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# Perceived Attributes of a Novel Teaching Aid of Local Anaesthetic Simulator Kit in Performing Inferior Alveolar Nerve Block

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***ABSTRACT: Background: The inferior alveolar nerve block (IANB) is the most frequent regional anaesthesia technique used in dental procedures and has been reported to have the highest failure rates among dental undergraduates, interns and even, dental professionals. Hence, local anaesthesia has been formally taught in worldwide dental curriculum since the 1940s. This was when lignocaine was introduced as the safest anaesthesia medium for dental anaesthesia. Otherwise, dental anaesthesia was performed by Horace Wells in 1920s using cocaine. Purpose. This study is mainly aimed to examine the difference between Year 1 and Year 3 dental undergraduates towards perceived attributes of innovation diffusion theory and intention to use a Novel Local Anaesthesia Simulator Kit (LASK) in competently performing inferior alveolar nerve block in pre-clinical simulation. Methodology. A cross-sectional survey was conducted using questionnaire; and distributed to dental undergraduates. A total of 150 questionnaires were valid for data analysis. Results. The findings revealed that the perceived attributes of relative advantage, compatibility, observability and trialability were statistically different for both groups of students. However, results indicate that complexity construct for both non-clinical and pre-clinical groups of students were not statistically significant difference. Conclusion. The findings of this study will contribute to specific educational significance in the dental curriculum, especially in assessment of dental undergraduates' clinical competence dental undergraduates at a more microscopic level.***

***Keywords: inferior alveolar nerve block (IANB), attitudes, innovation, teaching aid, university, students***

## 1. INTRODUCTION

Upon graduation, a dental surgeon must be equipped to contribute to the general health of the population by being capable of providing basic dental treatment independently. In Malaysia, a dental surgeon is expected to acquire this ability through a formal structured 5-year course at a tertiary institution based on Competency-based Curriculum by the Malaysian Dental Deans' Councils, based on pre-determined levels in Competencies of New Dental Graduates, Malaysia approved by the Malaysian Dental Council [1]. At the Faculty of Dentistry,

Universiti Teknologi MARA, the five-year Bachelor in Dentistry programme encompasses 2 pre-clinical years and 3 clinical years. The conventional pre-clinical teaching method requires undergraduates to train on a mandibular (lower jaw) model prior to performing an inferior alveolar nerve block (IANB) on their clinical partner in pre-clinical training sessions under vigilant eyes of dental educators. A major transition phase between training on a training kit to performing their first injection on a human being may contribute to deficiencies in performing the injection due to shortfalls on the conventional training model as it does not mimic the real-life oral environment of a human being. Cumulatively, other factors such as nervous and lack of confidence requires close supervision by dental educators [2]. The main aspect of Novel Local Anaesthesia Simulator Kit (LASK) [3] is to provide a simulation environment to dental undergraduates and to monitor the practice of performing IANB administration in a simulation environment. Whilst concurrently, providing real-time data accessibility (assessment records) for both parties, i.e., dental undergraduates and dental academicians. Furthermore, self-reflection of any improvements that could be made prior to real-life administration of IANB to patients is available via training on the LASK. Therefore, this study is mainly aimed to examine the difference between Year 1 and Year 3 dental undergraduates towards perceived attributes of innovation diffusion theory and intention to use a LASK in competently performing inferior alveolar nerve block in pre-clinical simulation.

## 2. UNITS

### *2.1 Adoption Theory*

The adoption of a new clinical behaviour by clinicians and healthcare system is a consequence of multiple factors. Research on the diffusion or adoption of innovations suggests that a few themes come into the game. This study focused on using Diffusion of Innovation Theory in examining dental undergraduates' attitudes of behaviour intention towards LASK prototype as a teaching aid for clinical undergraduates. There are five main factors that influence adoption of an innovation, and each of these factors is at play to a different extent in five adopter categories.

- Relative Advantage - The degree to which an innovation is seen as better than the idea, programme, or product it replaces.
- Compatibility - How consistent the innovation is with the values, experiences, and needs of the potential adopters.
- Complexity - How difficult the innovation is to understand and/or use.
- Trialability - The extent to which the innovation can be tested or experimented with before a commitment to adopt is made.
- Observability - The extent to which the innovation provides tangible results.

