Development and Validation of TAI-HeaST- a tool to explore perceptions of Health Sciences Teachers about Adoption and Integration of ICT in instruction: a pilot

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Abstract: Background:Teachers of Health Sciences (HS) in India did not routinely practice ICT (Information and Communications Technology)enabled instruction earlier, and it had a limited scope. Covid pandemic compelled them to adopt and integrate ICT tools in their didactic, laboratory and clinical teaching. In order to explore their perceptions regarding this, a tool- TAI-HeaSTwas developed, and its validity, reliability and practicality were assessed, by conducting a pilot study. Methods: Based on literature review and current practices of adoption and integration of ICT tools by HS teachers, this tool was developed. It was administered online using SurveyMonkey to 40 teachers from medical, dental, physiotherapy and nursing colleges from Maharashtra, India, who consented to be the part of this pilot study. Results: Statistical analysis was carried out using the IBM SPSS version 23. The Kaiser-Meyer-Olkin (KMO)measure for sampling adequacy was 0.81, and p value for Bartlett's test for sphericity was < 0.05. Exploratory factor analysis identified seven constructs that affected the adoption of ICT in teaching by the HS teachers. These cumulatively explained 79.50% of the variance, and none of the statements were rejected. The reliability of the tool was statistically significant. Conclusion: This pilot study showed TAI-HeaST tool to be valid and reliable for measuring perceptions of HS teachers towards adoption and integration of ICT tools in instruction. It also fulfilled all the criteria of practicality.[Lele GNatl J Integr Res Med, 2023; 14(6):01-08, Published on Dated: 28/12/2023]

Key Words:ICT adoption and integration, Health Sciences teachers, TAI-HeaST, Tool development, Teacher's perceptions.

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Introduction: The rapid development in ICT (Information and Communications Technology) has presented challenges to all stakeholders of Health Sciences (HS) institutions and universities in India. Even though there are several programs to help teachers of Health Sciences improve their 'teaching skills', like the teacher training programs conducted by state universities of HS such as the Maharashtra University of Health Sciences (MUHS), or apex bodies like the NMC (National Medical Council) or the Dental Council of India (DCI), this 'learning' is often not practised during teaching. Teachers of HS, such as of dentistry, medicine, nursing, and physiotherapy, are in a unique predicament most times, since either they have not undergone training in educational methods, or, with the additional responsibilities of clinical training and patient care, they find it difficult to implement these into practice.

While ICT enabled instruction in HS was a very rare practice earlier- limited to a topic, or a specialty at a particular college, Covid pandemic necessitated that HS teachers adopt and integrate ICT in their teaching activities. This led to the introduction of ICT tools in classroom, laboratory, and clinical teaching at most of the HS Universities and colleges in India. It paved way for adoption and integration of ICT tools by HS teachers in different teaching-learning situations. But since not many teachers had the requisite training, aptitude, and willingness for it, integrating ICT enabled instruction was not an easy task.

During, and following Covid pandemic exhaustive research has been conducted on teacher perceptions about online teaching including its merits and challenges, a few about use of social media and ICT tools in instruction, and some about innovative methods of clinical teaching and assessment using technology that were introduced. There has hardly been any research with a comprehensive overview regarding use of technology in instruction by teachers of Health Sciences, and their thoughts regarding adoption and integration of ICT tools before, during and post Covid pandemic.

Thus, there was a need felt to gain a better

understanding of perceptions of HS teachers about adopting and integrating ICT tools in instruction, to augment its utilisation[1]. To explore and gain an understanding of these perceptions among teachers of dentistry, medicine, nursing and physiotherapy from the state of Maharashtra, India, the TAI-HeaST (Technology adoption and integration in instruction- by Health Sciences teachers) tool was developed. It was designed specifically keeping in mind the teaching practices of these teachers before, during, and after the Covid pandemic. A pilot study was conducted to assess the validity, reliability, and practicality[2] of this tool.

