Research Article

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Art for improving skills in medical education: the validation of a scale for measuring the Visual Thinking Strategies method

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Abstract

Background. The skills needed in the medical and nursing field are considered both for the cognitive and the personal and interpersonal aspects. There are many studies that suggest using artistic practices and pedagogical methods such as Visual Thinking Strategies (VTS) or Artful Thinking in the medical education. The main aim of this research is to validate a grid to evaluate impact of art activities for improving skills in medical education sector.

Methods. The VTSkill grid was created by research group of Sapienza University, selecting the relevant dimension on the basis of literature analysis. To evaluate the validity and reliability, the grid was used in a quasi-experimental study involving the pediatric ward personnel, the nursing and medicine course students of Sapienza University of Rome. This analytic rubric was used to evaluate the written assessment form, composed by open-ended basic question related to the VTS method, administered in association with two images, a work of art and a clinical image. The Number of responders of the validation study was 105.

Results. Although obtained from a small sample, both construct validity and reliability analysis showed coherent and statistically significant results. On one hand, the construct validity results showed a relationship path consistent with the hypothesised one derived from previous literature, with relevant p-values (n = 78). On the other hand, the VTSkill reliability was first analysed through the inter-rater evaluation data. This reliability coefficient showed a high degree of convergence of judgments between different evaluators on both image data (n = 55), with statistically significant values ranging from good (r = .77) up to excellent for objectively observable items (r = 1). Similarly, the test-retest reliability coefficients calculated for both clinical and artwork image data resulted statistically significant (n = 95), although ranging from weak to adequate entity (up to r = .77).

Conclusions. Taking into account the high degree of coherence and the stability of measurement of VTSkill in combination with its consistent construct validity, this study suggest the opportunity to implement this measurement tool to research the effect of VTS protocol in future investigations on the field. Therefore, the results of this study will constitute the basis to collect further evidences on how arts-based learning methods can contribute in medical education to improve skills suitable to the health professionals. ***Clin Ter 2020; 171 (3):e253-259. doi: 10.7417/CT.2020.2223***

Key words: *Visual Thinking Strategies, health professional, medical education, score rubric, skills, validation*

Introduction and context

There are many training needs in the medical and nursing field in order to improve observation, communication, ambiguity tolerance and empathy skills for filling the gap between the personal of Care and the patient. Through the recovery of relations with medicine and used with innovative pedagogical methods, the visual arts can be considered as a tool for learning and developing skills by being able to respond to these needs (1,2,3). It is possible to introduce art activities in the medical curriculum to describe the historical relationships between art and medicine or nursing.

According to these reflections, since the 80's, particularly in the United States, courses based on the use of visual arts are undertaken in medical and nursing education. The scientific literature suggests that this practice improves both observation and empathy (4,5). The interesting activities and pedagogical methods that using visual arts are the Visual Thinking Strategies (6,7,8,9) and Artful Thinking (10,11,12).

These methods have the purpose of improving observation skill, of increasing self-confidence, of developing physical examination and diagnosis process (13). Furthermore, some research has shown that exposure to art allows stress reduction, increases self enhancement and self-awareness, induces behaviour patterns change, normalizing heart rate, blood pressure or cortisol levels (14,15).

The narrative reviews on this topic suggest there is a need for more robust, evidence-based approaches for using visual arts instruction in the training of medical students (1). In 2014 in Sapienza University of Rome the research group on VTS application in Medical Education has been established. This group started some experimentation of art activities in degree courses in medicine and nursing, in family medicine residency and in Paediatric ward. From 2015/16 academic year this group in collaboration with Head of Medicine degree "C" of Sapienza University of Rome have organized a training using art activities for III, IV and V year students. The training activities of "The art for medical education" involved VTS as a pedagogical method and other art practices for improving the soft skills useful for the medical education. In 2018-19 academic year the same experimentation has been applied for nursing students

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and Care Personal of Pediatric ward. A questionnaire to assess the impact of these activities on the skills and empathy improve was administered to students and healthcare operators. For this project the research group has designed a score rubric (vtskill grid) for assessment of VTS and art activities impact on skills improvement. Although inter-rater reliability has frequently been considered the solely component of performance assessments, it cannot ensure a scientifically sound and robust measurement. In fact, the psychometric literature has enlightened the major flaw of a measurement tool constructed like the VTSkill that resides in its single-item structure. Application of standard development procedures to this kind of instruments, that generally have poor measurement properties, would allow to draw valid inferences in applied research studies. The impossibility of computing an internal consistency reliability statistic also contribute to psychometrics negative consideration of these instruments.