Diffusion theory by Rogers [4] has developed one of the better-known theoretical approaches to diffusion of innovation. This theoretical framework is helpful when determining the adoption of specific clinical behaviors and when deciding which components will require additional effort if diffusion is to occur. It includes a consideration of aspects of the innovation (or new technology), style of communication, steps in decision making, and the social context. According to Rogers [4] there are five elements of a new or substitute clinical behavior that each will partly determine whether adoption or diffusion of a new activity will occur: relative advantage, compatibility, complexity, trialability and observability.
are numbered with numerals.

| Abbreviation | Fullname |
|---|---|
| age | age in years |
| sex | sex (1 = male; 0 = female) |
| cp | chest pain type |
| trestbps | resting blood pressure (in mm Hg) |
| chol | serum cholestoral in mg/dl |

Table 1: Attributes of Cleveland dataset

*2.2 Relative Advantage*

Rogers [5] defines "relative advantage" as the degree to which an innovation is perceived as better than the idea it supersedes. Research provides information on the cost-effectiveness and potential benefit to patients of implementing a new clinical activity. However, the objective data may be less important than the clinician's perception of whether the innovation will be advantageous. Decisions about implementing best-evidence practice are driven not only by patient welfare but also by the interplay between interests of the clinician and the healthcare system [6]. However, if the recommended behavior increases the status of adopting clinicians and brings in more benefits for individuals or the organization, the innovation may be readily adopted. These will result in increment of adoption rate towards the innovation.

*2.3 Compatibility*

Compatibility is a measure of the degree to which an innovation is perceived as being compatible with existing values, past experiences, and the needs of potential adopters [6]. To increase the probability of adoption, the innovation must address an issue that clinicians or others perceive to be a problem [7]. Thus, an innovation that is more compatible with one's teaching and learning methods is more likely to be assimilated into an individual's learning environment.

*2.4 Complexity*

Complexity is a measure of the degree to which an innovation is perceived as difficult to understand and use [5]. A clinical procedure is more likely to be adopted if it is simple and well defined. Hence, the level of difficulties of innovation will determine the diffusion rate for LASK adoption as a teaching aid.

*2.5 Trialability*

Trialability can be defined as the degree to which the innovation may be modified [5]. The ability to test a potential innovation on a limited basis allows clinicians to explore the implementation of the procedure, its acceptability to users, and the potential outcomes.

*2.6 Observability*

Rogers [5] defines observability as the degree to which the results of the innovation are visible to others. Previous studies revealed that the findings from observation will influence adoption of innovation rate or level [8-9].
In view of all the definition, one of the major goals of literature review is to outline the

direction of research and shows the development of knowledge. Based on the literature review, the researcher develops a conceptual framework of the study by testing the relationship of dependent and independent variables. However, in this paper our main aim was to examine the difference between Year 1 and Year 3 dental undergraduates towards perceived attributes of innovation diffusion theory and intention to use a Novel Local Anaesthesia Simulator Kit for competently performing inferior alveolar nerve block in pre-clinical simulations.

## 3. METHODOLOGY

In this study, a survey instrument was used to test differences between pre-clinical (Year 1) and first year clinical students (Year 3) towards perceived attributes of a new teaching aid in performing an inferior alveolar nerve block; namely Local Anaesthetic Simulator Kit (LASK). The study method is described in the following section.

### *3.1 Study design and participants*

A cross-sectional survey design was employed. This study was carried out at Faculty of Dentistry, Universiti Teknologi MARA (UiTM), Sungai Buloh Campus; with the study population comprising students from 1st and 3rd year who registered in Semester 1/2020.

### *3.2 Instrument and data analysis*

A 39-item survey question was used as a method for data collection. Three closed-ended items investigating demographic characteristics of participants and 36 items using 5-point Likert scale statements on the influence of five constructs of Rogers' innovation diffusion theory. No open-ended questions were included in this survey instrument. Prior to data collection, two local experts reviewed the questionnaire. Their comments to clarify the instrument were integrated to arrive at the final version.

