

FACTORS INFLUENCING ATTITUDES TOWARDS A NEW TEACHING AID FOR LOCAL ANAESTHESIA ADMINISTRATION USING SIMULATOR KIT

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ABSTRACT

Globally, local anaesthesia is an essential skill and is formally taught in the dental curriculum. The Inferior Alveolar Nerve Block (IANB) is the most frequent regional anaesthesia techniques used in dental procedures. However, this technique has been reported to have the highest rate of failure among dental undergraduates. Hence, a Local Anaesthetic Simulator Kit (LASK) is developed. The main aim of this study is thus to investigate factors related to the diffusion of innovation attributes on students' attitudes towards innovative teaching aids using simulator kit. A cross-sectional survey was conducted using questionnaire; and distributed to dental undergraduates. Questionnaire used in this study consisted of items that adapted from previous studies. There were 150 valid data for data analysis. Respondents were undergraduate dental students from Year 1 and Year 3, involving 80% female and 30% male. The study findings reported that all the attributes including relative advantage, complexity, compatibility, observability and trialability significantly influence attitudes of students towards the new teaching aid for local anaesthetics. However, complexity has statistically no significant relationship with the outcome variable. These empirical studies will significantly contribute to formal instructional significance, particularly in the assessment of clinical competence of dental undergraduates at a more microscopic level.

Keywords: Attitudes, Innovative Teaching Aids, Simulator Kit, Local Anaesthetics

INTRODUCTION

Local anaesthesia is a vital part in dental treatment and formally taught in worldwide dental curriculum. The Inferior Alveolar Nerve Block (IANB) is the most frequent regional anaesthesia techniques used in dental procedures. However, this technique has been reported to have substantial failure rates among dental undergraduates, interns and even, dental professionals (Alhindi et al., 2016; PotoEnik & Bajrovi, 1999). It is therefore imperative for dental undergraduates to have adequate practical training to minimize errors and ensure that they are completely trained with local anaesthesia administration skills prior to the care of patients in their clinical years. In response to this present issue, an innovative Local Anaesthesia Simulator Kit (LASK) is being developed as new andragogy in pre-clinical training in performing an IANB; and will further be introduced at regional dental schools. Skull mannequins (bone) or dental models are among the conventional approaches and commonly used pre-clinical teaching methods at worldwide dental schools. Student-to-student local anaesthesia administration has also been a traditional method of preclinical training in dental education. However, even though going through this simulation training, most students feel ill confident and insufficiently prepared for their first injection on a human being (Chandrasekaran et al., 2014; Sánchez-Garcés et al., 2020; Wong et al., 2019). The main purpose of this study is therefore to examine the factors affecting student's attitudes towards the intention to

use an innovative Local Anaesthesia Simulator Kit (LASK) to perform the Inferior Alveolar Nerve Block (IANB) in their pre-clinical training.

LITERATURE REVIEW

The adoption of new clinical behaviour by clinicians and the healthcare system is a consequence of multiple factors. Attitude has a strong effect on behaviour; however only under certain circumstances or factors (Fishbein & Ajzen, 2005; Guyer & Fabrigar, 2015). Research on the diffusion or adoption of innovations suggests that several innovation attributes may influence the behavioural intention. This can be fundamentally seen during the Coronavirus pandemic. This current research study focuses on the use of Roger's Diffusion of Innovation Theory in examining dental undergraduates' attitudes regarding their behavioural intention towards the LASK prototype as a teaching aid for dental undergraduates. There are five main factors that influence the adoption of an innovation. Innovation Diffusion Theory has developed one of the better-known theoretical approaches to the diffusion of innovation (Rogers, 2010). This theoretical framework is helpful when determining the adoption of specific clinical behaviours and when deciding which components will require additional effort if diffusion is to occur (Mohammadi et al., 2018; Sanson-Fisher, 2004). It includes a consideration of various aspects of the innovation (or new technology), style of communication, steps in decision making, and the social context. In Roger's Innovation Diffusion Theory (IDT), there are five elements of a new or substitute clinical behaviour namely relative advantage, compatibility, complexity, trialability and observability. Each element will partly determine whether adoption or diffusion of the new activity will occur.

Rogers (2010) 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 benefits to patients because 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's welfare but also by the interplay between the interests of the clinician and the healthcare system (Sanson-Fisher, 2004). However, if the recommended behaviour increases the status of adopting clinicians and brings in more benefits for individuals or the organisation, the innovation may be readily adopted. These will result in an increment of adoption rate towards innovation.

