

SHORT
COMMUNICATION

Volume 14 Issue 2 2022

DOI: 10.21315/eimj2022.14.2.7

ARTICLE INFO

Received: 04-07-2021

Accepted: 20-12-2021

Online: 30-06-2022

Piloting Online “Think Aloud” Sessions to Support Clinical Learning During the Pandemic

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To cite this article: Menon RK, Bhatia S, Nadarajah VD, Pau A. Piloting online “think aloud” sessions to support clinical learning during the pandemic. *Education in Medicine Journal*. 2022;14(2):93–102. <https://doi.org/10.21315/eimj2022.14.2.7>

To link to this article: <https://doi.org/10.21315/eimj2022.14.2.7>

ABSTRACT

Online clinical teaching can result in significant challenges for students and faculty. Online demonstrations of clinical skills may not adequately convey and share the underlying thought process seen in face-to-face sessions. For this study, an online activity was developed and piloted to enhance clinical teaching of border moulding for a complete denture. In the first session, an expert described a clinical dental procedure in a “think aloud” format to a group of 35 students with images and videos, and a procedural guide was provided. Second session was held a week later in a small-group format, whereby students described steps in the procedure using a think aloud format back to a facilitator who, in turn, provided individual feedback. Amongst the students who responded to the feedback questionnaire, 91% found the activity to be acceptable and effective. From the open comments provided by the students and facilitators, key areas of improvement were identified for the think aloud activity, namely, the need for prior training, the existing gap in think aloud capabilities and the need for post-session assessment, leading to the development of a workflow to be implemented in future. It can be concluded that the transferability of the think aloud activity for clinical teaching in other health professions is worth considering.

Keywords: *Think aloud, Dental education, Online learning, e-Learning*

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INTRODUCTION

Clinical dental education is usually delivered by faculty supporting a small group of students at the chairside while they are treating patients. This concept is built on the Miller’s pyramid of professional competence, whereby direct observation of

a student’s performance at the workplace assesses the level of “does” (1). Dental technical skill development is usually conducted in a simulation lab, providing the opportunity to assess the level of student competency at the level “shows how” (1). In addition to visually observing the procedure being performed by an expert, a

novice may benefit by understanding the expert's thought process while performing the procedure. "Think aloud" is a process of articulating one's thought process by which a clinician can verbally express the automatic, unconscious thinking process as they gather and analyse clinical data. "Capturing" and "verbalising" the thought process are the key elements, and the sequence of thoughts are not to be modified. There is previous evidence from laboratory analyses of reaction times, error rates, patterns of brain recordings and sequences of eye fixations that verbalisation reflects the thought process of an individual (2). Further, it has also been observed that the brain activity is different while answering questions as compared to a think aloud process (3).

Ericsson et al. (4) have shown that a key enabler for attaining expertise is to engage in deliberate practice. Deliberate practice supports the development of refined mental representations, allowing the expert clinician to engage in elaborate reasoning strategies and information processing (4). The aforementioned method has been used previously in medical education to enhance clinical reasoning amongst undergraduate students (5–6). In dentistry, cognitive task analysis has been used to identify the critical incidents in performing a preclinical dental task (7). In the lockdown situation of COVID-19 pandemic, all campus activities were suspended for an undetermined period of time; thus, the shows how activity of skill development was not possible. Hence, an online think aloud activity was designed to complement skill development learning.

METHODS

This activity was designed and piloted to complement skill development in a clinical procedure (border moulding of a maxillary complete denture) by training the students to think aloud in small groups. The performance of this task usually requires nine sequential steps (8). The preliminary

steps are performed in a lab, where the materials required for the clinical procedure are fabricated (involving fabrication of the maxillary and mandibular custom trays and designing the spacer for each arch). The preclinical steps were followed by the clinical procedure that involves moulding the oral musculature at different sites in the oral cavity, starting from the maxilla until the moulding of the posterior mandibular region is completed. In the first session, which was of 2 hour's duration, a clinical expert described the process of border moulding in a think aloud format to a group of 35 students in Microsoft Teams with the help of clinical images and videos. The number of students was determined by the number of students in the cohort who attended the session. During the session, the expert utilised numerous drawings on clinical images and videos to think aloud each step in the procedure by verbalising his thought process (Figure 1). In contrast to restricting the teaching activity to explaining the actions required to mould specific musculature while performing the clinical activity, the expert incorporated his knowledge of the oral anatomy as well as his previous experience or challenges faced while performing the activity. The key variation from the conventional method of teaching was in the narration of the process, where the thought process was being verbalised at every step. The expert had not received any specific training in the think aloud process. However, previous examples of the use of the think aloud technique in medical and dental education were thoroughly reviewed by the expert before the session.

