ORIGINAL ARTICLE

Development and Validation of a Comprehensive Tool for Assessing Postgraduate Students' Oral Presentations: Importance of the Role of Ergonomics

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ABSTRACT

Introduction: The aim of this exploratory sequential mixed methods study was to develop an oral presentations assessment tool for postgraduate students' oral presentations. **Methods:** First, a literature review and the ideas of 319 experienced professors were used to identify domains and potential items to develop the desired tool. Then the psychometric properties of the preliminary tool were measured using face and content validity, inter-rater agreement and test-retest reliability. **Results:** The qualitative phase indicated there should be four domains in the developed Oral Presentations Assessment Tool: subject knowledge, delivery, content and organization, and ergonomics, and that items in the developed tool should be weighted according to importance for the efficacy of a presentation. The final version included 19 items across four domains. Mean content validity index and content validity ratio scores were 0.93 and 0.76, respectively. Spearman's rank correlation coefficient for the two evaluation periods was 0.92. The intra-class correlation coefficient was 0.78. **Conclusion:** The Oral Presentations Assessment Tool has appropriate psychometric properties and can be used as a valid and applicable instrument to assess postgraduate students' oral presentations. Important cognitive factors in oral presentations in the form of an ergonomic domain was included for the first time, as part of this new comprehensive tool.
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INTRODUCTION

Oral communication skills play an important role in students' personal, academic, and professional success (1-3). These skills not only increase students' self-confidence but are also effective in shaping, structuring and presenting logical arguments. Oral communication and presentation skills are important competencies for successful entry into the global business world because language, writing, and listening communication skills are essential for effective decision-making and problem-solving at work (4).

Universities play an important role in the process of training and educating graduates for employment in many types of occupation. Similarly, the performance of organisations has some dependency on the quality of education provided by educational institutions (5). In many universities, oral communication skills are required by graduate students to demonstrate their competence in meeting learning outcomes (6). That is, post-graduate students are generally required to present seminars or defend their research projects to allow their supervisors to assess both the quality of the scientific project and their skills in disseminating the findings (7). Therefore, fair evaluation and judgment of a post-graduate student's oral presentation has an important impact on their academic success and potentially, their future career.

It is widely acknowledged that assessment is an important factor in the learning process. When the assessment process is performed correctly, in addition to providing a basis for evaluating student academic performance, it can also give information on how to plan and implement educational programmes (8). Systematic assessment and interventions based on evaluation results have a

direct impact on improving the educational process and achieving the educational goals set for a given field of study (9). Therefore, the evaluation of students' skills and abilities requires the use of valid tools and methods for determining the level of attainment of educational goals (10). This includes assessment of students' oral presentations. Moreover, using a valid tool makes it possible to assess the success of classes to enhance the effectiveness of students' oral presentations with greater confidence (11). To date, however, there is a dearth of published literature that report approaches to assessing post-graduate students' oral presentations. Likewise, our review of grey information shows that despite the existence of oral presentation assessment tools at various universities around the world, typically rubrics include descriptors referring to layout, overall appearance and organisation but they do not draw upon evidence from ergonomic studies.

Briefly, ergonomics is a science that seeks to design tools and environments according to humans' physical and intellectual abilities, interests, and limitations (12). Ergonomics analyses the relationship between the human and their environment so that equipment and tools are designed for best comfort, ease of access, safety, and efficiency, and also to reduce difficulties, fatigue, and costs (13). Ergonomics can make a valuable contribution to the impact of academic presentations because these communications commonly use supporting materials such as PowerPoint, graphics, photos, and video clips. Accordingly, an appreciation of the contribution of ergonomics can prevent poor practice in the use of equipment (e.g., improper height of the projector image can cause the audience to assume an inappropriate posture) and supporting materials (e.g., using poor colour contrast in PowerPoint slides). Rowley-Jolivet (2000) underlines the importance of cognitive and verbal elements of slides in inducing correct understanding of the subject matter of the presentation and believes the correct sharing of visual knowledge by the presenter affects the role of the verbal skills in the presentation (14).

In the postgraduate education system, there is a need for a comprehensive, reliable tool for the accurate assessment of oral presentations required for seminars and defence of a thesis. It has been argued that a valid tool would make it possible to better account for outcomes of oral doctoral examinations, and support intervention programmes to promote the quality of those oral presentations (15). Thus, the aim of this study was to develop a comprehensive standardized tool with desirable psychometric properties for assessment of oral presentations of postgraduate students.