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 (Rogers, 2010). To increase the probability of adoption, the innovation must address an issue that clinicians or others perceive to be a problem (Sanson-Fisher, 2004). 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.

Complexity is a measure of the degree to which an innovation is perceived as difficult to understand and use (Rogers, 2010). 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 IANB adoption as a teaching aid.

Trialability can be defined as the degree to which the innovation may be modified (Rogers, 2010). 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.

Rogers, (2010) describes observability as the degree to which the results of the innovation are visible to others. Previous studies revealed that the findings from the observation would

influence the adoption of innovation rate or level (Matthews et al., 2016; Pashaeypoor et al., 2016; Sanson-Fisher, 2004; Scott et al., 2008). As one of the major goals of the literature review is to outline the direction of the research and show the development of knowledge, a conceptual framework of the study was developed to examine the relationship between these dependent and independent variables.

Therefore, these five characteristics of diffusion of innovation theory play a substantial role in examining the willingness and readiness of individuals in accepting an innovation. This paper focused on answering the main objective of whether dental undergraduates are willing to use LASK as a teaching aid or otherwise.

In this study, Roger's innovation diffusion theory was divided into six variables; including perceived relative advantage, compatibility, complexity, trialability, observability and attitude towards intention to use, as indicated in Figure 1. Therefore, based on the conceptual framework in Figure 1, five hypotheses were tested in this study are presented as follows.

- H1 There is a positive relationship between relative advantage and students' attitude towards behavioural intention.*
- H2 There is a positive relationship between compatibility and students' attitude towards behavioural intention.*
- H3 There is a positive relationship between complexity and students' attitude towards behavioural intention.*
- H4 There is a positive relationship between trialability and students' attitude towards behavioural intention.*
- H5 There is a positive relationship between observability and students' attitude towards behavioural intention.*
- H6 Relative advantage affects students' attitude towards behavioural intention.*
- H7 Compatibility affects students' attitude towards behavioural intention.*
- H8 Complexity affects students' attitude towards behavioural intention.*
- H9 Trialability affects students' attitude towards behavioural intention.*
- H10 Observability affects students' attitude towards behavioural intention.*

By examining these factors, the attitudes of dental undergraduates for using the IANB simulator kit as a pre-clinical innovative teaching aid can be predicted.

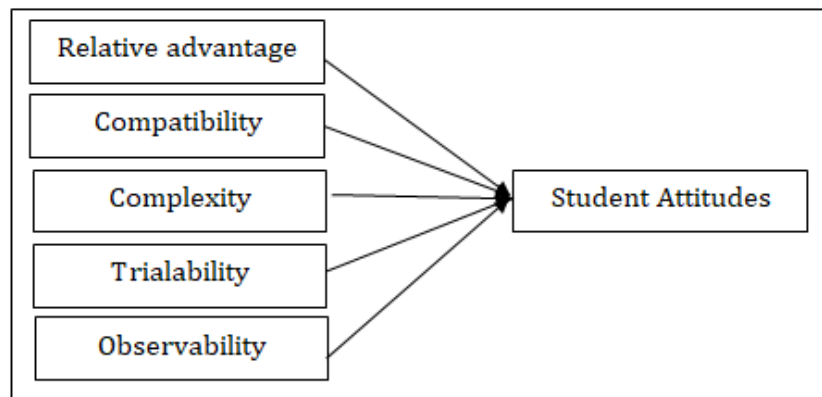


FIGURE 1
CONCEPTUAL FRAMEWORK

METHODOLOGY

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 graduate in Malaysia approved by the Malaysian Dental Council (2012). The Universiti Teknologi MARA dentistry bachelor's degree is a five-year programme. The Local Anaesthesia module is introduced in the third year. The conventional pre-clinical teaching method requires undergraduates to train on a mandibular (lower jaw) model prior to performing an 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. Details of this research study method are described in the following sections.

Study Design and Instrument

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 of first-year dental undergraduates registered in Semester 2/2019.

A 46-item survey question was used as method of data collection. This survey question was divided into three sections. Three closed-ended items investigating demographic characteristics of participants in Section A; Section B comprised 36 of 5-point Likert scale statements on the influence of five constructs of diffusion of innovation theory on the dental undergraduates' intention to use LASK. 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.

