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Preparation of the reliability and validity test of the Hungarian adaptation of the modified Simulation Effectiveness Tool (SET-M HU)

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Abstract

Introduction: The Simulation Effectiveness Tool-Modified (SET-M) questionnaire aims to assess students' perceptions of the effectiveness of teaching and learning in a simulation environment.

Aim: The aim of our research group was to develop a Hungarian version of the questionnaire (SET-M HU) and to test the reliability and validity of the psychometric characteristics of the questionnaire. In the preparatory phase of this process, a pilot study was conducted, and the results of which will serve as a basis for the development of the final Hungarian version and for further validity tests.

Material and methods: Data were collected from 91 students who participated in the simulation-based learning experience in the Faculty of Health Sciences at the University of Debrecen, between September 2023 and March 2024. The methods used for data analysis were descriptive statistics, exploratory factor analysis, correlation analysis, calculation of Cronbach alphas, Item-Total analysis, Split-Half reliability, and Rough Set analysis. The data analysis used Microsoft Excel 2016 and SPSS v24 software.

Result: As a result of the factor analysis, three factors accounted for 69.8% of the total variance. The correlations of the Hungarian version of the instrument ranged from r = 0.918 to r = 0.894. The overall Cronbach's alpha coefficient of the instrument was found to be 0.950. The correlations were statistically significant for the full instrument and the subscales. Rough Set analysis showed similar results for the Gauge test.

Conclusions: Based on the results of our research, the feasibility of the questionnaire in Hungary has been confirmed, so it is relevant to continue the validation process. The Hungarian version of the questionnaire can be a reliable and valid measurement tool to assess the effectiveness of learning in simulation environments.

Key words: simulation training; validation study; effectiveness; SET-M

Introduction

Health simulation education has developed significantly in the world and in Hungary in recent decades. Simulation as an educational tool and learning methodology is increasingly emphasized in the training of health professionals [1]. Simulation education is also supported by national and international professional bodies in the nursing profession. The International Nursing Association for Clinical Simulation and Learning (INACSL) includes more than 2400 members from around the world.

However, when using simulation in education, it is important to emphasise that simulation is an educational strategy and not a technology [2]. The goals of simulation in education are related to learning and assessment. Simulation is not a substitute for learning throughout the clinical practice, but allows the student to develop professional skills, assessment, critical thinking and decision-making in a safe and supportive environment [3].

Simulation training involves the modelling of clinical situations using simulators and possibly human actors. This solution provides students with the opportunity to practice their clinical skills through real-life situational experience, without endangering the patient's life, in the interest of patient safety. By providing conditions as close to reality as possible, the simulation environment gives the opportunity to practice certain activities in a targeted way by controlling specific factors, and minimising the possibility of manipulation, while using motivational experiential factors [4]. Patient care is highly influenced by the innovative modern education of future professionals, especially in the critical patient care environment where the patient's condition is highly dependent on timely, complex care [5, 6, 7, 8]. In addition, simulation education has a motivational effect on students, increases their ambition, self-confidence, and enhances their sense of profession [8, 9, 10]. It also supports competencies that are often neglected in traditional teaching methods, such as teamwork, explanation, collaboration, and also develops their communication skills [11, 12, 13, 14].

To provide effective, high quality simulation education, it is necessary to have an adequate pool of professionals who are well prepared for being able to train in a simulation environment, have adequate knowledge of the use of modern simulation tools, and therefore the organisation of professional training programmes and the development of simulation units are of great importance [7].

Pre-briefing and debriefing are important elements of effective teaching. The latter is an important feedback to the student. Debriefing provides an opportunity for the student to repeat the task until he or she has mastered it properly [15, 16]. In a survey, conducted at a university in the West of Ireland in 2020, researchers found that all students found debriefing to be a very valuable component of the learning experience through simulation. It was also reported that learning about students' opinions was a valuable component of the simulation-based learning experience since it allowed them to express their feelings and apply self-reflection [16]. This is why it is important to explore the views of students preparing for a health career to understand the impact of simulation education on training [17]. Evaluation ensures that simulations undergo consistent, continuous, quality process improvement. Evaluation processes and methods are designed during the simulation development phase. An assessment method should be incorporated to measure students' knowledge acquisition and their learning outcome achievement. Other components to be evaluated are the facilitators and the simulation environment [18].