MATERIALS AND METHODS

An exploratory sequential mixed-method research design was used to develop the Oral Presentation Assessment Tool. In the first qualitative phase of the study, a literature review and ideas of a panel of experts were used to identify the domains of students' oral presentations that should be included in an assessment tool. The data from the qualitative phase was then used in the quantitative phase. Integration was at primarily at the methods stage with outputs from phase 1 guiding the methods for phase 2. In line with the exploratory sequential mixed-method research design there was interdependency of the two phases. Following from this, the objective of the quantitative part of the study was to evaluate the psychometric properties of the items of the domains to develop a tool that would be reliable and valid. The study was approved by the Research Ethics Committee of Shiraz University of Medical Sciences (IR.SUMS.REC.1398.491).

Phase 1: Tool development

Scopus, PubMed, Web of Science, and Google Scholar databases were reviewed to identify the important domains in the design of effective oral presentations. Search keywords included presentation, oral presentation, seminar presentations, speaking assessment, oral presentations skills, face-to-face communication skills, oral communication skills, presentation design, and verbal communication. Then university professors from several different universities in Iran were surveyed in three large groups in WhatsApp Messenger and were asked, using a semi-structured guide, about the domains needed to assess students' oral presentations. The first group comprised 84 professors, the second group included 202 professors, and the third 33 professors. All these experts had experience in supervising post-graduate student's studies. Although it would have been ideal to have our Expert Panels meeting face-to-face, in the context of a pandemic this online approach was used. In practice, there were benefits to the online approach as we were able to include many more experts in this qualitative data collection phase from a much larger geographical area. In addition, we had a hard copy of the 'conversations' which supported the trustworthiness of our analyses.

After the overall assessment of the literature review and the three expert's WhatsApp conversations by the research team, criteria related to the assessment of students' oral presentations were extracted. Then, the criteria were sorted into four overarching domains. These domains, and also items designed from indicative descriptions for the criteria were provided to a new group of 30 professors – again with at least five years' experience of assessing master's and doctoral students. First they were asked the following three questions: (1) Can these domains, alongside the associated criteria and descriptions, provide a comprehensive assessment of a post-graduate student's oral presentation? (2) Can you sort these domains by importance and weight them as a percentage (0 to 100%)? (3) How should the items related to each domain be scored in the developed

tool? Regarding question 3, three options were given based on the most common scoring methods used in assessment tools in different universities: (a) A 4-point quality scale (weak, average, good, and excellent), (b) a 4-point quality-quantity scale (weak: 0.25, average: 0.5: good: 0.75, and excellent: 1), and (c) a visual analogue scale (scores range from 1–10.) Then, after confirming the domains, they were asked about the suitability of these tool items. The final set of items was then reviewed by ten professors with specialisations in medical education, ergonomics, health promotion and educational management. This data was then analysed in phase 2, regarding the psychometric properties of the developed assessment tool.

Phase 2: Psychometric properties of the Oral Presentation Assessment Tool (OPAT)

Validity

To evaluate the validity ten post-graduate tutors were asked to review the OPAT in terms of grammar, wording, and item allocation, and where necessary to provide suggestions for improving the items. After applying recommended changes, the content validity of the tool was assessed in several steps. For this purpose, the content validity index (CVI) and content validity ratio (CVR) of the tool were evaluated by another previously naıve sample of ten post-graduate tutors. The CVI of each item was checked in terms of three criteria of relevance, clarity, and simplicity (16). According to the guidelines, a CVI greater than 0.79 is relevant and valid, between 0.7 and 0.79 the item needed to be revised, and less than 0.7 is unacceptable, and the item should be removed. Using the CVR, the necessity of each item was checked and, according to the table provided by Lawshe (17). Items with a CVR of more than 0.60 (for 10 experts) were considered necessary and important ($p < 0.05$) and the items with lower CVR values were removed.

Reliability

The reliability of OPAT was assessed using the test-retest method and inter-rater reliability. To check the test-retest reliability, the oral presentations of four students enrolled on a PhD course were filmed. The four video recordings were given to five professors who were asked to evaluate the oral presentations using the OPAT. Then, four weeks later, the same five professors were asked to watch the videos again, and so evaluate the same presentations a second time. In this way, the correlation coefficient of the final scores given by each academic was calculated as the reliability of the tool. The Spearman's rank correlation coefficient was used to evaluate the correlation between the two scores. As a second / further test of reliability, 30 professors who attended a continuing professional development workshop were asked to assess the oral presentation of the workshop instructor using the OPAT. Then, inter-rater agreement was calculated using the Intra-class Correlation Coefficient (ICC) at a 95% confidence level.