Following the session, a step-by-step procedural guide with illustrations and diagrams for each step was provided to the students. The cohort was then divided into three groups of nine students and one group with eight students – each with a facilitator. A second session was conducted one week later for each group. The facilitator created an online Microsoft Teams meeting and invited students in their group to attend

the same. During this session, each student described one step from the nine sequential steps that were followed to perform the overall task in a think aloud format using the same clinical images that were used by the expert in the first session as shown in Figure 1. After each think aloud session by a student, the facilitator reflected with his/her small group and gave feedback to each student. The overall duration of the second

session was 2 hour. The first and the second sessions were audio-recorded and were made available for the students for review. Feedback on the activity was obtained from the students through a questionnaire. The questionnaire was provided to the students as a Microsoft Office link (supplementary material). The facilitators for the session were asked to provide a reflective report about their experience.

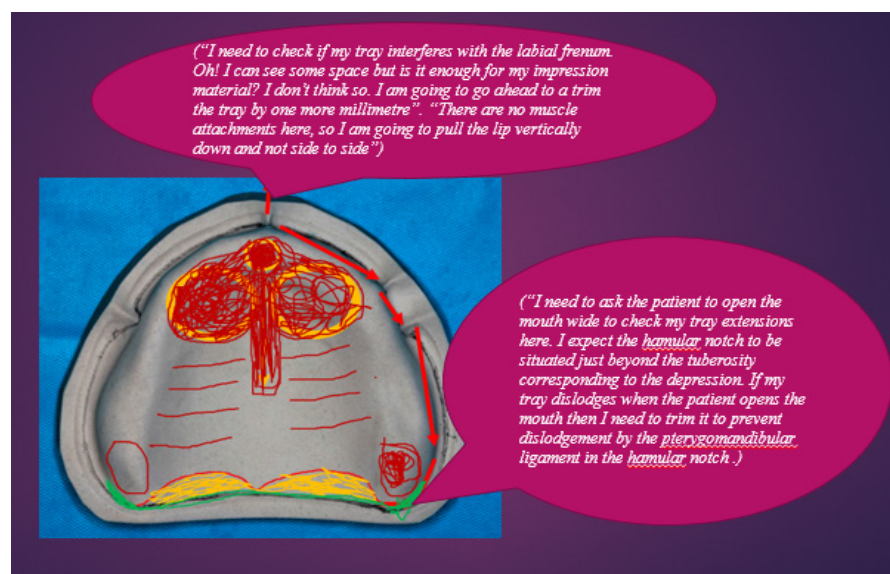


Figure 1: Drawings by the expert on a maxillary cast while thinking aloud.

RESULTS

Amongst 33 (94%) students who responded to the questionnaire, 91% reported the activity to be acceptable and effective. All the students rated the activity as good/very good. The students agreed that adequate learning material was provided for them during the first session were 88%. The students who agreed that the second session was effective in helping them to learn the specific topic assigned to them and also the overall topic were 90%. The students who

agreed that the first session where the expert performed the think aloud activity gave a clear insight into the clinical procedure were 97% and those who agreed that the activity helped them to understand the procedure better were 88%. Students who had found the method to be effective in learning clinical procedures in an online format were 91%. From the open comments provided by the students and the reflections from the facilitators, the challenges and areas of improvement for the think aloud activity were identified (Table 1).