DATA ANALYSIS

All statistical analyses were performed using the IBM SPSS Statistics software (Version 22, IBM SPSS Inc., Chicago, IL). Cronbach's alpha coefficient was used to confirm the internal consistency reliability of the items. Table 1 provides details of reliability analysis. Most constructs were found to be highly reliable. Only cronbach's alphas for the five compatibility and three complexity items were 0.794 and 0.759, respectively. The normality of data was also checked using skewness and kurtosis values. All constructs were normally distributed, with skewness and kurtosis values below ± 1 , near to zero values is better, *i.e.*, the rule of thumb.

Mean values with standard deviation were used to present quantitative data. Percentages were provided to summarise distribution patterns of categorical data. Correlation between variables was assessed using Pearson correlation. The level of significance was set at $P < 0.05$.

Ethical Consideration

This research project was approved by the University Teknologi MARA Human Research Ethics Committee of the Institute of Research Management and Innovation (IRMI) (REC/182/19). Informed consent forms were distributed to students to indicate their voluntary participation in the project and their right to withdraw from the project at any time without any adverse consequences.

Prior to completing the self-administered structured questionnaire, the nature and purpose of the study were explained to the respondents (Table 1).

No	Construct	Mean	SD	Cronbach's alpha	Total item	Skewness	Kurtosis
1	Relative advantage	4.094	0.548	0.936	11	0.032	-0.402
2	Complexity	3.629	0.543	0.759	3	-0.013	0.412
3	Compatibility	3.933	0.503	0.794	5	0.392	0.111
4	Observability	3.778	0.52	0.866	6	0.563	0.117
5	Trialability	3.928	0.573	0.859	5	0.103	-0.481
6	Attitude	3.997	0.526	0.933	8	0.248	-0.03

RESULTS

Descriptive and inferential analyses are presented in this section. The demographic background of the respondents is described.

Data results on internal consistency of the instrument, the descriptive analysis of variables and correlation analysis of variables are also reported (Table 2).

Item	Statement	SD	D	A	SA	M	SD	Decision
C1	The benefits of the LASK will make me continue to use them in the future.	-	-	98 (65.3%)	35 (23.3%)	4.12	0.58	Positive
C2	I intend to continue to use the LASK because they help manage my time better.	-	2 (1.3%)	85	25 (16.7%)	3.89	0.68	Positive
				-56.70%				
C3	Because the LASK IS appropriate to my profession, I will use it in future.	-	-	92 (61.3%)	37 (24.7%)	4.11	0.62	Positive
C4	The LASK usage is appropriate for my working style and I will continue using it.	-	2 (1.3%)	93 (62%)	27 (18%)	3.97	0.65	Positive
C5	The ease of use of the LASK will make me continue to use it.	-	1 (0.7%)	94 (62.7%)	34 (22.7%)	4.07	0.62	Positive
C6	The difficulty in learning to use the LASK will make me not use it in future.	13 (8.7%)	62 (41.3%)	20 (13.3%)	6	2.63	0.96	Positive
					-4%			
C7	Seeing my classmate use the LASK will make me continue to use it.	-	1 (0.7%)	79 (52.7%)	24 (16%)	3.84	0.69	Positive
C8	What I have observed about the use of the LASK in my studies will make me keep using it.	-	2 (1.3%)	93	24 (16%)	3.93	0.65	Positive
C9	Trying out the opportunities of using the LASK in my profession will make me continue using it in future.	-	-	93 (62%)	33 (22%)	4.06	0.62	Positive

Note: Percentages do not equal 100% because neutral responses were excluded. Abbrev: SD–Strongly Disagree, D–Disagree, A–Agree and SA –Strongly Agree

Demographic characteristics

All 150 participants were undergraduate dental students from Year 1 and Year 3; involving 55% (n=83) and 44.7% (n=67); 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 years. In analysing descriptive data, there was no attempt to add all the results into a composite score and the neutral responses were deleted, thus the N-value differs from item to item. A positive attitude will be resulted from obtaining high percentage of positive items, however less 50% of negative items responses (<50%). Details of survey findings are shown in Table 2.

Majority of the students strongly agreed or agreed to the intention to continue using this novel teaching aid because benefits of LASK offered (n=133;88.6%), ease of use of LASK (n=128; 85.4%) and help to manage better time (n=110;73.4%). Most of the students strongly agreed and agreed to continue using LASK in the future as it is perceived to be appropriate for their profession (n=129; 86%) and working style (n=120;80%); and having opportunities to LASK in their profession (n=126;84%).

The students also strongly agreed and agreed that after seeing classmate used the LASK (n=103; 68.7%) and examining the use of LASK in study plan had made them to continue using LASK in the future (n=117;78%). For all survey items, 5.3% of students have disagreement, namely strongly disagreed, or disagreed to continue using LASK in future (item C2, C4, C5, C7 and C8). However, 50% of respondents disagree and strongly disagree will not continue LASK when there was difficulty in learning to use the LASK (n=75).