Material & Methods: For validation of the TAI-HeaST tool, a pilot study was conducted wherein 40 teachers from dental, medical, nursing and physiotherapy colleges from the state of Maharashtra, India, were included, using convenience sampling method.TAI-HeaST is one of the tools to be used as a part of doctoral research, and this study was approved by the Institutional Research Committee, and Ethical Clearance was granted as well. This tool was administered online, using SurveyMonkey. Informed written consent was obtained from the participants. Suitable representation of teachers across all faculty, college ownership type and affiliation was ensured, as seen in Table 1.

Table 1: Demographic data of participants for the pilot study

SN	Variable	Content	Frequency	Percentage
1	Gender	Male	12	30%
		Female	28	70%
2	Age in completed years	Below 30	0	0.00%
		31-40	9	22.50%
		41-50	12	30.00%
		51-60	17	42.50%
		Above 60	2	5.00%
3	Highest professional educational qualification	Bachelor's	0	0.00%
		Master's	31	77.50%
		PhD	9	22.50%
4	Faculty	Medicine	10	25.00%
		Dentistry	11	27.50%
		Nursing	10	25.00%
		Physiotherapy	9	22.50%
5	College (type) and university affiliated to	Government college- MUHS	10	25.00%
		Private college- MUHS	10	25.00%
		Private college- Deemed to be University	20	50.00%
6	Teaching experience in completed years	6-10	4	10.00%
		11-15	11	27.50%
		16-20	7	17.50%
		More than 20	18	45.00%

Development of the TAI-HeaST tool: The first version of this tool was developed based on an exhaustive literature search. Studies conducted and tools developed by earlier researchers regarding various aspects of ICT integration by teachers were studied to decide the most relevant constructs and appropriate statements for the TAI-HeaST tool. These included ones described by Jimoyiannis& Komis, 2007[3], Bingimlas , 2009[4], Buchanan et al, 2013[5], Ndiku et al, 2014[6], Capuk& Ahmet, 2015[7], Goeman et al, 2015[8], Bas et al, 2016[9], Laabidi&Laabidi, 2016[10], Bhat & Beri, 2017[11], Benmansour, 2019[12], Lazar et al, 2020[13], Rubach & Lazarides, 2020[14], Seifu, 2020[15], Saltos-Rivas et al, 2021[16], and Antonietti et al, 2023[17].

Informal discussions were also held with a few teachers of dentistry, medicine, and physiotherapy, which provided a few pointers and guidelines about the state of adoption of ICT tools in teaching before, during, and after the Covid pandemic.

Face validity, or Semantic validation[18] was established by administering printed format of the tool to 12 teachers of dentistry, and an online version to 3 teachers of medicine and physiotherapy each. Based on the responses and feedback received, a pre-final version of the tool was ready. For its content validity, this tool was shared with 6 specialists with expertise in HS education and educational technology. Based on their feedback, final version of the tool was ready, and comprised of 2 sections. The 1st section was about 'information regarding use of technology.' The 2nd section- regarding perceptions about adoption and integration of ICT tools in teaching, had five constructs (perceived anxiety to use ICT tools in teaching, perceived self-efficacy for using ICT tools in teaching, willingness to adopt ICT tools in teaching, perceived benefits for learners by using ICT tools, and support for use of ICT tools in teaching) with 24 statements, and two open ended questions. This was named as the TAI-HeaST tool.

Table 2: Content and criterion validity of the tool

SN	Validity	Measure	Value	
			Section 1*	Section 2**
1	Content validity	CVI (Content validity Index)	1.0	0.78
		p value	<0.000	0.002
2	Criterion validity	Relevant	√	√
		Free from bias	√	√
		Reliable	√	√
		Provided information being asked	√	√
		Correlation Coefficient	1.00	1.00
		p value	0.00	0.00

Section 1* Information regarding use of technology
Section 2** Perceptions about adoption and integration of ICT in teaching

Scaling of the tool: The 1st section of TAI-HeaST tool had 13 statements with multiple responses provided for the respondents to select from. For the 2nd section, a five-point Likert scale was provided, with choice of responses ranging from Strongly Disagree, Disagree, Neutral, Agree, and Strongly Agree. The two open ended statements were regarding enabling and hindering factors for ICT adoption and integration.