The Modified Simulation Effectiveness Tool (SET-M) included in the study is a measurement tool that has been shown to be effective from a variety of approaches in research [19, 17] and has been used in relation to simulation-based learning experiences in a number of fields, for instance, among nursing and midwifery students. The research team aims to develop a range of valid and usable measurement tools that can be used in simulation-based teaching practice and are excellent for measuring the effectiveness of teaching, which includes the SET-M questionnaire. This paper summarises the results of a pilot study conducted in the preparatory phase of the validation process of the SET-M instrument. The purpose of this study is to prepare the Hungarian adaptation of the SET-M HU, to examine the validity of content, construct, and criterion reliability.

Material and methods

The SET-M questionnaire was developed in 2015 by Leighton and colleagues from the work of Elfrink-Cordi and colleagues in 2012 [18, 19]. The aim of the instrument is to assess the effectiveness of teaching in a simulation environment based on students' perceptions. The 19 questions of the SET-M questionnaire are usually analysed by the researchers in three or four parts. The first part (questions 1 and 2) measures the PREBRIEFING phase. The SCENARIO phase can be divided into two major parts (LEARNING sub-phase, questions 3 to 8, and CONFIDENCE sub-phase, questions 9 to 14) which measure students' self-perceptions of their learning and the development of their confidence. The DEBRIEFING phase examines the discussion and analysis phase (questions 15–19), see Table 1. Question 20 is an open question where respondents were asked to express their opinions in their own words.

Students can rate their opinion on the statements on a 3-point Likert-type scale (1–strongly disagree; 2–somewhat agree; 3–totally agree).

Based on previous measurements, the Cronbach's alpha coefficient of the instrument was 0.93, while the Cronbach's alpha coefficients of the subscales were 0.83 (pre-discussion), 0.85 (learning), 0.91 (confidence) and 0.90 (post-discussion). There were no items for which a reverse assessment was required. The total score is obtained by adding up the scores of all subscales [19, 17].

Language Validity of the SET-M HU Tool: In order to ensure the language validity of the SET-M HU, the tool was translated from English into Hungarian by two members of the research team and two English specialist translators, who were proficient in both languages. The Hungarian version was then translated again into English. The translations were reviewed again by the researchers before the final version was developed.

Ethical consideration: We have obtained the permission of the original authors (Kim Leighton) to adapt the questionnaire into Hungarian, and our team has ethical permission to conduct the research (BM/15069-1/2023).

Data Collection: The sampling took place at the Faculty of Health Sciences of the University of Debrecen. A subset of students who participated in a simulation practical class in the Faculty Skill Lab between September 2023 and March 2024 completed the questionnaire. The sample size was 91 students. The students completed a paper questionnaire at the beginning of the research and later the questionnaire was made available through the Google Forms application. The teachers leading the simulation exercise and the members of the Simulation Working Group participated in data collection.

Statistical Analysis: For data analysis Excel 2016 and SPSSv24 software were used. Results were evaluated with 85% confidence, and the significance level was $p < 0.05$. Descriptive statistics, factor analysis with varimax rotation, correlation examinations, Cronbach's alpha coefficients, Split-half correlations were used for data analysis. In addition, rough set analysis was used, which measured the interdependence of variables (attributes) based on the Polish Pawlak's theory [20].

Table 1. Distribution of responses to the SET-M HU questionnaire

	A (%)	B (%)	C (%)	NA (%)
PREBRIEFING				
1. Prebriefing increased my confidence	53 (58.2)	33 (36.3)	5 (5.5)	–
2. Prebriefing was beneficial to my learning.	64 (70.3)	24 (26.4)	3 (3.3)	–
SCENARIO (LEARNING)				
3. I am better prepared to respond to changes in my patient's condition.	58 (63.7)	31 (34.1)	2 (2.2)	–
4. I developed a better understanding of pathophysiology.	49 (53.8)	33 (36.3)	9 (9.9)	–
5. I am more confident in my assessment skills.	43 (47.3)	38 (41.8)	10 (11.0)	–
6. I felt empowered to make clinical decisions.	41 (45.1)	39 (42.9)	11 (12.1)	-
7. I developed a better understanding of medications.	46 (50.5)	29 (31.9)	7 (7.7)	9 (9.9)
8. I had the opportunity to practice my clinical decision making skills.	57 (62.6)	28 (30.8)	6 (6.6)	–
SCENARIO (CONFIDENCE)				
9. I am more confident in my ability to prioritise care and interventions.	52 (57.1)	28 (30.8)	10 (11.0)	1 (1.1)
10. I am more confident in communicating with my patient.	55 (60.4)	27 (29.7)	9 (9.9)	–
11. I am more confident in my ability to teach patients about their illness and interventions.	49 (53.8)	32 (35.2)	10 (11.0)	–
12. I am more confident in my ability to report information to health care team.	49 (53.8)	34 (37.4)	8 (8.8)	–
13. I am more confident in providing interventions that promote patient safety.	48 (52.7)	30 (33.0)	10 (11.0)	3 (3.3)
14. I am more confident in using evidence-based practice to provide care.	43 (47.3)	38 (41.8)	7 (7.7)	3 (3.3)
DEBRIEFING				
15. Debriefing contributed to my learning.	66 (72.5)	19 (20.9)	3 (3.3)	3 (3.3)
16. Debriefing allowed me to communicate my feelings before focusing on the scenario.	54 (59.3)	22 (24.2)	12 (13.2)	3 (3.3)
17. Debriefing was valuable in helping me improve my clinical judgment.	58 (63.7)	27 (29.7)	3 (3.3)	3 (3.3)
18. Debriefing provided opportunities to self-reflect on my performance during simulation.	66 (72.5)	20 (22.0)	2 (2.2)	3 (3.3)
19. Debriefing was a constructive evaluation of the simulation.	65 (71.4)	20 (22.0)	3 (3.3)	3 (3.3)