Association of Diffusion of Innovation Attributes and Student's Attitudes

Correlation analyses were performed to assess the relationship between the students' attitudes towards LASK and Roger's theory of innovation attributes, including relative advantage, complexity, compatibility, observability and trialability. Cohen's criterion benchmarks for small ($r=0.10$), medium ($r=0.30$), and large ($r=0.50$) effect sizes to help interpret the relative size of the correlation magnitudes (Cohen, 1988). Data results indicated that the level of student's attitude towards the new teaching aid of LASK was positively significant correlated with all five constructs of Roger's Diffusion of Theory; including relative advantage ($r=.730, p<0.05$), complexity ($r=.363, p<0.05$), compatibility ($r=.758, p<0.05$), observability ($r=.693, p<0.05$) and trialability ($r=.603, p<0.05$). Overall, the study findings indicate that correlation magnitudes were within medium and large effect. The proposed H1, H2, H3, H4 and H5 were supported.

A multiple regression was carried out to examine whether the constructs of diffusion Roger's theory; including relative advantage, complexity, compatibility, observability and trialability predicted the student's attitude towards a new teaching aid; namely Local Anaesthetic Simulator Kit (LASK). Regression analysis was first confirmed by testing the assumptions of normality, linearity, homoscedasticity, and independence of residuals, revealing that the residuals are normally distributed (Tabachnick & Fidell, 2014). Using the enter method, it was found that the model is significant ($F=68.782, p<0.001$). The adjusted R² of 0.695 indicates that 69.5% % of the variance in the attitudes towards the new teaching aid; namely LASK was explained by the model.

The value is considered a large effect (Cohen, 1988). The beta weights, presented in Table 3, suggest that the relative advantage (Beta=0.304, $t(149)=4.505, p<0.01$), compatibility (Beta=0.279, $t(149)=3.676, p<0.01$), observability (Beta=0.271, $t(149)=4.387, p<0.01$) and trialability (Beta=0.124, $t(149)=2.088, p=0.039$) significantly predict the attitudes of students towards LASK. However, complexity has statistically no significant relationship with the outcome variable (Beta=0.023, $t(149)=0.456, p=0.649$). Hence, H6, H7, H9 and H10 were supported. However, H8 was not supported in this study (Table 3).

Construct	B	SE(B)	β	t	p
Relative advantage	0.086	0.065	0.304	4.505	0
Complexity	0.292	0.049	0.023	0.456	0.649
Compatibility	0.022	0.08	0.279	3.676	0
Observability	0.274	0.063	0.271	4.387	0
Trialability	0.114	0.055	0.124	2.088	0.039
R ² =0.705. F (5,144)=68.782, $p<0.001$. Note: * $p<0.05$; ** $p<0.01$					

DISCUSSION

This research study was part of a larger study that are now in developing an innovation Local Anaesthesia Simulator Kit (LASK) as a new andragogy in pre-clinical IANB training and will be further introduced in regional dental schools. This study mainly to examine the factors affecting the attitudes of the intention to use the IANB simulator kit (LASK) as an innovative teaching aid for pre-clinical training among dental students. It also examined the attitudes of dental students towards new teaching aid. The descriptive analysis of attitudes, correlation and regression analyses in this study confirmed similar findings in the previous studies.

The results of this study revealed that majority students can be considered to have a positive attitude towards the new teaching aid called LASK. Attitude is a significant predictor of intention to use. Previous studies found that user's positive attitudes could lead to higher positive and direct impact on the intention to use new technology (Cheung & Vogel, 2013; Hussein, 2017; Mirzajani et al., 2016).

The correlation analysis shows that attitude of the dental students has a strong and positive relationship with relative advantage, compatibility, complexity, trialability and observability. It therefore indicates that, when these factors of perceived attributes of innovation Roger's theoretical constructs are enhanced among students, students' attitude of behavioural intention will be likely to increase. Upon having a strong attitude of behavioural intention, their willingness to adopt new teaching aid should be reflected in their actual use of LASK in performing IANB during their pre-clinical training. These findings are in congruence with previous studies conducted by Rogers (2010); Sanson-Fisher (2004); Matthews, et al., (2016).

