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UNDERSTANDING ONLINE COLLABORATION THROUGH STUDENTS' SELF-REPORTED COMPETENCIES

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ABSTRAKT (Slovakian):
Zručnosti 21. storočia zohrávajú v každodennom vzdelávaní čoraz dôležitejšiu úlohu. Spolupráca a digitálne zručnosti sú súčasťou väčšiny rámcov, ktoré definujú zručnosti 21. storočia. Kolaboratívne riešenie problémov žiakov poukazuje na to, ako dobre dokážu pracovať s ostatnými pri riešení problému. Predchádzajúci výskum sa snažil merať kolaboratívnu zložku tejto dvojzložkovej (kolaboratívnej a kognitívnej) zručnosti, avšak neexistoval precedens na prispôsobenie tejto zložky online prostrediu. Tento výskum som realizoval s cieľom vytvoriť vlastný merací nástroj založený na predtým aplikovanom teoretickom rámci, ktorý by umožnil merať sociálnu zložku online kolaboratívneho riešenia problémov žiakov a získať poznatky o prínosoch čoraz populárnejšej online spolupráce pre žiakov. Na základe analýzy údajov možno konštatovať, že hodnotenie prínosov online spolupráce súvisí s rozvojom kolaboratívnej zložky kolaboratívneho riešenia problémov.

Keywords (Slovakian): *online spolupráca, kolaboratívne riešenie problémov, zručnosti 21. storočia, študenti stredných škôl, Maďarsko*

ABSTRACT
21st century skills are playing an increasingly important role in everyday education. Collaboration and digital skills are elements of most frameworks that define 21st century skills. Students' collaborative problem-solving skills indicate how well they can work with others to solve a problem. Previous research has sought to measure the collaborative component of this two-part (collaborative and cognitive) skill, but there has been no precedent for adapting this component to the online space. We conducted this research to develop a proprietary measurement tool based on a previously applied theoretical framework that would make it possible to measure the social component of students' online collaborative problem-solving skills and to learn about the benefits of increasingly popular online collaboration for students.

Keywords: *online collaboration, collaborative problem solving, 21st century skills, secondary school students, Hungary*

Main work

Introduction

21st century skills play an increasingly important role in everyday education. This trend is reinforced by the fact that the 2020 National Core Curriculum identifies seven key competencies, including learning skills, communication skills, digital competencies, thinking competencies, creativity, employee and entrepreneurial competencies, and personal and social

relationship competencies (Egervári & Kovács, 2021). The concept of 21st-century competencies is defined differently across theoretical frameworks (Silva, 2008) However, most models agree that collaboration constitutes a core element of these competencies (Hesse et al., 2015; Suto & Eccles, 2014).

The aim of the present study was to develop a measurement instrument capable of assessing students' online collaborative problem-solving skills while also providing insight into the perceived benefits of online collaboration. To achieve this aim, the study adapts the theoretical framework proposed by Hesse et al. (2015), which conceptualizes the social component of collaborative problem solving within a hierarchical model. In addition, the categorization developed by Tóth-Mózer and Misley (2019) was used to examine perceived advantages of online collaboration across four dimensions.

The study addresses the following research questions:

- What patterns can be identified in relation to the perceived benefits of online collaboration?
- What patterns emerge when analyzing the different sub-skills of the theoretical framework?
- Is there a sub-skill whose development is related to the development of all other sub-skills?

1. Literature review

There is no universally accepted definition of collaborative problem solving (Pásztor-Kovács, 2015). In general, existing approaches emphasize interaction among group members and the sharing of knowledge and experience in pursuit of common goals (Pásztor-Kovács, 2018). Accordingly, several theoretical frameworks propose that collaborative problem-solving competence consists of two main components: a cognitive component and a social component (Dingler, Von Davier & Hao, 2017). One of the most influential two-component models was developed by Hesse and colleagues as part of the ATC21S project (Hesse et al., 2015). Building on this framework, Pásztor-Kovács and her colleagues developed a measurement instrument focusing on the social component of students' collaborative problem-solving skills (Pásztor-Kovács, Pásztor & Molnár, 2019).

Collaboration in educational practice has increasingly moved beyond the traditional classroom setting, with cooperation in digital environments becoming more prevalent. Innovative forms of online collaboration allow students to work together without temporal or geographical constraints, while simultaneously developing communication, problem-solving, and digital skills (Szűts, 2020). Online collaboration offers numerous advantages for both students and teachers, including increased transparency, traceability, and flexibility in collaborative learning processes (Tóth-Mózer & Misley, 2019).