Results

Table 1 shows the responses to the questions of the questionnaire in aggregated form. For each question, the highest level of agreement received the most marks. It is noteworthy that in the Debriefing questionnaire, with two exceptions, at least

70% of respondents indicated the highest level of agreement. The two exceptions also had response rates of around sixty percent. The Prebriefing section got a similarly high rating. The two sections of the Scenario question set scored slightly lower, but here too the highest rating was the most typical (column A). Question seven showed the highest level of uncertainty with a non-response rate of nearly 10%.

The columns show the number of cases for each response option and the percentage distribution in brackets. Column A indicates the 'Strongly Agree' response (3 points); column B indicates the 'Somewhat Agree' response (2 points); column C indicates the 'Do Not Agree' response (1 point). Column NA indicates the 'No Answer' response.

To the 20-question open questionnaire, *What else would you like to say about today's simulated clinical experience?*, 42 responses were received. These were typically positive, complimentary comments. Negative comments were reported by one respondent. Some asked for the use of more modern equipment and others asked for a greater proportion of simulation lessons in the curriculum.

The aggregated descriptive characteristics of each question group and the overall questionnaire are presented in Table 2. For all questions, the answers were crowded towards higher values. This is also reflected in the point averages of the individual questions (Mean/Number of questions row). All averages are above two. What was observed during the evaluation of Table 1, that the Prebriefing and Debriefing groups of questions were rated more highly, is also observed here with averages of around 2.6 compared to averages of around 2.4.

Table 2. Summary characteristics for the full questionnaire and for each group of questions

		All	Prebriefing	(Scenario) learning	(Scenario) confidence	Scenario	Debriefing
Mean		48,0253	5,1978	14,8659	14,7011	29,6203	13,2500
Mean/Number of questions		2,5277	2,5989	2,4777	2,4502	2,4684	2,6500
95% Confidence Interval for Mean	Lower	46,0988	4,9713	14,2037	13,9912	28,2487	12,7647
	Upper	49,9518	5,4243	15,5280	15,4111	30,9918	13,7353
5% Trimmed Mean		48,6280	5,3120	15,0854	14,9368	29,9958	13,4899
Median		49,0000	6,0000	15,0000	16,0000	30,0000	14,0000
Variance		73,974	1,183	9,081	11,096	37,495	5,247
Std. deviation		8,60080	1,08750	3,01339	3,33102	6,12331	2,29066
Minimum		24,00	2,00	7,00	6,00	14,00	5,00
Maximum		57,00	6,00	18,00	18,00	36,00	15,00
Range		33,00	4,00	11,00	12,00	22,00	10,00
Interquartile Range		14,00	2,00	5,00	6,00	11,00	3,00
Skewness		–,743	–1,147	–,662	–,760	–,649	–1,372
Kurtosis		–,294	,529	–,342	–,409	–,624	1,386

The strength of the relationship between each subgroup is indicated by Spearman's rho coefficient (see Table 3). The value of the smallest correlation coefficient is 0.556 (PREBRIEFING and DEBRIEFING). All coefficients indicate a moderately strong or strong significant relationship.