Results: Responses received from the 40 HS teachers from dental, medical, nursing and physiotherapy colleges via SurveyMonkey were grouped and tabulated. The statistical analysis of data collected was done using the IBM Statistical Package for the Social Sciences -SPSS version 23 (Chicago, Illinois, USA).

A research tool is valid when it measures what it is supposed to measure (4). Face validity implies checking for ease of comprehension by the participants, and, in this study, it was ascertained at the initial stage of tool development.

Content validity is achieved when the content of statements truly measures the concept being measured in the study (2) and is achieved based on inputs and feedback from experts (9).

Subsequently, statements could be kept as they are, or with some changes, or be deleted. All statements included in this tool were to be classified as 'Essential', 'Not Essential' and 'Useful but not essential' by the experts. Content validity for this tool was established by calculating Lawsche's Content validity ratio (CVR) for each statement, which was averaged to Content validity index (CVI), as shown in Table 2. The p value for the variables for both sections was less than 0.05 indicating that more than half of the experts agreed to these statements.

Criterion validity evaluates how accurately a test measures the outcome it is designed to measure. All the variables and statements included in the tool were found to be relevant, free from bias, reliable and provided information being asked. The experts gave the correlation of 1.00 indicating that all the experts had agreed to the aspects that ensure the criterion validity of the data collection tool. Further the p value was less than 0.05 indicating statistical significance as well (Table 2). Construct validity measures the extent to which a tool accurately measures a theoretical

construct that it is designed to measure (2). Construct validity was carried out only for the 2nd section of the tool as the 1st section is categorical. Kaiser-Meyer-Olkin (KMO) Measure of Sampling Adequacy was 0.81, and p value for Bartlett's Test of Sphericity was < 0.05, so data was considered suitable for factor analysis (13).

Exploratory factor analysis (EFA) was carried out to evaluate the construct validity and validate items loading[19]. Principal Components Analysis (PCA) helped in identifying the factors that affect the adoption and integration of ICT tools in instruction by teachers of dentistry, medicine, nursing and physiotherapy. The seven factors/constructs, with 24 statements, that were extracted were: willingness and motivation to adopt ICT tools in teaching, support for facilitating use of ICT tools in teaching, impact of ICT tools on teaching- learning, conviction regarding use of ICT tools for teaching, role of ICT tools in teaching, newer Methods of ICT enabled teaching, and anxiety to use ICT tools in teaching. None of the statements were rejected after iterations in EFA. The cumulative percentage of Eigen values for each of the seven constructs identified after the EFA were 20.725%, 36.443%, 50.247%, 58.809%, 66.895%, 73.281% and 79.504%.

Cumulatively, these constructs explained 79.50% of the variance in the process studied. EFA identified the most contributing statements for assessing the perception of HS teachers toward integration of ICT tools in teaching with the statement “The technology support staff in my college are qualified to solve problems related to technology integration during teaching” (0.934), “In my college, we have experts who offer help and support for integration of ICT tools in teaching materials” (0.912) and “I am willing to follow my colleagues for using ICT tools in teaching” (0.921). The result of EFA is summarized in the table 3.

Reliability is defined as ‘the extent to which responses/scores are free from measurement error’(2). The responses of 40 HS teachers were checked for stability, equivalence, and internal consistency. Stability was checked by test-retest method. Correlation (Spearman) was calculated for the responses. The equivalence of the tool was tested using inter rater method between the principal investigator and online data collection tool. The statistical analysis for equivalence was carried out by Kappa Statistic. The internal consistency was checked by the split half technique and Cronbach’s alpha was calculated, as shown in Table 4. The level of significance for statistical analysis of different aspects of reliability was kept at 95% level of confidence. Both sections of the tool were found to be highly reliable, as the coefficient for stability and equivalence were > 0.7 and the p value was < 0.05.

