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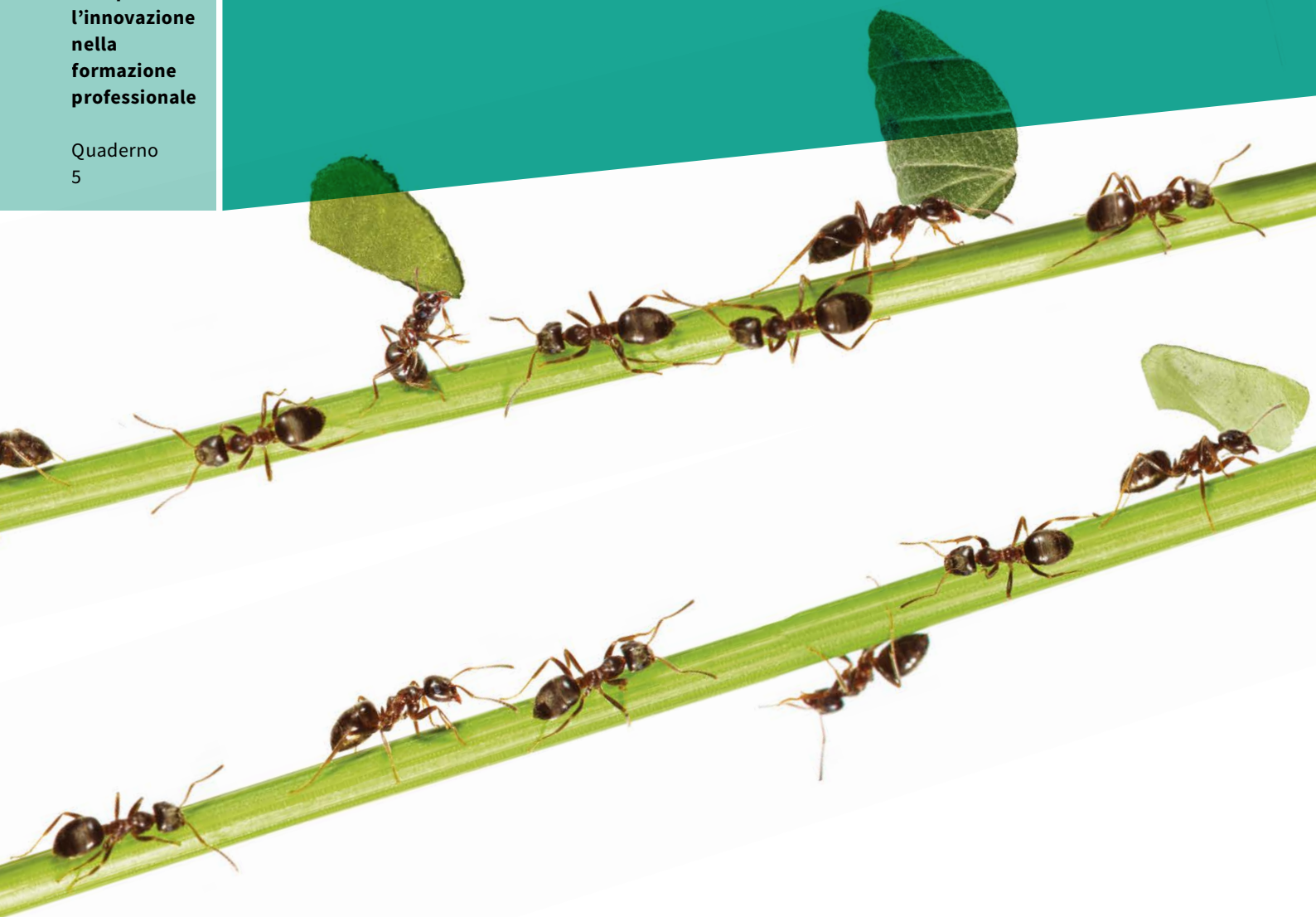
Conferenza della Svizzera italiana  
per la formazione continua degli adulti

# Le competenze trasversali in ambito educativo e formativo

## Dai discorsi alle pratiche

Idee per  
l'innovazione  
nella  
formazione  
professionale

Quaderno  
5



I *Quaderni Idee per l'innovazione nella formazione professionale* nascono su iniziativa della Scuola universitaria federale per la formazione professionale (SUFFP) e della Conferenza della Svizzera italiana per la formazione continua degli adulti (CFC) con un triplice intento.