RESULTS

Phase 1: Determining the domains and design of the tool items

The review of the literature and WhatsApp group conversations resulted in four general domains related to the assessment of students' oral presentations were identified and approved by 30 experienced post-graduate assessors: subject knowledge, delivery, content and organization, and ergonomics. In addition, following the opinions of the professors, the criteria and the descriptive elements of the four domains were confirmed (Table I).

Regarding scoring the tool items, there was an overall preference for the quantitative visual analogue scale (n=15), when compared to the qualitative-quantitative scale (n=10), and the qualitative scale (n=5). This was developed for use in the final version (Table II). The 30 professors' weightings of the importance and impact of each of the four domains contributed to the overall assessment outcome. Subject knowledge was identified as the most important domain (34.14%); followed by delivery (25.14%), content and organization (24.76%) and ergonomics (15.95%).

The tool was initially developed with the 88 items that emerged from the literature and the three WhatsApp group conversations: subject knowledge (12 items), content and organization (24 items), ergonomics (24 items), and delivery (28 items). The list of items included various iterations of same point across the range of descriptions, hence these items were merged. Ambiguous and repetitive items were also removed. This provided an interim assessment tool of 35 items after Phase 1 for further analysis in Phase 2.

Phase 2: Quantitative analyses

Content validity

The CVI and CVR values of 16 items (from 35 items) were inappropriate and removed. This reduced the tool to 19 items. Mean CVI and CVR scores of the 19 items were 0.93 and 0.76, respectively, indicating an appropriate content validity (Table III).

Reliability

In the test-retest analysis, five professors evaluated the video recordings of four student's oral presentations in two stages four weeks apart. The Spearman's rank correlation coefficient of the 19-item tool was 0.922 ($p < 0.001$). The total ICC scores for the first and second stages were 0.968 (0.940-0.983) and 0.966 (0.936-0.92) ($p < 0.001$), respectively, indicating an excellent inter-rater agreement. The ICC was 0.78 for the subsequent evaluation made by 30 professors, also indicating good agreement, and that the final OPAT was reliable.

Table I: Domains and criteria and associated descriptions of the OPAT

Domains	Criteria	Descriptions
Subject knowledge	Mastery of subject	Presenter's knowledge of the topic in question
	Questions from the audience	Quickly understands a question from the audience without referring to sources
		Able to give correct answers to questions from the audience
		Accuracy of reasoning when responding to challenging questions
	Technical language	Presenter's use of terms and language related to the topic
	Use of examples	Judicious use of examples to support audience understanding of the subject
Delivery	Verbal communication	Clear voice
		Correct pronunciation
		Correct grammar
		Elocution: Suitable pitch, pace, and use of pauses
		Use of active listening techniques: restatement, responding, and probing
		Use of one's own words
	Non-verbal communication	Eye contact
		Use of body language: assuming a good posture, avoiding distracting gestures, avoiding tics and nervous habits
		Maintaining the audience attention
		Dressing professionally
		Smiling
		Personal features: anxiety management; showing confidence throughout the presentation
Content and organization	The introduction	Facilitating interactive communication with the audience
		Guiding the discussion and clearly expressing the reason for the presentation and the topic under discussion
	Main body	Appropriate information structure and organization
		Selecting the appropriate information
		Logical information flow
		Interesting information sequence
		Coordination of information
		Time management
		Appropriate evidence base
		Clear conclusion
	IT skills	Effective use of supporting materials (pointers, markers, whiteboard, videos, and educational clips)
Ergonomics	Compliance with the principles of cognitive ergonomics	Use of graphics: superfluous graphics or no graphics
		Readability: font size
		Not overloading slides
		Balance of text and graphics
		Appropriate use of slide transitions
		Appropriate use of chart, diagrams, and other necessary items
		Correct use of symbols
		Writing style
		Good grammar
		Good contrast

DISCUSSION

This study used an exploratory sequential mixed methods design to develop and validate a standardized tool for assessment the oral presentations of postgraduate students. The findings of the initial qualitative exploration of the important areas and criteria for assessing postgraduate students' oral presentations provided a guide for the tool domains and items and permitted a robust quantitative assessment of the psychometric properties of the Oral Presentation Assessment Tool (OPAT). These were confirmed based on face and content validity, inter-rater agreement and test-retest reliability. Four domains were identified as being important to assessing the effectiveness of post-graduate student's oral presentations: subject knowledge, delivery, content and organization, and ergonomics. These four domains were not considered to be of equal weighting when considering learning outcomes, nevertheless, all four domains make a critical contribution to the assessment process. As such the scoring schedule for the OPAT includes a simple weighting calculation to use in calculating an overall mark.

