Pierpaolo Limone
Raffaele Di Fuccio
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Psychology, Learning, Technology

First International Conference, PLT 2022
Foggia, Italy, January 19–21, 2022
Revised Selected Papers

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Preface

The Psychology, Learning, and Technology Conference (PLT) aims at becoming a meeting point for researchers in education, psychology, and computing, along with anyone who has an interest in the future of learning with technology.

The first edition, PLT 2022, was held during January 19–21, 2022, in blended mode due to the COVID-19 pandemic situation. The conference was organized by the University of Foggia.

The objective of PLT is to advance scientific knowledge and methodologies of intervention at the intersection of education and psychology that can be purposefully applied to the design and development of technologies that support the learning process. PLT 2022 engaged researchers, practitioners, educational developers, and entrepreneurs to address current challenges and advances in the field.

This first edition of PLT was free, open to all, and early career researchers were encouraged to apply. Indeed, PLT aims to trigger and promote a community of practice in this area, offering different perspectives from the multidisciplinary field (e.g., psychology, education, computer science).

In keeping with current times, PLT 2022 considered themes relating to the COVID-19 experience. In particular, the conference focused on studies that consolidated the results that emerged during the pandemic. These studies describe the data and approaches that face the new challenges resulting from the COVID-19 learning revolution. Five studies submitted to the conference explicitly featured the word 'COVID-19' or 'pandemic' in the article title, although many of the studies were linked to this issue. Despite the initial period, where the shock of the pandemic produced a direct impact, the studies submitted show a more complex analysis of the consequences and, moreover, have considered the solutions and offer proposals for facing this challenge.

In total, 23 articles were submitted to PLT 2022 and 70 authors were involved in the papers. Among the 23 papers submitted for peer review, 13 papers were accepted for this volume, leading to an acceptance rate of 57%. The authors of the selected papers come from seven different countries (Italy, Poland, the Czech Republic, Spain, Nigeria, India, and Turkey). Each paper was reviewed by three external reviewers. Reviewers were not allocated any papers by authors belonging to the same university or having any kind of pre-existing connection to avoid conflicts of interests; papers coauthored by members of the conference committees were also handled in an appropriate review process. The Program Committee included 15 professors and researchers belonging to 10 different higher education institutions. In order to fulfill the assignment of three reviews for each article, we were grateful to have 14 additional reviewers.

An invited paper by Lucia Mason, professor of Developmental and Educational Psychology at the University of Padua, is also included in this book.

As it was the first PLT event, the chairs and the University of Foggia decided to organize the conference as an open event. The organizers did not ask for any registration fee related to the conference participation, considering the open results as important for

the development of the scientific research. In addition, the chairs decided to open the conference to 'external' participants. The idea was to disseminate the results beyond the traditional academic borders. This approach was a success: many participants attended the conference online through their universities. In particular, many teachers and people enrolled in initial teacher training courses attended the conferences sessions. In the YouTube link used for the event, the conference obtained a peak number of about 200 participants.

PLT 2022 was held over three days, with sessions that covered a half-day. This book collects the accepted papers and it is divided into sections in line with the sessions that took place during the three days of the conference.

The first section "Invited Paper" is reserved for the contribution of Lucia Mason.

The second section, called "New Intersections Between Psychology, Learning, and Technology", contains four papers reporting results from the field of psychology, ranging from grief as a consequence of COVID-19 to narrative practices for digital storytelling.

In the third section, the chairs gathered all the papers linked to promoting learning and teaching solutions for the school sector, calling the session "Apps and Innovative Tools: New Opportunities for School Learning/Teaching". This part contains five papers proposing new technologies and studies in the education field, from robotics to educational applications.

Finally, the fourth section, called "Empowering Study Attitude", collects papers in the field of developmental psychology, considering themes like well-being, orientation, and job crafting.

March 2022

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Pierpaolo Limone
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</div>

Organization

Contents

Invited Paper

Promoting Web-Source Evaluation and Comprehension of Conflicting Online Documents: Effects of Classroom Interventions

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Abstract. This study examines the effectiveness of two short-term instructional interventions on the evaluation of digital sources in the classroom context. One hundred sixty-one 8th graders were involved in one of three conditions: an intervention based on providing declarative knowledge (DK) on source evaluation, an intervention based on providing contrasting cases (CC) of source evaluation strategies, and a control condition (C) with no intervention. Students in both intervention conditions carried out a series of activities in two lessons. Prior topic knowledge and interest, reading comprehension, working memory, and perceived competence in online information search and evaluation were used as control variables to ensure the equivalence of participants across conditions. In all conditions, participants were asked to read four documents on the debated issue of the potential health risks associated with the use of the mobile phone and, after reading, to rank-order them for reliability, providing justifications for their rank-ordering, and to write a short essay to judge those health risks, based on the texts read. The findings indicate that both interventions were effective, to some extent, in promoting the use of source characteristics in reliability judgments, as revealed by the justifications provided by the students for motivating their rank-ordering of the read documents. Both interventions were also effective in supporting multiple-text comprehension as revealed by the students' argumentation in short essays.

Keywords: Source evaluation · Sourcing skills · Multiple-text comprehension · Digital reading · Internet

1 Introduction

One essential aspect of the democratization of our current societies is access to a disparate body of information through the Web. Although digital inequalities still exist even amongst young people, as the Covid-19 pandemic has revealed [1], in the digital era it is not necessary to possess books or to visit libraries to know more on unfamiliar

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M. C. Tornatora−Private professional psychologist; at the time of the study

topics. The Internet has become 'the' source of information, being easily accessed by students who are almost always connected through a smartphone, tablet, or laptop. From lower-secondary school onwards, students are daily 'consumers' of online information and use it to carry out school assignments. Even though the 'Google generation' of students has been raised in the Internet era, their information literacy has not improved as a result of the wide access to technology [2]. Even older and 'Internet savy' students have difficulties to identify fake news during online reasoning [3]. It is, therefore, vital that we teach beginner seekers of online information how to distinguish between reliable and unreliable sources. The huge array of documents that they can access by a simple click pose new challenges to them. Even if they are able to locate and select relevant webpages — which may not always be the case — students must then be able to evaluate their credibility or authoritativeness according to appropriate criteria [4–6].

The term 'sourcing' is used to refer to readers' use of information about the author, genre, and date of publication [7]. Digital literacy necessarily includes sourcing skills. What do we have to believe in? Why? How can this information be reconciled with the others? These are crucial questions to deal with when reading multiple online pages that focus on the same content, not only to be able to discern the sources that deserve to be followed up, but, more importantly, to understand source content better [8]. Sourcing is associated with deep multiple-document comprehension and this link is particularly important. Students who are more able to process a webpage for both its content and 'metadata' regarding the authoritativeness of the source, are also those who are more able to comprehend conflicting information [9, 10].

Research has shown that primary [e.g., 11] and secondary school students [e.g., 12–13], as well as undergraduates [14] may not evaluate sources at all, or appeal to naïve criteria when judging them and their content. Recent studies with adolescents have indicated that they use source information very little [15], or do not discern documents on the basis of author competence even when prompted with specific questions [16].

It is, therefore, not surprising if interventions on sourcing skills have been implemented in primary and secondary schools, as a recent review illustrates [7]. Some of them are long-term interventions that have not examined multiple-text comprehension as one of their possible effects [17, 18].

Our investigation focused on short-term interventions as they can be more easily implemented in the natural context of the classroom and also embedded in curriculum units of a subject like science or history. The study aimed to compare the effectiveness of two short-term instructional interventions implemented in lower-secondary school for promoting both evaluation skills of digital information sources and multiple-text comprehension. One intervention provided students with essential declarative knowledge on how to evaluate the reliability of online sources and the accuracy of the information [10, 19]. The other provided two contrasting cases of source evaluation strategies where students were asked to evaluate which was the best and should be followed up [20].

2   Evaluation of Source Credibility and Multiple-document Comprehension

In framing our study, we took into consideration the Discrepancy-Induced Source Comprehension (D-ISC) model [21, 22]. According to this model, readers pay more attention

to "who says what" when they are faced with conflicting information on the same issue or questions that are presented by a different source. The perception of discrepancies between texts acts as a potential mechanism through which readers are prompted to process and evaluate source information more deeply when encoding the links between sources and the related information. Greater encoding is likely to occur when the mental representation of information of texts includes the links between sources and their content and conflicting information is more likely to be integrated into a coherent overall mental model [23]. Not surprisingly, single text comprehension is a widely investigated research area, given the relevance of the skill to construct meaning from text [e.g., 24, 25]. Much research is based on the well-known Kintsch's model [26]. Compared to single-text comprehension in this model, multiple-text comprehension includes the additional layer of the intertext model [27]. When reading conflicting documents, readers may achieve overall coherence through the intertext model, despite there being contrasting information.

The link between sourcing and multiple-document comprehension is not only theoretically justified, but also empirically documented [4, 9, 28, 29]. All studies revealed a positive relation between sourcing and multiple-text comprehension as readers' attention to source information is associated with a greater comprehension of multiple conflicting documents.

3 Types of Short-Term Intervention for Promoting Sourcing Skills and Multiple-document Comprehension

Two main types of short-term intervention can be identified in the current literature as effective in promoting both source evaluation and comprehension of multiple documents in secondary school students.

3.1 Intervention Based on Declarative Knowledge

One type of short-term intervention focuses on providing declarative knowledge about source evaluation. An example of this type of intervention is the study by Mason et al. [19]. Ninth graders were given three pages of information about how to evaluate the reliability of a website and the accuracy of its contents. The written material included the "SEEK" (Source, Evaluation, Explanation, Knowledge) [10]. This material illustrated three main criteria for evaluating how reliable or credible websites are in the form of three questions: Who is the author? How reliable is the information? How well does the site explain the information? Readers were instructed to evaluate: for the Source (author), whether the authors were knowledgeable about the topic and their motivation; for the Evaluation of information, whether it was based on scientific evidence and whether similar information was provided across credible sources; for the Explanation of the information, whether they understood what the site said about the topic and whether the explanation corresponded with the scientific knowledge that they might have had, or with information given by other credible sources [10].

Participants in this study had the opportunity to practice source evaluation in a basic inquiry task on a given topic. A worksheet was given to them, which included

questions to prompt them to use the SEEK criteria in source evaluation. Next, they had to apply source evaluation to the transfer inquiry task on a different topic. Results revealed that participants who had received the instructional material with declarative knowledge about source evaluation in the transfer task outperformed non-instructed participants when rank-ordering the webpages and justifying their ranking in the transfer task. Moreover, SEEK-instructed participants were better at both surface and deeper comprehension of the conflicting information.

3.2   Intervention Based on Contrasting Cases

The other type of effective intervention on source evaluation is focused on providing contrasting cases. Contrasting cases is a classroom-based instructional practice that is used to promote the acquisition of declarative or procedural knowledge. Pertinent to our study is the investigation carried out by Braasch et al. [20] that focuses on the effectiveness of contrasting cases regarding protocols about source evaluation strategies. One was a protocol of expert strategies that rely on advanced criteria for judging a source; the other is the protocol of non-expert strategies that appeal to low-level criteria, which are often adopted by naïve readers. Participants in the last year of upper secondary school were asked to decide which were the best strategies to evaluate multiple documents retrieved from the Internet, and to explain why. They received the instructional material including two to-be-contrasted student strategy protocols attributed to student A and student B for practice on a basic topic. For each strategy protocol, the more competent and more critical student expressed more sophisticated strategies regarding source evaluation, taking into account author, venue, type, and date of publication: "…I start with the authors to see whether they are knowledgeable about the topic" [20, p. 184]. In contrast, the poorer, less critical student exhibited low-level strategies that did not take into consideration source characteristics: "Since this title contains my key words, I know I can trust and use the information" (p. 184). Results confirmed the effectiveness of the intervention in supporting students' rank-ordering and justifying their ranking by appealing to essential features of the sources. Moreover, the intervention favored the inclusion of more correct scientific concepts from the more useful texts when writing essays about the topic.

4   The Present Study

Current research indicates that students need to be instructed on the important criteria to use for evaluating the sources and information accessed on the Web. These criteria refer to the qualities that make a source reliable (i.e., expertise and unbiasedness) and information accurate (i.e., based on scientific evidence and corroborated by information from other reliable sites). Research also shows that relatively short-term instructional interventions on source evaluation, like those reviewed in the previous sections, can be effectively implemented in the context of upper-secondary school, improving multiple-document comprehension as well.

   To extend current research, we tested the effectiveness of the two aforementioned types of short-term instructional interventions as we do not know if the two types of

intervention are equally effective or if one is superior to the other, in particular in the case of lower-secondary school students. We focused on a two-lesson intervention, instead of long-lasting interventions, because the former is more easily embedded in a curriculum and implemented in the natural classroom context. We involved younger adolescents who have started to be daily seekers of online information for various purposes, including school assignments. They need to be competent users of Internet-based information to follow up only reliable sources and construct knowledge from accurate information. As the participants were younger than those involved in the Braasch et al. [20] and Mason et al. [19] studies, the interventions took place in two sessions, rather than one, to give them more time to practice source evaluation on basic tasks.

The following research questions (RQ) guided the study:

(RQ1) Are two interventions − one based on declarative knowledge on source evaluation and the other on contrasting cases of source evaluation − equally effective in promoting students' reliability judgments of various online documents?

(RQ2) Are the two interventions also equally effective in supporting multiple-document comprehension?

Based on the extant literature [19, 20], for RQ1, we hypothesized that students in both intervention conditions would express greater source evaluation skills than students in the control condition. Specifically, we expected that both intervention conditions would promote more reliability judgments based on source characteristics compared to the control condition for both high and low reliability documents (Hypothesis 1a). In addition, we expected a difference between the two intervention conditions in favor of the contrasting cases (Hypothesis 1b). The reason for this is that they acknowledge and target inappropriate source evaluation strategies often adopted by students and make what should and should not be considered in source reliability judgments more salient. In other words, the comparison/contrast process gives learners the opportunities to form a more differentiated knowledge base, which promotes the identification and interpretation of salient features in novel contexts [20]. On the other hand, compared to the control conditions, participants in the declarative knowledge condition would benefit from explicit instructions on what to consider in source evaluation for reliability. However, this advantage would be inferior to that promoted by the contrasting case situation, as the students would not be confronted with two concrete reliability judgments.

For RQ2, we considered that the link between source evaluation and multiple-document comprehension is not only theoretically legitimate [21], but also empirically documented [4, 9, 28]. Our hypothesis, therefore, was that students in both intervention conditions would also outperform those in the control condition for multiple-text comprehension (Hypothesis 2a), with a superior advantage for those who were provided with contrasting cases of source evaluation for reliability (Hypothesis 2b). This is because they would scrutinize source features and it would be easier for them to reconcile contrasting information in an integrated representation of multiple documents on the same topic [20].

5   Method

5.1   Participants and Design

One hundred sixty-one 8th graders (Mage = 13.44, SD = 0.7; girls = 79) from two lower-secondary schools participated in the study and were assigned to one of three conditions: intervention on declarative knowledge (DK, n = 51), intervention on contrasting cases (CC, n = 58), and no intervention or control (C, n = 52). Each condition included three classrooms in total (from both schools). All participants were native-born Italian and shared a middle-class socio-economic status. They voluntarily participated upon written parental consent. For practical constraints relating to school organization and classroom management, we used a quasi-experimental design with random assignment to conditions at the level of intact classrooms.

5.2   Interventions on Source Evaluation

Both interventions took place in two sessions, with the first about genetically modified food and the second about dinosaur extinction. At the beginning of the first session of both interventions, for 5 min the instructor introduced the issue that the Internet provides many types of document and readers must consider their reliability in order to understand the contents well. To reduce researcher bias, a scripted session plan was prepared for each of the intervention conditions and the control condition.

DK Intervention Condition. After the 5-min introduction, in this intervention condition students were informed that they would read material regarding source reliability. They were then provided with three pages of declarative information about how to evaluate the reliability of a website and the veracity of its content. The material was taken from Wiley et al.'s [10] instructional unit on Source, Evaluation, Explanation, Knowledge (SEEK). The declarative material explained that three main criteria are to be used when evaluating the reliability of a website, specifically: (1) Who is the author? (2) How reliable is the information? (3) How well does the site explain the information? (pp. 1098–1099).

In the first session, the documents read were taken from two websites about GM food, one being more reliable than the other. One document was written by a professor of agrarian microbiology, published in an online journal (414 words); the other was taken from a site of gourmet food and wellbeing (414 words). In the second session the documents read were about dinosaur extinction, again one being more reliable than the other. One was taken from an information site on dinosaurs, which was written by its webmaster (365 words), while the other was taken from the online bulletin of the national institute of astrophysics and written by a scientific journalist (365 words).

For both topics, the order of appearance of the most and least reliable document was counterbalanced. In both intervention sessions, students were given a worksheet for each site, with questions about the author, information, and explanation. The worksheets were intended to support students' practice in the use of the provided declarative information on what to consider when evaluating an information source for reliability.

CC Intervention Condition. After the 5-min introduction based on Braasch et al. [20, p. 186], in this intervention condition students were informed that they would read about the different strategies that two students from another lower-secondary school used to evaluate the source reliability of two documents on a specific topic. Participants were asked to compare and contrast the two students' strategies to distinguish what good readers do differently from poor readers when learning from information on the Internet. Participants were also instructed to take into account that one of the two students, who made comments on the documents, used better strategies than the other. The aim was to guide students to understand why some strategies are better than others.

In the first and second sessions, students were presented with the same two documents used in the DK intervention. For each topic, participants read the two documents and a pair of fictional students' protocols that reported the strategies used by student A and student B when evaluating the documents. Participants did not receive any clues regarding which student adopted the better strategies. To exemplify, in the first session on the topic of GM food, the more critical student started by saying: "I have seen that the first is written by an agriculture professor who teaches at the university, while the second is written by gourmets. Therefore, only the first is written by a competent person, who is real expert in the topic".

In the second session on the topic of dinosaur extinction, the less critical reader started by saying: "I have noticed that the first text is of the online bulletin of the institute of astrophysics, while the second is a site about dinosaurs. I am very interested in dinosaurs, and I always liked to read about them and watch cartoons on these animals. The site on dinosaurs is easier and more interesting…I like the idea that a big asteroid has fallen on the earth and caused a big crater. I do not like the idea that also volcano eruptions matter". The 'better' and 'poorer' students' protocols were of the same length (208 words).

Participants were also given a worksheet that asked to identify which student used the better strategies for evaluating the two documents and selecting the most reliable, as well as explaining as clearly as possible the reasons why they were the better strategies. The worksheets set out to support students' practice in source evaluation through the identification of the features to be considered when evaluating an information source for reliability. In the last ten minutes of the session, the instructor wrote on the blackboard student-generated suggestions about good and poor strategies in document evaluation.

Control Condition. Participants were provided with the same 5-min introduction as in the two-intervention conditions. They also read the same documents on GM food and dinosaur extinction during the same class periods, but no intervention on source evaluation was implemented. In other words, participants read exactly the same documents as those in the intervention conditions to be exposed at the same controversial topics, so they were not disadvantaged in terms of experience with different points of view on the same topic. However, the importance of source evaluation was not emphasized to them, nor were they provided with any specific information on source evaluation.

5.3 Application-Task Materials and Procedure

The material used in the application-task session, which was the same in all conditions, consisted of four documents read on a computer screen in the school computer lab.

Used in a previous study [30], the documents were taken from real sites (stored locally) and looked like the original; only the language was modified, in some cases, to make it simpler. They were balanced for reliability (low/high) and position on the debated topic of the potential health risks associated with the use of mobile phones. The two higher reliability documents were: (a) the report of an interview with a scientist, an expert in molecular biology, published in the science section of a newspaper and explaining the biological impact of radiations from mobile phones and (b) the report of a pediatrician, published on the site of the national association of pediatrics and stating the inconclusive nature of current scientific evidence, especially for children, but recommending many precautions. The two lower reliability documents were (c) the report of a webmaster, published on an online magazine on mobile phones, describing inconclusive data and wondering who would give up using the mobile phone and (d) the personal blog of an unknown supporter of natural life, describing various serious health problems caused by mobile phones.

At the beginning of each text, information about the author, credentials, and date of publication was provided. Each text included the same number of words (424 words). Participants were instructed to read the documents carefully at their own pace as they would then be asked to complete some tasks.

5.4   Pre-intervention Measures

Because of the quasi-experimental design of the study with random assignment to conditions of the level of intact classrooms, some individual differences were assessed to ensure that participants did not differ among conditions for a number of potentially interfering variables.

Topic Prior Knowledge. Prior knowledge of the application topic was measured using five open-ended questions about electromagnetism and the potential health risks associated with the use of mobile phones, taken from Bråten et al. [9]. Answers to these questions were analyzed for content and scored 1 for each correct information unit mentioned (range: 0–3). A random selection of 80 students' responses were scored by the second and third authors, resulting in an 89% agreement for all answers. Disagreements were resolved through discussion. The third author scored the remaining responses.

Topic Interest. It was measured using a 10-item self-report scale about the value and importance of knowing more about the potential health risks associated with the use of mobile phones (Cronbach's alpha = .84), examples item: "I like to be updated on the health consequences of the continuous use of mobile phones".

Reading Comprehension. It was measured using the Italian standardized test for the appropriate grade [31]. Participants read an informational text and answered 15 multiple-choice questions. One point was assigned to each correct answer.

Working Memory. It was measured using the Italian version of the well-known Daneman and Carpenter [32] Reading Span Test, which evaluates the simultaneous processing and storage of unrelated information and is, therefore, considered a complex span text [33].

Perceived Competence in Online Information Search and Evaluation. It was measured using a six-item self-report scale (Cronbach's alpha reliability = .78). A sample item is: "I always do well when I look for useful online information for a school assignment".

5.5   Post-intervention Measures

Multiple-document Comprehension. It was measured with an essay task as in many previous studies [e.g., 9, 34, 35]. Participants were asked to write a short essay to judge the health risks of mobile phone use, based on the texts read. Following Bråten et al. [9] and Mason et al. [34], the essays were scored for sourcing and argumentation. For sourcing, we considered (a) the total number of explicit references to the four source documents and (b) the total number of source-content links, that is, explicit and implicit references to the four source documents that also mentioned content from those sources. A composite score was computed for sourcing.

For argumentation, we considered whether both perspectives were reported and justified, and the unresolved nature of the debated issue was acknowledged. The essays were scored 1–3: 1 point was assigned for essays that reported only one position on the debated topic, with no reference to the controversy; 2 points were assigned when the negative and the more 'neutral' positions on the topic were reported, with no reference to the 'openness' of the issue; 3 points were assigned when the two positions were reported, but also where there was a need for more scientific information. A random selection of 80 essays were scored by the second and third author, resulting in an overall 90% agreement on the essays. Disagreements were resolved through discussion. The third author scored the remaining responses using the same coding system.

Rank-Ordering. Participants were asked to rank-order the four documents, from the most to the least reliable [4], assigning the value 1 to the website judged as being more reliable and the value 4 to the website judged as being the least reliable. Participants were awarded 1 point for ranking the two most reliable sites either as no. 1 or no. 2 and 1 point for ranking the two least reliable sites as either no. 3 or no. 4. When rank-ordering the documents, readers did not have the opportunity to look back at them but were provided with a randomized list of the URLs names.

Justification for Rank-Ordering. Participants were asked to motivate their rank-ordering, providing one or more justifications. These were analyzed for content and a coding system was then used, inspired by the categories identified in previous studies [e.g., 36]. The categories were the following:

- *source characteristics* (authors' credentials based on expertise and authoritativeness), for example: "This is credible and authoritative for knowledge";
- *personal opinion* (information corresponds to the reader' opinion), for example: "I disagree with what the site says";
- *reference to other sources* (information is corroborated by other sites), for example: "It is the only one to say that";

– *reference to the content of the document read* (information is easier to understand or interesting and appealing), for example: "This is more interesting and easier".

For each category, the scoring was dichotomous: 1 point was assigned when a justification explicitly mentioned the specific aspect of the category; 0 points when it was not mentioned. A random selection of 80 students' responses were scored by the second and third authors, resulting in an 87% agreement for all answers. Disagreements were resolved through discussion. The third author scored the remaining responses using the same coding system.

6   Results

6.1   Preliminary Analyses

Data were first screened for normality. Descriptive statistics showed that they did not substantially deviate from normality for skewness and kurtosis. A MANOVA was then performed to ensure that participants across conditions did not significantly differ for prior topic knowledge and interest, reading comprehension, working memory, and perceived competence in online information search and evaluation. The effect of condition did not emerge, Hotelling trace $= .10$, $F(10, 306) = 1.70$, $p = .080$. This outcome indicated that the participants were comparable across conditions for all these potentially interfering variables. To proceed in the most parsimonious way, we did not consider the latter in the subsequent analyses. Descriptive statistics for individual differences as a function of condition are reported in Table 1.

6.2   RQ1: Effectiveness of the Intervention for Source Evaluation

Rank-Ordering. We first conducted an ANOVA with rank-ordering scores as the dependent variable. The effect of condition was not significant, $F < 1$. Scores were substantially similar across the DK (declarative knowledge, $M = 1.37$; $SD = .66$), CC (contrasting cases, $M = 1.38$; $SD = .67$), and control (no intervention, $M = 1.29$; $SD = .57$) conditions.

Justifications for Rank-Ordering. We also qualitatively examined the justifications provided by participants to appropriately rank-order each of the four documents. Tables 2 reports frequencies and percentages of justifications for accurately rank-ordering the four documents as a function of condition. Non-parametric tests, specifically Kruskal-Wallis and Mann-Whitney, were then carried out to see whether statistically significant differences would emerge across categories and as a function of condition. As a measure of the effect size, for Kruskal-Wallis tests we used epsilon square (ε^2) and for Mann-Whitney tests we used r [37, 38].

Justifications for Rank-Ordering Document No. 1. We examined whether there were statistically significant differences across conditions for the criteria used by participants to support their evaluation of a document as the most reliable. First, a Kruskal-Wallis test was carried out with Bonferroni correction applied, resulting in a significance level set at $p < .012$, given 4 pairwise comparisons (response categories). This test revealed

Table 1. Descriptive statistics of all pre-intervention variables by condition

		Condition		
		DK $(n = 51)$	CC $(n = 58)$	C $(n = 52)$
Prior topic knowledge	M	1.98	1.93	1.54
	SD	1.40	1.47	1.14
	Skewness	17	.60	.26
	Kurtosis	−1.02	−.65	−.53
Prior topic interest	M	28.20	29.57	29.46
	SD	8.51	8.09	7.32
	Skewness	.38	.16	−.24
	Kurtosis	−.46	−.34	−.37
Reading comprehension	M	9.10	9.03	8.23
	SD	2.94	2.58	2.32
	Skewness	−.38	−.31	−.01
	Kurtosis	−.63	−.71	−.24
Working memory	M	1.94	1.66	1.88
	SD	.64	.63	.70
	Skewness	.51	.86	.51
	Kurtosis	1.25	1.77	.40
Perceived competence in online information search and evaluation	M	20.59	19.71	20.63
	SD	3.95	4.34	4.31
	Skewness	−.46	−.26	−.84
	Kurtosis	.74	−.02	1.25

Note. DK = declarative knowledge, CC = contrasting cases, C = control

significant differences for using judgments based on source characteristics [$\chi^2 (2) = 22.39, p < .001, \varepsilon^2 = .20$] and its content [$\chi^2 (2) = 10.08, p < .006, \varepsilon^2 = .09$]. Mann-Whitney U tests were then performed with Bonferroni correction applied, resulting in a significance level of .016, given 3 pairwise comparisons (conditions). As concerns the use of source characteristics for reliability judgments, participants in both DK ($U = 345.00, p < .001, r = .42$) and CC ($U = 293.00, p = .009, r = .39$) conditions outperformed those in the control condition, while the two intervention conditions did not differ from one other. As regards the reference to source content, students in the control condition used more this criterion than those in the DK ($U = 394.00, p = .002, r = .42$) and CC conditions ($U = 484.00, p = .009, r = .25$), while the two intervention conditions did not differ from one other.

Justifications for Rank-Ordering Document No. 2. A Kruskal-Wallis test did not reveal significant differences across conditions for the justifications provided by the participants to judge a document as the second more reliable among the four webpages.
Justifications for Rank-Ordering Document No. 3. A Kruskal-Wallis test revealed significant differences among the participants for using judgments based on source characteristics [$\chi^2 (2) = 8.82, p = .010, \varepsilon^2 = .09$], and based on the content provided [χ^2

(2) = 18.95, $p < .001$, $\varepsilon^2 = .20$]. Mann-Whitney U tests showed that only participants in the CC condition used the crucial criterion of source characteristics more frequently than participants in the control condition ($U = 275.00$, $p = .002$, $r = .29$). Reference to document content in the reliability judgments was more frequent in the control condition than among participants in both DK ($U = 261.00$, $p = .002$, $r = .30$) and CC conditions ($U = 200.00$, $p < .001$, $r = .41$), while the intervention conditions did not differ from one other.