In this study, findings reveal that perceived relative advantage, compatibility, observability and trialability significantly affect positive attitude of intention to use LASK. The complexity of LASK did not affect the dental students' attitude towards intention to use LASK. In this study, the complexity factor did not significantly predict the attitude of dental students towards intention to use LASK. According to Matthews, et al., (2016) perceived relative advantages of the diagnostic

mouth rinse over existing methods were potential time efficiency, low implementation cost, and utility of the tool. Low complexity and compatibility were other important features enhancing adoption of an innovation in dental practices (Matthews et al., 2016). The present findings suggest that factors from the Roger's innovation attributes should be taken into consideration to encourage and enhance attitudes towards intention to use LASK as new teaching aid in dental education. It is important to minimize negative attitudes and perceptions such as dislike or reluctant to use so that dental students willing to adopt new teaching aid for their pre-clinical training with an open mind.

CONCLUSION

Having an effective and efficient technique in performing the inferior alveolar nerve block (IANB) in dental procedures, particularly at undergraduate level, is crucial. LASK is currently designed and developed in response to this issue. The study findings provide positive responses from the pre-clinical dental undergraduate.

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REFERENCES

- Alhindi, M., Rashed, B., & Alotaibi, N. (2016). Failure rate of inferior alveolar nerve block among dental students and interns. *Saudi Medical Journal*, 37(1), 84-89.
- Chandrasekaran, B., Cugati, N., & Kumaresan, R. (2014). Dental students' perception and anxiety levels during their first local anesthetic injection. *Malays J Med Sci*, 21(6), 45-51.
- Cheung, R., & Vogel, D. (2013). Predicting user acceptance of collaborative technologies: An extension of the technology acceptance model for e-learning. *Computers and Education*, 63, 160-175.
- Fishbein, M., & Ajzen, I. (2005). *The influence of attitudes on behavior*. The Handbook of Attitudes.
- Guyer, J.J., & Fabrigar, L.R. (2015). *Attitudes and behaviour, (Second Edition)*. In International Encyclopedia of the Social & Behavioral Sciences.
- Hussein, Z. (2017). Leading to intention: The role of attitude in relation to technology acceptance model in E-Learning. *Procedia Computer Science*, 105, 159-164.
- Matthews, D.C., McNeil, K., Brilliant, M., Tax, C., Maillet, P., McCulloch, C.A., & Glogauer, M. (2016). Factors influencing adoption of new technologies into dental practice: A qualitative study. *JDR Clinical and Translational Research*, 1(1), 1-10.
- Mirzajani, H., Mahmud, R., Fauzi Mohd Ayub, A., & Wong, S.L. (2016). Teachers' acceptance of ICT and its integration in the classroom. *Quality Assurance in Education*, 24(1).
- Mohammadi, M.M., Poursaberi, R., & Salahshoor, M.R. (2018). Evaluating the adoption of evidence-based practice using Rogers's diffusion of innovation theory: A model testing study. *Health Promot Perspect*, 8(1), 25-32.
- Pashaepoor, S., Ashktorab, T., Rassouli, M., & Alavi-Majd, H. (2016). Predicting the adoption of evidence-based practice using "Rogers diffusion of innovation model. *Contemporary Nurse*, 52(1), 85-94.
- PotoEnik, I., & Bajrovic, F. (1999). *Failure of inferior alveolar nerve block in endodontics*. Endod Dent Traumatol.
- Rogers, E.M. (2010). Diffusion of innovations: Simon and Schuster. *Computer*, 21(4), 17-27.
- Sánchez-Garcés, M.Á., Arnabat-Domínguez, J., Camps-Font, O., Toledano-Serrabona, J., Guijarro-Baude, A., & Gay-Escoda, C. (2020). Evaluation of student-to-student local anaesthesia administration at the University of Barcelona: A cross-sectional study. *European Journal of Dental Education*, 24(20), 328-334.
- Sanson-Fisher, R.W. (2004). Diffusion of innovation theory for clinical change. *Medical Journal of Australia*, 180(S6), S55-S56.

- Scott, S.D., Plotnikoff, R.C., Karunamuni, N., Bize, R., & Rodgers, W. (2008). Factors influencing the adoption of an innovation: An examination of the uptake of the Canadian Heart Health Kit (HHK). *Implementation Science*, 3(41).
- Tabachnick, B.G., & Fidell, L.S. (2014). *Principal components and factor analysis - General purpose and description*. In using multivariate statistics.
- Wong, G., Apthorpe, H.C., Ruiz, K., & Nanayakkara, S. (2019). Student-to-Student dental local anesthetic preclinical training: Impact on students' confidence and anxiety in clinical practice. *Journal of Dental Education*, 83(1), 56-63.