Overall, empirical research demonstrates a growing interest in measuring collaboration (OECD, 2017; Pásztor-Kovács, Pásztor & Molnár, 2019), and several studies address the educational potential of online collaboration (Tóth-Mózer & Misley, 2019). Although previous research has examined collaborative problem solving and the pedagogical potential of online collaboration separately, limited attention has been given to systematically adapting established collaborative problem-solving frameworks to digitally mediated learning environments from the students' perspective. The present study seeks to address this gap.

2. Methodology

The aim of the research was to develop a measurement tool that, on the one hand, can assess students' online collaborative problem-solving skills and, on the other hand, provide information about the benefits of online collaboration. The study employed a cross-sectional quantitative design with a sample of 83 secondary school students (aged 18 or above). The data was collected in October 2024, and we recorded the respondents' answers using Google Forms. Respondents had to meet two criteria: they had to be at least 18 years old, and they had to be enrolled in some form of secondary education. The questionnaire was completed completely anonymously.

The measurement tool consisted of 13 categories. Nine categories were derived from Hesse's theoretical framework of collaborative problem solving and represented distinct sub-skills of the social component of collaboration. The remaining four categories focused on perceived advantages of online collaboration.

For each category, three items were developed. In the case of the sub-skills based on Hesse's framework, the items were designed to reflect three levels of development low, medium, and high. Regarding the perceived advantages of online collaboration, two items were formulated to confirm, and one item to reject whether the given category could be considered an advantage of online collaboration.

Data analysis was performed using SPSS 30.0 statistical software. The first step in the analysis was to examine the reliability of the measurement tool, which we did by calculating the Cronbach's alpha coefficient. Descriptive statistics and Pearson correlation analyses were conducted at both item and category levels. In addition to striving for transparency, it is essential to mention the limitations of the research. Basically, in the case of self-reported data collection, the subjective judgment of respondents can distort the accuracy of the results. We were able to perform data analysis on a sample of 83 people, which is sufficient to verify the reliability of the measurement tool or to perform various descriptive and correlation analyses, but it was not sufficient to perform factor analysis, for example. The convenience sampling strategy limits the generalizability of the findings, and the cross-sectional measurement did not allow for further refinement of the data analysis.

3. Results

3.1 Reliability

Reliability was checked by calculating Cronbach's alpha, which is one of the best-known indicators of internal consistency. Examining all items (N=39), the Cronbach's alpha value was 0.778 (Table 1), which indicates adequate reliability.

1. Table: Cronbach's alpha analysis (n=39)

Cronbach's alpha	Number of items
Value = 0.778	N=39

3.2 Descriptive analyses

At the item level, based on descriptive analysis, a characteristic pattern can be observed in the segment of the questionnaire based on Hesse's theoretical framework. According to this, when

considering items representing different levels of development within the same category, respondents most often agreed with the item that reflected the medium level of development within the category. This pattern is showcased in Table 2 via the *Task completion* sub-skill.

2. Table: Descriptive analysis of the items in Task completion category.

Average calculation per item – *TASK COMPLETION*	
Item reflecting on low development of the sub-skill	**AVERAGE= 1.87** (STANDARD DEVIATION= 0.866)
Item reflecting on medium development of the sub-skill	**AVERAGE=3.25**(STANDARD DEVIATION= 0.560)
Item reflecting on high development of the sub-skill	**AVERAGE= 2.98** (STANDARD DEVIATION= 0.811)

3.3 Correlation analysis of different categories

The results of correlation analyses performed at the category level show that there are clear relationships of varying strength between the items in the questionnaire. Based on the analysis, there are clear overlaps between the two main blocks of the questionnaire, the advantages of online collaboration and the theoretical model of collaborative problem-solving sub-skills. This suggests that there is a close relationship between the two dimensions examined, which provides an empirical basis for further research on the topic.

3.4 Correlation analysis of different items

From a research perspective, item-level correlation analyses proved to be the most decisive statistical procedure. Based on the classification described in the methodological section of the research, it became clear that not only positive but also negative correlations occur at the item level.

An analysis of the items in *Interaction* category highlights the pattern of how respondents position themselves between the different levels of development of the sub-skill. The pattern depicted by Table 3 is frequent throughout the different categories.