Justifications for Rank-Ordering Document No. 4. A Kruskal-Wallis test showed significant differences across conditions for participants' judgments based on source characteristics [χ^2 (2) = 14.72, $p = .001$, $\varepsilon^2 = .12$]. Mann-Whitney U tests revealed that students in both DK (U = 544.00, p < .001, $r = .35$) and CC conditions ($U = 648.00$, $p = .001$, $r = .31$) took this crucial criterion more often into consideration than their counterparts in the control condition.

6.3 RQ2: Effectiveness of the Intervention for Multiple-document Comprehension

We performed a MANOVA with the scores for sourcing and argumentation, as reflected in the essay task, the dependent variables being, overall, positively correlated ($r = .20$, $p = .009$). The MANOVA revealed an overall small significant effect of condition, Hotelling trace = .06, $F(4, 312) = 2.51$, $p < .041$, $\eta^2_p = .03$. Follow-up univariate analyses of variance indicated that differences emerged for argumentation, $F(2, 158) = 4.80$, $p = .009$, $\eta^2_p = .06$, but not for sourcing, $F(2, 158) = .75$, $p = .471$. Pairwise comparisons with Bonferroni correction revealed that both students in DK (declarative knowledge, $p = .017$, 95% CI [$-.65, -.04$]) and CC (contrasting cases, $p = .033$, 95% CI [$-.61, -.01$]) conditions outperformed students in the control condition. Participants who received an intervention on source evaluation, regardless of its type, generated greater arguments compared to their counterparts who were not exposed to any intervention. Table 3 reports the scores for sourcing and argumentation as a function of condition.

7 Discussion

Our first research question (RQ1) asked whether two classroom interventions are equally effective in promoting students' reliability judgments of various online documents. In accordance with hypothesis 1a, the analysis of the justifications provided to motivate the rank-ordering of the four sites revealed that the students in both intervention conditions were more able to appeal to the characteristics of the source (expertise and authoritativeness) than students in the control condition when appropriately judging the most (no. 1) and least (no. 4) reliable site, while the two intervention conditions did not differentiate. For the second least reliable (no. 3) site, only students in the CC intervention condition considered more the quality of the source than those who did not receive any intervention.

When differences emerged for appealing to personal opinions, they indicated that the latter students used this criterion more than their counterparts in the intervention conditions. Such criterion can lead to myside or confirmation bias, that is, to judge a

Table 2. Frequencies and percentages of justifications for rank-ordering the four online documents

No. 1: Interview with a scientist	Condition					
	DK (n = 51)		CC (n = 58)		C (n = 52)	
Type of justification	*f*	*%*	*n*	*%*	*n*	*%*
Source characteristics	29	76.3	27	64.3	5	15.6
Personal opinion	1	2.6	–	–	2	6.3
Corroboration across sources	–	–	–	–	3	9.4
Source content	20	52.6	25	59.5	28	87.5
No. 2: Italian society of pediatrics						
Source characteristics	19	54.3	19	50.0	10	27.02
Personal opinion	4	11.4	5	13.2	8	21.6
Corroboration across sources	4	11.4	2	5.3	1	2.7
Source content	20	57.1	19	50.0	23	62.2
No. 3: Online magazine						
Source characteristics	16	48.4	20	57.1	5	19.2
Personal opinion	4	12.1	5	14.3	4	15.4
Corroboration across sources	7	21.2	1	2.9	1	3.8
Source content	15	45.5	10	28.6	22	84.6
No. 4: Personal blog						
Source characteristics	22	55.0	22	48.9	6	14.0
Personal opinion	3	7.5	9	20.0	9	20.9
Corroboration across sources	5	12.5	1	2.2	5	11.6
Source content	24	60.0	22	48.9	32	74.4

Note. DK = declarative knowledge, CC = contrasting cases, C = control. Students could refer to more than one criterion to justify their ranking. Percentages are computed on the total number of justifications given by the participants

document as reliable or unreliable regardless of the real authoritativeness of the web source, but only because it is aligned (or not) with the reader's own opinion on a controversial topic [39]. It is worth noting that very few students in all conditions appealed to corroboration across sources to justify their rank-ordering. A plausible explanation is that there were few documents available, and the same position on the topic was shared by only two online resources, one of which was more reliable and the other less so. Thus, this important aspect for epistemic source evaluation my have not been salient enough in the current study.

Table 3. Descriptive statistics for post-reading variables of sourcing and argumentation by condition

| | | Condition | | |
		DK ($n = 51$)	CC ($n = 58$)	C ($n = 52$)
Sourcing	*M*	2.14	1.91	1.71
	SD	1.96	1.75	1.53
	Skewness	1.27	.80	1.18
	Kurtosis	1.25	.07	1.61
Argumentation	*M*	1.31	1.28	.96
	SD	.67	.61	.62
	Skewness	1.52	1.63	.52
	Kurtosis	1.65	2.37	1.55

Note. DK = declarative knowledge, CC = contrasting cases, C = control

The two types of short-term intervention did not differ in rank-ordering and from the control condition. This outcome is not aligned with Mason et al. [19] intervention study that involved upper-secondary school students providing declarative knowledge about source evaluation. However, in that study 9th graders were asked to rank-order nine documents, while in the current study there were only four documents to be rank-ordered by 8th graders. A possible explanation for the lack of significant differences across conditions in the current study is that the task may have been too easy due to the lower number of documents. An alternative explanation is that the documents were easy to discriminate, even by 8th graders, who could perceive their different levels of reliability. Recent research on source evaluation has documented low rank-ordering skills in 7th graders when they were provided with six online documents [33]. Given the mixed results in the literature, in future research both the number of documents and degree of differentiation for source reliability should be taken into account when using a more challenging set of materials to be evaluated by adolescents.

The finding about the lack of differences for rank-ordering is also in contrast with the results of the Braasch et al. [20] study that involved 13th graders, who were provided with two contrasting cases of source evaluation. However, in the Braasch et al. [20] study, students exposed to the intervention were better able than the control students to discriminate six documents for usefulness, not reliability. Judgments of the utility of a document to learn about a topic are easier to make than judgments of the reliability of a source, as the former are strictly related to the content provided. In contrast, the latter refer to the 'metadata' regarding author credentials, which may not receive particular attention during document processing, as indicated by studies with older students [40], even when they are explicitly asked to evaluate the information about sources [41], or with middle school students, even when they are specifically prompted to consider source competence [16].

Our second research question (RQ2) asked whether the two interventions were also equally effective in supporting multiple-document comprehension. Results confirmed

hypothesis 2a as both intervention conditions led to greater argumentation about the controversial topic than the control condition. This finding is aligned with previous research on high-school students' multiple-text comprehension after a short [19] and long-term source intervention [17]. Readers' essays did not differentiate as a function of condition for sourcing (number of sources and source-content links). This outcome may be related to the previous outcome on rank-ordering. As students were equally able across conditions to discriminate the online sources, although not always appealing to advanced criteria, in their written essays they did not differentiate for citing and relating the sources to their contents, but they did for forming a coherent and integrated representation of the contrasting information.

For both research questions, contrary to our hypotheses 1b and 2b, a superior advantage of providing contrasting cases over declarative knowledge did not emerge. The mechanisms underlying the two interventions are different. In the direct, more 'traditional', prescriptive intervention students bear in mind what to do and try to apply it. In the contrasting cases intervention, students are stimulated to solve an information problem, scrutinizing and identifying the best of two strategies without any direct prompt. Either one or the other mechanism has potential for sustaining, at least to some extent, sourcing and comprehension of conflicting information in eighth graders.

To sum up, the findings of this study do not allow us to determine if one of the two short-term interventions on source evaluation should be preferred to the other. By either allowing students to know directly what to look at, or stimulating reflections on different evaluation strategies, a consideration of source characteristics and a comprehension of multiple documents were encouraged. What we can expand from the current data, therefore, is that the two types of short-term intervention can be implemented in the real context of lower-secondary school classrooms and are substantially effective, at least to some extent and in a short time frame.

8 Limitations

Some limitations should be taken into account when interpreting the results of the current study. First, although both interventions favored reliability judgments based on digital source characteristics and multiple-text comprehension compared with a control condition, the effect sizes are small. Future research with more participants in each condition may provide more solid results. Second, we did not use process data to understand the underlying mechanisms that can explain the benefits of each type of intervention. Studies based on eye-tracking methodology, for example, can reveal if and where the interventions induce greater allocation of attention while reading the various materials provided to support source evaluation. The analysis of process and outcome findings will allow an in-depth understanding of the link between reading behavior and offline sourcing and argumentation. Third, it remains open to future studies if, and to what extent, what students learned during the intervention is also long-lasting, and therefore used over time when they spontaneously retrieve information, evaluate, and comprehend online documents for inquiry purposes.

9 Conclusions

Despite these limitations, the study has significance as it expands the evidence that two types of short-term intervention on source evaluation, which can be easily implemented in the classroom, are to some extent effective. The effectiveness of the interventions emerges in supporting students to appeal to the epistemic characteristics of information sources when judging the reliability of digital documents, as well as in constructing an integrated and comprehensive representation of multiple documents. Overall, the study indirectly contributes to the debate on the degree of guidance that promotes better learning, supporting the idea that either direct or guided instruction works [42].

Practical implications can also be drawn from the study as the critical use of contemporary digital media emphasizes the need to support students in becoming thinkers who are epistemically vigilant [43] and able to reason well in an information-saturated world steeped in socio-scientific issues that matter greatly in our society [44]. If students are equipped with source evaluation skills to be critical consumers of information, they will more likely be future citizens able to act as rational thinkers in decision-making processes that impact the individual and societal life. The results highlight the importance and feasibility of providing students with source evaluation skills from the early years of secondary education. Moreover, alternating one and the other kind of intervention to sustain sourcing when dealing with complex socio-scientific issues may represent a potentially effective pedagogical strategy. It combines direct and indirect instruction, depending on situational contexts, in the service of students' involvement and cognitive performance in a crucial task in the Google era.

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New Intersections Between Psychology, Learning and Technology

The Motivation of Distance Learning in Universities Since Covid- 19 Outbreak

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Abstract. Around midmonth March 2020, The World Health Organization acknowledged the COVID outbreak as a "public health emergency of international concern." Worldwide, various heads of state-imposed mandatory lockdowns to curb and ease the spread of the disease. With such restrictions in hand, the education sector was among the many which felt the pinch brought about by the restriction measures imposed. To try and flatten the curve and minimize the spreading of the virus from one person to another, there was a need for reduced physical contact among people. According to Shahzad et al. (2020), public gatherings such as parties, religious services, social amenities, political gatherings, and physical learning for both universities and lower levels stopped since health comes first before anything else. With that in hand, the world had to look for suitable solutions to cope with the pandemic since the virus was not ending time soon; as a result, the globe adapted 'the new normal of life. In response, education facilities had to embark on e-learning since life had to continue, which is great gratitude to technology. However, it brought about various issues that we will try and highlight since a change in anything is always accompanied by multiple challenges.

Keywords: Motivation · Distance learning · Universities · Covid-19 · Review

1 Introduction

Technology has changed traditional education to the current form of accessing education, an example being artificial intelligence. Shahzah et al. (2020) define E-learning as technology-based education retrieved through websites, learning thresholds, video conferencing, YouTube, mobile applications, and other various platforms through available websites of melded education tools. Also, virtual learning is sharpening scholars' understanding, also the educational staff and professional and industry people abilities via the internet. Currently, a majority of the complex learning universities are offering virtual programs for their scholars both around and off campuses, making education accessible to everyone despite your location, provided you have a laptop or mobile device with internet connectivity. In the current world, the eminence of teaching and excellent infrastructures such as computers and IT up-to-date apparatus reception are now in great ultimatum. Higher-level education facilities such as universities are shifting their schooling designs with the use of intelligent capital. Shahzah et al. (2020) explain

that universities closed down due to the COVID-19 epidemic, and most lecturers and students were happy to shift to online education. However, the sudden change from face-to-face learning to virtual education was faced with various challenges that hindered the smooth and fluent submission of learning resources among learning institutions.

The online tutelage milieu comprises of two parts of intermingling styles: the scholar, trainer, and content, and the second comprises of know-hows and approaches of interlinking. Shahzah et al. (2020) explain that Covid-19 positively and harmfully impacted the online education aspect of learners' lives to a temperate level. Improving social lives among students in online education is believed to be the core benefit of online learning all through the restriction period.

1.1 Effect of Covid-19 on University Education

In the current times, virtual learning constructs a more noteworthy impression on all kinds of students, as much as the freelance and permanent in the higher education institutions, and it is becoming very helpful to students since a majority of them are working in companies easing their schedules due to time constraints (Shahzah et al. 2020). COVID-19 theatrically restructured the way worldwide education is conveyed. Sums of learners were impacted by educational institutions' closure due to the endemic that has led to the greatest' shipment' in the history of education. Imposing a 24-h restriction changed students' lives, specifically at home, where they spent significant amounts of time. The results of this research show that remaining at household assisted students clearly restructure their priorities. The retro was a good time for spiritual replications and gaining equanimity, and enabling them to enjoy more time with their families. Feelings of solitude and being away from their communal associates, on the other side, were confirmed as negative impacts, implying that a passionate aspect of scholars' life lacked throughout their curfew experience. As a precaution, all venues where daily social activities take place have shut.

With the pandemic, all university facilities have been faced with various psychological, physical, and economic challenges, resulting in disorders in the running of these facilities. Browning et al. (2021) explain that university students are increasingly renowned as an exposed populace, going through higher levels of fretfulness, despair, drug abuse, and disorder eating equated to the general populace. Therefore, with the drastic change in the nature of their educational familiarity, changes such as sheltering in place throughout the corona plague created a more significant encumbrance on the students' mental health. Based on research conducted in the United States, college students contributed immensely to the population of the citizens stalwartly hit by COVID-19 due to ambiguity regarding academic progress, personal careers, and their societal life during their college life (Browning et al. 2021). Previously, we knew that university students rarely had psychiatric and counseling services, which is critical and essential to warrant immediate health interventions that would have helped curb the issue among students. However, according to (Browning et al. 2021), generally, U.S. students seemed not to have been affected toughly academically by the COVID-19 pandemic as elsewhere in the world. As a matter of fact, they portrayed a normal satisfaction with most of the survey elements. Moreover, compared to other parts of the world, American students were

among the first to expose their confidence in having competent computer literacy such as attending online classes and satisfaction with the support of the teaching practitioners.

The pandemic crisis substantiated the concerns of international institutions, an example being the United Nations, which stresses the prominence of the resourceful delivery of educational curriculums to shun from digital and social inequalities. Cessation of movement among citizens that required people to stay at home the whole day while also going on with the studies under unfamiliar environments had an impact among university students interpersonal and intrapersonal live in both pedagogically and publically (Alghamdi 2021). Another significant challenge posed on higher education learning is the students living accommodation. Almost all universities globally offer accommodation to students, even if not to all due to the capacity differences. However, with the enlisted health guidelines, it was difficult for university students to accommodate students with the previous capacity before the pandemic in their dormitories. Hence it posed a greater traumatizing scene to most students who never got dormitory slots within the school and had to rent with the school environs, and it was pretty expensive for them.

Younger students tend to experience greater fear since students in the age bracket of 18 and 24, irrespective of their educational grade, tend to be more angst about their educational forthcoming and their capability to pay for their university learning equated to older students. Also, due to the barrage of Covid-19 news, younger students who are addicts to societal media platforms get exposed to risk texts compared to older scholars.

More than a hundred partakers were enlisted cross-sectional from the targeted sample at seven significant state universities in spring. From the large population invited to play a part in the survey, 2,534 reactions with data on a majority of the relevant variable. According to Browning et al. (2021), there is anticipation that the assessment would be tough to tight-fistedly and systematically capture the broad array of impact from the COVID-19 on scholars with qualitative measures. Also, there was an unrestricted questionnaire that enquired respondents how the pandemic changed them and how they were feeling and what was on their minds. The current study's corresponding author conducted unstructured personal interviews about their early experiences with the COVID-19 epidemic in terms of new interview data. In February 2020, ten individuals aged 18 and over got gathered for these interviews. Enrollment happened in low- and high-risk areas across the America, including Washington's metropolitan areas and countryside areas in Tennessee, Iowa, and South Carolina. During the pandemic, the dialogues taken the outlooks of the interviewees.

E-learning.

The educational problems that the world is facing issues with as a byproduct of the virus have become highly burdensome. In spite of efforts at gradual normalization in learning, it seems that any semblance of normal will take some time to get to be a reality. Learners, instructors, school administrators, and parents all got tangled up in an educational process in which the fundamentals of face-to-face education had to get converted to digital environments in a short period of time. The benevolence of information technology's impact on numerous aspects of lives currently cannot be contradicted. According to Olum et al. (2020), e-learning has been implemented in many settings to speed up the furtherance of medical training. Nonetheless, the crisis led to stress among the world population, disrupting education globally. In order to facilitate all students so as to carry

on with their studies and achieve personal career goals, there was a need to implement online classes for students in all learning institutions. However, research conducted on university students across the U.S.A indicated that over half of scholars were concerned about the lack of social interfaces in the virtual learning environment. At the same time, about 10% had issues with the online learning setting (Olum et al. 2020). With the evolution of technology and the presence of copious parties to facilitate higher education, the majority of universities and educational institutions have shifted to conniving and hurling e-learning programs for students. (Olum et al. 2020). Various studies have shown that virtual learning is a beneficial tool for attaining educational requirements, expressly in developing nations.

With the great potentials brought forward by digital learning, some students sometimes opt to drop out of school (defer) and become indisposed to embark on their studies, which acts as a significant drawback to their literacy evolving. However, due to the pandemic's constraints, some students tend to drop out of school since they lack sufficient funds to continue with their classes. During the pandemic, so many people lost their jobs. As a result, they experienced poor financial status that could not support the access of internet connectivity and gadgets such as the computer to stream live classes (Abbasi et al. 2020). Nonetheless, as a result of the high recognition of students to enroll in online learning and the role of refining the eminence of education, the quality of learning impacted students can improve immensely.

2   Research Methods

2.1   Search Strategy

This systematic review used in this analysis adopted the recommendations of Dhingra et al. (2020). A systematic review was conducted using PubMed, Science Direct, Google Scholar, and Bloomberg CityLab, revealing a database of studies on e-learning in universities during the Covid-19 pandemic. The study was narrowed down to when the pandemic began to now and what impact it has had on learning among universities globally. Additionally, the search strategy was based on identifying the keywords, for example, motivation, academic success, university, and covid-19.

2.2   Study Identification

All journals, including cohort studies, review, and case studies were eligible if they highlighted more than ten cases of interview on students concerning their experience with the new form of learning. After removing the duplicates by comparison of DOI, all abstracts from identified publications were examined for eligibility.

2.3   Study Selection

The original study search brought forward to the identification of 150 studies with complete data. However, all this was made possible through automated electronic searches on various database platforms. Automated search engine generated 3762 results out of

which settled for 150 studies that could be screened and selected the once for use in the case study. From the remaining studies, 20 of them were nullified since they did not meet the minimal requirements for the study. However, the remaining 70 were screened through the eligibility criteria and out of that, 21 failed to meet the eligibility criteria. The Fig. 1 below shows the PRISMA 2021 flow diagram for updated system reviews (Liberati, A. et al. 2009).

2.4 Description of Studies

Among the research studies, the initial study conducted an investigation in a dentistry college regarding their perception and opinions regarding e-learning during the lockdown compared to the prior physical learning. Two of the inclusive resources highlight the students' motivation towards online classes in respect to internet connectivity and its accessibility during Covid-19 pandemic. While the third one encompasses its study on some of the activities and issues revolving around the capability of different students attending to classes, and some of the issues within United States learning process and third-world countries. The last two research are based on how tiresome it has become for students to undertake to their assignments from online classes and the challenges associated with practical learning courses.

3 Results

Through the search engine it revealed 150 publications. However, duplications were removed and 33 publications were left. While undertaking in-depth screening of the left articles 15 were feasible. The PRISMA flow diagram illustrates the elimination of publications. Some of the publications did not provide sufficient information for the review but they aided in sufficient information to give context to the topic in matter. Table 1 shows a summary of the findings.

3.1 Risk of Bias in the Selected Study

The risk of bias was summarized in Review Manager (RevMan 5.4.1), and the feedback indicated that the overall risk of bias was moderately low.

From the data collected, various information was present that was highly noticed. For example, persons known to have got infested with COVID-19 had an increased probability of being at risk of psychological impacts. According to Dhingra et al. (2021), students who had information of either one or more of their relatives was infected had higher chances of suffering from psychological compared to students who had no knowledge of anyone infected with the virus. Also, based on gender, women were at a greater peril of mental distress during the contagion as they were liable to depression and anxiety conditions compared to the male species of students as much as men were prone to get infected with the disease compared to the female.

Universities would be well-served to discourse the conceptual wellbeing issues of their all-inclusive student body, given the enormous fraction of scholars consigned to the high psychosomatic influence profile. Virtual group workout and consideration/mindfulness gatherings, liability partners and bodybuilding challenges, and

Identification

| Records identified through database searching (n = 150) |
| Additional records identified through other sources (n = 104) |

Screening

Records after duplicates removed (n = 90)

Records screened (n =75)

Records excluded (n = 20)

Eligibility

Full-text articles assessed for eligibility (n = 70)

Full-text articles excluded with reasons (n=21)

Included

Studies included in qualitative synthesis (n = 15)

Studies included in quantitative synthesis(meta-analysis) (n = 6)

Fig. 1. PRISMA flow diagram of studies in the systematic review.

telemedicine/therapy appointments are some of the activities that have endorsed mental well-being at the University of Connecticut, University of Kentucky, and Northeastern University (Browning et al. 2021). These group interactions may effectively reduce anxiety and the sense of remoteness that the students in this study felt. Scholars with clinical anxiety levels can gain from digital therapies. Since COVID-19 is likely to

Table. 1. Summary of the findings.

S.no	Author	Year	Study design	Population study	Outcome
1	Alghamdi, A.	2021	Systematic review	30	The study found that high to moderate level of agreement with regard to the positive and negative impacts on their social and educational lives associated with Covid-19 pandemic. Also, the impact of the pandemic on social aspects was higher than the educational aspect of students' lives
2	Abbasi, S. et al.	2020	Systematic review	377	From the sample size used 137 male and 245 females took part in the study. Overall, 77% of the students had negative perceptions towards e-learning. Additionally, 76% of the students use mobile devices for their e-learning. The review proved that students do nor prefer e-learning over face-to-face teaching during lock down state of affairs
3	Dhingra, S. et al.	2021	Meta-analysis	260	On the evaluation of 260 responses, it was found majority of students were motivated to attend online classes but external factors like internet connectivity and home environment were among the greatest drawbacks
4	Olum, R. et al.	2021	Systematic Review	221	In the study, the overall participant responded after removing some of the duplicates, 95% of the respondents possessed smart phones while 90% also had email address

(continued)

Table. 1. (*continued*)

S.no	Author	Year	Study design	Population study	Outcome
5	Shahzah, A.	2020	Theoretical review	107	The study majors on comparison between male and female counterparts on e-learning portal usage among university students. The male species portrayed to have more experience and more conversant with the portal as compared to the female
6	Muller, A. et al.	2020	Systematic Review	14	The study was conducted to get the experience and perspectives of university educators in Singapore. Educators had limited e-learning experience prior to Covid-19 sessions. Additionally, Hybrid or blended learning approaches were preferred, but support was necessary
7	Yekefallah, L. et al.	2020	Systematic Review	420	The study was to find out the effectiveness of online learning during the pandemic. From a sample size of 420 students, 310 were female and 2018 of the students were single. The review highlighted that satisfaction with e-learning was higher among female students and students with a history of attending online classes before Covid-19

trigger persistent mental pain, colleges should emphasize aiding students in promoting proper mindsets rather than avoiding stress. Contemporary discoveries that intellectual and behavioral circumvention (i.e., evading contexts where disclosure is plausible and unpleasant beliefs about the contagion) was the utmost unswerving prognosticator of amplified anxiety and melancholy signs throughout the endemic. Stressful circumstances are getting addressed using cognitive reappraisal. Students are encouraged to focus on the "silver linings" and developing prospects in their educational experiences.

Universities can strive to evolve mechanisms that allow for safe social engagement among students. During their undergrad days, many students seek out social attention. However, as this study's findings indicated, students' opportunities for mingling decreased significantly throughout COVID-19's early stages. Our student participants consistently expressed dismay for missing "stepping out" and massive achievement events (e.g., graduation, last sporting occasion). In other research, students conversed online with close household members or colleagues no less than once a day to keep their mental health through the initial surf of the COVID-19 virus.

E-learning.

A cross-sectional expressive study gets piloted among students undertaking in varied fields of medical science university to try and find out what some of the students felt about the new learning technique facing out face-to-face learning that was already a norm. According to Abbasi et al. (2020), sampling gets piloted using the stratified arbitrary sampling method to capture all the faculties in the research and avoid biased results. Students were selected randomly and provided with an online questionnaire, partial responding to the questionnaire, and discontent with assistance were the measures for omission from the research.

Data captured was composed using a three-part questionnaire that included demographic and background information based on age, gender, year of study, and class performance prior and during the pandemic while also considering their experience in joining online classes before Covid-19. In total, 420 students got recruited for the research (100 percent partaking rate), with 310 of them being female (73.8 percent), 208 having a single (49.5 percent), and 199 being sophomores (47.4 percent). The age of the participants was 21.14 (1.25) years on average (standard deviation). The mean (standard deviation) of the participants' average point grade from the previous year was 16.12 (1.48) out of a prospective 20 with regards to the table (Yekefallah et al. 2021) (Table 2).

Table. 2. Demographic and background appearances and relationship with satisfaction with virtual learning in scholars.

Qualitative variables		Desirable satisfaction	Undesirable satisfaction	P-value *
		Number (percent)	Number (percent)	
Gender	Female	135 (78.5)	175 (70.6)	0.039
	Male	37 (21.5)	73 (29.4)	
Marital status	Single	85 (49.4)	123 (49.6)	0.258
	Married	77 (44.8)	119 (48)	
	Divorce and death of a spouse	10 (5.8)	6 (2.4)	

(*continued*)

Table. 2. (*continued*)

Qualitative variables		Desirable satisfaction	Undesirable satisfaction	P-value *
		Number (percent)	Number (percent)	
Academic years	Freshman	28 (16.3)	30 (12.1)	0.411
	Sophomore	85 (49.4)	114 (46)	
	Third-year student	41 (23.8)	51 (20.5)	
	Fourth-year student	18 (10.5)	53 (21.4)	
A history of attending online classes before Covid-19	Yes	141 (81.2)	92 (37.1)	0.016
	No	31 (18.8)	156 (62.9)	
A suggestion for using e-learning system	Very high	31 (18)	53 (21.4)	0.339
	High	58 (33.7)	60 (24.2)	
	Moderate	25 (14.6)	24 (9.7)	
	Low	52 (30.2)	105 (42.3)	
	Very low	6 (3.5)	6 (2.4)	
More desirable educational method	E-learning method	7 (4.1)	12 (4.8)	0.253
	Traditional teaching methods	33 (19.2)	28 (11.3)	
	It makes no difference	90 (52.3)	132 (53.2)	
	Both	42 (24.4)	76 (30.7)	
Overall opinion about e-learning	Very excellent	18 (8.7)	36 (14.5)	0.181
	excellent	49 (28.5)	62 (25)	
	Moderate	40 (23.3)	57 (23)	
	Weak	62 (36)	87 (35.1)	
	Very weak	6 (3.5)	6 (2.4)	
Quantitative variables		**Mean ± standard deviation**	**Mean ± standard deviation**	**P-value * ***
Age		20.51 ± 1.31	21.52 ± 1.46	0.565
Grade point average of previous years		16.28 ± 1.58	16.09 ± 1.79	0.414

3.2   Data Analysis and Review

From the data collected and analyzed, the outcomes signposted that there was a note-worthy relationship between gratification with online learning and variables of sex and previous experience of joining online classes prior to the Covid-19 outbreak. Addition-ally, the age bracket had a tremendous impact on the satisfaction of attending online classes. According to Yekefallah et al. (2020), they explain that with an increase in age, the level of gratification was similarly increasing, and there was no affiliation between male and female scholars, based on gender, in the aspect of e-learning. The variations in the arithmetical populace of the research and the use of various techniques to mea-sure the performance of education are the factors for this discrepancy. The optimistic worry of women for men and society's culture and the boundless existence of women in societies might get cited as factors for this gender divide. Females consent to e-learning because their limitations do not preclude them from accessing many sciences. Further-more, the researchers found that 59 percent of them were displeased. Yekefallah et al. (2021) explain that Students' satisfaction with the evaluation technique portrayed that self-assessment gave students the chance to assess and do a recap of what they have learned and their perceptive and metacognitive approaches. Also, students grasped their strong point and weaknesses. There was a deep and optimistic connection between the lecturers' oral and non-verbal behavior and the prospect of using automated content to complete training.