It was not surprising that subject knowledge was identified as the domain that should have the largest weighting. Fletcher et al. considered subject knowledge to be the main feature of an oral presentation (6). Other literature has similarly pointed out that subject knowledge is critical to giving an effective scientific oral presentation (18), with other domains being responsible for the correct transfer of the subject knowledge of the presenter to the audience (19).

Oral presentations are a two-way process and as such, good communication with the audience is a skill that should be assessed (20), as an important contributor to the success of a presentation (21) and its efficacy (22). Similarly, in our study, the experts rated delivery as the second most important factor of a successful oral presentation after subject knowledge. Corresponding to their input, the OPAT includes items that enable assessment of students' verbal and nonverbal communication skills.

Proficiency in oral presentations also demands communication of information in logical order. That is, materials must be organised in an accessible and well-structured way with a narrative that flows from start to finish (21). In the present study too, the content and its organisation within an oral presentation was identified as an important domain for assessing the merit of that presentation. The OPAT includes items that measure how the topic is introduced, the information content and structure of the overall presentation, and the extent to which the presenter is familiar with information technology that will be suitable for a wide range of subjects.

Table II: Oral Presentation Assessment Tool

Dimensions	Items	Weak									Excellent
Subject Knowledge	1. Mastery of the topic	1	2	3	4	5	6	7	8	9	10
	2. Use of logical reasoning to deal with important and challenging issues	1	2	3	4	5	6	7	8	9	10
	3. Appropriate use of language and technical terms	1	2	3	4	5	6	7	8	9	10
Delivery	4. Was the presentation given in a clear and eloquent voice?	1	2	3	4	5	6	7	8	9	10
	5. Did the presenter maintain good eye contact with the audience?	1	2	3	4	5	6	7	8	9	10
	6. Was the presenter's appearance appropriate?	1	2	3	4	5	6	7	8	9	10
	7. Did the presenter effectively manage any stress/anxiety?	1	2	3	4	5	6	7	8	9	10
Content and Organisation	8. Was the topic introduced clearly?	1	2	3	4	5	6	7	8	9	10
	9. Was the information well organized and presented logically?	1	2	3	4	5	6	7	8	9	10
	10. Was the information presented relevant to the topic?	1	2	3	4	5	6	7	8	9	10
	11. Was the information sufficient for the goals of the presentation?	1	2	3	4	5	6	7	8	9	10
	12. Was a clear conclusion drawn from the overall discussion?	1	2	3	4	5	6	7	8	9	10
	13. Was the information presented within the time allowed?	1	2	3	4	5	6	7	8	9	10
	14. Did the presenter effectively use supporting materials (pointers, markers, whiteboard, videos, and educational clips)?	1	2	3	4	5	6	7	8	9	10
Ergonomics	15. Was the font size in the slides appropriate?	1	2	3	4	5	6	7	8	9	10
	16. Were all materials presented in a suitable size?	1	2	3	4	5	6	7	8	9	10
	17. Was there an appropriate balance between the text and graphics (figures, charts, etc.)?	1	2	3	4	5	6	7	8	9	10
	18. Were slides free from typographical and grammatical errors?	1	2	3	4	5	6	7	8	9	10
	19. Was the contrast between the text colour and the slide background appropriate?	1	2	3	4	5	6	7	8	9	10

A = Mean Subject Knowledge Score x 34%; B = Mean Delivery Score x 25%; C = Mean Content and Organisation Score x 25%; D = Mean Ergonomics Score x 16%
Total Score = A + B + C + D