3. Table: Correlation analysis of the items in *Interaction* category.

		Item reflecting on medium development of *interaction*	**Item reflecting on medium development of *interaction***
Item reflecting on low development of *interaction*	r	-,431**	-,235*
	p	<,001	0.032
	N	83	83

For example, a similar phenomenon can be observed in the category of *Adaptive responsiveness.* The results show that those who are less inclined to *take others' ideas into account* are unlikely to agree that *integrating other initiatives can lead to new solutions*. This supports the idea that a low level of development in each sub-skill can be a limiting factor in the success of group collaboration. Based on the analyses, it can be concluded that the two-part

division of collaborative problem-solving ability into cognitive and social components is valid. The behavior patterns of the respondents confirm that a low level of development of the social component hinders group interaction and the effectiveness of cooperation, even if the cognitive component is otherwise well developed.

One of the central questions of the research was whether there is a sub-skill whose level of development clearly determines the level of development of other sub-skills. The sub-skill of *interaction*, especially based on the analysis of the item representing its low level of development, comes close to this state. Table 4 represents the numerous correlations between this item and items from other categories that represent medium or high level of development.

4. Table: The correlation analysis of the item reflecting on low development of interaction.

	Item reflecting on low development of interaction		
	r	**p**	**N**
Item reflecting on high development of *task completion*	-0.338**	0.002	83
Item reflecting on medium development of *adaptive responsiveness*	-0.258*	0.018	83
Item reflecting on medium development of *audience awareness*	-0.233**	0.034	83
Item reflecting on medium development of *negotiation*	-0.338**	0.002	83
Item reflecting on high development of *self-evaluation*	-0.333**	0.002	83
Item reflecting on high development of *transactive memory*	-0.379**	<.001	83
Item reflecting on high development of *responsibility initiative*	-,0337**	0.002	83
Item rejecting *transparent deadlines* as an advantage of online collaboration	0.287**	0.009	83

Based on the correlations depicted in table 4, the low development of *interaction* is in significant negative correlation with most of the items that reflect on the medium or high development other sub-skills. These findings suggest that *interaction* may play a structurally central role within the social component, as lower levels of interaction were consistently associated with weaker development in multiple other sub-skills.

Table 4 depicts another significant but positive correlation which suggests that respondents who are unable to interact effectively with their peers not only perform poorly in group problem solving but also have low levels of time management and deadline management skills. This is particularly relevant, as the majority of respondents are preparing for higher education, where group project tasks are a regular occurrence. conclusions

Discussion

The present study aimed to develop and pilot a measurement instrument for assessing the social component of online collaborative problem-solving skills among secondary school students. The findings provide preliminary empirical support for the applicability of the theoretical framework proposed by Hesse et al. (2015) in digitally mediated learning contexts.

The reliability analysis indicated acceptable internal consistency, suggesting that the adapted instrument captures a coherent construct. While the sample size does not permit full validation through factor-analytic procedures, the results provide a foundation for further instrument refinement and large-scale validation.

Descriptive findings revealed a consistent tendency for students to identify with medium levels of collaborative development. This pattern may reflect realistic self-assessment during an ongoing developmental stage; however, central tendency bias in self-report measures cannot be excluded. Future research employing performance-based assessments could complement these findings.

A key contribution of the study lies in the observed associations between collaborative sub-skills and perceived advantages of online collaboration. Students reporting more developed social collaborative competencies were more likely to evaluate online collaboration positively. This suggests that the effective utilization of digital collaborative environments may depend partly on students' underlying social interaction skills.

Most notably, low levels of interaction were negatively associated with several other collaborative sub-skills, including task completion, adaptive responsiveness, negotiation, and responsibility. This pattern indicates that interaction may function as a structurally central element within the social component of collaborative problem solving. Rather than operating independently, collaborative sub-skills appear interconnected, with interaction potentially serving as a foundational mechanism enabling effective coordination and shared regulation.

Given the increasing integration of online learning environments in secondary education, these findings highlight the importance of explicitly developing interactional competencies alongside cognitive problem-solving skills. However, due to the study's cross-sectional design and reliance on self-report data, causal interpretations cannot be drawn.

Overall, the study contributes to collaborative learning research by offering an empirically grounded instrument for assessing online collaborative competencies and by providing preliminary evidence for the structural coherence of established collaborative frameworks in digital contexts.