In addition, considering the change of population and area of application of the VTS and given the fact that validity of an instruments derives from the data generated from its use in a given context, there is a compelling need for validation of this measurement instrument (16).

Materials and methods

Participants

The quasi-experimental study involved health operators of the Paediatric ward, as well as students of medicine and nursing university course, who participated voluntarily. The written assessment forms were collected between November 2018 and February 2019 for the Paediatric ward and from April and May 2019 for nursing students and between October 2016 and June 2019 for medicine students and them were recorded in a database created ad hoc. All participants were divided in small group of 8 for a session of 90 minutes.

Each session included a VTS discussion about an image, an individual written VTS activity and other art related tasks.

The chosen images had to respond to criteria like the need of dissolving ambiguity or to show link with care place or activities in order to consider this experience for improving skills or knowledge connected with health profession.

All participants who attended at 0 or 1 meeting have considered as part of control group. Nursing students have attended, with a weekly frequency, for 4 meetings in the classroom and 1 at the museum. A total sample of 25 nursing students has attended at least 4 meetings while 8 students were assigned to the control group.

The same process was proposed to health operators (Pediatrics, Nursing and Resident) of Hospital "Umberto I" – Sapienza University of Rome ward. A total of 7 Care professional for least 4 meetings were attended for a session of 90 minutes every two weeks, while 5 care professional were put in the control group. Other group included medicine students of Medicine and Surgery Degree "C" of Sapienza University. The research, for these students, started in the 2015 at the III-degree year course collecting the write assessment pre and finished in the 2019 with the same students attending the V degree year course collecting the write assessment post. A total sample of 54 medicine students has attended at least 4 meetings while 23 students were put in the control group.

Testing the scale

The aim of this study was to verify the reliability and validity of VTSkill grid to assess if VTS method can improve soft skills in medical education field as qualitative studies have indicated. Writing is one way to obtain concrete evidence of what the participants are learning from VTS discussions and other art practices, so the pre/post write assessment used. The participants wrote about two images, one of artistic and other of clinical kind, responding to "What's going on in this picture?" and "What do I see that makes me say that". The images present in the questionnaire aim to verify both the impact of the use of art on learning but also of the method applied as the Visual Thinking Strategies.

The image linked to the disease, in fact, can tell us if the method used can change the approach and learning also in the clinical environment.

The VTSkill Rubric

The writing rubric VTSkill (Visual Thinking Strategies Skills) used was designed to assess critical thinking, observation, problem solving and linguistic expression skills.

For this aim the research group referred to Student Thinking Assessment Rubric from Visual Thinking Strategies Organization (17) and to the Scoring rubric for assessment of visual analysis by Milkova (18).

The evaluation grid was implemented with the correlation between image description and competences requested (Fig.1).

The Analytic Rubric VTSkill for learning outcome assessment features a grid of "competences" (dimensions on the rows) and "levels" of achievement (score on the columns). The rater, usually the instructor of the course, evaluates the participant performance in each dimension and assigns values corresponding to a specific set of criteria, derived from specific literature on the topic. A single item assessment was considered adequate being the constructs narrow and unambiguous to the rater (Sackett & Larson, 1990).

The VTSkill includes the four main competences: critical thinking, observation and attention skill, linguistic expression for communication capacity and problem solving.

Furthermore, it was considered fundamental the addition of two observer rating dimensions (number of words and number of visual elements identified) to ensure reliability of the instrument. For each competence the evaluator can assign a score from 0 to 4 points according to the relation between the written responses of the participant and the description provided in the rubric for each level.