Under the scholars' point of view in the digital learning course, the efficacy of the educational contented, the layout of a page to the desired level, the efficiency of teaching-learning activities, and assisting scholars to the desired level, and the springiness of online learning course have been moderate. However, e-learning can deliver prospects for scholars to acquire self-assessment methods courtesy of information technology, their level of relations, and feedback becomes minimal (Abbasi et al. 2020). From the research, it is quite important to mention that efforts have to be made to expand the value of virtual learning and the factor distressing it due to the pervasiveness of Covid-19. Distance learning may be held for the longest period ever since no one has any idea when the pandemic will come to a halt. Abbasi et al. (2020) argue that inattentiveness to these suitcases can lessen the eminence of edification and scholars' level of acquaintance which would consequently, due to the unwelcome gratification with online learning, has generally reduced.

3.3   Motivation

Online courses are an impeccable option for eventful people with numerous burdens on their time. However, the tractability of distance learning brands it ideal for people held up with activities to have an adjusted learning schedule when they are off their work or during personal time. However, Sah Allam et al. (2020) explain that lack of self-discipline regarding the personal drive to learning influences readiness level owing to environmental disruption such as working obligation and massive home environment is a crucial challenge to online distance learning. Also, having friends' interruption during online learning sessions by inviting coursemates to join the online conversation,

including chatting or even blathering, significantly impacts enthusiasm level and self-discipline. Hence, the student who lacks willpower and experiences lower stimulus can fall into the abrasion group of students that affect their school performance in distance learning.

Sah Allam et al. (2020), talks of researchers who examine student online learning readiness, reported that computer internet literacy level has a more significant impact among students. Actually, so many students are ready to espouse online learning technology, although it has to counterpart with high competency in the literacy level. However, as much as so many students are into online distance learning, most of them lack the basic computer skills that hinder them from the e-learning platform, making the implementation ineffective and thriving backward. An arduous study on student virtual learning attitudes reported higher computer internet levels correlated with higher online learning attitudes. Also, the enthusiasm to explore computer tools and have the capability to use internet applications could reduce the sign of technology stress among scholars, mainly in venturing into online distance learning avenues. Sah Allah et al. (2020).

Having a self-drive towards distance learning enhances the verge of studying responsibility to become an independent learner, captivating as compared to traditional face-to-face learning and embedded sense of personal autonomy. Lassoued et al. (2020) explain that a scholar with a self-directed learning element possesses high self-disciplined, self-independent learning and high self-confidence to complete a duty in an online distance learning. However, the majority of students, especially during the pandemic period, may have difficulty presenting high performance on online distance activities during a pandemic outbreak since the means of study tends to seem peculiar to them and work solely, completing assessments with minimal or no contact with the lecturer, and unable to control their stress resulting to low triumph that affects their final results in studies.

Motivation is the key for anyone determined to see the other end of the tunnel to excel in this form of learning since various milestones in the journey face it. Sah Allah et al. (2020) defines it as the engine of learning and go ahead to describe it as the fuel of human understanding. The numerous activities that generate learning byproducts demand time, money, and commitment. With all this, there is an urge to be some kind of motivation to make the process run effectively. With regard to the principle of abilities and human learning on the role of stimulus, for any student to avail themselves to a learning lesson, there has to be incentive or drive force raise. For a student to sit down for a class, be it online or physical, they have to be strongly motivated for higher academic achievements, and this is through establishing good study habits. Integration technology in learning does not positively enhance students' level of motivation (Sah Allah et al. 2020). Online learning requires a student to have high internet connectivity while great effort and commitment for it to take place.

For the success of e-learning, lecturers need to understand students' motivation, while on the other side, students themselves need to adapt and shift from face-to-face learning into an online class. Sah Allah et al. (2020) states that the success or failure of online education is typically related to student motivation. Therefore, the lecturers have an obligation to keep in mind that motivation must get natured in students. This is by elaborating to students how the online environment may be exploited and embolden

interaction and teamwork among the students themselves to strengthen learning motivation. Also, creating study groups so that students do not study in isolation while still making friends by meeting other students as much as the social distance is upheld to prevent the virus from spread within the students and lecturers. Also, the professionals themselves need to be uplifted since they cannot work with students while they are not scythed up. According to research on distance education readiness El Refae et al. (2021), high education teachers show an optimistic attitude and enthusiasm to teach university scholars even with special needs like hearing despite the risk and challenges in learning equipment like pedagogy. Hence, with the pandemic being slated to stay with us until a protective vaccine is found, it is crucial to understand how the lecturers who are prime implementers of the learning accustomed to this switch and what encounters they face while adapting to the growth, and how well they are for the times ahead of us.

As much as online learning came as a solution to curb the supper of the Covid-19 virus among students and the whole world, it is faced with some challenges that have an impact on the delivery of what various university courses entail. So many courses undertaken at the university level get incorporated with practical classes in laboratories, especially ones that are quite difficult to undertake through e-learning. According to Plitnichenko (2020), practical classes require a face-to-face interaction of the student with the equipment involved while with the assistance of a technician and lecturer to facilitate the proper running of the experiments. It gives the students a much clear understanding and exposure of what they are learning about, getting a much valuable grasp of the class content. Hence, as much as containment measures have to be upheld, online learning cannot effectively facilitate practical classes for the student since virtual is unfit for practical courses. With that, it is up to the university as an institution to coordinate how practical classes will be conducted within the available laboratories and determine how much capacity each laboratory can hold, given the number of students in the university.

Connectivity is the second most significant challenge facing e-learning since it is also dependent on it entirely. Plitnichenko (2020) argues that millions of people worldwide experience technical challenges due to the extreme usage rate of online learning systems, video streaming apps, and other learning tools due to overloading, which leads to poor video and audio quality. To be precise, internet connectivity is a crucial challenge worldwide and especially in third-world countries. Internet connectivity determines the quality of teach students access from these classes attended. With that, so many countries have not invested enough in the internet connectivity; hence this acts as a drawback to the growth of online learning. Plitnichenko (2020) explains that the critical issue is not just having a computer but getting a computer with internet connectivity since the speed of connection acts as a limiting factor. In order to address the issue, it is in high demand for various heads of state to uphold internet connection as one of the basic needs since it is becoming of great importance to our daily lives activities. Poon (2020) explains that Wi-Fi connectivity ought to be regarded the same as power and running water due to the monetary and profitable implications. It was felt as if people were so many years from that.

4   Conclusion

Online is the future of where the world is heading to. Hence we have to move with the new trend that is approaching us. According to Swan (n.d.), the 21st century is rapidly becoming digitized, providing a valid reason for academics to be more aware of the specifics of their cohorts and learners and get ways to engage with and sustain isolated students. The reflection presented throughout this paper provides an overview of why e-learning should be embraced and given full support. With the pandemic being amongst us, preventing it from spreading is a better solution than curing, implying that e-learning is the resorted option left for academic institutions to run education with the condition at hand.

The transition towards e-learning has been a difficult task not only to students but also to the facilitator across the world, and it has manifested itself in various avenues. Turner (2020) says that students describe the situation as having more workload to handle and being a significant reason why they struggle to stay on top of their school work during the transition. In addition, a large population of students is still inclined to face-to-face learning systems making online studies a hard-to-get approach to adapt to. However, e-learning is the only option left to handle many people at one time since the social distance is a crucial issue.

Students have varied perceptions concerning e-learning, some being positive while others negative, which wildly contradict them, although they still have to attend classes and submit assignments. However, mobile is one of the most common devices among students for e-learning compared to laptops and tablets since it is cheaper and more easily portable than having a computer with you. Abbasi et al. (2020), explains that a study carried out on university students proved that 66% of the students use mobile devices for e-learning, which sound similar to that of a large percentage preferring having mobile device compared to having laptops for studies. This implies that online learning in universities could increase double if students gained an access to a reliable and convenient internet access since almost all have a smartphone that supports access to various websites and other learning platforms in the internet world.

In a nutshell, education is the backbone of a nation hence regardless of what happens education has to continues as it was a much as possible. Also the Covid-19 pandemic has significantly impacted the education sector but learning institutions have the obligation to continue devising suitable ways to ensure learning activities continue without much deterrent. Additionally, based on the majority of articles we have reviewed it is quite clear education cannot proceed while using the traditional method and a change had to be initiated. E-learning has proven to be the newest learning process that we have to go with since medical practitioners have not clarified when Covid-19 will come to an end, and learning has to continue. Hence various learning institutions should invest in their digital platforms in collaboration with the Heads of state and provide convenient internet access to their students to facilitate proper university learning. Finally, learning institutions can implement some of the recommendations that we have highlighted as they would be helpful while revising some of their policies.

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Storytelling Practice in Sectors of Education, Psychology, Communication, Marketing: A Narrative Review

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Abstract. Changes in digital storytelling are increasing the platforms for people in different professions such as business, family, healthcare, and research to communicate. Social movements through digital storytelling practices have increased over the past decade due to digital storytelling evolvement. Social activities through social media platforms have impacted freedom of communication, and continuous changes in digital storytelling will create more space for people to raise views. Other practices affected by the evolvement of digital storytelling include marketing, healthcare such as mental health of people, teaching, and research. Generally, digital storytelling changes over the past ten years have improved communication skills, enhanced interpersonal relationships, teamwork, and interprofessional collaboration globally.

Keywords: Digital storytelling · Education · Social media

1 Introduction

Digital storytelling (DST) has evolved in the presence of technological advancement over the past ten years, currently creating suitable and more inclusive stories. Consequently, digital stories are multimodal, multimedia presentations merging diverse digital aspects within tale structures. Instances of such media are video, social media aspects such as Tweets, images, audio, and cooperative facets such as digital maps. Therefore, digital storytelling is a digital media communications approach that lets individuals share their stories and experiences every day. Digital storytelling is utilized in various segments, including communication, research, marketing, psychology, and education. This study will emphasize three aspects of the digital version of storytelling: the studies, models, and practices. There are numerous studies on digital storytelling ranging in education, health, identity, and relationships.

On the other hand, digital storytelling practices focus on how best they are conveyed to other people. Examples of such patterns of digital storytelling include health, identity, strategic communication, and the creation of interrelationships. In such categories and many others, the best practices emphasize relevance and reaction, informing and

educating people. For instance, a healthy digital version of storytelling should provoke a response, and the person telling them must reach as many people as possible.

Therefore, the digital understanding of storytelling practices is to connect emotionally with the audience to impact their actions. Digital storytelling depicts a challenging form of generating a connection between old style oral storytelling and the communication form utilized in the modern era and information advancement. Therefore, models for digital storytelling describe the interventions used. The primary digital storytelling modes include videos, photovoice, and slide shows. Thus, the are also three implementation models of digital storytelling. They constitute digital storytelling using slide shows, using photovoice, and using video techniques. Older people face several challenges in relation to psycho-physical health and may experience a range of psychological comorbidities. Advances in multimodal, multimedia technology have made it possible to use digital storytelling (DST) as an intervention to improve health. A review by Stargatt et al. [1] focuses on the effects of DST on health in the elderly (cognitive and psychophysical well-being). The results of another review [2] showed that all stakeholders in the health system could be producers of digital stories with various objectives, such as community health, empathy promotion, attitude and behaviour change, clinical thinking, and skill improvement. A decisively interesting article, albeit one more concerned with the educational aspect, is Yeh and Mitric [3]; it demonstrates ways to incorporate Instagram as a multimodal DST tool to (1) promote the motivation and engagement English language learners (ELLs) at the university level; (2) improve the oral and written skills of ELLs; and (3) help ELL's stories and voices be heard. The advent of new media and new digital technologies have changed the classic storytelling methods. Starting in the 90s, thanks to the studies of Joe Lambert and Diana Atchley [4], Digital Storytelling was born, that is a particular narrative technique that makes use of the use of digital tools. Scholar Meadows [5] defines DST as «short and personal multimedia stories, told from the heart», stating that «it is not just a tool, but a revolution». Most digital stories are collected in online repositories, such as the Berkeley Center for Digital Storytelling website, where the stories are divided by subject areas. Over time, the advent of social media has brought about a considerable change. In fact, social media have in a short time revolutionized the classic way of communicating, allowing a rapid and viral use of information. With this in mind, the way in which digital stories are used also changes. There is an increasing tendency to use social media platforms for sharing digital stories, as their circulation is much more viral and dynamic than traditional media and platforms.

2   Background

Over the past ten years, our universe and how we narrate stories has changed in a myriad way. For example, people have shifted from face-to-face physical levels to digital platforms to stimulate social movements via digital smartphones through social media accounts. First, in the past decade, there has been an evolvement of digital visual storytelling. The rise of this form of storytelling has allowed numerous people to show stories more than before. Through such evolvement, it has added a storytelling dimension that demands improved connection and creativity. Whereas images have regularly had a place in narration dating back to the cave paintings times, the development of

methods such as live scribing, explainer animations, and infographics change the way individuals "show," listen to, and tell stories. Seeing concepts, projects, and dialogues brought to reality before people's eyes is a game changer to how organizations or people intend to tell stories. Arising digital storytelling via visuals in the past decade built a space for tremendous inclusion of diverse learners' types across cultural and language divides.

Secondly, story narration has evolved into sharing people's opinions and marketing trends through the digital brand story [6]. It is not enough to depend on the services and products' uniqueness or dominance to market themselves in the current century. The global market necessitates and demands more than their dominance to flourish through the brand story. Through such stories, they engage people's consciousness in ways that thus far has been difficult to achieve. The brand story enables one to share the products' purpose with customers and prospects. However, digital storytelling for strategic communication purposes should be authentic enough to connect and resonate with audiences. For example, over the past ten years, we have witnessed the Airbnb company maximizing on the "belong anywhere" story, enabling it to stand out. The company has been carrying out branding from its website to campaigns attracting more customers through video storytelling.

Thirdly, digital storytelling has evolved over the past decade to foster social movements, unlike with traditional story approaches. During this digital period, actions spark events across the whole human structure in moments. For instance, digital storytelling through Tweets has witnessed social movements such as #BlackLivesMatter and #MeToo. They are successful because they focus on using multimodal affordances of digital storytelling across digital platforms that in turn facilitate social change. Therefore, the practices of these digital storytelling movements have been carried out through YouTube, Instagram, Twitter, and Reddit over the past decade. The evolution of such stories, characterized by collective and united voices, have lead to new paradigms emerging. Consequently, new technologies have enabled the successful evolution of these digital stories since they have changed how people see, share, and listen to them. Digital technology platforms have allowed individuals to compress time and geographical barriers, enabling awareness creation, engagements, and development of the digital stories locally and globally.

Furthermore, digital storytelling over the past ten years has experienced more democratization than before. People have had storytelling power in their hands since 2010, leading to democratic evolution. With such changes, we are now hearing and seeing various narratives and voices across diverse stands than ever before. If we contemplate the implausible power that digital stories possess to impact perception, build connections, and make the universe change happen, storytelling democratization is considerable for all individuals. Consequently, within the past ten years, digital stories have allowed human beings to live the "mantra" (nothing about people, without people) and generate a more all encompassing and equitable universe.

3   Studies on Digital Storytelling

Over the past decade, there have been various studies on digital storytelling in multiple fields. Some studies have focused on how they have been utilized to support teaching and

learning in the education field. In this study, Robin [7] explains that digital storytelling in the past ten years has increased the number of students and educators worldwide through computerized short stories in the form of video, music, and audio. In the medical and health sector, some studies focus on digital storytelling as a technique in health research. According to Rieger et al., digital storytelling in the health sector is vital in developing a detailed comprehension of how researchers have utilized it as a technique aiming to refine its future iterations. Other studies base on the effectiveness of digital storytelling in education, revealing identity, family, relationships, and even human rights witnessed through social movements. These studies present various digital storytelling practices such as research, communication, educational learning, marketing, and cultural awareness and practices through tourism.

Sports depression is a serious mental health problem among athletes. Ofoegbu et al. [8] conducted a study to determine the effect of a rational DST as an intervention for depression in a sample of adolescent-athletes with special educational needs. The participants consisted of 60 school-aged adolescent athletes with special educational needs (treatment group, n = 30, control group, n = 30) and moderate to severe depression. Hakanurmi et al. [9] studied the improvement of work quality and well-being in a business organisation through DST. A study by Kim et al. [25] in a clinical setting qualitatively analysed the metacommunication developed during the DST process for patients undergoing haematopoietic cell transplantation (HCT). DST has been adopted for university courses, including sociology courses. In an experiment by Vaughn and Leon [11], the practice was useful for the following: (1) developing students' sociological imagination and intersectional thinking by linking their own experiences to social theory, (2) developing transferable technological skills, and (3) learning to apply sociological concepts outside the classroom. Rodriguez-Illera et al. [12] analysed the reasons that guide the publication of personal stories as well as the kind of filters, agents, and consequences articulated in these stories. For this purpose, the most qualitative part of a survey on guidelines for publishing adolescents on the Internet is summarised. Specifically, the results of a semi-structured interview with 12 adolescents aged 12–20 were shown.

The responses showed that the respondents' perspective on what constituted a digital story went beyond format and varied depending on the network it was published on as well as the type of content. Thus, the emphasis and motivation of the publication shifted from the digital, which was incorporated as something normal and non-differential, towards the personal, focusing the publications on the daily lives of young people. Liontas and Mannion [13] presented the main benefits of DST for teachers and students. The main objective of the review was to maximise the conditions of multimodal creation for optimal online and offline learning. It was concluded that students are effectively able to transform themselves from passive consumers of technology into active creators of digital compositions, of a voice and of a story.

Computational thinking (CT) is a problem-solving skill that can motivate students to learn English. The "present, practice and produce" method has been applied as a method for presenting computational thinking in the English language learning class [14]. The results demonstrate the positive effect of the CT strategy on strengthening the problem-solving skills of students participating in DST and on increasing their motivation and performance in learning the English language. Nosrati and Detlor [15] explored how

cultural organisations in cities can use digital stories to enhance the public perception of a city. The aim of this study was to understand how end users are influenced by a city's cultural DST information system and the benefits of using such a system. Meanwhile, Shiri et al. [16] examined the role of DST in the enhancement and preservation of oral traditions and cultural heritage. Schmier [17] highlighted how enabling primary school students to use digital tools to tell their stories has created new spaces for pupils to represent their identities. This has also educated them from the point of view of media and helped teachers plan practices of meaningful reading.

4 Objective

This review aimed to find and evaluate available studies of digital storytelling, practices, and its models. The objective will also constitute an in-depth evaluation of practices and models of digital storytelling. Consequently, the entire study will evaluate diverse digital storytelling aspects and their effectiveness in communicating the message to the audience.

4.1 Overall Aim and Review Questions

This review's overall aim is to acknowledge and synthesize evidence on the studies, models, and practices of digital storytelling over the past decade. The questions that will direct this narrative review are as mentioned: a) What are the main foci of the studies and contexts of digital storytelling in diverse fields? b) What models are available for digital storytelling? c) What are the fundamental practices of using digital storytelling within various fields and in real life?

5 Materials and Methods

This narrative review will create evidence about the practices, models, and studies on digital storytelling in various sectors such health and education, maximizing on established review techniques used in solving health problems. It is a unique review since it focuses on the research technique instead of the intervention or phenomenon. Even though quantitative and qualitative studies and mixed methods will be included, only narrative information related to our study questions will be extracted. The PRISMA-P checklist [18] guided the progression of this review protocol.

5.1 Eligibility Criteria

Only research in English language and exploring the studies, practices, and models on digital storytelling was included. Including only English language articles is due to the cost of obtaining and translating other language articles. We considered published articles from 2010 to the present to align the evolving digital storytelling nature. Articles chosen had to have accurate abstracts and titles. Accurate abstracts and titles emphasized the studies and models touching on digital storytelling's effectiveness and use in various fields such as education and health. The eligibility criteria were explained mainly to include the following attributes:

- Published in the English language Peer-reviewed
- A standard item containing novel information
- Focusing on digital storytelling in the education, health, and marketing sectors principally
- Published 2010 to present
- Focus on specified areas and data collection somewhat

The articles chosen based on the above attributes were further reread and systematized based on demonstrative sample quality. The evidence levels of the sample studies utilized in representation must have been determined based on a specific confidence grade in representative samples. The pieces had to have experienced digital storytelling effectiveness or impacts on that particular study.

5.2 Intervention and Outcomes

This narrative review will include primary research studies that utilize digital storytelling as a technique at any point in the study process (data collection, analysis, recruitment, or knowledge translation). On the other hand, outcomes will be extracted related to how digital storytelling impacts the individuals and their activities over the past ten years. Such actions can improve health, education, and business marketing.

5.3 Search Strategy and Information Sources

Informed by an initial literature search for "digital storytelling" and its deviations, various primary search databases were used. They include Google Scholar, Art Full Text, PsycINFO, MEDLINE, EMBASE, PubMed, and Cochrane Library.

Regarding the inclusion and exclusion criteria used here, the articles were selected from peer-reviewed English journals that aimed to describe or evaluate the dimensions and variables expressed with respect to the research topic mentioned above (screening). Articles from publications that did not deal with the topic in relation to the fields of education/psychology, communication, marketing, as well as those for which the complete text (relevance) was not found, were excluded. A qualitative synthesis of the most relevant information was also conducted with comparisons done between the various publications.

The search on these databases reflected the range of likely terminology to capture studies appropriate to digital storytelling evolvement in the past ten years. Search tools and approaches particular to each database is used, including keywords truncation where suitable. It includes using subject headings and thesaurus terms and compounding search and terms strings with the eligible Boolean operators. For the comprehensiveness, papers that employed mixed methods, quantitative, and qualitative techniques were considered.

5.4 Data Extraction

The selection procedure started with reading the abstracts and titles of the considered articles. After identifying and excluding the abstracts that rarely seem satisfactory, the

remaining articles were fully explored. Articles and papers identified as appropriate for the narrative review process were inspected, and considerable information on the studies, models, and practices was extracted. Data extracted will comprise purpose, setting, benefits, limitations, procedures, and ethical standards of digital storytelling practices, studies, and models. Other collected information was reported from the commencement of the review where representatives of the chosen populations faced threats or biasness in looking for the studies. Limitations to the strategies used and research efficiency to allow their reduction was similarly taken as considerable information. The data collection setting observed the predetermined questions technique defined by the review research questions. The extracted information from selected studies will include:

5.4.1 Title, article/journal title, authors, publication date
5.4.2 Digital storytelling description
5.4.3 Role of digital storytelling
5.4.4 Findings or results of the study relevant to digital storytelling

5.5 Data Synthesis

A narrative review is a type of publication that describes and discusses the state of the science of a specific topic or theme from a theoretical and contextual point of view. This type of review article does not list the types of databases and methodological approaches used to conduct the review or the evaluation criteria used to determine the inclusion of retrieved articles during database searches.

A narrative review consists of the critical analysis of the literature published in books and electronic or paper journals. Narrative reviews have an important role in continuing education because they provide readers with up-to-date knowledge about a specific topic or theme. This type of review does not describe the methodological approach in a way that would permit reproduction of analyses based on the data or answer specific quantitative research questions [19]. Care was taken to prevent falsely presenting the results and avoiding the unsuitable focus on the results of a specifically selected publication for the research. Consequently, the data synthesis approach resided on the following procedures and comprised the following:

5.5.1 Review of the effectiveness of digital storytelling as it evolved over the past ten years.
5.5.2 Description of the models and practices from the digital storytelling point of view.
5.5.3 Supposed weaknesses, contributions, and strengths of each digital storytelling publication included. It was carried out depending on how they analyzed digital storytelling in each field they covered.

Generally, the extracted narrative data will be presented in an evidence table ordered by study design and research procedure/stage integrating the digital stories. Provided that this narrative review will evaluate how digital storytelling has been employed across different fields, we will not emphasize synthesizing the study findings of the included research. Still, we will assess digital storytelling's impact in various areas such as medical, educational, and marketing or between individuals. Additionally, the synthesis will evaluate digital storytelling models and practices.

6   Results

6.1   Selected Studies

The databases produced 300 references. In this case, 50 were published in PubMed, 50 in Medline, and the remaining were in EMBASE, Google Scholar, and Cochrane.

The process we undertook for including studies in the systematic review included over 300,000 results. After eliminating duplicates and articles in languages other than English, the search identified 301 studies consistent with the search parameters. After excluding publications that did not fit with the selection criteria (n = 245) and those that had to be excluded because their content or the ways that the researchers applied the concept of digital storytelling the areas of application of digital storytelling fall outside the parameters set for the research sample (n = 31), 25 remained that met the inclusion criteria. The studies were integrated with a supplementary keyword search on the latest trends in the literature on the topics addressed in this study.

After evaluating the articles based on the eligibility as mentioned above criteria, 25 studies were selected. The high number of similar research articles depicted that there has been a more concern with studies on digital storytelling over the past decade. There are diverse research topics about digital storytelling, its models and practices in various fields from these articles (Table 1).

Table 1. Assessed selected articles.