Table 1: Open comments from students and facilitators

Question	Responses	
Do you find the instructional method acceptable?	Yes	29
	No	0
	Maybe	4
How would you rate this instructional method?	Very good	8
	Good	25
	Neither	0
	Bad	0
This instructional method stimulated me to look up the topic further?	Very bad	0
	Strongly agree	11
	Agree	17
	Neutral	5
The first session was adequate in providing a clear insight into the topic addressed.	Disagree	0
	Strongly disagree	0
	Strongly agree	12
	Agree	20
Adequate learning material was provided after the first session to prepare for the second session.	Neutral	1
	Disagree	0
	Strongly disagree	0
	Strongly agree	10
The second session was effective in helping to learn the specific topic assigned to each student.	Agree	19
	Neutral	4
	Disagree	0
	Strongly disagree	0
The second session was effective in helping to learn the overall task.	Strongly agree	10
	Agree	20
	Neutral	3
	Disagree	0
The second session was effective in helping to learn the overall task.	Strongly disagree	0
	Strongly agree	9
	Agree	21
	Neutral	3
The facilitator in your session was adequately informed and contributed their own insight during the session.	Disagree	0
	Strongly disagree	0
	Strongly agree	15
	Agree	18
	Neutral	0
	Disagree	0
	Strongly disagree	0

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Table 1: (continued)

Question	Responses	
The facilitator in your session provided individual feedback to each student.	Strongly agree	11
	Agree	19
	Neutral	3
	Disagree	0
	Strongly disagree	0
Would you recommend this instructional method for other topics?	Yes	23
	No	0
	Maybe	10
Which of the following method would you prefer to learn clinical skills online?	Lecture	7
	Online case-based learning (CBL)	11
	Online problem-based learning	0
	Online think aloud	15
	Online seminar	0
Kindly share feedback regarding the sessions and suggest areas of improvement.	Provided in Table 2	

Table 2: Open comments from students and facilitators

Open comments from students	Theme	Future action
In my opinion, "tell how" sessions are good to learn clinical skills. But we cannot solely depend on it. We need to have some lectures or CBLs before the tell how sessions to make sure that we have some basic understanding regarding the topic. This is important so that we can learn and prepare better for the tell how sessions.	Need for prior training in the topic and augmenting with other forms of teaching.	Organise a lecture and a CBL session prior to the first session conducted by the expert.
The endo and prostho tell how session was quite useful for me, I will recall the steps that we do in clinics. But I'm not so sure if it is better than the CBL. For me, both of them are quite useful.		
CBL and tell how sessions are very informative and interesting.	Gap in think aloud capabilities.	Provide training to faculty and students to think aloud during procedures.
"Tell how by the students" is not always effective because some do not know how to present properly and have too much unnecessary information (but this is a personal preference). "Tell how by the supervisor" was good and I really appreciated the quiz that was given before and after the lecture because it helps us look for gaps in our knowledge and also to see if we understood what was learnt. I hope that there will be more unofficial quizzes like this :) Also, for the previous question, lecture + CBL (since we are only allowed to choose one)		

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Table 2: (continued)

Open comments from students	Theme	Future action
Brief quiz can be conducted after session for better understanding and clarification about the topics.	Need for post-session assessment of the knowledge component.	Organise a post-session quiz to assess the knowledge component.
More online quiz with feedback for us to know where we stand and find out what we don't know.		
I think the recording in Microsoft Teams is useful for student to reassess when needed.	Revision	Uploading the recordings of the sessions in the learning portal for the students.
Reflection by facilitators		
Excellent way to enhance student learning.	Effective tool to support clinical learning.	Continue the sessions in an online format.
Effective tool to enhance student clinical learning through an online platform.		
Student can understand thought process of his or her supervisor.		
If some quiz can be arranged after the session to test their clinical knowledge it will be more beneficial.	Need for post-session assessment of the knowledge component.	Organize a post-session quiz to assess the knowledge component.
More standardisation of faculty members to conduct second session.	Gap in think aloud capabilities.	Provide training to faculty and students to think aloud during procedures.
More training of faculty members and students to think aloud.		

DISCUSSION

The current pandemic has dictated a change in the mode of delivery for education. In dentistry, most of the knowledge-based teaching activities have migrated to an online platform with restricted preclinical and clinical learning (9). Moreover, reported student evaluation of post-pandemic teaching activities have indicated concerns amongst students in relation to the worsening of preclinical and clinical learning experiences (10). However, these reports also indicate that students are receptive of technology-integrated teaching activities in the preclinical years as well as the clinical years. Hence, the online think aloud sessions were designed and piloted to augment the clinical learning experience for students to make them feel supported in their learning during this pandemic.

