Evaluating the Performance of Dental Students with Different Levels of Clinical Experience in Learning ICDAS

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Abstract

Aim: This study aimed to evaluate the dental students' performance in ICDAS (International Caries Detection and Assessment System) coding with different levels of clinical experience.

Materials and methods: Dental students ($n = 122$) in their clinical years, year 3 ($n = 37$), year 4 ($n = 44$), and year 5 ($n = 41$) received training (two-hour introductory lecture on ICDAS, followed by a 90 min e-learning video, and practice sessions using extracted teeth and photographs) from a calibrated expert. After training, the students examined a prevalidated set of extracted teeth and assigned scores in two sessions. The intra- and inter-examiner agreement between students was analyzed using weighted kappa statistics and a focus group discussion was conducted for qualitative feedback.

Results: The range of kappa values for intra-examiner agreement among the year 3, 4, and 5 students for ICDAS caries code (0.611–0.879, 0.633–0.848, and 0.645–1.000) and restoration code (0.615–0.942, 0.612–0.923, 0.653–1.000), respectively. The range of kappa values for inter-examiner agreement for year 3, 4, and 5 students with a trained expert for ICDAS caries code (0.526–0.713, 0.467–0.810, and 0.525–0.842) and restoration code (0.531–0.816, 0.682–0.842, and 0.645–0.928), respectively.

Conclusion: The ICDAS system is a promising tool for caries detection and its implementation in the curriculum was perceived by dental students as an effective method. In general, there was moderate to substantial agreement for ICDAS caries and restoration code between students of different academic year groups and with a trained ICDAS expert.

Clinical significance: ICDAS is a simple, logical, and evidence-based system for the detection and classification of caries. Introducing ICDAS to dental students enables them to detect caries in a reliable and reproducible manner irrespective of their past clinical experience and also significantly improves their caries detection skills.

Keywords: Caries detection, Dental students, ICDAS, Training.

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Introduction

Caries detection is one of the most important clinical skills that is acquired during the professional training of dental students. Over the years, there seems to be a lack of consensus regarding caries detection among dental trainers, and to overcome this, a scoring system was created so that it can serve as a common language for clinical practice. The International Caries Detection and Assessment System (ICDAS) was hence developed in 2002 by a group of researchers from various dental institutes across Europe and America to standardize caries detection.[1] ICDAS is a simple, logical, and evidence-based system for the detection and classification of caries in dental education, clinical practice, dental research, and dental public health. The modified version ICDAS-II was presented in 2005, which is now more widely accepted for coding caries severity.[2,3]

The ICDAS system assigns a two-digit code to each tooth surface allowing the advantage of each surface to be monitored over time. The system grades the severity of a carious lesion according to a numerical value (0–6) and this has been determined to correlate well with the histologic extent of the lesion. A separate numerical code (0–8) is assigned to each surface to record restorations and fissure sealants.[4]

The ICDAS system has been used in the field of research for almost a decade and has been effective when measured against established methods for caries detection, such as WHO index and laser fluorescence.[5–9] The use of the e-learning program of ICDAS

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training has been reported to improve the performance of dental students' diagnostics skills.[10] Since its development, many schools globally have incorporated the ICDAS system into the dental

curriculum, but there is limited evidence about the integration of the ICDAS system into clinical practice. There also seems to be a dearth of studies done to evaluate the performance of dental students having different levels of clinical experience in ICDAS caries severity coding.

At Penang International Dental College (PIDC), ICDAS was introduced in line with the global and national recommendation as best practice for the detection and assessment of dental caries in clinical practice. To introduce this new concept across the board in the dental school, an ICDAS task force was constituted that was entrusted with the duty of planning the training (staff and student) and implementation of ICDAS as a new module. The task force developed a reference set of extracted teeth and images which was validated by experts in the field. These reference sets of teeth were used for staff and student training. With this background, this study was designed to evaluate the performance of dental students with different levels of clinical experience as against a trained expert for ICDAS coding.

MATERIALS AND METHODS

The Institutional Review Board of Penang International Dental College approved this study (PIDC/IRB/FRP/4/17) that was conducted during the period from October 2018 to May 2019. The purpose of the study was explained and informed consent was obtained from the participants. The students participating in the study ($n = 122$) were in their clinical years: year 3 ($n = 37$), year 4 ($n = 44$), and year 5 ($n = 41$). All students received training by a calibrated expert, at the beginning of the semester. None of the students had any previous exposure to ICDAS. A full-day training session was conducted that included a two-hour introductory lecture on ICDAS, followed by a 90 minutes e-learning video and practice sessions using extracted teeth and photographs.

The next day after the training, students and a trained expert examined a prevalidated set of 40 extracted teeth and assigned scores. A week later, students and a trained expert again examined the same pre-validated set of teeth and assigned scores. Statistical analysis was performed using SPSS version 20. The intra-examiner agreement between students of different academic year groups and inter-examiner agreement of students with a trained expert was analyzed using weighted kappa statistics. Kappa values ≤ 0 shows no agreement; 0.01–0.20, none to slight; 0.21–0.40, fair; 0.41–0.60, moderate; 0.61–0.80 substantial; and 0.81–1.00, almost perfect agreement.[11,12] After 6 months of training, a focus group discussion was conducted to understand the perception of the students regarding their experience and thematically analyzed. The focus group discussion was transcribed and the transcript was read thoroughly several times to obtain general clarity and then the data was segmented into small sections and the texts were labeled as codes. The coded data were used to identify the possible themes to link the underlying meaning. The themes identified were categorized to reflect the student's experience and opinion.