Author	Place of Study	The field in which the study focuses	Outcomes	
			Practices	Models
Ellison and Wang, 2018) [43]	Digital Storytelling Workshops in university computer labs and participants' home	The study focuses on digital storytelling between African American son and mother	Family literacy practices Digital literacies	Narrative model of digital storytelling
(De Vecchi et al. 2016) [44]	Digital databases for peer-reviewed literature	The study emphasizes how digital storytelling is utilized in supporting stakeholders of mental health	Psychology (mental health)	Interactive model of digital storytelling

(*continued*)

Table 1. (*continued*)

Author	Place of Study	The field in which the study focuses	Outcomes	
			Practices	Models
(Ribeiro 2016) [45]	The Polytechnic School in Porto, Portugal in Business Communication Course	Education. The study emphasizes identifying the practices and how students feel about digital storytelling in communication	Teaching with a primary focus on communication practices	Narrative and interactive models
(Pera and Viglia 2016) [46]	Airbnb's social platforms	Marketing with a primary focus in online peer-to-peer communities	Digital stories in aiding consumer experience relationship	Interactive
(Rieger et al. 2018) [47]	Critical Databases and grey literature	Healthcare research	Digital storytelling's significance in an in-depth understanding of health researches	Narrative model
(Beierwaltes et al. 2020) [48]	Nursing healthcare databases	Education in the healthcare setting	Provision of an educational intervention to nurses in healthcare practice and focusing on family practices	Interactive model in healthcare settings
(Kasemsarn and Nickpour 2016) [49]	Thailand	Tourism and marketing	Digital storytelling in increasing tourists' motivation	Interactive model
(Blue Bird Jernigan et al. 2011) [50]	California, United States	Research	Investigating food security and using digital storytelling as the approach in focus groups	Narrative

Table 1. (*continued*)

Author	Place of Study	The field in which the study focuses	Outcomes	
			Practices	Models
(Urstad et al. 2018) [51]	Norway: two diverse nursing education institutions in the country	Healthcare	Exploring the nursing students' experiences digital storytelling as a reflection tool during clinical placement studies	Narrative model
(Clisbee et al. 2019) [52]	Continuing education workshop via Academic Team and Translational Partners	Healthcare to promote continuous education to empower nurses	Adapting approaching in creating digital stories to minimize logistics concerns and overcome digital storytelling implementation	Interactive digital storytelling model
(Alexander 2017) [53]	The creation of Digital Storytelling through new media	The new Digital Storytelling	New platforms and new media for telling stories	Narrative models
(Canella 2017) [54]	Denver, Colorado	Collaborative media-making projects assist in building local grassroots campaigns of racial and economic justice	Social networks and community screenings	Narrative and interactive models
(Cersosimo 2020) [55]	Digital Storytelling in social sciences	Digital storytelling as the telling of stories through the network of digital media	Literacy practices Digital literacies	Narrative model

Table 1. (*continued*)

Author	Place of Study	The field in which the study focuses	Outcomes	
			Practices	Models
(Chan and Holosko 2017) [56]	Hong Kong, Japan	The use of social media in youth outreach engagement in Hong Kong	Online searches, initial encounters before direct verbal dialogue, ice-breaking via multi-modal communication, and snowballing	Interactive model
(Chan and Sage 2021) [57]	Digital Storytelling in Social Work	A narrative review of digital storytelling for social work practice	Digital Storytelling as a kind of narrative practice	Narrative model
(Pettengill 2020) [58]	A collaboration between Michigan-based, online water journalism organization and Ball State University in Muncie in Indiana	Social Media and Digital Storytelling for Social Good	Social media as a tool for accessing and connecting with already established communities	Narrative and interactive models
(Pireddu 2019) [59]	Britain	Creative works as an ongoing 'emergent' process at the intersection between porous media boundaries	Storytelling combines oral narrative (mode) in the form of a script (genre) but uses a variety of media to create meaning	Interactive and narrative models
(Podara et al. 2021) [60]	Digital storytelling in cultural heritage: Audience engagement in the interactive documentary new life	Storytelling in the context of interactive documentary	The Greek interactive documentary NEW LIFE as a case study	Interactive model

Table 1. (*continued*)

Author	Place of Study	The field in which the study focuses	Outcomes	
			Practices	Models
(Smed et al. 2021) [41]	Finland	Interactive storytelling	Platform, designer and interactor	
(Moradi, Chen 2019) [61]	Cina	A systematic review for the use and implementation of digital storytelling in education, specifically language education	The DST is a tool for mediating language education	Narrative model
(Rolbiecki et al., 2021) [26]	Colombia	Digital Storytelling as a bereavement intervention	Qualitative data revealed that for some, participation in Digital Storytelling facilitated growth and meaning-making	Narrative model
(Ofoegbu et al. 2020) [28]	Nigeria	Effect of digital storytelling intervention on burnout thoughts of adolescent	The digital storytelling intervention based on REBT significantly reduced burnout thoughts among disabled adolescent-athletes	Interactive model
(Rodriguez-Almagro et al. 2021) [62]	Spain	Digital Storytelling as a Teaching Method for nursing students	They believe that this teaching technique is more stimulating and more enjoyable than the conventional system, giving them more motivation to study the subject	Narrative model

Table 1. (*continued*)

Author	Place of Study	The field in which the study focuses	Outcomes	
			Practices	Models
(O'Byrne et al. 2018) [63]	United States	Digital storytelling to support students' learning by encouraging them to organize and express their ideas and knowledge	Students develop enhanced communication skills by learning to organize their ideas, ask questions, express opinions	Interactive model
(Kim et al. 2020) [42]	United States	Trial of a Digital Storytelling Intervention for Smoking Cessation in Women Living With HIV	A digital storytelling intervention seems to be a valuable strategy to enhance the effect of conventional tobacco dependence treatment for women living with HIV	Narrative model

6.2 Methodological Quality Assessment of Included Reviews

The two reviewers assisting with this review independently executed this assessment. However, these two reviews conducted pilot testing to assess the three review questions before the actual evaluation. The outcome showed suitable and reliable review questions reliability (depicting 85% agreement). They also performed the second pilot test on another review to evaluate if the understanding of reliability had improved. The second review pilot test showed 100% agreement depicting an improvement in reliability. Disagreements in the evaluations were managed in a consensus dialogue after comparing differences between the two assessors on digital stories. This narrative review has the following characteristics [20]:

- research method: not predefined based on a protocol, which implies subjective selection bias
- inclusion of studies: undertaken based on authors' intuition and research experience
- data extraction: non-protocol-based and providing a simple description of study results
- data quality: partially objective classification using anecdotal resources

6.3   Certainty of Evidence Assessment

To assess certainty in the general evidence body, we utilized the GRADE approach. Guyatt et al. [21] highlight that certainty of the evidence is how certain it is that the actual intervention effect lies within the selected range or on one side of a quantified threshold. In this review, the 95% of confidence interval was used the specified range, or the instituted MID (minimal importance difference) as the selected threshold. When available, GRADE and risk of bias assessments were utilized made by the included reviews' authors. When not available, GRADE was applied and assessed the potential limitations due to the bias risk, imprecision, inconsistency, and indirectness grounded the original studies.

6.4   Individual Studies Results

Individuals' articles were categorized as either representing an individual, group, or organizational-focused approach. Contemplating the individuals' category, the primary concern was the qualification and improvement of personal internal resources. Such could be carried out through the individual's dynamic behavior. Generally, the articles present a customized approach where the instruments perform considerably to empower individuals in digital storytelling via expanding their knowledge and skills. Concerning group approaches, digital storytelling practices and models promoted interprofessional collectiveness, interpersonal relations, teamwork, and good communication. The research articles advocate that digital storytelling has been the core of transition from analogue to digital stories over the past ten years regarding the organization mechanism. Improvement of the instruments and models used during digital storytelling can boost its practices in various fields. All the studies examined present diverse approach forms of practicing digital storytelling and what is perceived as the ultimate advantage: improved quality of digital storytelling practices (Table 2).

Table 2. Types of digital storytelling practices per category

Digital storytelling practices	Category type	%
Perfection of communication Stress management through web-based moves Meditation through digital platforms	Individual	5%
Communication Interpersonal relationships Interprofessional collaboration Teamwork	Group	80%
Improvement of work environment Incentives for healthy leaving and psychological improvement	Organizational	15%

7   Discussion

This narrative review concentrated on the frameworks, practices, models, and purposes for which digital storytelling is utilized in various platforms, circumstances, and fields.

Similarly, it outlines the impact of digital storytelling in such outlined areas and people's behavior on its usage. Given the popularity of social media platforms, for instance, Instagram (informal digital stories), Twitter (social movement digital stories), and Facebook, we speculate that diverse fields will continue to embrace and utilize digital storytelling. Such outcomes are because individuals, organizations, and even firms use digital storytelling for communication, marketing, education, and the health profession. Currently, this review depicts that most digital storytelling studies over the past ten years are happening in educational, health care, and marketing settings. These findings emphasize that education, health, and marketing fields often utilize digital platforms, constructive environments, and collaborative learning in different practices. In a medical or health setting, there is a developing interest in arts-based education which entails digital storytelling. Such pedagogy utilizes art as a channel to back knowledge progression in subjects other than art. People can create art such as digital stories or respond to that of others to learn specific matters. Research reveals that the digital stories pedagogy can foster cultural awareness (for example, through tourism), community partnerships, social collaboration, self-awareness, observational skills in nursing, and whole personal progression. Therefore, as interest in arts-based teaching intensifies, were more confident that digital storytelling will become more predominant in various professions in the coming years. A significant question raised by this review's findings is: what counts or constitutes digital storytelling? As defined in the introduction, digital storytelling necessitates that it combines first-person and stand-alone narratives with multimedia. Therefore, from this review, digital storytelling constitutes or counts digital platforms and is used for diverse practices. From this review, communication, health, marketing, and family practices through digital storytelling have been more critical in the past ten years. Similarly, interactive and narrative models have been used in such practices over the last ten years.

8   Conclusion

This narrative review assessed 25 empirical studies. All studies focused on digital storytelling, as well as different fields of tourism, then marketing, communication, health, such as psychology and education. Therefore, the assessed studies reported on the utilization of digital storytelling for varied, diverse aims, practices and covered an extensive range of topics. The authors emphasized the following issues:

- Family interactions and learning from generating their digital stories
- Health practices and professionals' learning from the variation of digital stories
- Digital storytelling variations and impact on tourism and marketing
- Communication practices in digital storytelling over the past decade
- Digital storytelling as a research method in the health profession
- Digital storytelling effects in supporting learning and education

Overall, creating digital stories in different fields enhances the understanding, promotes cultural activities, research, and gives individuals the platforms to express themselves. There is a growing number of publications establishing DST as an effective

strategy for improving hypertension outcomes. DST reduced unscheduled meetings, and the programme was deemed feasible [22]. The study by Enverga et al. [23] aimed to explore the lived experiences of school-age students while digitally narrating the story of a boy and his undesirable food choices. The participants exhibited varying degrees of connection and understanding with the digital story and no doubt encountered a learning experience through the digital story presented. DST supports student learning and enables teachers to adopt better and innovative teaching methods. Fiction is a proven and popular pedagogy; however, DST is relatively recent and still rarely used in early childhood education. Using a case study of "fiction – art – science club" in Jakarta, Indonesia, Rahiem [24] explored how and why DST is used in early childhood education. It was found that DST is engaging and communicative. Kim and Li [10] examined how DST has facilitated middle school students' reflection and learning. It showed how to incorporate DST into a school curriculum to develop expressive resources and identity by improving motivation, creativity, and connection with others. Rolbiecki et al. [26] studied bereaved family members. The data revealed that participation in DST induced various effects: (1) writing and verbalising the script helped participants organise their thoughts and emotions about the loss; (2) having the space to share with a collective group enhanced their confidence in their ability to discuss their feelings with others; and (3) the final product served to process and distance themselves from the event. Hsieh [27] probed the positive and negative effects on students and their perceptions as a result of various presentation modes (robot-assisted or PowerPoint-assisted) using DST. This study involved 52 eighth-grade students. Despite the positive emotions experienced in both modes of presentation, the results of negative emotions were more mixed, as the students in both groups highlighted the feeling of fear during preparation and presentation. In addition, some trials [28] used DST intervention based on rational emotional behavioral therapy, which shows great potential in addressing burnout among adolescent athletes with disabilities. Furthermore, DST is an effective method for reducing anxiety in patients who are candidates for open heart surgery [29]. Patients with post-traumatic stress disorder (PTSD) can recall their memories in a digital diary and recreate them in a 3D WorldBuilder. During therapy, a virtual agent is present to inform and guide patients through the sessions, using a question form to recall traumatic memories [30]. This system has the potential to be a valuable addition to the spectrum of PTSD treatments, offering a new type of virtual agent-assisted home therapy. VoicingHan [31] is a project that uses digital avatars that promote the reworking of the meaning of one's life for dying patients. VoicingHan enrolled 12 patients receiving outpatient palliative care at the VCU Massey Cancer Centre. The narrative performances were recorded via the avatar video format to build the life re-meaning process. One study developed a marketing simulation through DST to facilitate the learning of marketing strategies; this is a useful tool for entrepreneurs that includes communication techniques, emotional involvement, and user persuasion [32]. The aim of the study by Fischbach and Guerrero [33] was to explore how the DST of a brand's story creates a transformative learning experience for students. The tool is therefore digital brand storytelling, a new and contemporary application area of this DST model.

The applications of DST include its link with creativity. For instance, using creative DST to help crowdsourcing companies [34] brings out the persuasive nature of the practice. In the context of learning, the goal was to evaluate the development of students' creativity through the practice of science-centred DST [35]. The students turned their personal values into stories; hence, this creative procedure was influenced by social, cultural, and ethnographic characteristics. DSTs conveyed on social media through hashtags also lead to some political discussions. This is the case for the narratives on the theme of LGBTQ rights and freedom of speech to challenge political censorship [36]. Social participation and democratic commitment have often accompanied the application of DST. In fact, DST is a democratic tool for mediating knowledge and a mode of scientific diplomacy [37]. Dissemination has produced science-citizen interfaces highlighting citizen engagement in critical scientific debates. Within this sector, there exists a niche of studies conducted on the relationship between DST and social movements [38]. Analysis in the context of applying social participation and democracy through qualitative data indicated the power of the feminist DST for opportunities, access, validation, and healing with respect to HIV disease, promoting social equity in sexual health, or advocating for abortion rights in Ireland [39] or as a bereavement intervention in the family [26]. Special needs are also experimenting with this practice as an inclusive laboratory, such as in the project that used an innovative DST to explore the experiences and perspectives of five four-year-old autistic children and their families. As the children prepared to make the transition from inclusive day-care to primary school [40]. The authors tried to answer two related questions: (1) How do we listen to children who "have no words"? (2) What do we learn from them when we do so?

Rahiem [24] suggested that teachers' ability to use DST should be improved. Information and communication technology (ICT) devices in schools should be more widespread, as governments need to modernize school equipment, which is rapidly becoming obsolete. Similarly, the curriculum should be adapted to meet technological developments and provide opportunities for children to learn how to make good use of technology.

New digital media and new technologies have revolutionized the way of storytelling; starting from the 90s, we start talking about "Interactive Storytelling" on the basis of some studies done on the presentation of stories on two-dimensional screens [41]. "Interactive Storytelling" means a particular storytelling technique in which the reader is an integral part of the story itself.

Unlike conventional storytelling, where the author of the book has full control over what happens in the story, in Interactive Storytelling users or readers can transform the story in real time, based on a series of interactions with the content and of choices made. The plot, in fact, is not static but varies on the basis of the choices made by the reader. When structuring an "Interactive Narration" it is necessary to take into account four fundamental elements:

1. The platform - in which to build the story;
2. The designer - who structures the story;
3. The interactor - who modifies the story on the basis of his choices;
4. The Storyworld - which includes all the characters, props, scenes and events organized by the designer for the interactor.

The designer structures the skeleton of the story on an ad hoc platform (providing the characters, external events and props), which is however experienced and influenced by the interactor. As the interactor makes his choices, various instances of the story are created. Since the interactor is the one who mainly experiences the story as it unfolds, he generally plays the role of the protagonist.

Furthermore, the choices made by the interactor can be more or less significant, changing the story significantly or imperceptibly; it follows that the degree of interaction with history also varies.

The degree of interactivity of the story can be influenced by three factors:

- Speed: the faster the turnaround, the better the chances of interaction. This means that stakeholders can react faster and see the result of their actions faster.
- Depth: it concerns the human similarity of the interaction. It takes into account not only simple cognitive modalities, such as hand-eye coordination or spatial reasoning, but also social reasoning, which is fundamental in these types of history.
- The choice: which concerns both the functional meaning of the interactor's choices, and the perceived completeness, or the number of existing choices compared to those that the interactor can imagine.

9 Limitations

Foremost, while the review attempted to identify relevant search terms, provided the searching complexity within digital storytelling topic in the past decade, the study might have unintentionally omitted keywords or synonyms utilized for digital storytelling. Therefore, the review could have missed empirical studies on this theme. Digital storytelling dates back to the 1970s. The ten-year criteria of this study might exclude significant studies regarding the practice. Therefore, it could have missed older or recently published studies on this theme. Thirdly, most studies assessed have focused on digital storytelling practices without including the cause of changes in digital storytelling over the past ten years. Lastly, there is no recognized standard for gauging the changes in digital storytelling in various fields. Instead, the studies assessed utilize practices and how they impact people and activities in their particular fields as the standard for measuring digital storytelling changes.

9.1 Implications for Digital Storytelling Practices

Individuals can benefit as much as organisations by incorporating digital storytelling practices in their daily activities. Communication, marketing, psychology, health, and education are dynamic fields and require people to engage on deep levels to be effective. Digital stories offer the potential to meet these expectations. The significance of digital storytelling is that it creates a collaborative framework, promotes effective communication, and enhances better interpersonal relationships among diverse professions.

The application of DST is no longer restricted to the educational field. The review shows that DST is adaptable to various forms of intervention to promote personal

well-being [43, 44]. However, there is a lack of analyses that demonstrate this using quantitative methods.

This review highlights the necessity for additional high-quality research on the impact and usage of digital storytelling in educational, research, communication, marketing, and psychology fields.

9.2 Implications of the Review

It is evident that digital storytelling practices and models are changing. However, these practices cannot be solely relied on as the standards of measuring the changes. It should include all significant changes over the years and their impact on individuals. However, while it is impossible to adopt and establish a standard measurement approach for digital story changes, digital history workshops should promote and publish not only the changes but also the implications on people, to improve familiarity with variations.

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Problematic Use of Social Networking Sites Among Adolescents in the Czech Republic Versus Offline Risk Behaviour and Parental Control

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Abstract. The Problematic Use (PU) of Social Networking Sites (SNS) is a diagnostic and preventive as well as educational challenge. Problematic Use of new media is currently a phenomenon discussed by psychologists, sociologists, and media educators in the field of diagnosing the scale of the phenomenon, as well as protective factors and risks related to this phenomenon. This text is part of the debate on the scale of SNS among young people, as well as on the role of parents in reducing this phenomenon. The text also juxtaposes issues related to the prediction of PU SNS and risk behaviours in the offline space. The study employed a triangulation of quantitative tools in the form of: frequency of SNS use, parental control online, and scale of psychoactive substance use. Based on the data collected among a group of adolescents in the Czech Republic (N = 531 individuals aged 13–19 years, study year 2018/2019), it was noted that: 1) Almost 75% of adolescents systematically use SNS before bedtime; 2) Every fifth adolescent consumes dinner daily or almost daily accompanied by SNS; 3) Less than a third of respondents use SNS almost continuously; 4) SNS UI indicators are mutually related; however, the relationship is not always strong; 5) Girls have a slightly higher level of PU SNS than boys; 6) Systematic alcohol consumption is a predictor of PU SNS; 7) Parental restriction of Internet use time leads to a reduction in PU SNS among adolescents.

Keywords: Problematic internet use · Social networks · Adolescents · Czech Republic · Offline risk behavior · Parental control · Parents

1 Introduction

The current stage of development of the information society is characterized by an increasing intensity in the use of digital services [1, 2] and a simultaneous increase in

awareness related to the positive and negative impact of new media on individuals and social groups [3]. Paradoxically, the development of new technologies, which by definition was supposed to contribute to the improvement of the quality of life of people using information and communication technology (ICT), has revealed itself to be something of a trap at the same time. It transpires that selected digital services have the potential to negatively affect selected social groups. One example of such a condition is Problematic Use of the Internet (PUI). PUI consists of intensive, unsupervised use of digital services, in particular Social Networking Sites (SNS), instant messaging, online shops, online games, gambling sites, and pornography sites; as well as proving a behavioural challenge, it has also become something of a diagnostic and preventive challenge as well [3]. PUI is an umbrella term that covers various forms of uncontrolled SNS use. The groups at particular risk for out-of-control use of SNS and online games are primarily adolescents [4, 5]. Considering that adolescents are a group at particular risk there is a need to undertake in-depth research on the scale of the phenomenon in this group with a particular focus on countries where research on PUI is rarely conducted on large research samples [6, 7]. The present text fills the gap in relation to one type of PUI, that of the style of SNS use among Czech adolescents. The text is also an attempt to discuss the concept of excessive SNS use and to link this concept to the broader framework of Problematic Internet Use, which is sometimes erroneously identified with Internet addiction.

2 Theoretical Framework

Problematic Internet Use is a theoretical concept that emerged as an attempt to describe the colloquial term Internet addiction. Due to the unclear diagnostic criteria associated with digital addiction, the concept is controversial among both experts in media psychology and pedagogy and young people who use new technologies intensively [8–10].

The concept of PUI is a safer term, not only because it does not evoke stereotypes, but above all because it offers space for a discussion on diagnostic criteria and effective ways of counteracting the excessive and uncontrolled spending of time on the Internet. The issue of combatting PUI is also an element in strengthening digital security, i.e. raising awareness and shaping habits related to controlled use of new media while maintaining a high level of reflection relating to how ICTs transform users' habits [11]. Studies devoted to PUI, or ICT use more broadly, contain many elements. On the one hand, one can find studies devoted to the constructive use of ICTs, where new media satisfy different needs of individuals [12, 13], while on the other hand, there are indications that ICTs make that relationship shallower, triggering conflicts that result from the time spent using ICTs in the immediate family environment [14]. In general, since ICTs are characterized by a high level of duality, the analysis of selected PUI factors requires particular care not to create additional stereotypes about the functioning of selected age groups in cyberspace.

Problematic use in this text will be understood as a situation related to the misuse of online services that lead to conflicts with the environment and have a negative impact on the quality of life of individuals, and that occur in inappropriate situations. Among the types of PUI there can be distinguished the Problematic Use of social networks (PU

SNS). Due to the popularity and ubiquity of SNS, as well as the place that SNS occupy in the lives of young people, it seems reasonable to distinguish this type of PUI. Among the diagnostic criteria of problematic SNS use is, first of all: the place of SNS use, the time of SNS use, the type of activities undertaken in SNS, the type of needs that SNS satisfy, and the type of negative consequences that they cause in the individual and from a macro-social perspective. Due to the multiplicity of indicators, this study uses a simple SNS PU scale [15], which takes into account only the key parts of daily life currently affected by active SNS use.

In this text, PU SNS will be defined as the use of different types of Social Networking Sites in an uncontrolled manner. SNS generate many individual and social problems. Individual problems include: loss of control of one's own behaviour, reduced mobility, reduced physical fitness, reduced activity in cyberspace, reduction of one's own life to virtual communication spaces, building one's own identity on the basis of SNS, and deteriorating school grades. Social problems include conflicts in the immediate environment due to the intensive use of SNS, and a lack of social interaction (especially peer interaction) outside SNS (Fig. 1).
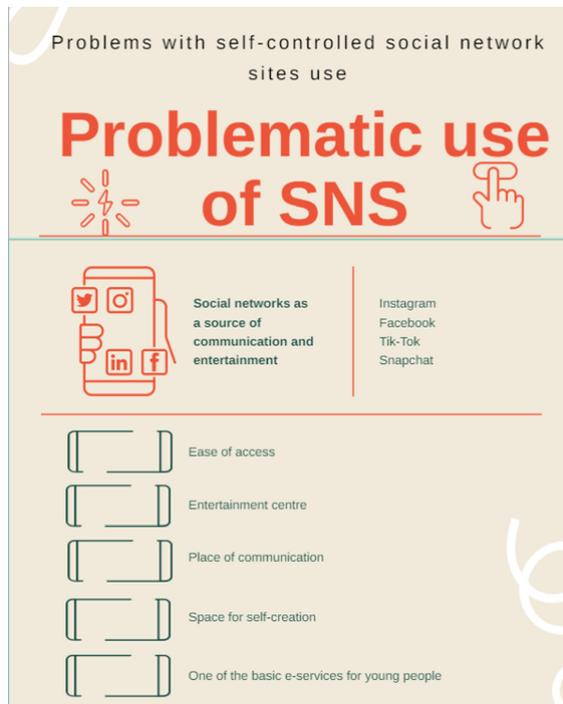
Fig. 1. Characteristics of problematic SNS use

Diagram number 1 presents the typical features associated with SNS. The popularity of SNS is due to several features of the development of the information society. First,

access to this type of service is now provided by easily accessible devices (e.g., smartphones) with unlimited Internet access. SNS are characterized by an attractive visual interface, enabling quick and seamless sharing of information and networking with other users. SNS provide access not only to attractive pieces of information created by other users and commercial entities, but are also an entertainment center. SNSs are a space for the ready creation of one's own image, through posting photos, descriptions, comments, and the interactions that occur with other users [16]. SNSs have become fundamental among the e-services used by adolescents that do not require advanced digital competence. SNS developers stimulate user activity through a system of notifications about other users' activities and information profiling. It is also increasingly noticeable that SNS use algorithms to target selected age groups and the type of content viewed and posted by users. Due to all the mentioned features of SNSs, it is these types of sites (Tik-Tok, Instagram, Facebook) that have become the most popular sites in cyberspace.

In this text, the authors seek to highlight not only the scale of the PU SNS phenomenon, but also to show to what extent PU SNS is related to parental influence and the risk behaviour of adolescents. This research is unique because to date no such analyses have been conducted with respect to Czech adolescents in the narrow field of PU SNS. The research is an extension of analyses conducted in the same area, but in other countries [17–20].

3   Methodology

3.1   Aim of the Research and Research Problems

The aim of the research is to show the scale of Problematic Use of social networks and the issues that differentiate this phenomenon according to sociodemographic variables. The indirect aim is to determine the level of influence of risk factors (risky behavior in the offline space) and protective factors (restrictive upbringing methods in the home environment) on PU SNS. The subject of the research are the declarations of adolescents from the Czech Republic. The following research problems are assumed:

RQ1: What is the level of Problematic Use of Social Networking Sites among adolescents in the Czech Republic?
RQ2: To what extent are indicators of the level of Problematic Use of Social Networking Sites mutually related?
RQ3: To what extent is the level of Problematic Use of Social Networking Sites differentiated by sociodemographic variables?
RQ4: What is the relationship between problematic social network use and online risk behaviors with the application of a restrictive new media parenting style in the family environment?

3.2   Research Tools

The study used a triangulation of quantitative research tools. The research tools were translated into Czech and then transferred into digital form. The battery of tests consisted of the following research tools:

1. SNS use frequency scale [15], consisting of 5 items measuring SNS use style at mealtimes and just before bedtime and after waking up. Responses were constructed on a 5-point Likert scale ranging from 1 - never (low SNS use) to 5 - daily (high SNS use).
2. Parental control of online activity [21, 22] constructed from 7 items, using a Likert scale from 1 - never (no parental control of digital safety) - to 5 - very often (high level of parental control of digital safety).
3. Scale of psychoactive substance use [23] constructed from 5 items, Likert scale from 1 - never (no experience of psychoactive substance use) - to 5 - very often (many systematic experiences of psychoactive substance use).

The instrument also included basic sociodemographic questions such as age, gender, place of residence, and type of school attended. The questionnaire also included a field related to the family's subjective sense of wealth, which was inspired by similar research on digital risk behavior [24].

The tool was translated by experts with many years of experience in conducting research on risk behaviour in online and offline spaces. The battery of tests was adapted to the age of the adolescents. The adaptation of the tool took place through pilot studies as well as through feedback offered by two experts involved in the research project. These tools included in the test battery are widely used to measure risk behaviour in selected Central and Eastern European (CEE) countries. However, this study did not aim to standardise tools on representative samples.

3.3   Research Procedure

The research was conducted using an online survey. The original versions of the tool were translated from English into Polish and Czech. The translations were completed by a Polish and Czech team of researchers specializing in media pedagogy. The research was planned in cooperation with scientists from Palacky University in Olomouc and Pedagogical University in Cracow. The research was conducted among Czech adolescents during the school year 2018–2019 by volunteers cooperating with the Centre for the prevention of risky virtual communication Faculty of Education of Palacký University in Olomouc (PRVOK).

3.4 Selection and Characteristics of the Research Sample

The research was carried out across the whole Czech Republic. The data were collected by persons cooperating with PRVOK. The research was conducted in the school year 2018/2019. The respondents filled in electronic forms in the school institutions, with 531 respondents being surveyed. Of the respondents, 58.6% were girls and the remaining 41.4% were boys. The respondents were adolescents aged 13–19 years (mean = 16.61, median = 17, standard deviation = 1.76). The research was conducted among adolescents living in: villages (46.9%), towns up to 50 thousand citizens (37.7%), cities from 50 to 100 thousand (7.7%), cities over 200 thousand (5.8%), cities from 100 to 200 thousand (1.9%). The respondents described the subjective status of family wealth as: medium (76.8%), wealthy (13.0%), low status (10.2%). The study included students who were educated in: secondary school that offers the maturity exam (N = 426, 80.22%), primary school (N = 99, 18.64%), secondary vocational school without the maturity exam (N = 6, 1.12%).

3.5 Research Ethics

The research was conducted following the usual ethical principles for social sciences. The questionnaire study was approved by PRVOK staff. The questionnaire was screened for offensive questions and data collection was sensitive to the respondents. The tool was devoid of items to identify respondents. Participation in the study was completely voluntary. The respondents could opt out of completing the questionnaire at any time. Participation in the research required a multi-step consent: school management first, and then the respondent. The research tool was preceded by a letter of introduction showing the purpose of the research, as well as the how the collected data would be processed.