The professors who participated in our research noted that students can underestimate the importance of various ergonomic principles when preparing their presentations. Whilst there is some supportive literature on preparing effective oral presentations (21, 23) the inclusion of ergonomic aspects is rare in this literature. Nevertheless, according to the results of this study, observance of the principles of cognitive ergonomics is important in students' oral presentations. The balance and readability of text and visuals on slides, for example, can have a positive and a negative impact on knowledge dissemination, and these are among the variables that were identified as necessary for inclusion in a comprehensive OPAT. Correspondingly, Collins identified common ergonomic errors in the use of font, colour, sound, and graphics in the use of PowerPoint presentations (24) arguing that include a large number of text lines per slide, writing errors, a large number of animations, poor colour and low contrast, small font size, and illegibility of text can reduce the transmission of concepts and distract the audience. Shieh and Lai examined the effects of ambient illumination, luminance contrast, and stimulus type on the subjective preference of VDT target and background colour combinations (25). Their results indicated that black on white and blue on white was more favoured by the audience, while turquoise on green and turquoise on red were least welcomed. Understanding these principles are a part of an effective oral presentation, and an appreciation that graphs, photos and other illustrations serve to increase the audience's perception and cognitive grasp of the subject is a skill (14). The use of colour in the text and images is effective in showing details, emphasizing and increasing the amount of information received and a deeper understanding (26). In oral presentations, even the way that bullets and symbols are used using slides is important in terms of cognitive ergonomics. Bullets can be used to conveys many concepts (27) and they can be very helpful in outlining the overall content (28). In sum, the use of supporting materials is important, and non-compliance with ergonomic rules such as colour, size, type of font, and background colour on slides can lead to low-quality oral presentations (29, 30). Accordingly, if visual slides prepared to support an oral presentation are not prepared based on the principles of cognitive ergonomics, the intended positive effects could be minimized through fatigue or disengagement. Thus, items assessing these points were recognized as important for the OPAT.

A current limitation of the OPAT lies in its development for postgraduate presentations. Although marking criteria determining what would attract 'weak' and 'excellent' marks (etc.) are factored into assessments at all levels, we do not assume the validity of the OPAT at other levels of study. Nevertheless, there remains a need to assess student's presentations at other levels using a valid and reliable tool. This should be undertaken in a future research project. We also acknowledge that although we referred to the international literature, postgraduate

Table II: CVI and CVR values for the oral presentations assessment tool

Dimensions	Items	CVI			CVR
		Clarity	Simplicity	Relevance	
Subject Knowledge	Did the presenter have full mastery over the topic under discussion?	1	1	1	0.8
	Did the presenter use logical reasoning to deal with important and challenging issues?	1	1	1	0.8
	Did the presenter use appropriate scientific terms and language?	0.8	0.9	1	0.8
Delivery	Was the presentation given in a clear and eloquent voice?	0.9	0.9	0.9	1
	Did the presenter maintain good eye contact with the audience?	0.9	0.9	0.8	0.8
	Was the presenter's appearance appropriate?	1	1	0.9	0.6
	Did the presenter effectively manage any stress/anxiety?	0.8	0.8	0.7	0.6
Content and Organization	Was the topic of the presentation introduced clearly?	1	1	1	0.8
	Was the information presented in a logical and organised way?	0.9	0.9	0.9	0.8
	Was the information well organized and presented logically?	0.9	1	1	0.8
	Was the information sufficient for the goals of the presentation?	0.9	0.9	0.9	0.6
	Was a clear conclusion drawn from the overall discussion?	0.9	0. 9	0.9	0.8
	Was the information presented within the time allowed?	1	1	1	1
Ergonomics	Did the presenter effectively use supporting materials (pointers, markers, whiteboard, videos, and educational clips)?	1	1	1	0.6
	Was the font size in the slides appropriate?	1	1	1	1
	Were all materials presented in a suitable size?	1	1	1	1
	Was there an appropriate balance between the text and graphics (figures, charts, etc.)?	1	1	0.9	0.8
	Were slides free from typographical and grammatical errors?	1	1	1	0.8
	Was the contrast between the text colour and the slide background appropriate?	1	1	1	1
	Mean	0.93	0.97	0.96	0.76

student supervisors in other countries were not surveyed when developing the tool. We sought to minimize this limitation by drawing upon professors with much experience of postgraduate oral presentations across a wide range of subjects.

CONCLUSION

This study delivered its aim of developing a comprehensive and standardised tool for assessing the oral presentations of postgraduate students. Moreover, important cognitive factors in oral presentations in the form of an ergonomic domain were included for the first time in a presentation assessment tool, as part of the OPAT. The four domains of the developed tool were subject knowledge, delivery, content and organization, and ergonomics. The weight of each of these four domains in the assessment of students' oral presentations was determined based on scientific criteria. The developed tool has appropriate psychometric properties and can be used as a valid and applicable instrument to assess postgraduate students' oral presentations. Furthermore, based on the identified domains and criteria, purposeful educational intervention programmes can be implemented to improve students' oral presentations.

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