Score	0	1	2	3	4
Critical thinking	The respondent is completely unable to evaluate the image characteristics neither provides any interpretation of the scene	The respondent evaluates the image characteristics without providing any interpretation of the scene or any supporting reasoning	The respondent evaluates the image characteristics and provides an interpretation of the scene with scarce supporting reasoning	The respondent evaluates the image characteristics and provides an interpretation of the scene with adequate supporting reasoning	The respondent evaluates the image characteristics and provides multiple hypothetical interpretations of the scene considering corresponding supporting reasonings
Observation skill	The respondent does not identify most visible figures/objects in the scene	The respondent partially identifies the main figures/objects in the scene	The respondent identifies all the main figures/ objects in the scene	The respondent identifies all the main figures/objects and also the ones in the scene's background	The respondent identifies all the figures/objects and also the details in the background of the scene
Linguistic expression	The respondent just lists and/or denominates the elements represented in the image	The respondent just lists and/or denominates the elements represented in the image and describes them using adjectives (a least a few in order to deepen their characteristics)	The respondent describes the elements and the scene through complete and articulated sentences	The respondent describes the elements and the scene through whole and articulated sentences using language coherent with the type of image	The respondent elaborate a short narrative that deals with characters, dynamics, emotions and relationships present in the scene in accord to the type of image
Problem solving / Inference ability	The respondent does not considers (or partially considers) the scene as a whole, missing the identification of relationships within the image (elements are considered independently)	The respondent considers the scene as a whole, although the relationships among elements are not motivated	The respondent considers the scene as a whole and the relationships among elements are briefly motivated	The respondent considers the scene as a whole and the relationships among elements are thoroughly and exhaustively motivated	The respondent considers the scene as a whole and the relationships among elements are thoroughly and exhaustively motivated. the description encompass empirical details, personal experience and prior knowledge (either of artistic nature, e. g. historical context or art movement, or of medical nature e.g. semiotic or clinical explanations)
Word count (number of words)					
Element count (number of elements identified)					

Fig. 1. VTSkill Rubric

Psychometric properties of the VTSkill

Inter-rater reliability

Each essay of the participants who were not involved in the VTS training was evaluated separately by two research members, expert in the VTS method. The respondents completed the task at to different time point and a correlation coefficient was calculated to verify inter-rater reliability.

Initially, the two raters trained together by scoring few exemplary test in order to ensure a consistent evaluation.

Test-retest reliability

Test-retest reliability coefficients deal with the reproducibility of a measurement method. If an instrument is reliable, stable measurement outcomes are expected across time if there is no alteration in the construct due to external factors. For this reason, this reliability method was applied to results of participants who did not undertake the VTS training, considered as a probable cause of alteration. More in details, artistic image data (39 valid cases) and clinical image data (46 valid cases) were analyzed separately in order to investigate possible differences due to the nature of the visual stimulus.

This control group completed retest at different time points according to participants' availability (one month, 5 months or 1 year). Although 1 year could be considered an extreme interval, interclass analysis did not show a relevant difference in tendency and cases were included in order to obtain a more numerous and robust sample. Moreover, the professional training of these participants during the whole period was not directly and specifically aimed to enhance the key dimensions of the VTS method and this constructs tend to be stable in adult population according to sociodemographic characteristics (20).

Construct validity

As an analytic rubric to assess a learning outcome, it is particularly difficult to adapt the general procedure of construct validity evaluation to the VTSkill. A matrix of correlation among the dimensions of VTSkill was calculated (105 valid cases) and the path of relationships was studied as results of divergent and convergent validity (21).

However, a single item tool can never fully predict individual learning outcome, that depend on many different factors, therefore high level coefficients are not expected, unlike reliability ones.

Statistical analysis

Test-retest and inter-rater reliability coefficients and construct validity were assessed through the correlation between ordinal variables using the Spearman rank correlation coefficient, and the values were evaluated and interpreted as: excellent relationship >0.91; good 0.90–0.71; adequate 0.70–0.51; weak 0.5–0.31 (may have limited applicability); irrelevant or none <0.3. The data analysis was conducted using the software JASP 2019 for MacOS.

Results

Test-retest and inter-rater reliability coefficients

The results of test-retest reliability for each VTSkill item are presented in the tables 1 and 2, separately for each kind of image. Regarding the clinical image, it is important to note that all the stability coefficients were statistically significant and of adequate entity, except Critical Thinking and Word Counting that showed a lower value though still significant.

Similarly, all the stability coefficients for the artistic image were statistically significant and of adequate entity (up to $r = .77$), except Problem Solving that presented a lower value though still significant.

These results show a positive stability of the VSTkill, taking into consideration the limited non homogenous sample and the long interval between the two test for the majority of the participants (around 65% repeated the measure at one year).