4 Results

4.1 RQ1: Level of Problematic Use of Social Networking Sites among Adolescents in the Czech Republic

Based on the data collected, it can be observed that Problematic Use of Social Networking Sites most often takes the form of SNS use as the last activity before bedtime. In this case, half of the respondents declare that SNS use is one of the last activities undertaken before bedtime. On the other hand, just after waking up, almost a third of the respondents also check new SNS resources with very high frequency. Almost every fifth teenager regularly checks SNS resources while eating dinner, while during other meals 11.3% do so during breakfast, and 13.2% do so very frequently during lunch. A detailed summary of the responses related to the frequency of SNS use during meals, just after waking up, and before going to bed is summarized in Fig. 2 below.
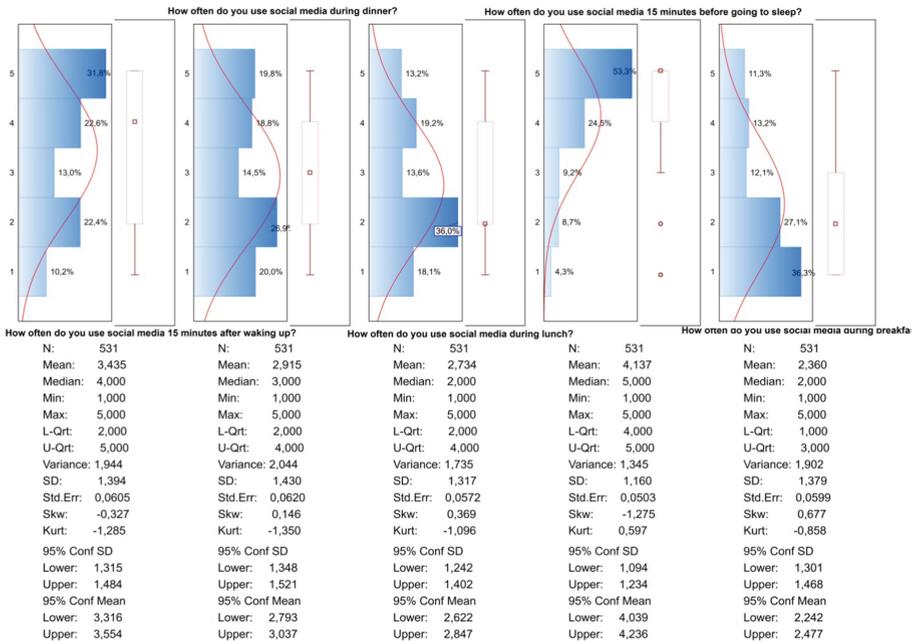
Fig. 2. Descriptive statistics - distribution of responses for the variable *Problematic Use of Social Networking Sites*

Using the k-means cluster analysis technique, four major groups can be distinguished according to the intensity of social media use. Cluster number 4 (pink) are those who use social media in all situations. Cluster 4 (N = 28.06%) includes almost a third of the respondents. These are the young people who actively use new media regardless of circumstances. The converse situation is seen in Cluster 2 (N = 135, 25.42%), where one in four of the surveyed teens use SNS at a very low intensity. Cluster 2 confirms the stereotype that not all individuals from the younger generation are immersed in social media activities without interruption. In contrast, Cluster 1 (N = 100, 18.83%) and Cluster 3 (N = 147, 27.68%) show that the adolescent group is strongly heterogeneous in terms of situations related to frequent SNS use. Nevertheless, it should be emphasized that what almost 75% of the adolescents have in common is their very frequent or frequent SNS use just before bedtime. The detailed distribution of the cluster analysis is presented in Fig. 3.
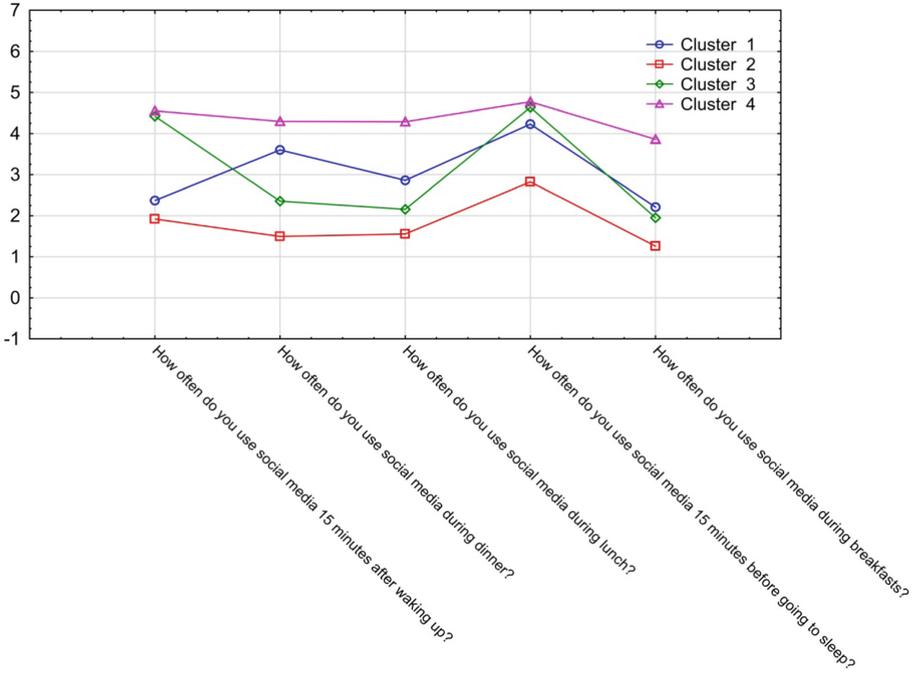
Fig. 3. Cluster analysis by k-means: adolescent groups by frequency of SNS use

Obviously, the five indicators indicated do not cover the full range of problematic situations related to SNS. It is important to include in further studies more variables related to the actual time use of SNS. The issue of limitations resulting from the applied research tool is discussed in Subsect. 4.1.

4.2   RQ2: Co-occurrence of Indicators of Problematic Social Network Use

To analyse the co-occurrence of indicators of Problematic Use of social networks the rho-Spearman correlation coefficient was used. All 5 indicators are positively correlated with each other. The co-occurrence is characterized by medium or strong strength. This means that adolescents who have adopted the habit of using social networks very often repeat the same behavior in different situations. For example, respondents who declare that they happen to browse SNS resources during breakfast also very often repeat this behavior during dinner or lunch. The results of the correlation coefficient are an important indication for the process of prevention of risky behaviors associated with new media. Table 1 below presents the results of the correlation test between the indicators.

Table 1. Correlation coefficient for indicators of problematic social network use

	1	2	3	4
1 How often do you use social media 15 min after waking up?	-			
2 how often do you use social media during dinner?	.4038***	-		
3 how often do you use social media during lunch?	.4318***	.6634***	-	
4 how often do you use social media 15 min before going to sleep?	.5509***	.4531***	.4327***	-
5 how often do you use social media during breakfasts?	.4335***	.4556***	.6467***	.3264***

4.3 RQ3: Level of Problematic Social Network Use Versus Sociodemographic Variables

The differentiation of behaviors related to problematic SNS use was also analyzed for changes according to sociodemographic characteristics. Based on the one-way analysis of variance, it was noted that slightly higher saturation of this type of problematic behaviour occurred among girls than among boys. Such a regularity is noticeable for all five indicators. A detailed visualization of gender differences is presented in Fig. 4.
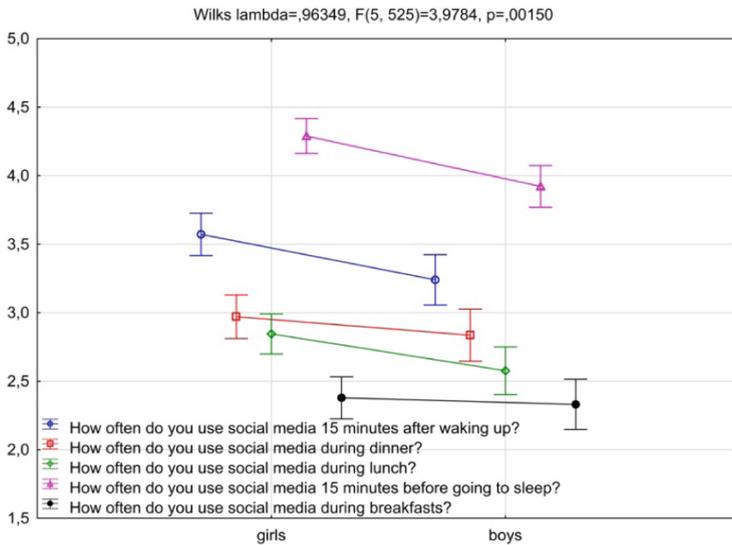
Fig. 4. Problematic use of SNS and gender

It was also observed that the subjective wealth status of the family is not related to the level of the discussed e-risk, with Wilks lambda = .98983, F(10, 1048) = .53704, p = .86461. However, it was observed that a slightly higher level of saturation of selected problematic behaviors related to social media is found among students from secondary vocational schools that do not offer a high school diploma (in particular, browsing social media resources during breakfast). A detailed depiction of co-occurrence is presented in the Fig. 5 below.
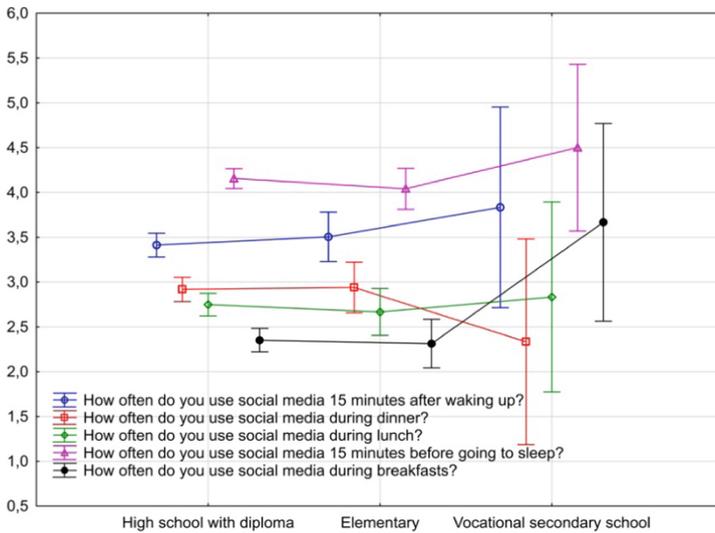
Fig. 5. Problematic use of SNS and school type

Metric age does not correlate with any of the indicators and thus was not deemed statistically significant.

4.4 RQ4: Predicting the Level of Problematic Social Network Use Versus Offline Risk Behaviors and Parental Control

In the present research, it was assumed that it is possible to predict problematic SNS use by considering the scale of risky behaviors in the offline space, as well as the forms of education for safe use of new media in the family environment. Separate calculations were performed for each form of problematic behavior use using multivariate regression analysis. Firstly, the collected data clearly show that combining risky behaviors from the online and offline sphere do not always correlate. In the present predictive models, three such cases were noted in reference to alcohol consumption, which determines the increase of selected forms of problematic SNS use. Moreover, in this age group, the most effective way to reduce the level of problematic SNS use is parental control over the time spent online. Since there is a different intensity of PU SNS for each of the behaviours identified in the tool, it was decided to carry out a predictive analysis separately for each factor. However, it should be clearly emphasized, referring to Table 2, that these are not indicators that have a strong impact on all adolescents.

Table 2. Predictors of problematic SNS use versus offline risk behavior and online parental control

	How often do you use social media 15 min after waking up?		How often do you use social media during dinner?		How often do you use social media during lunch?		How often do you use social media 15 min before going to sleep?		How often do you use social media during breakfasts?	
	β	SE	β	SE	β	SE	β	SE	β	SE
Cigarette smoking	0,03	0,06	0,02	0,06	0,03	0,06	0,11	0,06	0,06	0,06
Alcohol consumption	0,13	0,07	−0,08	0,07	**0,13***	**0,07**	−0,05	0,07	**0,17***	**0,06**
Getting drunk	0,03	0,07	**0,18***	**0,07**	0,00	0,07	0,12	0,07	0,00	0,07
Smoking marijuana	−0,02	0,06	0,02	0,06	0,08	0,06	−0,01	0,06	0,07	0,06
Drug use	0,05	0,05	0,07	0,05	0,08	0,05	−0,01	0,05	0,07	0,05
Parents check if I use the Internet safely	−0,01	0,07	−0,08	0,07	−0,12	0,07	−0,03	0,07	−0,03	0,07
Parents check what I do on the Internet	0,03	0,07	0,07	0,07	0,11	0,07	0,06	0,07	0,06	0,07
Parents control the time I spend on the Internet	−0,05	0,05	**−0,16***	**0,05**	−0,06	0,05	−0,05	0,05	**−0,11***	**0,05**
My parents control the software I download	0,04	0,05	0,03	0,05	−0,01	0,05	−0,07	0,05	0,01	0,05
Parents control the games I play	−0,04	0,06	0,02	0,06	−0,07	0,06	**−0,13***	**0,06**	0,05	0,06
My parents control the websites I visit	−0,07	0,07	0,01	0,07	0,02	0,07	0,03	0,07	−0,04	0,07
I have parental control software installed for my Internet activities	0,05	0,06	−0,02	0,06	0,03	0,06	0,00	0,06	0,02	0,06
	$R =,212$ $R2 =,045$ $F(12,518) = 2.04$ $p < .0190$ Std. Error of estimate: 1.3782		$R =,252$ $R2 =,063$ $F(12,518) = 2.94$ $p < .0005$ Std. Error of estimate: 1.3991		$R =,270$ $R2 =,073$ $F(12,518) = 3.40$ $p < .0000$ Std. Error of estimate: 1.2828		$R =,247$ $R2 =,061$ $F(12,518) = 2.80$ $p < .0009$ Std. Error of estimate: 1.1368		$R =,310$ $R2 =,096$ $F(12,518) = 4.61$ $p < .0000$ Std. Error of estimate: 1.3261	

*$< 0,05$, **$< 0,001$, ***$< 0,0001$.

5 Discussion

Adolescents most often use social media just before going to bed and just after waking up. Based on the data collected, it was noted that three-quarters of the respondents engage in such activity in the evening very often or every day. This behavior is dictated by the desire to access information in digital form, thus satisfying a basic need in the information society. SNS sites also allow adolescents to keep up to date with information shared by peers and peer groups, and to communicate with those close to them. Thus, the issue of frequency of SNS use, on the one hand, is a factor with which to identify problematic Internet use, while on the other hand, it is a factor that has a close relationship with the social needs of adolescents [25–27]. As part of the answer to the first research problem, it was also noted that young people very often use SNS during selected meals. This is also one of the factors that can be considered as inappropriate use of new media [28, 29]. Such behaviour is increasingly becoming the norm, which is sometimes more often criticised by older people, e.g. parents, while among some young people it does not raise serious objections linked to savoir-vivre, or is treated as something that needs to be corrected [30, 31]. Analyzing the scale of the phenomenon, it was also noted that not all young people use SNS extensively in all of the situations mentioned in the study. Based on the data collected, only about a third of the respondents are up-to-date (all the time) with social network resources. This result is more or less consistent with studies conducted in other countries among adolescents [32]. This means that not all young people are characterized by high levels of problematic Internet use. The results send a clear message that treating all young people as internet and smartphone addicts is an abuse caused by the stereotypes circulating in public opinion [33].

The collected results of the research confirm the previous results on different forms of problematic Internet use. Regardless of the adopted diagnostic factors (and the tools used to measure them) and measurement scales, there is a high probability that the indicators measuring the analyzed phenomenon mutually co-occur [34, 35]. Of course, co-occurrence is not always characterized by high strength of correlation for all diagnostic indicators. The diagnosis of the PUI scale may therefore take a different form depending on the adopted reasons for new media use, time, type of devices used, and many other elements related to the style of digital media use.

The findings among Czech adolescents do not differ significantly from analyses from other countries. Girls are slightly more likely to have higher levels of problematic SNS use than boys. However, this relationship is variable in the context of problematic Internet use depending on the diagnostic criteria adopted, as well as the type of behaviour commonly classified as 'Internet addiction'. In this respect, particular caution should be exercised in terms of attributing the behaviours in question to gender. Moreover, when analyzing the elevated level of problematic SNS use, it is necessary to link the given indicators to the specific needs they satisfy [36–39].

Adolescence is a marked by a tendency to test external limits, such as those set by teachers and parents. Many of these behaviours are treated as typical for this developmental period. Others, on the other hand, are treated as deviations from social norms and are sometimes a source of intergenerational conflict. Maturation involves redefining the boundaries set by adults [40, 41]. Earlier parenting strategies (e.g., those used in late childhood) related to setting boundaries regarding the use of new media, e.g.,

controlling the websites visited or using software that limits the time of new media and access to selected websites, do not meet the assumed goals for adolescents' functioning in cyberspace. The results of regression models for all indicators of problematic SNS use clearly indicate that only for a selected group of adolescents is parental control of time spent on the Internet a factor reducing the intensity of SNS use. Therefore, in order to conduct prevention of behaviors related to problematic Internet use, it is necessary to move away from the assumption that only restrictive methods of education to new media are able to increase the level of digital safety of adolescents and protect this group from the harmful effects of new media [42–44]. Increasingly, it is not so much parental control as universal skill development that is becoming key to achieving a reduction. The prevalence of high levels of PUI is seen primarily among young people who have problems with self-control or who have unclear boundaries for SNS use in the home environment [45–47]. Prevention of risk behaviors in cyberspace should therefore capture a set of individual and social determinants.

6   Research Limitations

The data collected are characterized by several limitations. Firstly, the sample was selected in a near random manner. It is not a study based on full and stratified sampling considering the size of the different regions in the Czech Republic. This means that the data are not characterized by a structure that allows generalization of SNS problematic use behavior among all adolescents in the Czech Republic. Moreover, the data were collected in the pre-pandemic period, so the style of SNS use in this period is likely to differ significantly from the pandemic period, where a definite increase in the frequency of use of various e-services, including SNS, has been observed [48, 49].

Research on styles of SNS use is evolving. There is now increasing attention to issues related to the prevention of problematic Internet use, which includes problematic SNS use. When analyzing this type of behavior among adolescents, it is necessary to look more precisely at the different types of time spent using this type of media (screen time, awake time, thinking about SNS), as well as the real impact of SNS abuse on the quality of life in the offline space. Moreover, screen time should be much more precisely measured using improved indicators than the classic Likert scale. Real time measured through embedded applications (e.g. parental controls in Android systems) may become an effective solution in this case. Another interesting issue related to the Problematic Use of SNS is the connection between activities in SNS and the real needs of adolescents. Narrowing the research only to inappropriate locations and times of day may lead to partially accurate conclusions characterized by the error of reductionism.

It should be clearly noted that the research tools used are based on questionnaires that have not been validated in the Czech Republic on a representative sample of adolescents. Therefore, it is important to be aware that the present research is characterised by limitations resulting from the lack of a full adaptation of the tool to cultural and linguistic conditions. Such an action will be taken in the next stages of research on problematic Internet use.

7 Conclusions

The present research is an attempt to look at adolescents' style of new media use. The research allows us to look at problematic SNS use from the perspective of times of day, places, and frequency of use, as well as the influence of parental control and selected forms of risk behaviors in the offline space. The research was conducted in the pre-pandemic time, so it is interesting from a historical perspective, but still reveals some noteworthy trends. First, SNSs have become a natural tool for adolescents to interact with each other [50, 51] much like analogue phones used to be, and which were likewise heavily used by adolescents at times and for periods that were unacceptable to their parents and often caused concern or conflict. The difference between the state of the analogue period and the current stage of development of the information society [52] is mainly related to the ease of access to the smartphone, multimedia, hassle-free use, and the effect of rewards for using new media (including SNS) [53]. Research on usage styles on the ways in which SNS, or more broadly digital services, are used among adolescents is an interesting area of research on the culture and ways in which young people function in cyberspace [54]. In turn, questions about the scale of the phenomenon and the protective and risk factors associated with problematic SNS use are issues that relate directly to dynamically changing diagnostic criteria and individual, cultural conditions and global processes [55–58].

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Apps and Innovative Tools: New Opportunities for School Learning/Teaching

A Project to Promote English Learning in Primary School: "An English Island®" E-learning Platform

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Abstract. The present study was aimed to investigate English learning as second language, in school, in first, second and third graders of twelve classes randomly assigned to a control or an experimental group. Children in the latter are exposed during English school teaching to the method "An English Island®" and to its platform activities. The method "An English Island®" offers a variety of strategies for teaching English in primary school, an innovative digital tool that promotes teaching/learning English language's communicative approach, lead students to become familiar with the language in a sort of continuous, inclusive workout, in which everyone participates and talks.

English skills as well as cognitive abilities are tested in both groups at the beginning and at the end of the school year with the aim to compare control and experimental classes in both a longitudinal and a cross-sectional design.

Keywords: English learning · English teaching · Primary school · English communicative skills

1 Introduction

According to the M.I.U.R. National Guidelines for nursery and primary schools (September 2012, p. 37), "in learning languages, motivation comes from the students' natural aptitude to communicate, socialize, and interact as well as from their willingness to "*exercise their tongues*" [1].

Thus, the *communicative* aspect prevails when the starting point is the oral language. Because of the lack of linguistic transparency in English, the written language gets in the way, causes errors, and creates disparities in students with SLD, Specific Learning Disabilities, or other problems [2]. *Writing*, especially in primary school, means *speaking on paper*, and it is about arriving at spelling only after being *spoken correctly*.

In order to keep the children's motivation alive and steady, it is important to use multi-sensory strategies, presenting information through different methods. In addition, the effectiveness in the learning phase of integrating sensory input through other channels is now recognized.

Factors such as stress and anxiety are reduced by increasing communication skills, motivation, and self-esteem, highlighting that "both activity and direct personal experiences—games, physical activities—play a fundamental role in children's development and early learning" [3].

The different phonemes and graphemes between the English and Italian languages should always be considered so as not to create difficulties in understanding and speaking [4]. The child must become familiar with the sounds and sound differences always associated with the meaning/phoneme through conscious and unconscious assimilation" [5]. Consequently, the language becomes proactive communication, with "language learning based on the children's recognizing their ability to communicate with others, their sensitivity to visual attention, and a desire to imitate" [6].

The method "*An English Island*®" uses a series of didactic strategies to transform the role of the teacher, who becomes coach and observer, and directs the learning process, focusing closely on the learner role (*learner-centred*) and the learning process (*process-oriented instruction*).

The "*An English Island*®" methodology develops a "*circular learning path*" that activates three expressive languages (mime, visual, and oral) to fix almost simultaneously the elements by association. The synergy of these three languages helps to create the *mental/physical grooves* that, developed over time, expand through habit and repetition and help to create familiarity. Thanks to this mental groove, created through mime and drawing, the child can globalize the written word with the oral one and read it correctly.

Thus, written language is introduced gradually, as shown by recent studies: "Among the multiple language competences to be pursued, writing is definitely the lowest priority in primary school, also in consideration of specific learning difficulties (dyslexia, dysgraphia, dysorthography) that usually emerge at this school level and that may be, in some way, also increased in the mother-tongue by an approach to English which focuses too much on writing" [7].

An innovative approach to teaching and teaching foreign languages cannot ignore the issues of inclusion and the personalization of teaching-learning paths. The method "*An English Island*®" offers a variety of strategies for teaching English in primary school that, through codified modalities, seek to achieve the same goal: to develop oral communication skills in all children.

"The use of the spoken language should be introduced by the teacher in a systematic way, proceeding gradually according to the complexity of the language structures presented" [7]. On the other hand, speaking English for the child has to become a natural activity, preferably integrated with the use of creative and interactive games that can be supported by other nonverbal languages (music, movements, images, etc.) to promote participation and involvement in cooperative learning activities [8, 9].

Finally, creating a learning environment that responds to metacognitive teaching canons will enhance the development of a generation of people who will know how to

navigate in a constantly and unpredictably changing panorama of life by being effective problem solvers and lifelong learners.

2   Learning English as Foreign Language

The research on foreign language learning suggested that it is a complex skill, largely based upon native language proficiency. Sparks and Ganschow [10, 11], for example, analysing learning and cognitive profiles of high school and college students, showed that foreign language learning is built on phonological-orthographic and syntactic skills in native language, according to the Linguistic Coding Difference Hypotesis – LCDH they developed following their evidence. LCDH predicts that students with weaker native language skills, particularly in grammatical knowledge and sensitivity as well as sound-symbol association and language phonology, may show poor foreign language proficiency [12].

The involvement of L1 processing in FL learning was confirmed by several studies conducted within different languages. For example, a series of studies conducted on Finnish young student, learning English as foreign language, demonstrated that phonological-orthographic ability in L1 and phonological memory are prerequisites for learning English as foreign language [13–15]. Moreover, an association between native reading decoding skills and second language learning has been observed. FL proficiency was explained by the ability of word reading in L1 [16]. Similar results were obtained with a group of college students: The authors found that the native language decoding skills predicted students' second language proficiency [17].

Some studies have been conducted with Italian students learning English as foreign language. Young Italian students with Difficulties in Learning English as Foreign Language (FLLD) were compared to control students without difficulties [18] on memory measures both verbal and visuo-spatial. Results indicated that poor components of verbal working memory are related to students' foreign language learning difficulties. These students showed also weak ability in phonological sensitivity [18], again verbal skills. Indeed, phonological sensitivity, a broad terms that refer to the analysis and manipulation of the sub-components of spoken word forms, including specific processes such as blending, deleting, and synthesising the speech units [19] seemed to be relevant not only to native language acquisition and reading abilities [20, 21] but also contribute to a correct analysis, representation, and manipulation of a new phonological trace during foreign language learning [22]. However, it should be noticed that due to the high transparency of Italian ortography, Italian readers can use effectively a phonological strategy (i.e. a direct grapheme to phoneme conversion) but, such phonological strategy seems not effective in English, due to its low orthographic regularity [23]. Palladino et al. [24, 25] demonstrated how children with dyslexia may have trouble in learning to read and to write in English as second language. However their performance were not completely negative since reading non-words appeared comparable to peers without dyslexia and in spelling errors were mainly phonological. Non phonological errors were comparable between same age groups, with or without dyslexia.

In the Italian context, the article 5 (point 2c) of the law 170/2010 describes the devices that schools have to adopt for teaching FL to student with specific learning

difficulties. Beside the use of compensatory tools promoting oral communication and ensuring a gradual learning, the law allow the possibility of exemption. In addition, it is recommended to choose, if possible, a transparent second language. However, this kind of policies (i.e. exemption and the choice of a transparent FL) seem disadvantageous for students with learning impairments. Research demonstrates indeed that in a more immersive environment, with an appropriate balance between literacy and communication, teaching may be really inclusive and learning may be promoted for all students [26].

Miller-Guron and Lundberg [27] discovered adults with dyslexia with a preference for reading in English: they were Swedish adults able to learn English at school at such a good level to be able to feel so confident in using the second language for reading.

3   Why the "An English Island®" E-learning Platform was Created

There is increasing discussion of "digitization", as highlighted in the National Plan for the Digital School. "It is, therefore, necessary that digitization efforts be channelled into the idea of innovation, of a school no longer solely transmissive, and an open, inclusive school in a changing society... At the same time, staff training geared towards didactic innovation and openness to organizational innovation will be crucial for taking a step forward. Education in the digital age must not focus on technology but on the new models of didactic interaction that use it. Moreover, teachers, particularly with regard to digital skills, must have the right conditions to act as facilitators of innovative educational courses based on more familiar content. Teacher training must be centred on didactic innovation, taking digital technologies into account as a support for implementing new educational paradigms and the operational planning of activities" [28].

Alongside this important prospect is Legislative Decree no. 62 of 13 April 2017, which introduced important changes in student assessment, including the INVALSI tests. Over the years, these tests have shown different, although positive on average, results in the three Italian macro-areas, starting with primary school. However, a closer look shows the importance of focusing on the degree of equity in the educational system. While it is stated that "Schools should ensure the same educational opportunities for all, without offering more fortunate students because of their family or social background the best possibilities, and vice versa", the results show that "the variability component between schools and between classes is higher in southern Italy and the islands than in central and northern Italy. This means test results are not only lower overall in the south and on the islands; they also differ more from one school to another and from one class to another in contrast to the rest of Italy. Therefore, the school system is less effective in the south and less capable of ensuring students have the same educational opportunities" [29].

The 2021 INVALSI tests confirm that "Primary-school outcomes are substantially stable, but the considerable difference between schools and classes in the south and the rest of the country remains…. Very important differences were already found within the school system in the first analysis of the data, not only for the territories but also depending on the original social environment" [30].

In light of these challenges, the British School-Pistoia created the e-learning platform "An English Island®" as an innovative and effective digital tool that homogenizes

teaching/learning both vertically and horizontally between the various classes and the various schools. This facilitating tool for teachers conveys the English language's communicative approach through a series of teaching strategies that, in various forms, lead students to become familiar with the language in a sort of continuous, inclusive workout, in which everyone participates and talks. The main *goal* is to ensure that all students are included, even those most disadvantaged from a socio-economic-cultural point of view, along the democratic course of learning that must take place in public schools.

Furthermore, and by no means secondary, if skills/knowledge in the primary school can be increased, there will be a push upwards, and fertile ground will be further cultivated in the lower and upper secondary schools, improving current results and providing a *passe-partout* for active citizenship.

The innovative e-learning platform "*An English Island*®" was designed and constructed to offer primary school classes 1 to 5 an educational path, divided into units, complete with suggestions, strategies, audio, videos, multimedia, and printable materials. In addition, the use of educational content can be conveyed through an IWB, Smart-TV, and other devices to make students' participation in this learning program even more appealing.