Practicality of the tool was assessed by the same 6 experts who were approached for the validation of the tool. Both sections of the tool were marked as being economic, convenient, and interpretable.

Discussion: The purpose of this study was to develop and validate TAI-HeaST- a tool to explore HS teachers’ perceptions about ICT adoption and integration in instruction by conducting a pilot study. As stated by Fokides, 2023[20], the development of a research tool is a multi-stage process. In the present study, sample selection and tool development were carried out simultaneously. Based on the guidelines suggested by earlier researchers[11] development of TAI-HeaST tool was carried out in two stages.

The first stage was identifying or exploring an initial ‘pool’ of constructs, and statements to be considered. Next, appropriate ‘constructs’ were developed, and relevant statements were listed under each construct.

Table 3: Results of the Exploratory Factor Analysis

Factor	Construct	Item	Communalities	Factor loading	Percentage of variance
1	Willingness and Motivation to adopt ICT tools in	I encourage my colleagues to use ICT tools in teaching.	.889	.882	20.725
		I am willing to follow my colleagues for using ICT tools in teaching.	.921	.861	
		I am willing to use ICT tools in my	.801	.767	

	teaching	teaching.			
		I can cater to different learning styles (visual, auditory, read/write, kinesthetic) of my students by judicious use of ICT tools in teaching.	.817	.760	
		During teaching sessions, I can effectively engage students in learning activities with use of ICT tools.	.757	.729	
		I am equally comfortable using digital devices (computers/ laptops/ tablets/ smartphones) as using conventional resources (books, overhead/ LCD projectors etc.) for teaching.	.535	.574	
		Using ICT tools in teaching takes up a lot of time.	.699	-.568	
		I feel confident in using conferencing software (e.g., Zoom, Meet, Messenger, Skype, Teams) for online teaching.	.628	.494	
2	Support for facilitating use of ICT tools in teaching	The technology support staff in my college are qualified to solve problems related to technology integration during teaching.	.934	.921	36.443
		In my college, we have experts who offer help and support for integration of ICT tools in teaching materials.	.912	.904	
		In my college, there is adequate ICT infrastructure/facilities for teaching.	.825	.876	
		In my college, teachers are encouraged to use ICT tools in teaching.	.824	.846	
3	Impact of ICT tools on teaching-learning	Use of ICT tools facilitates teacher-student communication.	.822	.854	50.247
		Use of ICT tools in teaching promotes deep learning in my students.	.803	.732	
		Use of ICT tools in teaching makes a teacher's role less important	.896	-.701	
		The use of ICT tools increases the interest of students towards the subject.	.763	.621	
		Use of ICT tools makes teaching complicated.	.775	-.560	
4	Conviction regarding use of ICT tools for teaching	I am able to use Learning Management Systems (e.g. Blackboard, Moodle, Canvas) to support my teaching.	.855	.765	58.809
		I am confident in using presentation software such as	.781	.734	

		Microsoft PowerPoint for classroom teaching.			
5	Role of ICT in teaching	Technology will replace teachers in the future.	.807	.825	66.895
		I will use ICT tools in teaching only when it is made compulsory.	.682	.765	
6	Newer Methods of ICT enabled teaching	I use social media to support my teaching.	.808	.721	73.281
		I am not willing to completely give up conventional methods of teaching.	.851	.613	
7	Anxiety to use ICT in teaching	I feel apprehensive while using computers and Internet technologies.	.696	.785	79.504

Likert scale was used for obtaining responses[21], which can range from two categories (Agree/Disagree) to as many categories as deemed fit by the researcher[11], with an upper limit of around 6 to 7 categories. In the present study five categories were considered suitable.