Table 3. Correlation values for the response scores of the question groups

		All	Prebriefing	Learning	Confidence	Scenario	Debriefing
ALL	Correlation Coeff.	1,000	,727**	,938**	,929**	,964**	,789**
	Sig. (2-tailed)	.	,000	,000	,000	,000	,000
	N	79	79	79	79	79	79
PREBRIEFING	Correlation Coeff.	,727**	1,000	,589**	,592**	,613**	,556**
	Sig. (2-tailed)	,000	.	,000	,000	,000	,000
	N	79	91	82	87	79	88
LEARNING	Correlation Coeff.	,938**	,589**	1,000	,868**	,960**	,678**
	Sig. (2-tailed)	,000	,000	.	,000	,000	,000
	N	79	82	82	79	79	79
CONFI-DENCE	Correlation Coeff.	,929**	,592**	,868**	1,000	,965**	,630**
	Sig. (2-tailed)	,000	,000	,000	.	,000	,000
	N	79	87	79	87	79	87
SCENARIO	Correlation Coeff.	,964**	,613**	,960**	,965**	1,000	,672**
	Sig. (2-tailed)	,000	,000	,000	,000	.	,000
	N	79	79	79	79	79	79
DEBRIEF-ING	Correlation Coeff.	,789**	,556**	,678**	,630**	,672**	1,000
	Sig. (2-tailed)	,000	,000	,000	,000	,000	.
	N	79	88	79	87	79	88

Legend: Spearman's rho coefficient, ** sign correlation is significant at the 0.01 level (2-tailed)

Principal Component Analysis (Factor Analysis, Varimax Rotation, listwise) was carried out to analyse the answers to the questions in more depth. The resulting components revealed relevant correlations (KMO = 0.886; Bartlett's Test of Sphericity Approx. Chi-Square = 1183.614; df = 171; $p < 0.000$). Rotation Sums of Squared Loadings–Cumulative % (1, 2, 3 components) = 69.860%. Table 4 shows the structure of the three components resulting from the test.

Table 4. Rotated Component Matrix with 3 separated components

Rotated Component Matrix[a]			
	Component		
	1	2	3
V4 – SCENARIO – L	,814	,229	,191
V5 – SCENARIO – L	,810	,203	,176
V6 – SCENARIO – L	,755	,253	,396
V12 – SCENARIO – C	,729	,148	,385
V14 – SCENARIO – C	,722	,176	,385
V13 – SCENARIO – C	,716	,218	,456
V3 – SCENARIO – L	,694	,252	,225
V17 DEBRIEFING	,125	,829	,262
V19 DEBRIEFING	,282	,765	,068
V2 PREBRIEFING	,448	,749	,055
V18 DEBRIEFING	,053	,733	,285
V15 DEBRIEFING	,218	,723	,197
V16 DEBRIEFING	,108	,679	,464
V1 PREBRIEFING	,564	,596	,042
V8 – SCENARIO – L	,362	,467	,404
V11 – SCENARIO – C	,359	,290	,754
V10 – SCENARIO – C	,394	,203	,730
V9 – SCENARIO – C	,496	,144	,728
V7 – SCENARIO – L	,236	,402	,633
Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization.			
a. Rotation converged in 7 iterations			

The factor analysis sharply separated the PRE- and DEBRIEFING questions (Factor 2) from the SCENARIO questions, which were included in Factors 1 and 3. Only the V8 question shows the ambiguous position of the component classification.

Question V8 is included in the five items that showed the lowest dependency value in the rough set analysis ($\gamma = 0.7089$–question 5; $\gamma = 0.7468$–questions 1, 7, 8, 14; $\gamma = 0.960$–question 2; $\gamma = 9747$–question 13; for the other questions the dependency value was $\gamma = 1$). This means that for most questions full dependency can be shown in relation to the other questions. There are minor differences in the dependency for the cases listed.

The reliability of the questionnaire was tested with Cronbach's alpha, which was 0.950 for all questions. The Cronbach's alpha coefficients for the subscales were 0.895 (pre-discussion), 0.880 (learning), 0.907(confidence) and 0.860 (post-discussion).

The results of the Item-Total Statistics are summarised in Table 5. It can be seen that by deleting questions one by one from the question set, Cronbach's alpha values hardly change. For further analysis, the SET-M questions were also examined using the Split-Half procedure. The procedure split the question set into two parts (questions 1–10 and 11–19). The Cronbach's alpha values for the two sets of questions were 0.918 and 0.894, respectively. Correlation between the two sets of questions was 0.886, Spearman-Brown Coefficient = 0.939; Guttman Split-Half Coefficient = 0.931.