RESULTS

Intra-examiner Agreement

Intra-examiner agreement for each student was measured using Cohen's kappa statistic for ICDAS caries codes and restoration codes assigned by students during sessions 1 and 2. The lowest and highest kappa scores for intra-examiner agreement for ICDAS caries codes among the academic year groups ranged between 0.611 and 1.000 (year 3: 0.611–0.879, year 4: 0.633–0.848, and year

Table 1: Kappa value interpretation for intra-examiner agreement

	Academic year	0.41–0.60 moderate	0.61–0.80 substantial	0.81–1.00 perfect agreement
ICDAS caries code	Year 3 ($n = 37$)	0	30 (81%)	7 (19%)
	Year 4 ($n = 44$)	0	34 (77%)	10 (23%)
	Year 5 ($n = 41$)	0	26 (63.5%)	15 (36.5%)
ICDAS restoration code	Year 3 ($n = 37$)	0	28 (75.6%)	9 (24.4%)
	Year 4 ($n = 44$)	0	31 (70.5%)	13 (29.5%)
	Year 5 ($n = 41$)	0	24 (58.6%)	17 (41.4%)

5: 0.645–1.000). Similarly, the lowest and highest kappa scores for ICDAS restoration codes among the academic year groups ranged between 0.615 and 1.000 (year 3: 0.615–0.942, year 4: 0.612–0.923, and year 5: 0.653–1.000).

Table 1 represents the kappa value interpretation for the intra-examiner agreement for ICDAS caries codes and restoration codes. Overall, the intra-examiner agreement between the students for caries and restoration codes was noted to be moderate to substantial that indicates good strength of agreement in assigning codes for caries and restoration using ICDAS in both sessions.

Inter-examiner Agreement

Inter-examiner agreement between each student and trained expert for ICDAS caries codes and restoration codes assigned during sessions 1 and 2 was measured using Cohen's kappa statistic. The lowest and highest kappa value for inter-examiner agreement between students and trained expert for ICDAS caries codes were: year 3—session 1: 0.526—0.713 and session 2: 0.414—0.684, year 4—session 1: 0.467–0.810 and session 2: 0.479–0.752, and year 5—session 1: 0.525–0.842 and session 2: 0.477–0.774.

The lowest and highest kappa value for between students and trained expert for ICDAS restoration codes with a trained expert were: year 3—session 1: 0.531–0.816 and session 2: 0.427–0.821, year 4—session 1: 0.682–0.842 and session 2: 0.642–0.863, and year 5—session 1: 0.645–0.928 and session—2: 0.621–0.989.

The kappa value interpretation between different academic year groups of students with a trained expert ranged between moderate to substantial for ICDAS caries codes and moderate to perfect for ICDAS restoration codes, which indicates that both students and trained expert are similarly assigning ICDAS codes as seen in Table 2.

Focus Group Discussion

The analysis of the focus group discussion showed that the ICDAS training and implementation experience had both positive and negative influences on students' perceptions. The following themes emerged through focus group discussion:

- Conservative tooth preparation
  - "Very detailed and specific", "now I am more conservative in tooth preparation".

- Holistic treatment plan
  - "Knowing the severity of caries helps in deciding the treatment", "risk assessment helps in explaining the patient", "I can answer my patient's questions more confidently", "helps in holistic treatment planning".

Table 2: Kappa value interpretation for inter-examiner agreement

	Academic year	Session 1			Session 2		
		0.41–0.60 moderate	0.61–0.80 substantial	0.81–1.00 perfect agreement	0.41–0.60 moderate	0.61–0.80 substantial	0.81–1.00 perfect agreement
Students with trained expert for ICDAS caries code	Year 3 ($n = 37$)	23 (62.2%)	14 (37.8%)	0	20 (54.1%)	17 (45.9%)	0
	Year 4 ($n = 44$)	26 (59.2%)	16 (36.3%)	2 (4.5%)	24 (54.6%)	20 (45.4%)	0
	Year 5 ($n = 41$)	25 (60%)	14 (35.2%)	2 (4.8%)	23 (56.1%)	18 (43.9%)	0
Students with trained expert for ICDAS restoration code	Year 3 ($n = 37$)	17 (46%)	16 (43.2%)	4 (10.8%)	15 (40.5%)	19 (51.3%)	3 (8.2%)
	Year 4 ($n = 44$)	24 (54.5)	18 (41%)	2 (4.5%)	20 (45.5%)	21 (47.7%)	3 (6.8%)
	Year 5 ($n = 41$)	18 (44%)	19 (46.3%)	4 (9.7%)	15 (36.5%)	21 (51.4%)	5 (12.1%)

- Challenges in learning
  - o "Time-consuming", "I am always confused with 01 and 02 caries code", "have to rely on a patient's memory for 97 v/s 98 restoration code", "always have to keep referring to the score chart".