Face validity or semantic validation of the tool was carried out to check if the respondents had any difficulty in understanding the statements, with due consideration to simplicity of language and terms used, as described by Hair et al, 2019[18]. At this stage, a printed version of the tool was presented to dental teachers, in smaller groups based on their availability, in the presence of the researcher.

This has been described as the ideal method to perform a semantic validation[18]. For the medical and physiotherapy teachers, it was sent online as Google forms, and telephonic discussions were carried out. The teachers were encouraged to ask or discuss about items that they did not understand, and were requested to mark those on the tool, which was further modified.

Content validity is an important procedure in tool development[22] and for TAI-HeaST tool, it was established by sharing it with experts, till it was fully refined with respect to the constructs and related statements, and p values were statistically significant for both sections. As stated by Gilbert & Prion[23] when all experts agree to all items as ‘‘essential,’’ the CVI is 1.00. Although the CVI for section 2 was more than 0 and closer to 1 (0.78), the changes in the statements suggested by the experts were incorporated and retained in the final tool[23].

For assessing the criterion validity, correlations between the scores from the tool and the criterion variable were calculated using Pearson’s

correlation coefficient. This expresses the strength of the relationship between two variables in a single value with r = 1, indicating a perfect positive correlation. In this pilot study, the value of correlation coefficient (p value) was 1 for both the sections.

Establishing construct validity using EFA is generally regarded as a technique for large sample sizes with N = 50 as a reasonable absolute minimum, but a comprehensive overview by de Winter et al[24] showed that for N well below 50, as in the present study, it can yield reliable results as well. The construct validity was carried out only for the 2nd section of tool. Prior to extraction of the constructs, tests such as KMO Measure of Sampling Adequacy and Bartlett's Test of Sphericity should be conducted to assess the suitability of the respondent data for factor analysis [9,21]. The KMO index values range from 0 to 1, where 0.50 is considered suitable for factor analysis. This was 0.81 in this study, with Bartlett's Test of Sphericity also being significant ($p<.05$), indicating suitability for factor analysis[25].

Table 4: Reliability of the tool

Sections	Stability (Test Retest)	Equivalence (Inter Rater)	Internal Consistency (Cronbach’s Alpha)
Section 1*	1.00 (0.003)	1.00 (0.01)	0.97 (0.00)
Section 2**	0.89 (0.000)	0.87 (0.03)	0.84 (0.04)

Section 1* Information regarding use of technology,Section 2**Perceptions about adoption and integration of ICT in teaching

EFA is widely used in medical education research in the early phases of instrument development, specifically for measures of latent variables that cannot be assessed directly[26].EFA was carried out to evaluate the construct validity and validate items loading[21]. It helped in identifying the constructs/factors that affected the adoption of ICT in teaching by the HS teachers. Even though all statements were retained the constructs got modified and changed from five to seven in number.

The most commonly used extraction method in EFA is the PCA[25,27], which is also recommended when no priori theory or model exists and was used in this study. Factor loading is the correlation between the statement/item and the factor/construct; a factor loading of more than 0.30 usually indicates a moderate correlation between the item and the factor[9, 25]. When a factor has four or more loadings that are greater than 0.6 the factor may be stable regardless of sample size[21]. Thus, the constructs explained with these 24 statements were stable, and none of the statements were rejected.

Reliability is a measure of stability or internal consistency of an instrument in measuring certain concepts[2]. The higher the correlation value, more reliable is the tool.Internal consistency reliability indicates the correlation between all items that make up the constructs to ensure that the items are measuring the same concept[2]. Based on values of all considered measures[13], reliability of the TAI-HeaST tool was statistically significant.

Conclusion: Results of this pilot study showed the TAI-HeaST to be a valid and reliable tool for measuring perception of HS teachers towards ICT adoption and integration in instruction. Both sections of the tool were found to fit the criteria of 'practicality'.Thus, this tool could be administered to a larger sample size of HS teachers, including more specialties from HS, from colleges with different ownership types, university affiliations, and across different geographic locations.

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