Cronbach's alpha coefficient was used to confirm the internal consistency reliability of the items. Descriptive statistics (i.e. means, standard deviations and frequency distributions) were carried out to describe survey respondents including demographic profile and perceived attributes of LASK. Independent t-test was used to test differences of mean values also reported. A p-value of 0.05 was used as a cut-off for statistical significance. All analyses were performed using IBM SPSS Statistics version 23®.

| No | Construct | Cronbach's alpha | Total item | Skewness | Kurtosis |
|---|---|---|---|---|---|
| 1 | Relative advantage | 0.930 | 11 | -0.235 | -0.622 |
| 2 | Complexity | 0.760 | 5 | 0.477 | 0.633 |
| 3 | Compatibility | 0.768 | 6 | 0.562 | -0.464 |
| 4 | Observability | 0.846 | 6 | 0.471 | -0.273 |
| 5 | Trialability | 0.870 | 5 | 0.069 | -0.534 |
| 6 | Intention to use | 0.835 | 9 | 0.284 | -0.398 |

Table 1: Reliability and data distribution analysis

### *3.3 Ethics approval*

Participation of this study is voluntary and informed consent was obtained from the respondents. Prior to completing the self-administered structured questionnaire, all students were explained regarding the nature and purpose of the study. This research study obtained ethics approval from UiTM Research Ethics Committee (REC/182/19).

## 4. RESULTS AND FINDINGS

Descriptive analysis is presented in this section. Demographic background of respondents will be described. Frequency and percentage of data obtained will be presented.

### *4.1 Demographic Profile*

One hundred and fifty students participated in completing the questionnaire, who were dental undergraduates; 83 from Year 1 and 67 from Year 3, 55% and 44.7%; respectively. Most of students were female (80%, n=120) and 20% male students (n=30). Majority of students (94.7%) from age range between ages of 18 to 20 years (n=71), and ages of 21 – 22 years (n=71). Only 5.3% (n=12) were between 23 to 25.

### *4.2 Differences in Mean Values*

An independent samples t-test was performed to examine if there are any statistically significant differences in attitudes and constructs of Diffusion of Innovation Theory [10] towards the new teaching aid called LASK in performing inferior alveolar nerve block between Year 1 and Year 3 students. As can be seen in Table 1, the distributions of data were sufficiently normal for the purposes of conducting a test (i.e. skewness < |2.0| and kurtosis < |9.0| [11]. Cohen's guidelines [12] for small (r=0.01), medium (r=0.06), and large (r=0.14) effect sizes to help interpret the relative size of the difference magnitudes.

#### *4.2.1 Relative advantage*

As shown in Table 2, findings indicated that the mean scores of relative advantages were statistically significant difference for both groups of students ($t(149) = 6.386$ $p<0.001$), two-tailed. The mean score of Year 1 students (M=4.32, SD=0.51) was much higher than Year 3 students (M=3.81, SD=0.73). The magnitude of differences in the means (d=0.507, CI = 0.349 – 0.664) was large (eta squared = 0.22). Therefore, there was 22% of variance in relative advantage is explained by type of student; either pre-clinical or clinical students.

#### *4.2.2 Compatibility*

Data findings reported that mean scores of compatibility construct for both groups of students had statistically significant difference ($t(149) = 4.160$ $p<0.001$), two-tailed. The mean score of Year 1 students (M=4.04, SD=0.48) was much higher than Year 3 students (M=3.75, SD=0.37). The magnitude of the differences in the means (d=0.287, CI = 0.151 – 0.423) was large (eta squared = 0.10). Therefore, there was 10% variance in relative advantage is explained by type of student; either pre-clinical or clinical students.

#### *4.2.3 Observability*

Data findings reported that the mean scores of observability construct for both groups of

students had statistically significant difference (t (148) = 4.512 p<0.001), two-tailed. The mean score of Year 1 students (M=3.94, SD=0.53) was much higher than Year 3 students (M=3.58, SD=0.434). The magnitude of the differences in the means (x1-x2=0.362, CI = 0.204 – 0.521) was moderate (eta squared = 0.11). Therefore, there was 11% of the variance in relative advantage is explained by type of student; either pre-clinical or clinical students.