The knowledge and skills developed and acquired over a five-year period meet the corresponding goals of the A1 Level of the Common European Framework for Languages (C.E.F.R.) of the Council of Europe.

In programming the platform, particular attention was paid to teachers in their role as educational facilitators and who, therefore, must become familiar with the structural system, the founding principles, and its applications. Therefore, a *Training* area on guidelines and strategies for "*An English Island*®" was produced. Moreover, it is always available for a self-directed consultation through a series of 11 podcasts that can be used immediately to develop an in-class teaching activity and facilitate the coach's role. Over time, *on-the-job training* accompanies the teacher, whose support and advice become a personal reference for resolving doubts or oversights and optimal planning of activities.

Not only is the teacher's *scaffolding* action intellectual or technical [31], it is also emotional, cognitive, and metacognitive. The emotional sphere concerns stimulating the student to learn through encouragement and overcoming motivational barriers. The development of metacognitive skills enables the child to learn *continuously* and confront more complex processes such as reflection [32]. An awareness of one's progress and being equipped with the required skills help to increase the student's self-esteem.

4   Structure of the E-learning Platform "An English Island®"

This digital platform was developed to provide practical support for teaching children to speak English through continuous practice. Its focus on oral communication makes it a practical tool that integrates curricular teaching.

Each platform step has video and audio made by native speakers, cards with codified drawings that move when clicked and speak individually or move by building the various sentences by pronouncing them, following the right rhythm. With the same video game appeal, children are excited about participating, acting with the body, using cards, writing through drawings, and touching the IWB until they become protagonists and teachers themselves.

Five levels have been created, one for each primary school class, modelled on the same structure scheme repeated for all 48 units, inserting different and progressively more complex contents in line with the school program.

The teacher has a general index representing the year's activity and contents to enter the various units directly. Each is introduced by a *mission* that the teacher presents to the class, focusing on motivation and consequent *problem-solving*.

Each unit is developed with the following series of *learning strategies*: *Mimes, Board Game, Circles, Twin Brother, Initials* (from class 3 onwards), and *Mix & Match*.

Mimes:

This engaging strategy associates three languages: mime/visual/oral. It captures the students' attention and enables increasing their participation as they become conscious actors.

Board Game:

It is the most powerful strategy: through the drawing cards, grouped by chunks, which "speak" and are moved by clicking on them, the students construct the sentences without any written words yet. The exercise uses the drawing cards already associated with *Mimes* and repeats orally in different ways what has already been learned, forming complete sentences.

Circles:

A *listening comprehension* exercise: a layout is used where the drawing cards of the grammar structure are positioned at the top, and the empty circles, representing the second part of the sentence, are at the bottom. The teacher plays the sentence several times, and the students then draw what they hear in the circles below. By clicking on the circle, the corresponding drawings appear. Therefore, it is possible to self-correct. (Written words have not been introduced yet!). It is an inclusive, SLD-friendly exercise.

Twin Brother:

This exercise associates the oral word with its *spelling* and is the first encounter with written words. Despite this, students are confident because they have acquired familiarity and habit via the various modes of repetition earlier.

Initials:

Initials is an aid, a kind of visual guide, that helps to understand how many words are contained in a chunk or a sentence. It also helps to avoid grammatical mistakes. They are the last step to arrive at the written word now that oral familiarity has been acquired. This exercise is seen as a game by all the students who view it as a sort of competition to recognize the sentence and then say it. It is first introduced in the third grade.

Mix&Match:

It trains for sequential or random *listening comprehension* of sentences spoken by native speakers identified in the list and heard both in English and Italian to verify understanding and do any translation. The exercise leads to a conscious consideration that represents a transition from *habit* to *knowledge*.

The platform offers teachers four specific podcasts on *Extra Speaking Games (Cards/Pencil Game/Finger Game/Child Actors),* which are played with the students to improve rhythm in pronouncing chunks or phrases, correct any errors without explaining grammar rules, and the sequential positioning of the drawing cards to build the sentences

respecting the rhythm. These are games that the teacher can introduce at any time with the IWB off and repeated by involving the students as fully as possible.

The platform has a Dashboard through which the teacher can move from one exercise to another, from one unit to another, play games, suggest activities, and continuous listening for use in passive and active phases. In addition, the 'T' = Teacher area can be consulted where suggestions and tips are put forward, as well as any printable materials for classroom exercises.

5   Aims of the Study

The present study is aimed to test the role of cognitive variables such as short term memory and working memory but also emotions and motivation in learning English as second language at school. In particular the study compared two conditions of learning: a control condition where teachers followed traditional textbooks and an experimental conditions where teachers were able to implement in the ordinary teaching activity the use of the e-learning platform "an English Island".

6   Methodology and Tools

6.1   Design

The study has a longitudinal design and wants to investigate whether the use of the app An English Island has significant effects in learning English in primary school children.

To this end, a battery of assessment was provided to be given at two different times (t1 and t2) i.e. before and after the treatment. The treatment is identified in the learning of the English language through the app An English Island. The group was divided into control group and experimental group in order to assess the presence or absence of any significant change.

At t1, collective tests were administered in order to investigate emotions related to learning English; subsequently, an individual assessment was conducted using a battery of instruments set for the reference class (first grade; second grade; third grade). Currently, the study is in the individual assessment phase at t1.

In concomitance, interested teachers are learning the use of the app. Teachers have in fact experienced an initial cognitive and exploratory meeting about the project's aims and the educational and training objectives of the platform; currently, teachers are being trained through specific webinars and lessons built to meet the needs of the teachers and children involved.

6.2   Participants

The participants of the study are primary school children aged between 6 and 8 years. The school of reference is the "Istituto Comprensivo Santa Chiara - Pascoli – Altamura" located in Foggia. In particular, the participants are children attending elementary school in the Santa Chiara and Altamura school complexes.

The study involves $n = 12$ classes of elementary school for a total of $n = 193$ participants ($n = 102$ males; $n = 91$ female), the participants are distributed in control group ($n = 102$; $n = 51$ males; $n = 51$ female) and experimental group ($n = 91$; $n = 51$ males; $n = 40$ female). Specifically, the control group consisted of $n = 2$ first classes ($n = 23$; $n = 11$ males; $n = 12$ female); $n = 2$ second classes ($n = 40$; $n = 22$ males; $n = 18$ female); $n = 2$ third classes ($n = 39$; $n = 18$ males; $n = 21$ female). The experimental group consisted of $n = 2$ first classes ($n = 30$; $n = 19$ males; $n = 11$ female); $n = 2$ second classes ($n = 26$; $n = 12$ males; $n = 14$ female); $n = 2$ third classes ($n = 35$; $n = 20$ males; $n = 15$ female).

6.3 Procedure

The participants in the experimental group follow an English course through an innovative didactic method using the app *An English Island*. In order to compare the skills acquired by the experimental group with those of the control group, a collective battery and an individual battery are administered before and after the course, both conventional and experimental. During the screening session with collective battery, participants provide written informed consent before undergoing an assessment.

Collective Test: AEQ-ES

Achievement emotions in English as a second language were assessed by means of the Italian version of the Achievement Emotion Questionnaire for elementary school children [33] (AEQ-ES). Since the original questionnaire included only the domain of first language (i.e., Italian), for the present study, we adapted the questionnaire by substituting Italian with English. The questionnaire consisted of a total of 32 items: nine on enjoyment, 12 on anxiety, 11 on boredom. These were divided in three parts referring to different settings, that is, attending English class (e.g., I enjoy English class), doing English homework (e.g., English homework bores me to death), and taking English tests (e.g., When I take an English test, I am afraid of getting a bad grade). For each item children had to rate the intensity of their emotion on a five-point Likert scale ranging from 1 (= not at all) to 5 (= very much). The scale was supported by pictures of faces of boys or girls (matched with children's gender) representing the intensity of emotions [34]. The completion of the questionnaire took a total of 45 min. In order to avoid fatigue, children were given the possibility to take short breaks between the different parts of the questionnaire.

Individual Battery

The individual battery consists of 7 tests that assess: learning new words, working memory, long-term memory, comprehension, production, pronunciation and repetition of English words, metacognition of the performance produced and problem-solving skills. Below are the tests that make up the battery.

a) **Learning New Words**

   The test for learning new words is an Auditory Verbal Learning Test, where the participant is asked to repeat a list of 10 non-words (such *as Zila, Muci and Libo*), consisting of 2 syllables and having a total of 4 phonemes [35]. When children hear and then utter a non-word for the first time, they must transform a novel speech signal into a series of coordinated, precisely timed oral movements. The test is used

to measure verbal learning and is administered by reading the list of non-words to the child at a rate of one word per second. At the end of the reading, the child is asked to repeat as many of the newly heard non-words as possible in any order. This procedure is used, with the same list of words, for five consecutive times, each time recording the correct non-words recalled as well as the intruding words reported by the subject. The test is expected to measure learning.

b) **Digit Span**

The children's version of digit span is a subtest from the WISC-IV scale [36]. The test consists of an immediate serial recall of a string of numbers. This test requires children to recall a sequence of digits in the same order (DSF) or in reverse order (DSB) that the experimenter has given them verbally [37]. The score corresponds to the highest span measure, with the sequences produced correctly at least two out of three times.

c) **Delayed Recall**

Approximately 10 min after the immediate recall test, during which time the digit span test is administered, the patient is asked to remember (without the list being presented again by the examiner) as many words as possible from the list. This is the second part of the test and consists of delayed recall. The test measures verbal long-term memory capacity.

d) **Repetition of Short Words**

In this test, an audio recorder is set up so that the details of the performance can be assessed later. The Experimenter reads to the child words in English and requires the child to repeat the verbal stimuli just heard. The terms used are *read, turn, seat, mind, law, hell*. Children's production is recorded and analysed in order to score two different indices: Accuracy and correct pronunciation.

e) **English Vocabulary**

This test involves comprehension and production of the English language. The tests are individualized and are videotaped so that comprehension and production constructs can be analyzed later. All vocabulary tests begin with an initial familiarization phase to the task and are individualized with respect to the target classes. Rehearsals include a first part during which the child listens to the production, by the experimenter, and, immediately afterwards, states the corresponding picture to the word heard. In the second part, the child produces the word associated with the image indicated by the experimenter.

– For the first grade, the assessment alternates between the comprehension task and the production task: the child listens, one at a time, to the following numbers in English "*four, eight, three, six, ten, five*" and points with his fingers to the corresponding number. Next, the experimenter points to the following numbers on the relevant pictures "*nine, two, seven, four, eight, six*" and the child verbally produces the corresponding number in English. In the second phase, there is again a comprehension task: the child listens, one at a time, to the following colors "*yellow, green, black, orange, red, brown*" and points to the corresponding color from the selected and presented pictures. Next, the experimenter points to the following colors "*black, orange, brown, green, yellow, red*" and the child verbally produces in English the corresponding color.

- For class two, the assessment alternates between the comprehension task and the production task: the child listens, one at a time, to the production of the following school objects in English "*pencil, rubber, book, ruler, glue, pen*" and points to the corresponding object among the pictures selected and presented. Next, the experimenter points to the following animal names "*tiger, cat, fish, dog, cow, sheep*" and the child verbally produces in English the corresponding animal from the pictures presented.

- For the third grade, the assessment alternates between the comprehension task and the production task: the child listens, one at a time, to the production of the following garments in English "*t-shirt, dress, shoes, jacket, coat, scarf*" and points to the corresponding garment among the pictures selected and presented. Next, the experimenter indicates the following domestic environments "*bathroom, living room, kitchen, dining room, bedroom, basement*" and the child verbally produces in English the corresponding environment among the pictures presented.

It should be noted, moreover, that all the images come from depository without copyright.

f) Metacognitive Control Task

The metacognitive control task is closely related to the English vocabulary production test. The test was adapted from the studies of Roebers et al. [40] and Lavis and Mahy [41]. In the test, the experimenter presents a 5-point confidence scale consisting of faces. The scale has 5 faces and represents the confidence judgment. Specifically, the extremes represent a very smiling face and a frowning face. The smiling face means "very, very sure", the frowning face means "not sure at all", in the middle there is a neutral face meaning "uncertain". At the end of the vocabulary rehearsal, the safety judgment through faces is explained to the child; we verify that the child has understood by asking control questions such as "*how old are you*?", "*how old am I*?", "*how much hair do you have on your head?*" and based on the indication on the scale we try to understand if the child has understood the safety judgment scale. Next, the pictures related to the vocabulary task are presented again and the child is asked to indicate how confident they were in the vocabulary they provided.

Next, two boxes are presented to the child: one red and one green. The child is asked to put pictures in the red box if they think they said the wrong word and to put pictures in the green box if they think they said the right word. The purpose of these confidence judgments is to encourage children to reflect on the accuracy of their verbal production after performing the task.

g) Problem Solving

This test has problem solving skills applied in a situation where communication in English is necessary. The experimenter introduces the child to a situation that must be solved through verbal production in English. The tests are individual and are video-recorded in order to be able to subsequently analyze the investigated constructs; moreover, the tests are individualized with respect to the reference classes. Each problem solving test has, in particular, two phases: in the first phase there is the simulation of a situation, in the second phase the child must respond, in English, to a question posed in English.

- For class one, in the first part, a situation is simulated in which it is necessary to ask another child, in English, his or her name. In the second phase, the child is asked, in English, how old he/she is and asked to answer in English.
- For class two, in the first part, a situation is simulated where you want to ask a child, in English, who his favorite singer is. In the second phase, the child is asked, in English, what his favorite sport is and is asked to answer in English.
- For the third grade, in the first part, a situation is simulated where the child is in an ice cream shop and is asked, in English, for a chocolate ice cream. In the second phase, the child is asked, in English, when his class starts.

7 Conclusions

The spirit that inspired the British School-Pistoia to create the "*An English Island*®" e-learning platform is connected to a *vision* whose fundamental core is to improve English language knowledge/skills as early as primary school. Pistoia is, by definition, the city of plants, a permanent nursery that focuses on producing strong and healthy plants. If some in the group of plants are a little weaker, they are supported by the others, and everyone together can create a wonderful forest under the banner of *inclusiveness*. No matter where they teach—classroom, school, or city—teachers can find in this platform an organized framework that facilitates their work, advancing the goals pursued in their constant daily effort to achieve our School 3.0. Our study may therefore better clarify the role that a teaching approach like that promoted by this e-learning platform may exert on learning English as second language at school in early grades of primary school and shed light on the complex relationships between cognitive and metacognitive processes and emotion and English learning at school comparing two different teaching conditions.

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Diligo 2.0: A Pilot Study for the Use of a Mobile App to Assess School Readiness

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Abstract. Diligo 2.0 is a mobile app designed as a serious game to assess spatial and numerical cognition as key elements of the school readiness concept in association with a preference for slow and fast thinking strategies. School readiness is a key concept for the future development of cognitive and emotional abilities of children, and it is highly correlated with academic success. The app is also focused on evaluating a preference for slow or fast thinking activities. The Diligo 2.0 app has been developed for Android platform and has been distributed in two Italian schools as a pilot study with 44 children. Usage data have been collected and are discussed in this paper to show possible directions for this kind of digital tool both for assessment and for training children's abilities.

Keywords: Mobile app · School readiness · Assessment · Children

1 Introduction

Children approaching primary school are asked to meet several standards and find themselves at facing several challenges when starting their entrance to the school system. In this scenario, the concept of *school readiness* becomes a fundamental factor to consider [1]. School readiness is a label used to describe children's mathematical, literacy and socio-emotional skills that are strong predictors of their academic success and personality development [2–4].

The importance of these skills is widely recognized, and it has become a key element in the Italian National Guidelines for Kindergarten since 2012 issued by the Italian Ministry of Education [5]. School readiness is a set of abilities that represents the basic achievements, from a cognitive and emotional point of view, to face the transition between kindergarten and primary school.

Considering the different abilities which are included in the concept of school readiness, we focused on two main branches stemming from them, or *numerical and spatial thinking* and *socio-emotional* skills. These two cores have been used as the root for the development of two parallel versions of the Diligo 2.0 mobile app [6]. The version which focuses on emotional skills is designed to assess these key abilities: awareness of the emotions, use and comprehension of emotion-related vocabulary, recognition of facial expressions and their link to the emotions, comprehension of the situations that

elicit emotions, knowledge of the cultural rules for displaying emotion and regulation and management of one's own and others' emotions. The other version, which is the one which has already been tested in schools and whose results are discussed in this paper, is focused on these skills: knowledge of the geometrical figures, acquisition of big and small concepts, recognition of number representation, spatial concepts of in-out and up-down, temporal order in terms of before and after, spatial directions left and right.

These mobile apps not only allow to monitor the school readiness abilities, but they also evaluate the cognitive preference for slow or fast thinking activities as described in Kahneman's theory [7] who describes human thinking based on two main reasoning systems which uses different strategies, where "System 1" is fast, automatic, unconscious, and emotional and "System 2" is slow, logical, conscious, and effortful. So, the hypothesis underlying this study is that children are much more used to engage in fast thinking activities that in slower ones, and this may be due to the experience children have more chances to encounter in modern entertainment forms and environments.

2   The Structure of the App

Diligo 2.0 can be described as a serious game, developed for children of age 5 to 6 years old. The game has been developed using the STELT (Smart Technologies to Enhance Learning Technologies) [8] development framework and it follows an agent-based approach [9], since it is based on the continuous interaction between a natural agent (the kid) and the main character of the game, which is the artificial agent.

The game is focused on helping the character of "Leo the Explorer" to solve puzzles in eight different islands to collect treasures. To solve the puzzles, children must answer to 32 different questions, divided by eight sets of items, one for every school readiness skill related to numerical and spatial thinking. For every interaction, the Explorer has been fully voiced by a professional voice actor, and if needed, the child can listen any number of times the instructions by just pressing an on-screen button. For every group of four items, there have been programmed four alternative forms, which are randomly selected for every game session, allowing the game to be various enough for children if played more than once with a total number of 128 possible items.

At the beginning of every level, which is represented by an island on a treasure map, the child can choose between a slow or fast approach by selecting the preferred mode.

The fast mode is characterized by presenting the four items of the skill in quick sequence, without any storytelling, encouraging the child to play as fast as possible, as it is shown in Fig. 1.

The slow mode is based on a narrative approach, since the same item of the fast mode are mixed with other requests for the child that does not deal with numerical or spatial abilities but are necessary for the story undergoing in which the child and the Explorer are involved. The idea is that a narrative approach may improve children's performances [10–13], since it activates Kahneman's System 2, allowing the children to better focus on the task, and achieving a higher score in the game. It is possible to see a "narrative" item from slow mode in Fig. 2.

The app can perform both online and offline, requiring an online connection to send data to the database where they have been stored for this study, and where they can be
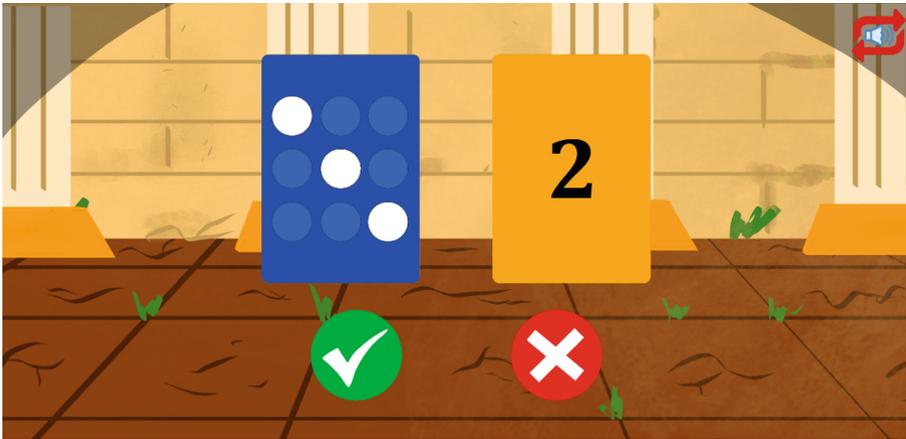
Fig. 1. An item from the number recognition skill. In this case, the Explorer voice asks the child to say if the two depicted number are the same or not.
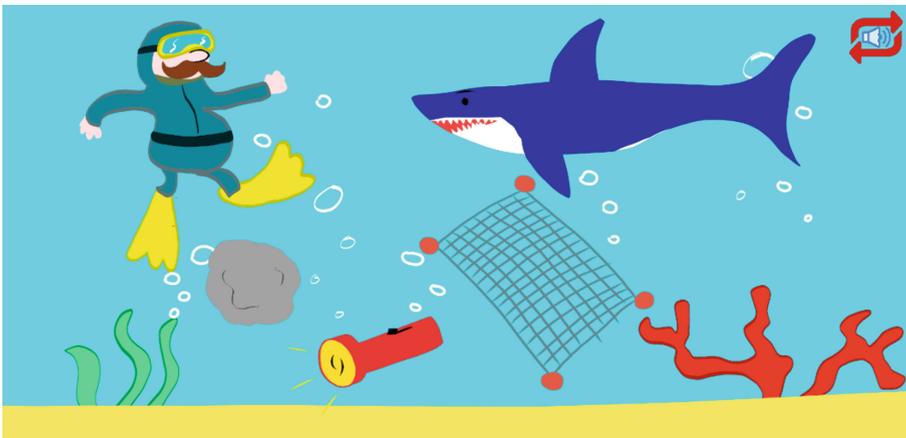
Fig. 2. This is an example of narrative items from the slow mode. In this case, the Explorer's voice asks the children to choose an item to run away from the shark during an immersion. This kind of item does not affect the final score.

accessed only by researcher and in anonymous mode. The only score the child can see in the app is the preference for fast or slow mode, and this is because Diligo is still not validated as an assessment tool, so we did not want it to become misunderstood.

The concept behind Diligo is both to create the structure for an ipsative tool and to make a normative one. The game can be an ipsative tool for teachers to collect cumulative data on a specific child, and at the same time, teachers can monitor the entire classroom considering it as a normative tool to understand the level of the entire group.

Both numerical-spatial cognition and emotional skills versions of Diligo are currently available in Italian language for Android devices and can be found on the Google Play

Store [14, 15], but the one we have used for this pilot study is the one focused on the numerical and spatial cognition.

3 Methods

This pilot study involved n = 44 Italian children from kindergarten with age between 5 and 6 years old from two different schools in Center Italy.

Before administering the mobile app, a prototype of the app has been given to teachers, allowing them to familiarize with it, and to collect feedbacks from teachers through a checklist. These feedbacks have been since used to correct some minor issues and to improve the UI and the overall experience of the app.

Before the experiment, teachers were given access keys to associate to children profiles to collect data anonymously but allowing children to login as distinct users. All data collected has been anonymously and safely stored in an online database.

The experiment has been conducted with the help of teachers, who administered the mobile app through Android tablets in small groups, so that every child had the opportunity to play a complete session, receiving help from teachers if they had technical issues.

4 Results and Discussion

We can start describing results by observing Table 1, where descriptive statistics have been reported. Every sub/scale had a minimum possible score of 0 and a maximum of 4 per-scale, while the total maximum score for the complete session was 32. The mean score of the sample is slightly above the mode, which shows that most of the children answered correctly to the 58% of the items.

This may be explained by the difficulty of the items, or by the dimensions of the sample, which may be not enough big to shed light on this data. Even if we consider the possible difficulty of items, we could attribute it to different factors. Since we used a mobile app, UI usability, devices performances and graphics may have a major role in children's performances, so it would be interesting to repeat this experiment together with other available evaluation methods for numerical and spatial skills. We can also compare the different scores in subscales. One notable difference is the low score on the "Inside-Outside" and "Up-down" scales, which have the lowest scores on all descriptive measures.

Taking account that other spatial thinking abilities shows higher scores, it is possible to hypothesize that these low scores may be due to some interface or graphics factors, like interface readability or level design elements. This aspect may play an important role, since the environments of the game are realized in 2D, especially in these two subscales, which may benefit more than the others of a 3D environment to improve UI clarity.

We can now discuss data related to the preference for fast or slow thinking modes. Considering Table 2, we can notice that all the measures are very much closer to 1 than to 2, which means that if 1 is the score assigned for the fast mode and 2 the one for the

Table 1. Descriptive statistics for the n = 44 children sample considering correct answers

Subscales	Mean	Median	Mode	Std. deviation
Shape	2,59	3	3	1,064
Dimension	2,68	3	4	1,216
Number	2,93	3	4	1,043
Inside-outside	1,36	1	1	0,942
Up-down	1,68	1	1	1,137
Before-after	2,55	3	3	1,19
Left/right	1,86	2	2	1,357
Differences	2,98	3	3	1
Total	18,64	18,5	16	4,143

slow preference, most of the children showed a strong tendency towards the use of fast thinking cognitive strategies.

This data is even more consistent when considering that standard deviation for this measure is quite low and even smaller than the one observed in the score for the different subscales in Table 1, showing that variance is low, and it is very evident the preference for fast mode. This result is quite close to the hypothesis, expressed in the previous paragraph, that today's children may have a stronger preference for fast thinking activities due to the exposition to experiences and entertainment products that privilege this mode at the expense of slow cognitive activities.

Table 2. Descriptive statistics for the n = 44 children sample considering fast/slow preferences, where 1 = fast and 2 = slow

Subscales	Mean	Median	Mode	Std. deviation
Shape	1,48	1	1	0,505
Dimension	1,52	2	2	0,505
Number	1,36	1	1	0,487
Inside-outside	1,61	2	2	0,493
Up-down	1,36	1	1	0,487
Before-after	1,55	2	2	0,504
Left/right	1,45	1	1	0,504
Differences	1,57	2	2	0,501
Total	1,11	1	1	0,784

5   Conclusions

The first results coming from this pilot study on the usage of Diligo 2.0 open some interesting scenarios to better understand.

The first point to deepen is the impact of the game design, UI and UX on the performances of children. This theme is highly relevant when designing a serious game which has the aim to become an assessment tool, since the user experience of the design elements of the app/game inevitably add a layer between the user and the evaluation tool, having an impact on the final performance that can be improved or slowed down by the ease of use and clarity of app design. It would be interesting, for example, to redesign the UI for the two subscales which have shown lower average scores, because it would allow to better understand if a 2D or 3D environment can affect children performances on cognitive tasks.

Further data analysis is needed to be realized on a bigger sample, since preliminary data analysis showed a weak reliability of item scales ($\alpha = .61$) with different methodologies (KR-20 $= 0.59$ and KR-21 $= 0.56$), and this may easily be due to the small sample or the shortness of the scale.

Even correlation seems to be quite low between the preference for fast mode and average scores on all subscales, but for the same reasons above, it is difficult to consider appropriately this data on a small size sample. Even a preliminary one sample t-test has not shown significant differences in average scores between children with preference towards fast and slow thinking activities, and this may be linked to the size of the sample, so further analysis and a bigger study are needed to better understand the role of cognitive mode preference and performance, which seems, by now, not significant.

For the future development of the Diligo 2.0 app it will be important to improve game design, UI and UX and, moreover, it is soon expected to start a new pilot study with the other version of the game, which is focused on social and emotional skills.

This may give even more information to understand the role of the design of the app on children performances, other than giving information about the specific skills on which the game is focused.

Summarizing all these points, future studies with Diligo 2.0 need to include a bigger sample, to consider possible differences related to gender, and to improve the game UX to make it even more accessible and usable in kindergarten.

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Robot Assistive Therapy Strategies for Children with Autism

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Abstract. Background: Autism spectrum disorder (ASD) is a category of neurodevelopmental disorder characterized by persistent deficits in social communication and social interaction across multiple contexts as well as restricted, repetitive patterns of behaviour, interests, or activities. Social robots offer clinicians new ways to interact and work with people with ASD. Robot-Assisted Training (RAT) is a growing body of research in HRI, which studies how robots can assist and enhance human skills during a task-centred interaction. RAT systems have a wide range of application for children with ASD.

Aims: In a pilot RCT with an experimental group and a control group, research aims will be: to assess group differences in repetitive and maladaptive behaviours (RMBs), affective states and performance tasks across sessions and within each group; to assess the perception of family relationships between two groups before and post robot interaction; to develop a robotic app capable to run Raven's Progressive Matrices (RPM), a test typically used to measure general human intelligence and to compare the accuracy of the robot to capture the data with that run by psychologists.