Tab. 1. Test-retest reliability - Clinical Image

CT_PRE	CT_POST	0.367	*
OS_PRE	OS_POST	0.585	***
LE_PRE	LE_POST	0.538	***
WC_PRE	WC_POST	0.302	*
PS_PRE	PS_POST	0.602	***
EC_PRE	EC_POST	0.497	***

* p < .05, ** p < .01, *** p < .001
Note: CT = Critical thinking, OS = Observation Skill, LE = Linguistic expression, WC = Word count, PS = Problem solving, EC = Element count

Tab. 2. Test-retest reliability - Artistic Image

CT_PRE	-	CT_POST	0.487	**
OS_PRE	-	OS_POST	0.765	***
LE_PRE	-	LE_POST	0.485	**
WC_PRE	-	WC_POST	0.687	***
PS_PRE	-	PS_POST	0.418	**
EC_PRE	-	EC_POST	0.770	***

* p < .05, ** p < .01, *** p < .001
Note: CT = Critical thinking, OS = Observation Skill, LE = Linguistic expression, WC = Word count, PS = Problem solving, EC = Element count

Subsequently, inter-rater reliability coefficients, for each combination of VTSkill item and kind of image, are presented in table 3. As described from previous literature, these values were higher than in the test-retest case. Moreover, all the reliability coefficients were statistically significant ranging from good to excellent entity. In particular, it is relevant to note that the peak of the coefficients was registered on "Word Counts" and "Number of Element Identified", that theoretically are also the more unbiased items. The general pattern of correlation suggests the claim of an inter-rater reliability of VTSkill.

Construct validity

The correlation matrix of the six dimension of the rubric was analysed in order to evaluate the degree to which the measurement tool (VTSkill) produced observations behaving in a manner consistent with the theoretical domain definition of VTS method. Essentially, the procedure requires the confrontation of empirical correlations with explicit theoretical predictions, in a similar but less conceptually complex way convergent and discriminant validity work.

Table 3. Inter-rater reliability Pre-Post VTS.

CT_PRE_1_CI	-	CT_PRE_2	0.893	***
OS_PRE_1	-	OS_PRE_2	0.872	***
LE_PRE_1	-	LE_PRE_2	0.870	***
WC_PRE_1	-	WC_PRE_2	1.000	***
PS_PRE_1	-	PS_PRE_2	0.865	***
EC_PRE_1	-	EC_PRE_2	0.947	***
CT_POST_1 AI	-	CT_POST_2	0.836	***
OS_POST_1	-	OS_POST_2	0.800	***
LE_POST_1	-	LE_POST_2	0.766	***
WC_POST_1	-	WC_POST_2	0.983	***
PS_POST_1	-	PS_POST_2	0.836	***
EC_POST_1	-	EC_POST_2	0.936	***

* p < .05, ** p < .01, *** p < .001
Note: CT = Critical thinking, OS = Observation Skill, LE = Linguistic expression, WC = Word count, PS = Problem solving, EC = Element count

Table 4. Correlation Matrix for construct validity - Clinical Image

	CT_PRE		OS_PRE		LE_PRE		WC_PRE		PS_PRE	EC_PRE	
CT_PRE	-										
OS_PRE	0.541	***	-								
LE_PRE	0.616	***	0.607	***	-						
WC_PRE	0.589	***	0.475	***	0.631	***	-				
PS_PRE	0.585	***	0.479	***	0.438	***	0.325	**	-		
EC_PRE	0.450	***	0.644	***	0.483	***	0.547	***	0.380	***	-

* p < .05, ** p < .01, *** p < .001
Note: CT = Critical thinking, OS = Observation Skill, LE = Linguistic expression, WC = Word count, PS = Problem solving, EC = Element count

Statistical analysis was run using the data collected at T0, in order to avoid biases due to VTS training. The tables 4 and 5 show the correlation matrix for each VTSkill item, separately for each kind of image.