References

DINGLER, C. – VON DAVIER, A. A. – HAO, J. 2017. Methodological challenges in measuring collaborative problem-solving skills over time. In: SALAS, E.; VESSEY, W. B.; LANDON, L. B. (eds.). *Research on Managing Groups and Teams.* Vol. 18. Bingley: Emerald Publishing Limited, pp. 51–70. DOI: https://doi.org/10.1108/S1534-085620160000018003

EGERVÁRI, D. – KOVÁCS, E. 2021. A XXI. századi kompetenciák megjelenése a 2020-as NAT-ban. *Tudásmenedzsment*, *22*(1), art. 19. DOI: https://doi.org/10.15170/TM.2021.22.K1.19

HESSE, F. – CARE, E. – BUDER, J. – SASSENBERG, K. – GRIFFIN, P. 2015. A framework for teachable collaborative problem-solving skills. In: GRIFFIN, P. – CARE, E. (eds.).

Assessment and Teaching of 21st Century Skills. Dordrecht: Springer Netherlands, pp. 37–56. DOI: https://doi.org/10.1007/978-94-017-9395-7_2
OECD. 2017. *PISA 2015 results (Volume V): Collaborative problem solving.* Paris: OECD Publishing. URL: https://www.oecd.org/en/publications/collaborative-problem solving_cdae6d2een.html
PÁSZTOR-KOVÁCS, A. 2018. *A kollaboratív problémamegoldó képesség vizsgálata.* PhD értekezés. Szeged: Szegedi Tudományegyetem. DOI: https://doi.org/10.14232/phd.9986
PÁSZTOR-KOVÁCS, A. 2015. Kollaboratív problémamegoldó képesség: egy új, integratív elméleti keret. *Iskolakultúra, 25*(2), pp. 3–16. DOI: https://doi.org/10.17543/ISKKULT.2015.2.3
PÁSZTOR-KOVÁCS, A. – PÁSZTOR, A. – MOLNÁR, G. 2019. Önértékelő kérdőív fejlesztése a kollaboratív problémamegoldó képességet leíró modellek egyikének validálására: a kollaboratív komponens vizsgálata. *Neveléstudomány – Oktatás – Kutatás – Innováció, 7*(2), art. 1. DOI: https://doi.org/10.21549/NTNY.26.2019.2.1
SILVA, E. 2008. *Measuring skills for the 21st century.* Washington, DC: Education Sector Reports.
SUTO, I. – ECCLES, H. 2014. *The Cambridge approach to 21st century skills: Definitions, development and dilemmas for assessment.* Cambridge: Cambridge Assessment.
SZŰTS, Z. 2020. Digitális pedagógia módszertanok a VUCA világában. *Iskolakultúra*, 30(7), art. 7.
TÓTH-MÓZER, S. – MISLEY, H. 2019. *Online együttműködés: jó gyakorlatok, tantárgyi példák és modern eszközlista.* Budapest.

Résumé: The study examines the online collaborative problem solving skills of high school students through the results of empirical research. The research is based on the adaptation of an internationally recognized theoretical framework to the online environment, supplemented by an examination of the benefits of online collaboration. The measurement tool developed for the research enabled a differentiated analysis of the development of collaborative skills. According to the results, the respondents most closely identify with items of medium development level in the various categories. Overall, students evaluate online collaboration positively, emphasizing the importance of real-time communication in particular. Correlation analyses support the internal coherence of the theoretical model used. Low development of the interaction sub-skill may hinder the development of several other sub-skills. The results also suggest that the interaction sub-skill may play a decisive role in online collaboration as a whole. The study contributes to a deeper understanding of collaboration in online learning environments.

Résumé (Slovakian): Štúdia skúma schopnosti stredoškolských študentov riešiť problémy prostredníctvom online spolupráce na základe výsledkov empirického výskumu. Výskum je založený na adaptácii medzinárodne uznávaného teoretického rámca na online prostredie, doplneného o skúmanie výhod online spolupráce. Merací nástroj vyvinutý pre tento výskum umožnil diferencovanú analýzu rozvoja schopností spolupráce. Podľa výsledkov sa respondenti najviac stotožňujú s položkami strednej úrovne rozvoja v rôznych kategóriách. Celkovo študenti hodnotia online spoluprácu pozitívne, pričom zdôrazňujú najmä dôležitosť komunikácie v reálnom čase. Korelačné analýzy potvrdzujú vnútornú koherentnosť použitého teoretického modelu. Nízka úroveň rozvoja čiastkovej zručnosti interakcie môže brániť rozvoju viacerých ďalších čiastkových zručností. Výsledky tiež naznačujú, že čiastková zručnosť

interakcie môže hrať rozhodujúcu úlohu v online spolupráci ako celku. Štúdia prispieva k hlbšiemu pochopeniu spolupráce v online vzdelávacích prostrediach.

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