Table 5. Item Total Statistics of the SET-M questionnaire

Item-Total Statistics				
	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
V1	45,52	66,689	,684	,948
V2	45,38	67,239	,705	,947
V3	45,41	67,706	,675	,948
V4	45,58	65,400	,722	,947
V5	45,66	66,023	,696	,948
V6	45,67	65,172	,810	,946
V7	45,57	66,479	,660	,948
V8	45,46	66,918	,665	,948
V9	45,54	65,431	,738	,947
V10	45,54	65,764	,706	,947
V11	45,57	65,351	,748	,947
V12	45,53	66,098	,720	,947
V13	45,58	64,887	,794	,946
V14	45,57	66,248	,733	,947
V15	45,30	68,624	,609	,949
V16	45,54	65,790	,645	,949
V17	45,39	67,754	,642	,948
V18	45,30	69,112	,549	,950
V19	45,33	68,249	,609	,949

Discussion

There are several conditions for the validity of a measuring instrument. One of these is reliability, but reliability does not guarantee the validity of a measurement instrument [21]. The validity of a measurement instrument is usually assessed by researchers through content validity and factor construct validity. The content validity of the SET-M HU measure was 0.95. This is very similar to the results of the original questionnaire and the results of measurements conducted by other national research teams (Table 6). The results show that the content validity of the SET-M HU questionnaire as a measurement instrument is adequate.

Table 6. Reliability (Cronbach's alpha) values of the different studies

	Total	Prebriefing	Learning	Confidence	Scenario	Debriefing
EN	0.950	0.985	0.880	0.907	0.944	0.860
Elfrink-Cordi et al. [19]	0.93	0.83	0.85	0.91	–	0.90
Bergamasco et al. [22]	–	0.792	0.823	0.874	–	0.758
Leighton et al. [18]	0.936	0.833	0.852	0.913	–	0.908
Olvera-Cortes et al. [23]	0.932	–	–	–	–	–
Sahin et al. [21]	0.920	0.900	0.850	0.890	–	0.840

The results of the factor analysis differ slightly from the factor structure of the original questionnaire where 4 components were identified, while in the present study 3 principal components were identified accounting for 69.8% of the total variance. In the components, the components for the scenario, prebriefing and debriefing are well separated, which is in line with the structure of the original questionnaire. The results of the present study show that the results of the factor analysis were reasonable. In the future, when a larger number of items is available, confirmatory factor analysis can be performed to investigate in more detail the fit between the data collected and the principal components.

A reliable measuring instrument provides sensitive, consistent and stable measurement results. To measure the reliability of the measurement instrument, the internal consistency and correlation (Spearman's rho coefficient) relationships were analysed in this study. Internal consistency was measured by item analysis and Chronbach's alpha coefficient. The correlation coefficient of all items ranged from 0.55 to 0.96. This indicates the adequacy of the reliability level of the items (Table 6). Based on the internal consistency scores of the subscales and the entire instrument, it can be concluded that the Hungarian version of the instrument (SET-M HU) has a high reliability.

The Split-Half procedure was used to assess the reliability of the instrument, where Chronbach's alpha values for the two halves of the instrument were between 0.91 and 0.89.

Leighton et al. converted the 5 response options of the original instrument to a 3-point Likert scale, which did not change the reliability of the instrument [18]. In the present study, the instrument included a 3-point Likert scale for all items.

In previous studies, it was observed that most people did not answer question 7 on medication (*I developed a better understanding of medications*), with 8.3% of participants in the original study not completing this question [18, 21]. This was because the researchers assumed that the scenario did not include an element of medication. In the present pre-study, this question was also the one with the highest proportion of non-response (9.9%, Table 1), presumably because the competences of nurses and midwives in our country do not include prescribing medication, only the administration of after doctor's order. Previous studies have suggested that if medication administration is not included in the scenario tasks, students should not complete this question [21]. Overall, based on the responses to each question, students' perceptions of the simulation exercise were positive in this preliminary study.

Conclusions and recommendation

The results of the studies showed that the SET-M HU questionnaire is a reliable and valid measurement tool that will be used in clinical simulation in Hungary. Simulation education practitioners can use the measurement tool to measure students' perceptions of the effectiveness of simulation education and the effectiveness of learning in a simulation environment.

A preliminary analysis of the Hungarian version of the SET-M questionnaire confirms the need for further implementation of the questionnaire. This justifies the research team's goal of completing the full validation process and finalising the Hungarian version. The planned measurements will include the investigation of additional socio-demographic factors (gender, age, type of course, etc.) and an increase in the sample size.

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