Material and Methods: Patients with mild or moderate level of ASD will be enrolled in the study which will last 3 years. The sample size is: 60 patients (30 patients will be located in the experimental group and 30 patients will be located in the control group) indicated by an evaluation of the estimated enrolment time. Inclusion criteria will be the following: eligibility of children confirmed using the Autism Diagnostic Observation Schedule -2; age ≥ 7 years; clinician judgment during a clinical psychology evaluation; written parental consent approved by the local ethical committee. The study will be conducted over 10 weeks for each participant, with the pretest and post test conducted during the first and last weeks of the study. The training will be provided over the intermediate eight weeks, with one session provided each week, for a total of 8 sessions. Baseline and follow-up evaluation include: socioeconomic status of families will be assessed using the Hollingshead scale; Social Communication Questionnaire (SCQ) will be used to screen the communication skills and social functioning in children with ASD; Vineland Adaptive Behavior Scale, 2nd edition (VABS) will be used to assess the capabilities of children in dealing with everyday life; severity and variety of children's ripetitive behaviours will be also assessed using Repetitive Behavior

Scale-Revised (RBS-R). Moreover, the perception of family relationships assessment will be run by Portfolio for the validation of parental acceptance and refusal (PARENTS).

Expected Results: 1) improbe communication skills; 2) reduced repetitive and maladaptive behaviors; 3) more positive perception of family relationships; 4) improved performance.

Conclusions: Robot-Assisted Training aims to train and enhance user (physical or cognitive) skills, through the interaction, and not assist users to complete a task thus a target is to enhance user performance by providing personalized and targeted assistance towards maximizing training and learning effects. Robotics systems can be used to manage therapy sessions, gather and analyse data and like interactions with the patient and generate useful information in the form of reports and graphs, thus are a powerful tool for the therapist to check patient's progress and facilitate diagnosis.

Keywords: Psychology · Learning · Technology · Autism · Robot Assisted Training

1   Introduction

Autism spectrum disorder (ASD) is a category of neurodevelopmental disorder characterized by persistent deficits in social communication and social interaction across multiple contexts as well as restricted, repetitive patterns of behaviour, interests, or activities [1]. The care and social needs of preschool children with ASD (typically up to six years of age), in particular, are significant [2, 3], usually extend to parents and siblings [2, 4, 5], and require substantial community resources [2, 6, 7]. Estimated costs per year for children affected by Autistic Spectrum Disorders (ASD) in the US are expected to be between $ 11.5 billion – $ 60.9 billion (2011 US $), representing a significant economic burden from medical care to private education [8, 9]. An increasing amount of research has investigated the use of digital interventions for support and treatment of ASD individuals under terms such as digital health [10], computer-based [11, 12], computer-assisted [13], innovative technology-based [14] and technology-aided interventions [15]. Devices like computers, smartphones, wearable technologies, virtual reality, robotics and tablets [13] have been used. The interventions attempt to teach or train e.g. communication [9], social and emotional skills [10] and academic skills [11]. The use of digital interventions may be beneficial for ASD individuals, since such interventions are consistent, predictable, and without social interaction, which is preferred by ASD individuals [16]. Computer-assisted and robot-assisted therapy is infiltrating the social skills teaching environment, being trailed or incorporated into therapy by a variety of professions to help teach the child with ASD [17–19]. Validation of the effectiveness of computer-aided therapies to teach social skills is warranted to justify the quality of these interventions. Useful technologies will likely proliferate further into therapy regimens, offering new models and assistance to those who serve these children and their families. Animal-like robots and humanoid robot have received especially notable acceptance in therapeutic settings. The notion that children with ASD prefer robots as tutors to improve their social interaction and communication abilities is supported by recent studies. Indeed,

the research focused on developing a very promising form of intervention called robot-assisted therapy. This therapy has some challenges, e.g., the necessary flexibility and adaptability to real unrestricted therapeutic settings. The most frequent deficiency to children with autism and mental disability is social attention, which includes the difficulty of focusing good visual attention. Di Nuovo and his colleagues [20] examined the use of a new deep learning neural network architectures to automatically determine whether a child-focused on visual attention during a therapeutic session, indicating their commitment. They used the NAO humanoid robot [21] for their research and have proposed the use of computational intelligence techniques to increase robot capabilities for greater adaptability and flexibility, enabling the robot to be integrated into any therapeutic environment, according to the specific needs of the therapist and the individual child. A study by Huskens et coll. Utilized a robot-mediated intervention based on LEGO® Therapy to study the impact on collaborative play behaviour [22, 23], using NAO robot. The robot reinforced collaboration and offered prompts.

In another study by Srinivasan et al. [24] utilizing the rhythm and robotic therapy intervention with NAO and Rovio, the outcome targets were repetitive behaviours and affective states in children with ASD. After training, the rhythm group reduced negative behaviours. Affective state results indicated the rhythm and robotic groups demonstrated greater interested affection across all sessions. Negative affection was decreased and interested affection increased in the rhythm group after training. Other studies have reported improvement in communication, social skills and gestural delay for a child with ASD after robot therapy intervention [25–31]. These studies highlight the uses of robot-assisted interventions to teach social skills to children with ASD. The systematic review by Grossard and colleagues [32] reported excellent state of the art in the topic ICT and autism care from 2017 to 2018. They analyzed serious games and social robots. The authors noted children with ASD have a specific need for predictability, visual support, and a sequential presentation of information, which aligns well with the use of social robots. They concluded that social robots offer clinicians new ways to interact and work with people with ASD. Robot-Assisted Training (RAT) is a growing body of research in HRI, which studies how robots can assist and enhance human skills during a task-centred interaction. RAT systems have a wide range of application from physical assistance in post-stroke rehabilitation and robotic prosthetics [33], to cognitive training for patients suffering from dementia, Alzheimer's disease [34, 35], MCI and intervention and therapy for children with ASD. Socially Assistive Robotics (SAR) is also employed for language learning and children education [36, 37]. HRI is a multidisciplinary research field that involves human-machine interaction, machine learning, data mining, computer vision as well as psychology and educational sciences, kinesiology, occupational therapy and others. The main difference from other assistive robotic systems is that Robot-Assisted Training aims to train and enhance user (physical or cognitive) skills, through the interaction, and not assist users to complete a task (Activities of Daily Living) thus a target is to enhance user performance by providing personalized and targeted assistance towards maximizing training and learning effects. Applied behaviour analysis (ABA) is one of the most extended therapies for the treatment of autism, consisting of improving specific behaviours which are divided into simple and repetitive tasks that are presented sequentially and strategically while measuring and analysing the patient's performance

during the therapy [38]. Robotics systems can be used to manage therapy sessions, gather and analyse data and like interactions with the patient and generate useful information in the form of reports and graphs, thus are a powerful tool for the therapist to check patient's progress and facilitate diagnosis. The visual appeal of the robotics platform is a key factor to engaging the attention of children with autism; indeed those robots tend to use bright colours, rotating mechanical parts, striking shapes and lights [39].

2 Objective

In a pilot RCT with an experimental group and a control group, research aims will be:

- to assess group differences in repetitive and maladaptive behaviours (RMBs), affective states and performance tasks across sessions and within each group;
- to assess the perception of family relationships between two groups before and post robot interaction;
- to develop a robotic app capable to run Raven's Progressive Matrices (RPM), a test typically used to measure general human intelligence and to compare the accuracy of the robot to capture the data with that run by psychologists.

3 Application Field

Patients with mild or moderate level of ASD to enrol in Fondazione IRCCS Casa Sollievo della Sofferenza, San Giovanni Rotondo (FG).

Duration of the study: 3 years.

Sample size: 60 patients (30 patients will be located in the experimental group and 30 patients will be located in the control group) indicated by an evaluation of the estimated enrolment time.

Inclusion criteria will be the following:

1) eligibility of children confirmed using the Autism Diagnostic Observation Schedule −2, a gold standard diagnostic assessment for ASD [40];
2) age ≥ 7 years;
3) clinician judgment during a clinical psychology evaluation;
4) written parental consent approved by the local ethical committee.

4 Description of the Process Phases, Indicators and Monitoring

4.1 Procedure

The study will be conducted over 10 weeks for each participant, with the pretest and posttest conducted during the first and last weeks of the study. The training will be provided over the intermediate eight weeks, with one session provided each week, for a total of 8 sessions.

4.2 Baseline and Follow-up Evaluation

The socioeconomic status of families will be assessed using the Hollingshead scale [41]. The Social Communication Questionnaire (SCQ) [42] was used to screen the communication skills and social functioning in children with ASD. Vineland Adaptive Behavior Scale, 2nd edition (VABS) [43] will be used to assess the capabilities of children in dealing with everyday life (i.e., communication skills, motor skills, functionalities needed in everyday life, and socialization). It will be also assessed the severity and variety of children's repetitive behaviours using the parent questionnaire, Repetitive Behavior Scale-Revised (RBS-R) [44]. Moreover, the perception of family relationships assessment will be run by Portfolio for the validation of parental acceptance and refusal (PARENTS) [45].

4.3 Robot-Mediated Training

Among android social assistive robots, Pepper from Softbank Robotics is a humanoid (height = 1.21 m and width = 0.48 m) that has almost the same articulations as a human, except for its mobile base and the impossibility of moving every finger independently. It has four microphones, two loudspeakers, two RGB cameras and a depth sensor (Asus Xtion). It has tactile sensors in the head and the back of its hands. It has a speech recognition engine that is able of identifying multiple variations in the human voice and a speech to text module that makes it talk with people, as well as face detection and recognition and emotion detection engines. It is also provided with a tablet, enabling it in showing interactive content. Nao, Pepper's little brother with similar software characteristics, is also a humanoid (height = 0.57 m and weight = 5 kg) appearing as of a human toddler and already widely adopted in ABA with ASD. Pepper and Nao are equipped with cameras and software for eye-tracking, face detection and recognition however it will not be employed in this study (Fig. 1).

Fig. 1. Pepper and Nao robots from Softbank Robotics.

Robot-assisted therapy today is available through applications running on the robot Pepper itself; the Research Hospital IRCCS "Casa Sollievo della Sofferenza" is licensed with a solution named Robomate, developed by BehaviorLabs. Robomate is an LMS (Learning Management System) platform for humanoid robots, created for the following purposes (Fig. 2):

- Simplify the use of robots by clinicians, therapists and educators
- Realize an easy and intuitive platform for the human-machine interaction
- Handle e-learning contents and "edutainment"
- Manage contents
- Track and store results of the executed sessions and patient data
- Generate reports and statistics on the results of the executed sessions

Fig. 2. Managing users' sessions and results on Robomate.

Robomate is then tailored for the use of a humanoid robot, representing a direct communication channel between the content and the child, and a tablet device as a reinforcing and feedback element where the child himself can answer and interact in the session. In this sense, the robot and the tablet work together both as executors and catchers of feedbacks during the training sessions. Through the iPad app Robomate, a

therapist can register patient data and sessions as well as trigger predefined animations on the robot to catch the attention during a test session. Telepresence on the app through Pepper's mics and cameras is also available (Fig. 3).
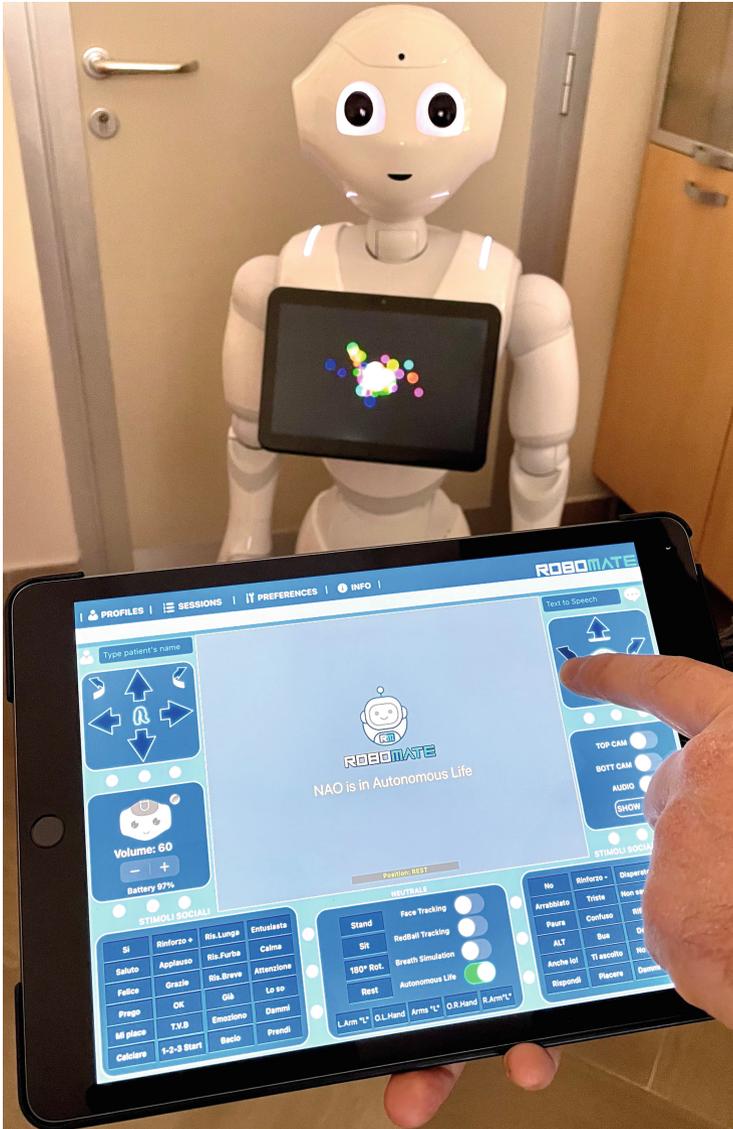
Fig. 3. Robomate app for remote controlling Pepper.

Following, a description of the exercises available on the robot through Robomate.

4.4 Interactive Sessions with the Robot

Interactive sessions of the child with the robot will take place after the baseline session and before the follow-up evaluation session. Three standard session types have been designed with a predefined set of tests selected from the table above that the therapist will administer using the robot (Table 1 and 2):

Table 1. Set of available exercises on Pepper through Robomate.

Game name	Learning objective	Description
Riconosci gli animali	*Identification*	Pepper asks to recognize animals from paints on paper and to show them to its camera for acknowledgement
Gioco delle imitazioni	*Identification*	Pepper mimics objects and animals and asks to identify them
Caravan Palace Dance	*Dance-Animation*	Pepper dances on the notes of the song "Caravan Palace"
Thriller Dance	*Dance-Animation*	Pepper dances on the notes of the song "Thriller", by Michael Jackson
Around the World	*Dance-Animation*	Pepper dances on the notes of the song "Around the World", by Daft Punk
Row Row Row Your Boat	*Dance-Animation*	Pepper dances on the notes of the song "Row Row Row Your Boat"
Ai Se Eu Te Pego!	*Dance-Animation*	Pepper dances on the notes of the song "Ai Se Eu Te Pego!"
Come mi sento?	*Emotions*	Pepper tells stories and asks to recognize emotions felt by characters
Training imitazione A	*Physical Imitation*	Imitation training of non-significative movements of one limb
Training imitazione B	*Physical Imitation*	Imitation training of non-significative movements of two limbs
Training imitazione C	*Physical Imitation*	Imitation training of non-significative movements of two hands
Training imitazione D	*Physical Imitation*	Imitation training of 10 movements from A, B, C repeated 4 times
Training imitazione F	*Physical Imitation*	Imitation training of crossed movements
Training imitazione H	*Physical Imitation*	Two different answers at the time
Training imitazione I	*Physical Imitation*	20 movements, Pantomime
Test Geometria	*Object Identification*	Pepper asks to identify geometric shapes
Prerequisiti Visivo	*Identification*	Visual perception, identification of sequences and spatial position of the objects

<div align="right">(continued)</div>

Table 1. (*continued*)

Game name	Learning objective	Description
Lettura Vocali (Test)	*Identification*	Pepper asks to identify the right answer for the presented vowel
Lettura e Discriminazione	*Identification*	Pepper asks to identify the group of vowels for a prompt
La colomba e la formica 1	*Identification*	Demonstrate a good auditory memory, grasping the details of an overheard story
Matematica Posizioni	*Identification*	Pepper asks about the location of the objects
Digit Span Test	*Efficiency and Attention*	WAIS and WMS sub-test where Pepper dictates sequences of digits and the patient should repeat them in the same order
Token Test	*Oral comprehension*	Pepper shows on its tablet a set of coloured geometrical shapes and asks the interviewee to touch or move some of them, to evaluate the residual potential of the understanding of the oral language

Table 2. Set of exercises for each session type.

Session Type 1	Session Type 2	Session Type 3
Orientamento meteorologico	Orientamento meteorologico	Orientamento meteorologico
Come mi sento?	Riconosci gli animali	Token Test
Training imitazione mix	Training imitazione mix	Come mi sento?
Prerequisiti Visivo	Come mi sento?	Training imitazione mix
Canzone per ballare	Canzone per ballare	Canzone per ballare

In the eight interactive sessions with Pepper, the schemas proposed in the table above will be administered as follows in Fig. 4.
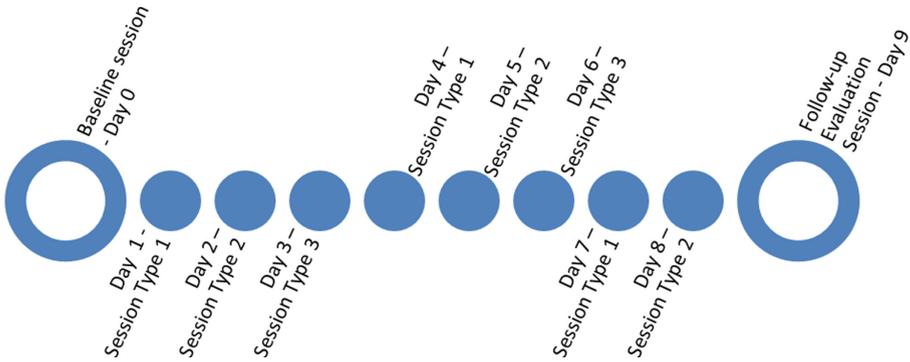
Fig. 4. Timeline of the sessions.

5 Ethical Considerations

5.1 General Ethical Aspects in the Conduction of the Study

Declaration of Helsinki.

The current version of the Declaration of Helsinki (2013) is a reference for the ethical aspects of this clinical study and it will be respected by those employed in this research study.

5.2 Ethical Committee

The Principal Investigator of the study will present to the Ethical Committee of the Research Hospital IRCCS "Casa Sollievo della Sofferenza" in San Giovanni Rotondo. The study protocol including documentation relating to the information to be provided to patients and forms for obtaining informed consent to medical treatment, informed consent to the processing of personal data and any other document necessary for them to fulfil their responsibilities. The study will be started only after obtaining the written approval, dated and signed by the Ethical Committee, under the guidelines of Good Clinical Practice (Buona pratica Clinica, Italian Ministerial Decree No. 162 of July 15, 1997) and the Italian Ministerial Decree of March 18, 1998 "Linee Guida per l'istituzione ed il funzionanamento dei Comitati Etici" published in the Official Gazette No. 122 of May 28, 1998.

5.3 The Informed Consent Form and Information Sheet

Before carrying out any study procedure on a patient belonging to the centre, the Investigator must obtain the acquisition of all written consent. It is the Investigator's responsibility to provide comprehensive information relating to the study's operating procedures. The documents that identify the subject will be kept confidential and, under EU Regulation 2016/679 (GDPR) and Legislative Decree 196/2003, will not be made publicly available or communicated to unauthorized subjects. If the results of the study are published, the identity of the subject will remain secret. The patient must be informed that

participation in the study is voluntary and that refusal to participate does not imply any penalty, that he has the right to terminate his participation in the study at any time and that this decision will not affect future care. Before the start of the study, the Investigator will deliver to each patient's parent the Information Sheet, containing the description of the study and the telephone number of the Investigator. The subject will be given sufficient time to be able to decide on possible participation in the study and to obtain any necessary clarification from the Investigator regarding the study. Furthermore, the patient's parent must carefully read, and understand, what is present in the "Prospect - Informed Consent" form, section "Information on Data Processing"; subsequently, he/she may affix his written consent. If the patient's parent is in favour of participating in the study, he/she will personally sign and date the "Prospect - Informed Consent" form. The Investigator will in turn sign the Informed Consent form. A copy of the aforementioned forms, duly signed, will be delivered to the patient's parent.

5.4 Data Recording and Storage

The data collected through electronic devices and questionnaires will report the codes assigned to patients. The codes will be designed in such a way as not to allow inferring the identity of the subject to which they refer. All documents that could disclose the identity of patients will be kept by the Investigator in strict confidentiality, under EU Regulation 2016/679 (GDPR) and Legislative Decree 196/2003. All documents containing the original data and transcribed in the CRF will remain in the archives of the Unit of Child Neuropsychiatry of the Research Hospital IRCCS "Casa Sollievo della Sofferenza". The signed originals of the forms, the hospital documentation and other documents relating to the study must be archived by the Investigator and kept in the limited access archives of the Unit of Child Neuropsychiatry "Casa Sollievo della Sofferenza". No documents relating to the study may be destroyed without prior authorization from the investigators.

5.5 Financial Aspects

This kind of research will not entail any cost for the Italian National Health Service. As this is a spontaneous study, the participating investigators will not receive any compensation by way of reimbursement for the research activities carried out.

6   Conclusions

Robot-Assisted Training (RAT) aims to train and improve both physical and cognitive skills of the user, through interaction, so one of the goals of this study is to improve user performance by providing personalized and targeted assistance towards maximizing training and learning effects. Robotic systems can be used to manage therapy sessions, collect and analyze both data and parental interactions and perceptions of family relationships. One of the most disabling deficits of children with ASD is difficulty in communication and social interaction. Specifically, children with ASD may exhibit difficulties with social-emotional reciprocity; deficits in nonverbal communicative behaviors used for social interaction; and deficits in the development, management, and understanding

of relationships. RAT appears to be a valuable support for improving communication skills. In addition, the study aims to reduce repetitive and maladaptive behaviors through the use of specific therapy sessions that will help children with ASD to manage repetitive and maladaptive patterns of behavior, interest or activities. The RAT supports the processing of useful information in the form of reports and graphs, proving to be a powerful tool for the therapist in order to monitor the patient's therapeutic progress and facilitate in a timely manner the formulation of a correct diagnosis, useful also for the multidisciplinary team (educational, psychological, medical).

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Empowering Study Attitude

Educational Digital Storytelling: Empowering Students to Shape Their Future

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Abstract. Education digital storytelling (EDS) refers to digital storytelling in education. EDS is often presented as a technology-enhanced learning approach with powerful educational benefits. The use of EDS as a tool to support students to consider and pursue a meaningful life based on their interests, talents, and aspirations is spreading. Due to its nature, EDS could be an optimal tool to create and share digital stories to stimulate career plans. This paper deals with the educational uses of digital storytelling and presents an overview of how EDS can be used to support career guidance. It concludes with a brief description of the NEFELE Erasmus+ project that will implement tangible user interfaces (TUIs) in the classrooms to promote the EDS as a tool for career intervention.

Keywords: Educational digital storytelling · Career choices · Life design

1 Introduction

Educational digital storytelling (EDS) has grown out of Digital Storytelling (DS) in the past two decades. EDS refers to digital storytelling in the field of education, such as schools.

EDS is often presented as a technology-enhanced learning approach with powerful educational benefits. Starting from Lambert's definition of DS as a short narrated film [1], is it possible to define EDS as facilitated production of a short digital story in an educational community setting that should contain a mixture of digital media, including text, recorded audio narration, pictures, music and video.

Due to its nature, EDS could be an optimal tool to create and share digital stories to stimulate career plans. Students can think about their futures and use media to express their aspirations, expectations, needs and dreams in a narrative way. Although often used as a tool for agentic identity development [2,3], its use as a career guidance tool is very recent [4].

This paper deals with the educational uses of digital storytelling and presents an overview of how EDS can be used to support career guidance. The first section "Education Digital Storytelling" begins with a definition of EDS and focuses on how EDS is being used in education as support teaching and learning. The second part "Life design paradigm" proposes career guidance interventions focusing on the life design (LD) paradigm. The following part "Link between Educational Digital Storytelling and Life Design" discusses the use of EDS as a tool for LD career intervention. The paper concludes with a description of the NEFELE ERASMUS+ project that will implement tangible user interfaces in classrooms to promote the use of EDS as a tool for LD career intervention.

2   Educational Digital Storytelling

"When we enter human life, it is as if we walk on stage into a play whose enactment is already in progress – a play whose somewhat open plot determines what parts we may play and toward what denouements we may be heading" ([5], p.34).

Storytelling is sharing ideas, needs, and experiences through words to make meaning about our lives [5]. Through narrative, individuals shape their imagination and reflect on the concept of "the possible". In this sense, the focus is transferring meaning [6]. Storytelling practice enhances the ability to negotiate new meanings and understandings and allows bringing together both the canonical and the exceptional and cultivating the possible [5].

Digital Storytelling (DS) offers new instruments for revisiting storytelling, blending multimedia, interactivity and the web into traditional storytelling practices [7,8]. It can be defined as a modern expression of ancient storytelling [8]. Individuals become active creators by creating electronic personal narratives [9–11].DS is conceived as a new creative cultural mode [7].

Seven elements of DS are presented by Lambert [9,12]: point of view, a dramatic question, emotional content, the gift of your voice, the power of the soundtrack, economy, pacing. Point of view refers to the personal perspective of the narrator and the sense of authenticity of the story. A dramatic question is defined as an "existential" question to which the narrator wants to find an answer at the end of the story. Emotional content reflects the emotional connection to the story. The gift of voice and the power of the soundtrack refers to the personalization of the story. Finally, economy and pacing refer to just enough content to tell the story and its pacing (slowly or quickly).

Robin [13] describe the types of digital stories: personal narrative, which includes stories with significant incidents in the narrator's life; historical documentaries, which refers to the exploration of dramatic events in search of meaning; stories designed to train concepts or practices.

DS was applied in different fields, e.g. health [14] and youth civic engagement [15]. In the last year, its application in education has grown [16]. DS storytelling offers a meaningful context for the effective integration of digital technologies in the classroom [17].

In a recent review, Wu and Lee [16] showed five types of EDS orientation: appropriative, agentive, reflective, reconstructive, and reflexive. The appropriative EDS is designed for storytellers to understand through production. The agentive EDS is structured to enhance autonomy. The reflective EDS is designed to engage in a reflective process. The reconstructive EDS refers to the process of reconstructing meanings of a concept. Finally, the reflexive EDS allows to negotiate and manage the understanding of self and others.

Eight types of outcomes of EDS can be identified [16]: affective, cognitive, conceptual, academic, technological, linguistic, ontological, and social. Affective refer to learner attitude (e.g., motivation, empathy). Cognitive outcomes refer to creative thinking. Conceptual outcomes are concerned with a reformulation of concepts. Academic, technological and linguistic outcomes refer to the related skills. Ontological skills refer to identity topics. Finally, social outcomes are concerned with all the collaborative skills. Moreover, learning to construct and tell stories is a means of defining and reflecting on personal experiences and communicating them to others.

In the context of disability, structuring storytelling educational interventions is challenging. New strategies and forms of storytelling practices are mainly designed for typically developing pupils. However, there is no lack of evidence of the potential of storytelling and DS tools in special and inclusive education contexts for students with disabilities or special educational needs (SEN) such as physical and sensory disability, learning disorders or intellectual disability [18].

Particularly, DS activities could be useful and engaging to support the expressive abilities of children and young people with disabilities or SEN. One of the toughest difficulties of pupils with disabilities and SEN, indeed, concerns the ability to communicate. Communication impairments range from language disorders, inability to effectively implement non-verbal communication or difficulty expressing feelings and thoughts; they all generate negative emotions and interfere with learning and development (DSM-5, [19]).

Neurodevelopmental disorders, such as intellectual disorders or autism spectrum disorders, often pervasively affect children's language learning and communication abilities; then, one of the main interventions' purposes is to teach them effective expression strategies. In order to reach this goal, visual communication tools for Augmented Alternative Communication (ACC), such as PECS protocol (Picture Exchange Communication System), were developed, but also new technologies that empowered this communication system based on a solid Applied Behavior Analysis (ABA) methodological framework [20]. In one study [21], researchers integrated the PECS communication system with a digital storytelling intervention for disabled children who suffer severe impairments in body and fine-grained movements and limited cognitive functions such as memory, problem-solving, attention, visual and language comprehension. The approach was applied in a real school context, where the benefits for disabled children were evident in positive emotional expression, linguistic and narrative capability improvement, moreover in autonomy and movement control, but also for classmates in social cohesion and a stronger sense of community.