*In primo luogo*, raccogliere i testi delle conferenze aperte al pubblico promosse dalle due istituzioni nell'ambito del ciclo di conferenze *Un'officina delle idee: incontri per l'innovazione nella formazione professionale*, mirati a promuovere occasioni di scambio sui grandi temi dell'attualità e i loro risvolti sull'economia, sulla formazione e sulla società.

*In secondo luogo*, mettere a disposizione uno spazio dove condividere risultati di ricerca, spunti di riflessione e materiali prodotti nel quadro delle attività di formazione e ricerca dalle due istituzioni coinvolte, offrendo una cassa di risonanza ad attività innovative e sperimentali i cui confini, per i temi, le metodologie, le prospettive sviluppate, meritano di essere divulgati. È in questo secondo intento che si colloca il presente terzo numero dei *Quaderni*, testimoniando del lavoro di ricerca dapprima regionale e in seguito nazionale condotto negli ultimi sei anni dalla SUFFP in collaborazione con vari partner sul tema delle tecnologie nel settore delle cure.

*In terzo luogo*, i *Quaderni* vogliono offrire anche ad altre istituzioni formative attive sul territorio una piattaforma grazie alla quale dialogare su temi di comune interesse, favorendo in questo modo la messa in comune di esperienze e pratiche significative da cui la formazione professionale possa trarre giovamento.

La Redazione

# **Le competenze trasversali in ambito educativo e formativo**

**Dai discorsi alle pratiche**

In collaborazione con

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Scuola universitaria professionale  
della Svizzera italiana

**SUPSI**

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**SGL** SSFE  
SSFI SSFSS

Schweizerische Gesellschaft für Lehrerinnen- und Lehrerbildung  
Société suisse pour la formation des enseignantes et des enseignants  
Società svizzera per la formazione degli insegnanti  
Societad svizra per la furmaziun da scolastas e scolasts

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**SSRE**  **SGBF**

Société suisse pour la recherche en éducation  
Schweizerische Gesellschaft für Bildungsforschung  
Società svizzera di ricerca in educazione

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Swiss Academy  
of Humanities  
and Social Sciences

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Parte 5

## **Monitoraggio e valutazione**

## 5.1 Assessing Problem-Solving Abilities in K9: A Digital Approach

Arianna Marras · Masiar Babazadeh

### Introduction

Video games, though not originally designed for educational purposes, have significantly influenced teaching methodologies. Gamification and game-based learning have emerged as powerful tools for enhancing student motivation and engagement (Gee, 2005). Video games provide immediate feedback, allowing students to learn from their actions in a safe and often realistic environment (Gee, 2005; Squire, 2005). This environment fosters resilience (McGonigal, 2011) and enables personalized learning experiences, further enhanced by modern technologies like generative AI (Shaffer, 2006). Beyond academic subjects, serious games cultivate essential soft skills such as problem-solving, collaboration, and critical thinking (Shaffer, 2006; Peconio et al., 2022).

In addition to supporting learning, video games are effective tools for formative and summative assessments. They offer immediate feedback, enabling continuous self-evaluation. By aligning tasks with specific learning objectives, games can authentically assess both subject knowledge and soft skills, particularly when linked to real-world scenarios (Barab & Dede, 2007). Furthermore, digital tools facilitate the collection, storage, and visualization of performance data, aiding educators in monitoring and analyzing student progress (Shute & Ke, 2012).

Executive Functions (EF)—cognitive skills essential for planning, problem-solving, and reasoning—are closely tied to academic success (Diamond, 2013; Duckworth & Seligman, 2005). These interdependent abilities (shifting, updating, and inhibition) are crucial for managing complex tasks in both school and daily life (Diamond, 2016). Insufficient EF development can hinder learning and disrupt classroom dynamics, potentially leading to behavioral challenges such as ADHD (Vicari & Di Vara, 2017). Computerized training has shown great promise in fostering EF, particularly among younger students (Diamond & Ling, 2020; Oberste et al., 2019).

### The Tower of London (ToL) Project: Tool Design and Methodology

This study explores the use of a mobile application to assess and enhance EF and problem-solving skills. Developed in collaboration with the University of Applied Sciences and Arts of Southern Switzerland, the application employs an immersive educational approach. Tablets, favored for their accessibility and efficiency (Falloon, 2013), enable students to work independently while allowing educators to manage multiple learners effectively. However, challenges remain in ensuring psychometric reliability and capturing students' experiences and perceptions (Berg et al., 2020). Robust game-based assessments represent a promising innovation for bridging gaps between technology, pedagogy, and cognitive development.