*4.2.4 Trialability*

Data findings reported that the mean scores of trialability construct for both groups of students had statistically significant difference (t (149) = 4.160 p<0.001), two-tailed. The mean score of Year 1 students (M=4.09, SD=0.56) was much higher than Year 3 students (M=3.72, SD=0.53). The magnitude of the differences in the means (d=0.371, CI = 0.195 – 0.548) was large (eta squared = 0.10). Therefore, there was 10% of the variance in relative advantage is explained by type of student; either pre-clinical or clinical students.

*4.2.5 Complexity*

However, results indicated that the mean scores of complexity construct for both groups of students had no statistically significant differences (t (148) = 0.218 p=0.828), two-tailed. The mean score of Year 1 students (M=3.65, SD=0.51) was slightly similar with Year 3 students (M=3.63, SD=0.39).

*4.2.6 Intention to Use*

Lastly, the findings indicate that the mean scores of intentions to use for both groups of students had statistically significant difference (t (148) = 5.570 p<0.001), two-tailed. The mean score of Year 1 students (M=4.11, SD=0.5) was much higher than Year 3 students (M=3.71, SD=0.38). The magnitude of differences in the means (d=0.401, CI = 0.258 – 0.543) was large (eta squared = 0.173). Therefore, there was 17.32% of variance in relative advantage is explained by type of student; either pre-clinical or clinical students.

| | Year 1 | Year 3 | t | p | Mean Difference | Confidence interval | |
|---|---|---|---|---|---|---|---|
| | M (SD) | M (SD) | | | | Lower | Upper |
| Relative advantage | 4.321 (0.507) | 3.814 (0.731) | 6.386 | 0.000 | 0.507 | 0.349 | 0.664 |
| Compatibility | 4.038 (0.476) | 3.751 (0.368) | 4.160 | 0.000 | 0.287 | 0.150 | 0.432 |
| Observability | 3.939 (0.529) | 3.577 (0.434) | 4.512 | 0.000 | 0.362 | 0.204 | 0.521 |
| Complexity | 3.655 (0.513) | 3.639 (0.392) | 0.218 | 0.828 | 0.017 | -0.134 | 0.167 |
| | | | | | | | |
| Trialability | 4.094 (0.556) | 3.722 (0.528) | 4.160 | 0.000 | 0.372 | 0.195 | 0.548 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Intention to use | 4.107 (0.497) | 3.706 (0.383) | 5.570 | 0.000 | 0.401 | 0.258 | 0.543 |

Table 2: Independent t-test analysis

## 5. CONCLUSION

The results of this study further portray how imperative it is for dental undergraduates to practice and master profound clinical skills prior to embarking into clinical practice. In the era of Big Data, evidence of competence in LASK will definitely prepare a pre-clinical student comprehensively before interacting and treating their patients. This reaffirms with a study conducted by Ziv et al [13] where learners can therefore, have their first encounter with patients at a higher level of technical and clinical proficiency, which protects patients. Simulation-based learning via the novel LASK is designed to cater to the addressed issues with an iterative training platform to increase competency of dental undergraduates as well as data acquisition features for systematic competency assessment in pre-clinical simulation sessions.

These findings also demonstrated the advantageous effect of Year 3 dental undergraduates who have experience in clinical simulation and has expectations to perform dental procedures on their patients competently. Whereas, the variance is large for most factors as Year 1 students who have learned theoretical knowledge but has yet to grasp the clinical applications of it. Interestingly, this demonstrates that the ongoing clinical study between two sample year 3 students, using conventional versus LASK training would perform IANB on their patients.

The findings revealed that the perceived attributes of relative advantage, compatibility, observability and trialability were statistically different for both groups of students. However, results indicated that complexity construct for both non-clinical and pre-clinical groups of students had no statistically significant differences. However, we strongly suggest for a research that determines the underlying causes why scenarios such as these occur. One of the limitations of this study was the target population that was focused on were solely dental undergraduates from one university. This was due to time and resource limitations to complete the study. For future research, it we recommend that a wider population is used in this study from dental faculties in Malaysian universities. This is to ensure that the findings represent nationwide dental students' opinions towards the attributes of using the LASK as a new learning tool. This study will scientifically contribute to specific educational significance, especially in assessment of clinical competence of dental undergraduates at a more microscopic level in terms of both students' and dental educators' perspectives.

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