Although a higher average correlation coefficient was observed in clinical image data in respect to artistic one, a similar path of correlation can be identified. The difference in the average strength of correlation can be explained by the fact that health professionals are more accustomed to situations represented in clinical image and they achieve better performance in multiple dimensions. At the same time, the persistence of a statistically significant relationship pattern among VTSkill dimensions, in the analysis of artistic image data, suggested the claim that the rubric correctly measured the hypothesized skill set. For example, Critical thinking item presented higher correlations with the Linguistic expression item, the word count item and the Problem solving one. As highlighted by previous literature on the topic, the production of new ideas (critical thinking item in the VTSkill) is related to the skill of inference that encompass querying evidence, conjecturing alternatives and drawing conclusions (problem solving item in the VTSkill), while the explanation skill includes such subskills, as stating results and presenting arguments (linguistic expression and word count items in the VTSkill) (22). Ultimately, even if the results suggested the VTSkill measures covary in a manner consistent with the intended theoretical structure and can be used for VTS method assessment, further studies could focus also on other facets of validity the evaluation of construct underrepresentation and construct irrelevancy.

Limitations

As previously introduced, the main limitation of the study derives from the very nature of the rubric, because it scores each dimension on a single item discrete scale. Previous literature on the topic suggest that the use of single item is inappropriate in particular for multidimensional constructs and can adversely impact the quality of the measurement underrepresenting or confounding the construct (23).

Conversely, single item measures constitute a viable option in case of non-homogenous sample population and concrete constructs perceived similarly by all raters, yielding to appropriate information (24). This kind of stimulus is also used in exploratory research situations where typically weaker effect sizes are expected and smaller samples are used (25).

Secondly, the relatively small research sample may have a potentially important drawback, that is a higher difficulty in detecting statistically significant relationships. Specifically, the medical training context in which VTS method was applied is renown to rely on small research samples, given the high job demands of the health professions, and such a study might reduce the generalizability of the findings.

Indications of criterion validity of the VTSkill were not calculated as this element was not taken under consideration in the study design. Nonetheless, a positive predictive validity could be important if VTSkill is considered as a measure of individual maximum performance. Therefore, to foster use VTS method it will be necessary to assess its learning outcomes, for example in medical context, in relation to achievements in professional training.

Table 5. Correlation Matrix for construct validity - Artistic Image

	CT_PRE		OS_PRE		LE_PRE		WC_PRE		PS_PRE	RE	EC_P
CT_PRE	-										
OS_PRE	0.074		-								
LE_PRE	0.382	***	0.705	***	-						
WC_PRE	0.322	**	0.645	***	0.730	***	-				
PS_PRE	0.464	***	0.577	***	0.791	***	0.610	***	-		
EC_PRE	0.096		0.805	***	0.687	***	0.702	***	0.541	***	-

* p < .05, ** p < .01, *** p < .001
Note: CT = Critical thinking, OS = Observation Skill, LE = Linguistic expression, WC = Word count, PS = Problem solving, EC = Element count

Discussion and Conclusion

The Italian application of VTS method required a scientifically valid and reliable measurement tool. Although the difficulties related to the construction of this kind of instrument, the indications of validity and reliability deriving from the results of this study suggest the opportunity of its implementation.

The fact that the rater is an expert facilitates unambiguous interpretations and consistent evaluations. Among others, simplicity, ease of use, and global assessment are several advantages of using single-item measurement (26).

Although obtained from a relative small sample for contextual and practical reasons, the results for the VTSkill rubric validation show a sufficient degree of reliability and validity. In fact, the stability of measurement registered for the control sample indicates a certain reliability of the instrument used both to collect the data and for their analysis.

It is certainly necessary to expand the sample in order to provide more evidences with respect to the predictive validity and the analysis of skills modification. This analysis confirms that art can be useful in the medical education sector to meet the training needs of students and care professionals.

Medical Humanities and especially the arts involvement in basic and lifelong education can improve essential skills, communication and inter-professional collaboration and empathy. This study is connected to innovative activities included in the medical and nursing curriculum as learning strategies, that have already demonstrated adequate efficacy (27) (28). Furthermore, many studies have shown that medical humanities can address some critical aspects of medical training such as the practice of effective communication and the correct relationship between doctor and patient that still exists in the health profession and that are difficult to solve through traditional training (29). The positive impact on the well-being of students and operators is also important.

A survey on stress limitation reports is being conducted on the same participants indicating and the first results seem to confirm that this type of activity related to the visual arts can foster a holistic approach to the care and well-being of health personnel.

Author contributions

VF designed and conducted the study. VF and SDS conducted the literature searches. VF and SDS provided the acquisition of the data and FMM overlooked methods and undertook the statistical analyses. VF, SDS and FMM wrote the first draft of the manuscript. All authors significantly participated in interpreting the results, revising the manuscript, and approved its final version.

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