DISCUSSION

The most common and convenient method in dental practice to detect caries is the visual-tactile method. ICDAS is both a visual and tactile method of caries detection and assessment that meets the requirements of validity and reliability.[13] The present study helped to determine the intra-examiner agreement among years 3, 4, and 5 dental students and inter-examiner agreement between students and against a trained expert. The study has indicated moderate to substantial agreement for ICDAS caries and restoration codes between students of different academic year groups and with a trained expert. These results are in contrast to a study by Foley that indicated that the consistency of ICDAS codes varied between students and also between different year groups. [14]

Our study results show that the three groups of students had similar consistency in coding caries and restoration. The possible reason for not detecting any significant difference among the three groups of students belonging to different academic years might be because the ICDAS scoring system was a new concept and the lack of familiarity was equal among all three groups, even though the topic of caries detection is familiar to all. In a study by Zandona et al., there were no significant differences between the students and faculty for intra- and inter-examiner agreement for ICDAS severity coding indicating that previous clinical dental experiences do not seem to play a significant role in learning ICDAS as a new concept.[15] In a study by Khalifa, the pre-survey demonstrated that dental interns and senior students in year 5 and 6 had better knowledge of cariology and were more confident detecting dental caries compared to junior students who are in year 3 and 4.[16]

ICDAS is a visual-tactile method of caries detection that depends on good visual examination without the destruction of incipient lesions. Students during training were confused while assigning caries codes of 1, 2, and 4, which was also experienced by participants in other studies.[16–18] El-housseiny and Jamjoum found no significant difference between the two groups of dentists with different levels of experience using the visual method of caries detection and yet the less experienced dentists performed better in comparison to the more experienced ones.[19]

The introduction of ICDAS as a new diagnostics system in the curriculum saw the faculty and students face a fair bit of challenges
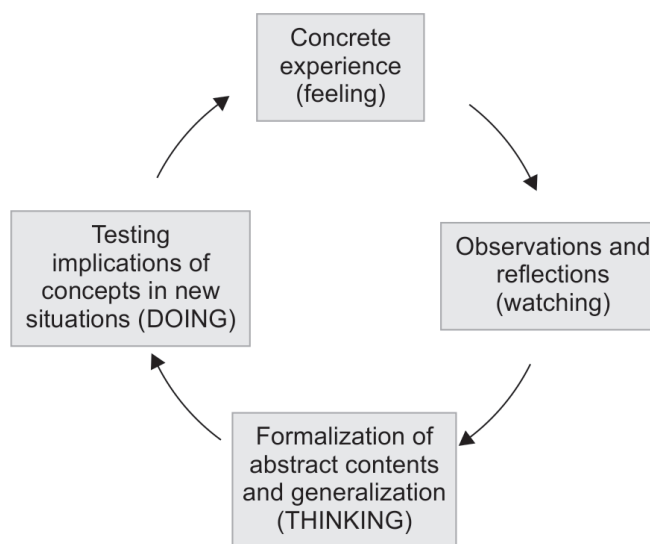

Fig. 1: Kolb cycle for experiential learning

yet adapting to it eventually. When such new concepts are introduced, the performance and reproducibility of the examination are both important factors to consider in determining the success of an implementation. The positive aspects of ICDAS perceived by students were the detailed and specific nature of the system, ease of treatment planning based on the severity of caries, and conservative tooth preparation. The negative aspects revolved around the system being more elaborate, time-consuming, and confusing between the scores.

The results of our study show that the students' response was good and they were ready to adopt this new system of caries detection and prevention into their clinical practice, thus, assisting in its overall implementation in the curriculum and clinical practice.

In our study, across the board implementation of the ICDAS training module did not show differences in agreement between the students and a trained expert, which can be explained in the context of David Kolb's experiential learning model for adult learners. In Kolb's scheme, the learner has a concrete experience, upon which they reflect (Fig. 1). Through their reflection, they can formulate abstract concepts, and make appropriate generalizations. They then consolidate their understanding by testing the implications of their knowledge in new situations. This then provides them with a concrete experience, and the cycle continues. Learners with different learning preferences will have

strengths in different quadrants of the (Kolb) cycle.[20] Thus, the introduction of a new concept or learning module, such as ICDAS is well-received showing moderate to perfect agreement between students and experts as the module has been built keeping the principles of instructional design for adult learning. The scope for future research, however, could explore the difference between senior dental practitioners who have been using the older caries detection system for many years as against young practitioners' adoption of ICDAS in the working environment.

CONCLUSION

ICDAS is an evidence-based system for the detection and classification of caries that has good reproducibility and its sensitivity and specificity are clinically acceptable. Systematic introduction of ICDAS to dental students teaches them to detect caries in a reliable and reproducible manner irrespective of their past clinical experience. This study shows moderate to substantial agreement for ICDAS caries and restoration codes between students of different academic years as against a trained expert, which is a success of the adult learning instructional design.

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