Online teaching presents a significant challenge in continuous and individualised engagement with a student. However, reducing the number of students in a teaching session may help overcome this challenge (11). Therefore, the second session, where the students performed the think aloud activity, was planned and conducted as a small group activity, facilitating the expert to provide individualised feedback to each student.

In the first session, where the clinical expert performed the think aloud session, modelling was employed as an instructional strategy, where the expert performed a task and verbalised the thought process simultaneously. This may be considered as meta-cognitive modelling. The strategy is based on the social learning theory and attempts to guide the thinking process

of students early on in their preclinical learning with influential examples rather than unguided thoughts (12). This may guide the student's cognitive process while performing the same clinical activity themselves and help in reducing superfluous cognitive load because of the previous exposure to an illustrated example. Further, during the second session, the students get an opportunity to verbalise their own thought process while performing the task. The other students in the group are now exposed to thinking process of their peers and get the opportunity to critically evaluate it. Thus, the learning processes occurring in the activity employing all the three aspects of meta-cognition, namely meta-cognitive knowledge, meta-cognitive monitoring and meta-cognitive control could be explained.

During the first think aloud session by the expert, the students form the knowledge base for their future thinking process regarding the procedure (meta-cognitive knowledge). Further, the students model their thinking based on the example illustrated by the expert (meta-cognitive modelling). During the second session, where the students perform the think aloud process in small groups, the expert is able to assess the cognitive activity of the students (meta-cognitive monitoring) and the students are able to assess the cognitive activity of their peers. Further, the students employ strategies to control their thinking process based on the exposure to

the thinking process of the expert and their peers (meta-cognitive control).

Meta-cognition denotes awareness, understanding, control and manipulation of one's own cognitive practice (13). Meta-cognition may operate at a subconscious level (14–15) and may influence an individual's display of enhanced adaptability and flexibility in a learning environment. Enhancement in a student's meta-cognitive regulation has been previously found to be correlated with increased academic performance in education (16–18). Even though it is impossible to predict the academic or clinical performance of a group of students based on one activity, the lessons learnt by the implementation of this activity as well as the student feedback may guide us in a promising direction.

The student feedback was mainly about the acceptability and perceived effectiveness of the procedure. The open comments from the students and the reflective comments from the facilitators also gave an insight on the improvements needed. The comments highlighted the need for having prior knowledge of the subject content, conducting training for students to help them articulate their thoughts and assessing and revising opportunities post-activity. Subsequently, a workflow was developed to be followed in future sessions by incorporating the student feedback to remediate the limitations of the current session (Figure 2).



Figure 2 : Think aloud workflow.

Regarding the limitations of this study, the inability of the students to provide anonymous feedback may have influenced the overall feedback; however, the provision of neutral responses may have mitigated this to some extent. Another limitation may be that the student performed the think aloud activity for only one step of the procedure. The session was planned in the aforementioned manner after considering the time constraints in allowing all the students to think aloud and the complete procedure. This shortcoming may be overcome by asking the students to record their think aloud sessions individually and submitting it for evaluation. However, even in the current format, the students get a unique opportunity to listen to their peers think aloud, which may facilitate meta-cognitive monitoring and inculcate meta-cognitive control. The learning activity, which was piloted to support student learning as a quick response to the challenges of the pandemic, enabled

us to identify the unique strengths and even limitations of the activity. In future, after more similar sessions will have been conducted, the impact of the think aloud sessions may be evaluated by assessing the student performance in the clinical setting.

CONCLUSION

In clinical procedures where students have limited authentic exposure, understanding the thought process of an expert and developing a similar thought process early on in their training will augment their learning. Implementation of the insights gained from the recording of the verbalised thoughts of students and experts is an opportunity for developing student-centred instructional guides. While the context described here relates to dental education, it is proposed that the concept can be applied to other health professions as well to complement clinical learning.

ACKNOWLEDGEMENTS

We would like to acknowledge the contributions from Dr. Shivani Kohli, Dr. Ranjeet Bapat, Dr. Mandakini Mohan and Dr. Pravinkumar Patil for their contribution to the teaching activity and their participation as facilitators.

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