and annual modalities, suggesting that the structural change did not significantly impact these courses.

In contrast, statistically significant differences associated with curricular modality were observed in Periodontics and Endodontics, with higher approval rates under the annual format. In Periodontics, students perform therapies involving procedures distributed over time with the objective of preserving and maintaining natural dentition and periodontal tissues, in which maintenance appointments over several months

are essential determinants of treatment success (21). Within this context, the annual structure may facilitate completion of all therapeutic phases and fulfillment of established clinical requirements. Additionally, the extended timeframe could allow students more opportunity to educate patients regarding the oral care measures necessary to maintain periodontal health, which may translate into greater treatment adherence and improved attendance at supportive follow-up appointments, both critical factors for achieving long-term periodontal stability (22).

Similarly, the improvement observed in Endodontics may be explained by the concept of the learning curve, understood as the relationship between accumulated experience and performance in task execution (23,24). Performing endodontic treatment requires the ability to interpret diagnostic images, adequately plan treatment, and execute multiple complex technical procedures, including anesthesia, rubber dam isolation, cavity preparation, working length determination, canal shaping, disinfection, and obturation (25). These competencies develop progressively through clinical practice. Indeed, both teaching experience at the FOd and studies conducted in other universities report that during the early stages of clinical training, students may require multiple appointments to complete a root canal treatment or retreatment (26,27). The extended timeframe of the annual model may support this progressive consolidation of skills.

In Pediatric Dentistry and Orthodontics, although the annual format showed a tendency toward higher approval rates, the difference was not statistically significant. Historically, this clinic has presented one of the highest failure rates at the FOd and has particular characteristics. Treating pediatric patients has been associated with elevated levels of student stress; for example, research conducted at the Universidad de Santo Tomás reported high stress levels among students when administering anesthesia and placing rubber dam isolation in pediatric patients (28). Additionally, this course includes, often for the first time, complex procedures such as pulp therapies (29), stainless steel crown restorations, which may cause gingival inflammation and patient discomfort (30), and extractions, procedures described in the literature as generating considerable anxiety and fear among students (31). These factors may help explain why the positive effect of increased temporal continuity was insufficient to produce statistically significant differences.

The only clinic in which annualization yielded less favorable results was Restorative Dentistry. Students demonstrated a 66% higher probability of approval when the course was delivered under the semester-based format. Several factors may have contributed to this finding. First, the initiation of clinical practice is typically gradual, as treating patients and performing irreversible procedures is associated with high levels of stress (32). Second, annualization involved integrating the requirements of Clinic I and Clinic II into a single cumulative block. Many restorative procedures require multiple clinical appointments; for example, complete denture fabrication involves an average of eight appointments because of the complex sequence of clinical and laboratory steps, as well as post-delivery adjustments (33). Likewise, removable partial dentures require multiple stages, including possible reimpressions and adjustments that may prolong laboratory timelines (34). When requirements are aggregated within a single annual period, students may accumulate multiple patients and procedures simultaneously, making it more difficult to meet course requirements in a timely manner.

Regarding individual variables, age at entry and admission note were not associated with clinic approval. However, sex was significantly associa-

ted with approval in Pediatric Dentistry and Orthodontics, in which female students demonstrated a higher probability of approval under both modalities. This finding is consistent with studies conducted in Saudi Arabia reporting higher female performance in Pediatric Dentistry (29). Additionally, another study reported better female performance in Pediatric Dentistry, although males achieved higher averages in Orthodontics (35). At the FOd, Pediatric Dentistry and Orthodontics are integrated into a single clinic focused on interceptive orthodontic treatment in children, which may explain differences compared with universities in which adult patients receive fixed orthodontic treatment. Furthermore, the literature suggests that communication skills and emotional intelligence, more frequently attributed to female students, may positively influence pediatric patient care (36,37).

With respect to academic delay, only 3.7% of students experienced delayed graduation attributable exclusively to failure in clinical courses, indicating that clinical course failure is not the primary cause of extended time to graduation. Nevertheless, although annualization improved approval rates in Endodontics and Periodontics, failing an annual course entails a longer delay (12 months compared with 6 months). Academic delay may carry psychological consequences, including anxiety and impairment of general well-being (38,39), as well as economic repercussions related to prolonged financial dependence and delayed entry into professional practice (40).

Overall, the findings reinforce that the impact of annualization is not homogeneous across disciplines and may depend on the nature of clinical procedures, the structure of requirements, and the organizational complexity of each course. Considering differentiated models, maintaining some clinics in a semester-based format and others in an annual format may contribute to optimizing both academic performance and student well-being.

Among the principal strengths of this study is that it constitutes the first formal evaluation of the academic effect of annualization in fifth-year clinical courses at the FOd, using a robust institutional database spanning 14 years of student entry. Moreover, statistically significant differences were identified between semester-based and annual modalities, providing objective indicators to inform evidence-based curricular decision-making, in alignment with the need to review and update contemporary models of dental education (11). As a limitation, variables related to full-block enrollment or substantial modifications in clinical requirements or evaluation systems were not included. These factors may have influenced the results and should be explored in future research to further clarify the curricular impact.

CONCLUSIONS

Annualization of fifth-year clinical courses did not produce a homogeneous effect on student academic performance. Significant improvements were observed in Periodontics and Endodontics, whereas in Restorative Dentistry, the semester-based format was associated with a higher probability of approval. Although annualization demonstrated benefits in specific disciplines, its impact on academic progression should be interpreted cautiously, given that failure in an annual course entails a longer academic delay.

These findings support the need to evaluate curricular reforms using objective indicators and longitudinal analyses before consolidating permanent structural changes. They also support the consideration of differentiated curricular models tailored to the specific characteristics of each clinical discipline.

CONFLICT OF INTEREST: The authors declare no conflict of interest.

AUTHOR CONTRIBUTION STATEMENT: Conceptualization and study design, N.G.M., A.G.F. and M.G.Ch.; Literature review,. N.G.M., A.G.F. and M.G.Ch.; Methodology and validation, N.G.M., A.G.F. and M.G.Ch.; Formal analysis, N.G.M., A.G.F. and M.G.Ch.; Investigation and data collection, N.G.M., A.G.F. and M.G.Ch.; Resources, N.G.M., A.G.F. and M.G.Ch.; Data analysis and interpretation, N.G.M. and A.G.F.; Writing-original draft preparation, N.G.M., A.G.F. and M.G.Ch.; Writing-review and editing, N.G.M., A.G.F. and M.G.Ch.; Supervision, N.G.M., A.G.F. and M.G.Ch.; Project administration, N.G.M. and A.G.F.

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