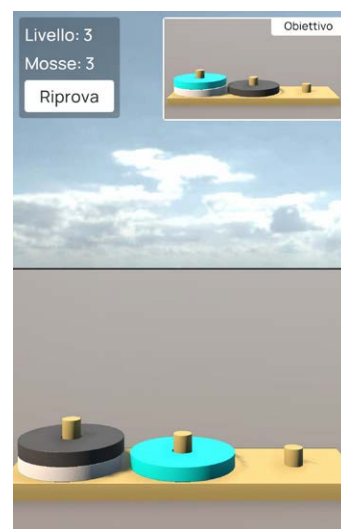
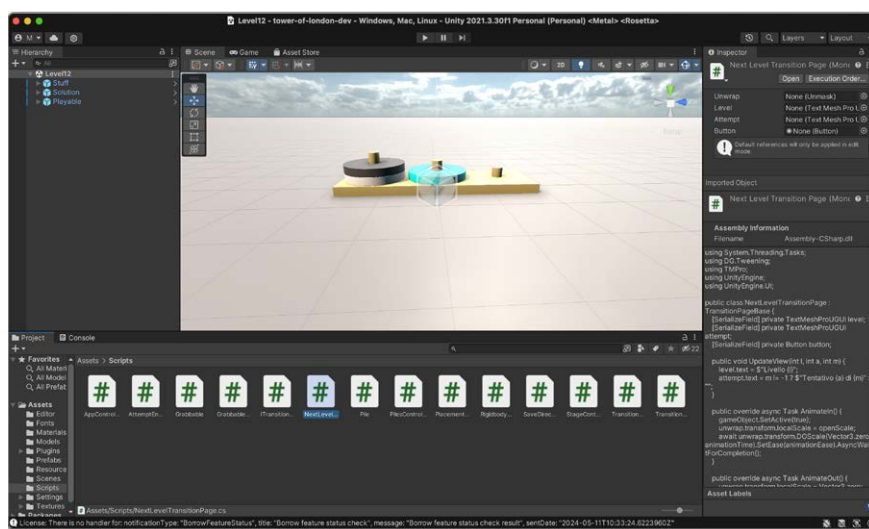
The project stems from a joint collaboration between the Department of Innovative Technologies of the University of Applied Sciences and Arts of Southern Switzerland and aims to implement and study the potential of an edugame as a teaching device for inclusive teaching through immersive educational pathways. In this paper we present one of the applications developed and implemented in the edugame, a series of tasks inspired by the Tower of London (Shallice, 1982) (ToL), which assess and

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enhance the problem solving and planning skills of primary and middle school students. The “Digital ToL” qualifies as an innovative and sustainable tool in compulsory formal education and stimulates teachers’ involvement in experimenting with technology-mediated approaches.

The tool was developed in Unity and presents a representation of the physical tasks of the original ToL on a tablet in a 3D environment. Participants must move three disks of different colors from an initial position to a target position shown in the upper right corner of the screen. After an initial trial during the 2022/2023 academic year (Marras & Babazadeh, 2023), the feedback received motivated a redesign of the application (Figure 1). Participants suggested taking longer breaks between tasks, examiners suggested adding positive reinforcements during the test, and using a different color palette for accessibility. Participants also identified small bugs, which were fixed during the redesign process. The redesign of the application also involved changes to the interface and improved the experience of players during the game, while not affecting the very nature of the proposed tasks.



**Figure 1**  
Re-design of Digital ToL application

Upon running the application, students are prompted with a series of tasks to be solved. The interface shows the maximum number of moves available, the target i.e., the arrangement of the disks players need to achieve, and the number of moves to do so. Students are not shown the time they are taking to reach the target arrangement, nor their final score. To study the differences in the accuracy of the ToL tasks depending on the modality presented (physical vs. digital), two different groups of students in two different school years were examined, resulting in two experiments. The first experiment (S1; N=57) used the first version of the application (Marras & Babazadeh, 2024), the second (S2; N=46), which we present and discuss in this paper, used the redesigned tool.

Both the experiments were divided into two phases. In the first phase, one group was presented first with the physical ToL (Fancello et al., 2013) and, a month and a half later, was presented with the digital ToL; in the second phase, another group was presented first with the digital ToL and then with the physical ToL. The participants were coming from seven different classes in South Sardinia, attending sixth grade. The two tests collected students’ data on their scores on the ToL.

## Results and Discussion

Inferential analysis found no significant difference between the averages of the two versions. Paired-samples t-test analysis had not shown statistically significant differences in the scores obtained at both tasks at S1 (Phase 1 (N=26):  $t(25)=0.0415$ ,  $p=.967$ ; Phase 2 (N=31):  $t(30)=-1.26$ ,  $p=.217$ ), and had encouraged the re-design of the instrument. The second experiment (S2) involved beta-testing the redesigned instrument, showing no statistically significant differences in accuracy scores (Phase 1 (N=22):  $t(21)=-1.68$ ,  $p=.107$ ; Phase 2 (N=24):  $t(23)=-0.748$ ,  $p=.462$ ). However, by looking at the timings, the decision-making, execution, and total time for the digital ToL were lower than for the physical version (Table 1). It is reasonable to assume that young students adapt more quickly to digital tools. This could be attributed, firstly, to the appeal of using such tools in a school setting. Additionally, their positive attitude may be influenced by a desire for social conformity and their inherent familiarity with digital devices. It is considered necessary to further investigate the timings by examining the results of the individual tasks in order to understand whether the use of a digital tool may not lead to greater impulsiveness resulting in less time for reflection and planning for task resolution.

**Table 1**  
Paired-samples t-test analysis between the two versions of the ToL (digital and physical) at the two times

		RE-DESIGN APP STUDY PHASE 1 (TANGTO_DIGT1)					RE-DESIGN APP STUDY PHASE 1 (TANGTO_DIGT1)				
Factors	ToL	Mean	SD	T di Student	gdl	p	Mean	SD	T di Student	gdl	p
Problem-solving accuracy	Physical	29.86	2.57	-1.68	21	0.107	29.17	3.86	-0.748	23	0.462
	Digital	31.27	3.12				29.17	4.82			
Decision Time	Physical	98.62	59.82	4.91	21	<.001	107.98	78.21	-4.748	23	<.001
	Digital	26.73	17.31				26.39	17.95			
Executive Time	Physical	98.16	27.08	15.79	21	<.001	96.58	36.32	-12.167	23	<.001
	Digital	6.29	3.14				5.17	3.12			
Total Time	Physical	196.78	69.85	7.85	21	<.001	201.68	91.18	-9.338	23	<.001
	Digital	55.09	37.50				50.58	28.74			

The results show the ability of the implemented digital application to assess student performance regardless of when it is presented. Although the study included a small sample, the additional data collected and analyzed in S2 confirms that in both modes (physical and digital), the ToL adequately measures the functions involved.

After the ToL administrations, we collected and analyzed students' perceptions of the two modalities (Table 2). The only difference found was that students preferred the most recent modality they used.

**Table 2**  
Students' perceptions of the two ToL modalities (Digital and Physical)

Aspect investigated	RE-DESIGN APP PERCEPTIONS STUDY							
	PHASE 1				PHASE 1			
	Digital		Physical		Digital		Physical	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Pleasure	4.4	0.80	4.3	0.9	8.5	0.78	4.4	0.88
Comfort	4.5	0.96	4.6	0.6	3.8	1.02	4	0.86
Enjoyment	4.4	0.96	4.5	0.6	4.1	0.88	4.2	0.64
Discouragement	1.5	1.01	1.5	0.9	2	1.16	2.2	1.06

Despite the small sample of the study, the additional data collected in S2 confirms the findings that the digital ToL adequately measures the functions involved without differences in accuracy scores.

This result calls for further verification of the assessment capacity of the digital tool using a larger sample, which would also allow the validation of psychometric properties of the application. If this is confirmed, the digital ToL could certainly become a valid support tool in classroom teaching for the assessment of students' executive functions, which could then be augmented with new tasks in order to facilitate not only the assessment but also the training of these functions in school.

## Conclusions

The study explored the use of a digital version of the "Tower of London" (ToL) as a tool for assessing executive functions and problem-solving skills in a school setting. The findings indicate that, with no significant differences in accuracy between the physical and digital versions, the digital ToL holds promise as an effective method for evaluating these skills in educational environments. However, the notably shorter completion times observed in the digital version suggest students' adaptability to technological tools, while also raising concerns about potential impulsivity in their decision-making processes.

An analysis of students' perceptions revealed that the design of the digital application was well-received, with comparable levels of comfort and enjoyment to the physical version. Interestingly, the preference for the most recently used modality underscores the importance of context and the order of presentation when studying students' preferences.

The educational implications of this research are substantial. The digital ToL has the potential to serve not only as an assessment tool but also as a resource for training executive functions, offering support to teachers and students in creating personalized learning pathways. To maximize the tool's effectiveness and validate its reliability, additional studies with larger, more diverse samples and a focus on its psychometric properties are crucial.

Moreover, the development of new digital tasks that combine assessment and training elements could mark a significant advancement in fostering inclusive, competence-based learning. Such an approach, aligned with modern educational priorities, emphasizes the seamless integration of technology as a fundamental component of teaching and learning processes.

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