One aspect that makes DS particularly suitable for pupils with disabilities or SEN is that it is a highly adaptable and flexible methodology; therefore, it allows the personalization of interventions and features of the tools used based on the needs, potential and competences of individuals. Having identified specific objectives, teachers and educators can organize storytelling activities and materials (visual, auditory, and more) so that each student can make the most of their personal resources. DS is also a cooperative learning tool, as it stimulates children with SEN to interact and collaborate with their peers to develop social and interpersonal skills, thus promoting true inclusion.

Certainly, to fully exploit the support of digital media for storytelling and involve vulnerable children in the development of expressive skills, it is important to customize the design and intervention based on the differences of each one. Botturi and colleagues [18] developed a model, the digital storytelling for development model (DSD), to support DS activities implementation in educational contexts for children with SEN.

3   Life Design Paradigm

Career transitions represent critical developmental tasks in adolescence and early adulthood [22]. In the present era, a new social arrangement of work poses a series of concerns and challenges in careers [23,24].

Due to this unstable environment, the relationship between adolescents and career choices must be carefully rethought [25]. New barriers interrupt the linearity of career transitions, and adolescents have to cope with unpredictable career trajectories increasingly. Moreover, the career choices do not end at a given moment in life (i.e., school-to-work transition), but the number of career transitions that individuals must make in their lifetime has dramatically increased [26].

The transitions among educational systems are the crucial career decision-making moments [27,28]. During these transitions, the quality of career decisions and the difficulties that the individual encounters play a central role. Transitions like this can promote indecision [29] and are defined as the most widespread vocational problem [30].

Furthermore, adolescents are currently thinking about their future in this continuously changing context. These environmental risk factors could inhibit the development of the future orientation in adolescents [31], leading to a lack of optimism and hope toward themselves and their future [31]. The negative feelings about their future possibilities could become obstacles to adolescents' career development and restrict their future expectations [32].

Becoming prepared for a career is necessary to master career transitions [33]. Lifelong learning, counseling and life designing are needed to help individuals access sustainable careers [34]. In this sense, constructing a sustainable career requires a preventive perspective in guidance and career intervention.

Interventions should guarantee a positive orientation toward future vision promoting hope and optimism [35] and enhancing coping strategies.

Although traditionally career guidance followed the person-environment fit approach that aimed to assess people's skills and interests for oriented the suitable job [36], from the end of the 20th century the Life Design (LD, [37,38]) was the leading paradigm. The LD model for career intervention endorses that preventive career interventions with children and adolescents are helpful to prepare adolescents for their transition, increase their choice opportunities and decrease at-risk situations and social inequalities [37]. LD conceives career as a self-directed process: the adolescents through personal negotiation meaning in social interactions shape their life course. In this paradigm, adolescents are actively engaged in the career development process and enhance the needed skills that can lead them to successfully interact with their environment [24]. In the LD model, individuals are required to tell small stories. Storytelling allows to make the self and crystallizes what individuals think of themselves. Savickas argues that "the more stories they tell, the more clients develop their identities and careers" ([37], p.15). LD allows individuals with and without disabilities to aspire to an inclusive and sustainable future [39].

Students with disabilities and SEN, due to lack of targeted opportunities for reflection, expression and support in career and life choices, often develop feelings of anxiety and worry, motivational and cognitive beliefs that include a low sense of self-efficacy [40]. It is important to emphasize that people in disadvantaged conditions, such as disability, can become more self-determined, autonomous, satisfied with their life and able to make life choices if they are provided with adequate support [41]: it is, therefore, essential to create self-expression spaces to stimulate reflection and awareness on personal resources, desires, and expectations for their future life. Therefore, the storytelling and narrative approach are not limited to the creation of educational spaces for linguistic-narrative development: they are tools to increase the self-awareness of people with disabilities that aim to design a life path as autonomous and independent as possible.

To promote disabled persons career guidance, it is necessary to provide more opportunities for reflection and expression. Young people with disabilities, in an inclusive perspective, should be helped to recognize and focus on their resources and strengths and the skills and competences needed to identify life goals. In addition, they could be stimulated to talk about themselves in a positive way, as well as their peers, to support positive visions of themselves and the future, helping them to overcome the stigmatization of their disability, obstacles, and barriers to their positive personal and professional development [40].

4   Link Between Educational Digital Storytelling and Life Design

In an EDS, students are encouraged to express their life stories jointly using music, video, and recorded voice. In the life design paradigm, individuals are encouraged to write their life stories. Career stories are at the heart of storytelling. Storytelling has a transformative role in enhancing adolescents' ability

in making a clear statement of their identity and helps them express their future expectations. LD paradigm believes that adolescents give meaning to careers through stories creating a narrative identity [38].

Pordelan and colleagues [4] have integrated the use of DS in LD intervention. The authors refer to specific career counseling sessions, and the DS was used as one part of the LD protocol. The findings showed that the use of digital storytelling in the LD promotes students' career decision-making.

No studies have proposed the use of DS in a school setting, defined as EDS, to support career guidance.

We believe that the EDS can be used as a tool to support students to consider and pursue a meaningful life based on their interests, talents and aspirations. Telling is a crucial ingredient of peoples' attempts to construct, deconstruct, reconstruct, and co-construct their career-life stories [42]. Due to the nature of the reflective practice [43], EDS can be a tool for telling career stories. In this way, EDS may help students talk about their needs easily and relate their present as students and future and life trajectories [44,45] and their agency to pursue their aspirations [45].

EDS is a flexible and adaptable tool. Consistent with Pordeland and colleagues [4], the novelty approach of digital storytelling in LD is that over the development process because the story can be modified, enhancing career self-efficacy. Through "career digital storytelling", adolescents can express their own career identity in terms of life themes [37,38] and the identifications of a career path. This capability allows them to face social, contextual, and career changes, interpreting them as opportunities.

Moreover, as an innovative and flexible tool, EDS could empower the orientation and career guidance process of students with SEN: EDS opens to different and creative ways of expression. The digital features of EDS, such as images, music, different presentation forms, allow a selection of those techniques that best suit each student. To view and show one story means narrating differently than through words. It means being able to listen to it several times and modify it, if necessary, in the process of continuous reflection and construction of oneself and one's life story. Storytelling with images means understanding everything from a new point of view, and if it is a good exercise for all, vulnerable children could discover new strategies for naming emotions and ideas.

5   NEFELE Erasmus+ Project

Against this background, the NEFELE Erasmus+ project aims to develop an authoring tool that allows the creation of games for middle school pupils to support career choices.

This innovative tool allows students to experiment with themselves in different roles, opening to a positive future vision and enhancing planning and future orientation skills. The game, in this sense, is an elective tool for engaging learning, in which children in an authoring system will be able to construct their contents.

Alongside the tangibility of the real objects and multisensorial experience, the storytelling tool itself will allow adolescents to think about the future, encouraging meaning-making processes and enhancing a positive vision of the future characterized by hope and optimism.

Consistent with Maree [42], the school provides the adolescent with a much-needed holding environment. The ability to hold refers to enabling adolescents to make meaning in their careers. In line with this point of view, teachers in the school environment should allow adolescents to acknowledge and validate their narratives [46].

The authoring tool will be based on the Tangible User Interface paradigm. Tangible user interfaces (TUIs) is defined as user interfaces that allow the individual to interact with digital information through physical environments [47]. TUIs' potential is to encourage exploratory and expressive activities to enhance learning [48], and there are several uses of TUI in educational settings [49, 50]. TUI paradigm has been used for storytelling. For example, Ryokai and Cassell [51] developed Storymat, a play carpet that can record and replay children's stories to support children's everyday narrative play. Instead, Shiva's Rangoli [52] is an interactive and tangible storytelling installation that enables composing the emotional context of the stories by shaping the ambient settings (light, sound, music, and video). According to Gupta and colleagues [52], TUIs at the service of storytelling allows creating an emotional tone augmenting specific components like lights, sound, music to make them stand out more, aiding in narrative coherence.

TUIs have been widely used to stimulate learning for children with special needs (for example, [53, 54] and enhance participation, inclusion, and a sense of community in a classroom environment [55]. In this way, all students become constructive agents of their realities.

Thanks to the TUIs approach, NEFELE wants to guarantee laboratory activities for all children in the classrooms designed to create an environment that stimulates storytelling and design a sustainable and inclusive future for all. We believe that EDS can serve as a tool in educational systems to strengthen and foster the necessary skills as well as awareness of the choices available for oneself, to design and continuously improve a collective vision of multiple possible futures and ways of being both individually and collectively, to foster students' optimism and hope about their future.

6   Conclusions

Adolescents career decision-making is required to go through a process of self-understanding, exploring an umbrella of career options with the aid of guidance and planning [56, 57]. Life design interventions in a lifelong paradigm are intended to support students in their career plans, helping them generate actions that promote sustainable careers and decent working conditions [34].

EDS, through the creation of a digital story, makes the creator think more deeply [58]. We believe that this process is helpful to enhance student career

plans. As a tool for lifelong LD intervention, EDS is expected to foster students' empowerment and fulfilment while tempering the impacts of fragmented career paths.

In conclusion, EDS brings old and new and has an adaptable, dynamic and inclusive nature. Therefore, it allows it to be an optimal tool to empower students to shape their future.

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On the Perceptions of Online Learning Due to COVID-19 Pandemic. Case Study: University of Foggia, Italy

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Abstract. Due to COVID-19, higher education institutions all over the world transitioned to online learning. The sudden and forced transition to this new learning methodology pushed the Universities to rapidly adequate to the needs, upgrading their digital platforms to comply with the new requirements. In the same way, teachers had to adapt their teaching to fit the new medium's potentials and limitations. The final receivers of this striking change, the students, had to adequate to the novelty approach, though this process has not been painless. Several difficulties, challenges and opportunities arose in this transition process for students, and the full digital class delivery also stressed them emotively. This study explores University of Foggia students' perceptions of the emergency online learning. The factors analyzed involved their perception about the University implementation of the online class delivery, their consideration about the future of online learning and their emotional impact in attending courses with this methodology. Quantitative and qualitative data were collected from 3,140 participants. The findings present how students have globally appreciated online learning, but they mostly prefer a blended learning approach. Furthermore, by using segmentation variables, differences emerged among the participants' groups, indicating online learning can have great potentials, but more complex and integrated approaches are needed to fulfill the different learning needs.

Keywords: Online learning · COVID-19 · Students' perception · University · Blended learning · Remote learning

1 Introduction

The world is facing a health crisis due to the COVID-19 pandemic. As a result of COVID-19, higher education all over the world has moved to deliver courses

online during Spring 2020 [2,7,12,21]. In particular, in Italy, online learning has been expanded to Fall 2020 and also Spring 2021 [3,11]. However, students have expressed stress related to online learning and difficulties compared to the traditional learning in physical classrooms [10]. By understanding students' challenges and preferences, universities can develop strategies to assist students in case there are further weaves of COVID-19 or any other disaster requiring an emergency transition to remote learning. The shift towards online education during the pandemic of COVID-19 has led many studies to focus on perceived learning outcomes and student satisfaction in this new learning environment [1, 4]. This paper explores Italian University students' perceptions about online learning after COVID-19 government measures (*stay-at-home* and/or *physical distance*), and in particular students from University of Foggia.

To reduce transmission of the COVID-19, several countries established measures on infection prevention and control by limiting contact between people[1]. Governments suggested or ordered physical distancing and movement restrictions[2].

Universities aimed to slow down the spread of COVID-19 by protecting all the individuals involved in the education compartments – students, staff, and faculty members – and to help ensure a safe and healthy learning environment [5,13]. Many universities transitioned to remote learning where classes were held online [2,13]. Some universities were offering *asynchronous* classes where instructors prepare assignments or record lectures and students can complete them at their own pace [12]. Some institutions used *synchronous* learning that occurs at a specific time via a specific medium. In this paper, we focus on the case of the University of Foggia (Southern-Italy), a young University (about 20 years since its foundation) with about 11 thousand students in six departments (Table 1). The University of Foggia, even before the COVID-19 pandemic, was engaged in online teaching. Specifically, 7 courses were in *blended-form* and the University of Foggia was leading the *Eduopen* project (http://www.eduopen.org/), a platform providing more than 300 massive open online courses (MOOCs), involving 27 higher education institutions and 262 tutors and teachers. When the COVID-19 pandemic forced the University of Foggia (together with all the Italian education system) to switch to a complete online teaching, its previous experience helped this transition to be not so critical. The University of Foggia was already equipped with a Moodle platform, a Virtual Classroom Tool together with an e-learning center (founded in 2015) with specialized administrative staff. As a result, the University of Foggia response to the COVID-19 outbreak was not so dramatic. After the Italian President of the Council of Ministers' decree[3], enacted on 4 March 2020, all the activities were switched to a *virtual* form; lessons, exams, seminars, meetings were held online, and all planned academic activities have been confirmed, including graduation sessions, orientation events and research activities. In order to understand the effect of the

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[1] https://www.who.int/emergencies/diseases/novel-coronavirus-2019.

[2] https://www.cdc.gov/coronavirus/2019-ncov/index.html.

[3] https://www.governo.it/node/14343.

COVID-19 outbreak on the students' community, the Italian National Agency for the Evaluation of Universities and Research Institutes (ANVUR – www. anvur.it) and the European Association for Quality Assurance in Higher Education (ENQA – www.enqa.eu) have promoted and established a working group to develop a survey to analyze the didactic experiences made in Italian universities during the COVID-19 health emergency, also in order to offer valuable elements in view of the strategies that the universities will have to adopt once the current pandemic phase will be over. In this paper, we analyze the questionnaire provided by the University of Foggia according to the indications received by ANVUR and ENQA.

Table 1. Students at University of Foggia in academic year 2020–2021. Unique = Unique Cycle (Master degree), also known as Long First Degree Courses at Master level.

Department	Degree	Duration (y)	Year of enrollment					
			I	II	III	IV	V	VI
Economics	Bachelor	3	539	355	826	-	-	-
	Master	2	167	206	-	-	-	-
Law	Bachelor	3	340	235	655	-	-	-
	Master	2	56	27	-	-	-	-
	Unique	5	154	92	103	111	327	-
Clinical and experimental medicine	Bachelor	3	446	129	207	-	-	-
	Master	2	88	116	-	-	-	-
	Unique	6	51	41	31	36	28	46
Agricultural science, food, natural resources and engineering	Bachelor	3	244	170	438	-	-	-
	Master	2	207	194	-	-	-	-
Medical and surgical sciences	Bachelor	3	273	256	344	-	-	-
	Unique	6	101	101	80	75	76	269
Humanities	Bachelor	3	1253	655	1090	-	-	-
	Master	2	283	335	-	-	-	-

This paper is organized as follows: Sect. 2 provides detail on the methodology adopted to survey students at University of Foggia. Section 3 presents the obtained results and discuss about them. Finally, Sect. 4 concludes with final remarks and recommendations.

2   Method

To study the perceptions of online learning during COVID-19 pandemic at University of Foggia, we built a questionnaire that circulated among students by

emails, messages, and word of mouth. Also University professors during lessons asked students to fill the questionnaire sharing the link. Such questionnaire includes questions to get preliminary information of participants (e.g., University degree course they are enrolled in), questions about the perceptions of online learning due to COVID-19, and about preferences of learning modalities for future. More details are reported in Sect. 2.1. Next, we analyzed the proposed questionnare. In this work, we select the Pairwise Markov random field method (PMRF), which relies also on graphs. Therefore, in this section, we briefly describe graphs in general (Sect. 2.2), and then how they are applied within the PMRF (Sect. 2.3).

2.1 The Questionnaire

In order to study the perceptions of online learning during COVID-19 pandemic at University of Foggia, we built the questionnaire reported in Table 2. The questionnaire is composed of 10 questions about perceptions related to online learning during COVID-19 (questions with Q identifier). To this we added further four questions asking participants general information (GQ identifier), their preferences on learning modalities for the future, and suggestions (LQ identifier). The answers to questions Qs are set on a 4-point likert scale (“*Absolutely No*”, “*More No than Yes*”, “*More Yes than No*”, “*Absolutely Yes*”). LQ is a nominal question and LQ2 is an open-ended question. Some of the questions (Q1, Q3, Q4, Q5, Q6, Q7, Q9, Q10) are written with a positive formulation: it means that a high agreement received as answer implicates a positive result. We refer to these questions as *positive questions*. Other questions (Q2, Q8) are written with a negative formulation: it means that a high agreement received as answer implicates a negative result. We refer to this latter group of questions as *negative questions*.

We shared the questionnaire by emails, messages, and word of mouth starting from 1st April 2021. The last student participant submitted on 19 April 2021.

2.2 Briefs on Graphs

Network theory is the study of graphs, representations of relations occurring between discrete objects. Deeply rooted in graph theory – a branch of mathematics whose origins can be traced back to 1735, when the Swiss mathematician Leonhard Euler solved the Königsberg bridge problem – network theory has been applied in disciplines spanning from statistical physics to computer science, from electrical engineering to biology or climatology [6,14,16–20]. In particular, as we will see in the following section, graphs can be applied to study questionnaires.

Graphs are very abstract conceptual structures that can be used to model relations and processes taking place in extremely different systems. A network is a graph with N nodes (or vertices) and L links (or edges) that can be weighted or unweighted, directed or not. An unweighted network is completely represented by its $N \times N$ adjacency matrix A such that $A_{ij} = 1$ if node i points to node j, $A_{ij} = 0$ otherwise. Let $G = (V, E)$ be a graph, where V is the set of its

Table 2. List of the questions (Q) about online/remote learning posed to students at University of Foggia.

Identifier	Question (English ver.)	Original question (Italian ver.)
GQ1	To which University degree course you are enrolled in?	*A quale corso di laurea sei iscritto?*
GQ2	To which kind of degree course you are enrolled in?	*A quale tipologia dicorso di studi sei iscritto?*
GQ3	To which year of the degree course you are enrolled in?	*A quale anno del corso di studi sei iscritto?*
GQ4	How far do you live from University of Foggia?	*Quanto distante vivi dall'Università degli Studi di Foggia?*
Q1	Do you think the e-learning platform is easy to use?	*Ritieni che la piattaforma e-learning sia di facile utilizzo?*
Q2	Have you struggled to find the teaching material (textbooks, handouts, slides, etc.)?	*Hai riscontrato difficoltà nel reperire il materiale didattico (libri di testo, dispense, slide, ecc)?*
Q3	With remote learning, has your class attendance increased (synchronous and/or asynchronous)?	*Con la didattica a distanza, è aumentata la tua frequenza alle lezioni (in sincrono e/o in asincrono)?*
Q4	Do you believe that listening to the lessons recording on the e-learning platform are useful for the purpose of studying and learning the concepts explained?	*Ritieni che l'ascolto delle registrazioni delle lezioni presenti sulla piattaforma e-learning siano utili ai fini dello studio e dell'apprendimento dei concetti spiegati?*
Q5	Did the teachers mostly manage with ease the tools/platform used for remote learning?	*I docenti hanno prevalentemente gestito con facilità gli strumenti/la piattaforma utilizzati per la didattica a distanza?*
Q6	Did the equipment (computers, tablets, smartphones) and the internet connection available to you allow you to enjoy in a satisfactory way (audio, video, interactivity) the activities of the remote learning courses?	*Le apparecchiature (computer, tablet, smartphone) e la connessione internet a tua disposizione ti hanno permesso di fruire in modo soddisfacente (audio, video, interattività) delle attività degli insegnamenti erogati a distanza?*
Q7	Are you overall satisfied with how the online or blended teaching was carried out for the courses of your Degree course?	*Sei complessivamente soddisfatto di come si è svolta la didattica online o in modalità duale per gli insegnamenti del tuo Corso di Studio?*
Q8	Did the lessons in online mode improve your time management?	*La fruizione delle lezioni in modalità online ha migliorato la gestione del tempo a tua disposizione?*
Q9	Do you think that the remote learning eased the communication with the teacher, since you can express your opinions without the embarrassment of public speaking and/or the fear of being judged?	*Pensi che la DaD ti consenta una maggiore facilità di interlocuzione con il docente, poiché puoi esporre le tue opinioni senza l'imbarazzo di parlare in pubblico e/o il timore di essere giudicato?*
Q10	Do you think that remote learning negatively affects your emotional state (anxiety, stress, sense of isolation and loneliness, etc.)?	*Pensi che la DaD influenzi negativamente il tuo stato emotivo (ansia, stress, senso di isolamento e solitudine, ecc)?*
LQ1	At the end of the COVID-19 emergency what type of teaching method would you choose?	*Al termine dell'emergenza COVID-19 quale tipo di metodo di insegnamento sceglieresti?*
LQ2	Further suggestions/observations	*Ulteriori suggerimenti/osservazioni*

vertices such that $|V| = N$ and E is the set of its edges such that $|E| = L$. Edges may denote just the connection among two nodes or being labeled with a number indicating weights assigned to them. In the latter case, the graph is called weighted.

2.3   The Pairwise Markov Random Field Method

Pairwise Markov random field (PMRF) is a well-known network model, used for estimating psychological networks. The PMRF are networks where the nodes represent variables connected by undirected networks, i.e., edges where the relation between nodes can be traversed by both ways. The edges between the nodes (variables) indicate that there is conditional dependence between the two variable, while low weight or absent edges indicate that the two variable are independent after conditioning on other variables [9]. When data are multivariate normal, such a conditional independence would correspond to a partial correlation being equal to zero [9]. According to [8] this method can be applied also on ordinal data, which are available in the dataset we gathered for this research. We can imagine a network model $G = (Y, E)$ with three nodes y_1, y_2, y_3 and undirected edges (y_1, y_2) and (y_2, y_3). We can consider y_1 conditionally independent from y_3, given y_2 that may be a mediator or a moderator in a *network psychometric*. But if we remove the y_2 from the network, the two variable may be correlated. The two variable y_1 and y_3, may be the answers to the questions "Are you happy to go to work?" and "Do you consider your work environment comfortable?", the two question have a high chance to be correlated, but their correlation could be explained by the variable y_2 "Is it your dream job?".

When the data follow a multivariate normal density, the appropriate PRMF model is called the Gaussian graphical model (GGM; [15]), in which edges can directly be interpreted as partial correlation coefficients [9].

Such network is encoded in a symmetrical and real valued $p \times p$ weight matrix $\mathbf{\Omega}$, which elements ω_{jk} represents the edge between the node j and k given by $Cor(y_j, y_k | \mathbf{y}^{-(j,k)}) = \omega_{jk} = \omega_{kj}$ where $\mathbf{y}^{-(j,k)}$ is the vector of variables excluding the variable y_j and y_k [9]. The partial correlations coefficient can be obtained from the inverse of variace-covariance matrix $\mathbf{\Sigma}$, also named the precision matrix $\mathbf{K}$ [15]. In case of ordinal data are used polychoric correlations [8].

The GGM model used is defined by:

$$\mathbf{\Sigma} = \mathbf{\Delta}(I - \mathbf{\Omega})^{-1}\mathbf{\Delta} \tag{1}$$

where $\mathbf{\Delta}$ is a diagonal matrix with $\delta_{jj} = k_{jj}^{-\frac{1}{2}}$ and $\mathbf{\Omega}$ has zeros on the diagonal.

The edge missing between nodes means the two variable are conditionally independent [9].

In this work, we used GGM as a way to visualize the correlation between different segments of the sample we used. In Fig. 7 the tree different models show the variable interaction, and are helpful to explain what factors are more connected by the typology of students.

The GGM model have been generated using the R package "psychonetrics"[4].

Figure 10 shows the most used keywords in the conclusive open question "Further observations", and is built with the R package "tm"[5].

3   Results

In this section, we report the results obtained from the analysis of questionnaire. We gathered a total of 3,140 participants, i.e., 26.5% of total students ad University of Foggia. The analysis is split as follows: Sect. 3.1 presents the result obtained analyzing GQs; Sect. 3.2 shows the results obtained studying Qs through both descriptive and PMRF analysis; lastly, Sect. 3.3 illustrates the future preferences of students with respect to learning modalities and the analysis of their suggestions.

3.1   Analysis of GQs

In this section, we analyze the questions GQs (Table 2). Information about GQ2, GQ4 are reported in Table 3. To ease the reading, results of GQ1, GQ3 are reported in Fig. 3 and Fig. 4, respectively.

The distribution of participants with respect to total students per degree course is shown in Fig. 1a. We observe that, except for Humanities and Law (20% or lower), all degree courses provided a similar percentage of participants (more than 25% and less than 35%). In Fig. 1b, we show the distribution of participants with respect to total students at University of Foggia based on the year of enrollment. We notice that the majority of students of the last years were involved as participants in the questionnaire, with respect to what happens for the first three years (less than 30% of students participate to the questionnaire). Figure 2 also show the distribution of student's enrollment year by course type, indicating a great part of respondents are enrolled at first year of a bachelor course.

The distribution of participants by degree course is depicted in Fig. 3; the participants were equally distributed across the different courses at University of Foggia (from 14% of Clinical and Experimental Medicine, to 22% of Humanities).

The participants were mainly enrolled in Bachelor degree courses (66.3%); the rest are evenly split between Master degree courses and Unique Cycle degree courses, 17.8% and 15.7% respectively (Table 3). The vast majority of them are enrolled in the first and second year of University (63% of total participants). We gathered answers from a small percentage of participants from four, fifth, sixth and successive years (Fig. 4). Furthermore, the vast majority of them do not live in the city of Foggia: in particular, 37.8% of them live within 50 km from University of Foggia, while 33% live more than 50 km far from the University (Table 3).

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[4] https://cran.r-project.org/web/packages/psychonetrics/psychonetrics.pdf.
[5] https://cran.r-project.org/web/packages/tm/tm.pdf.
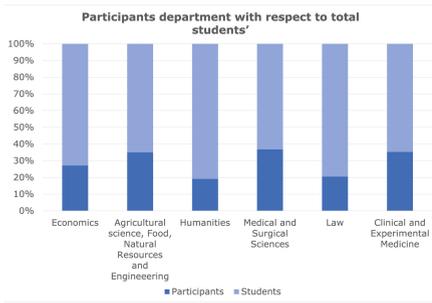
(a) Distribution of participants with respect to total students enrolled at University of Foggia per degree course.
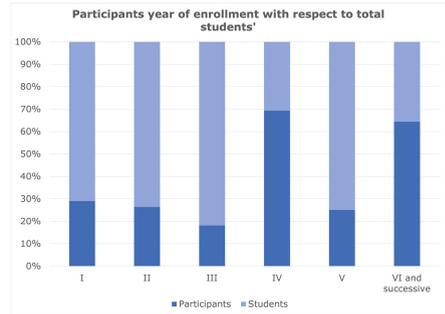
(b) Distribution of participants with respect to total students enrolled at University of Foggia per year of enrollment.

Fig. 1. Distribution of participants to questionnaire with respect to students at University of Foggia.
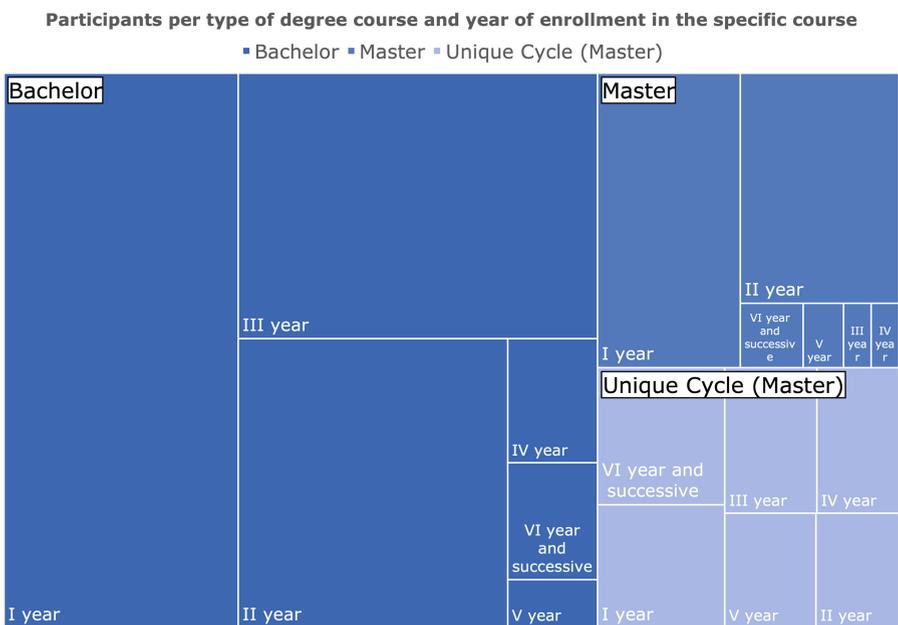
Fig. 2. Participants to questionnaire split based on the type of degree course and the year of enrollment to that specific course.
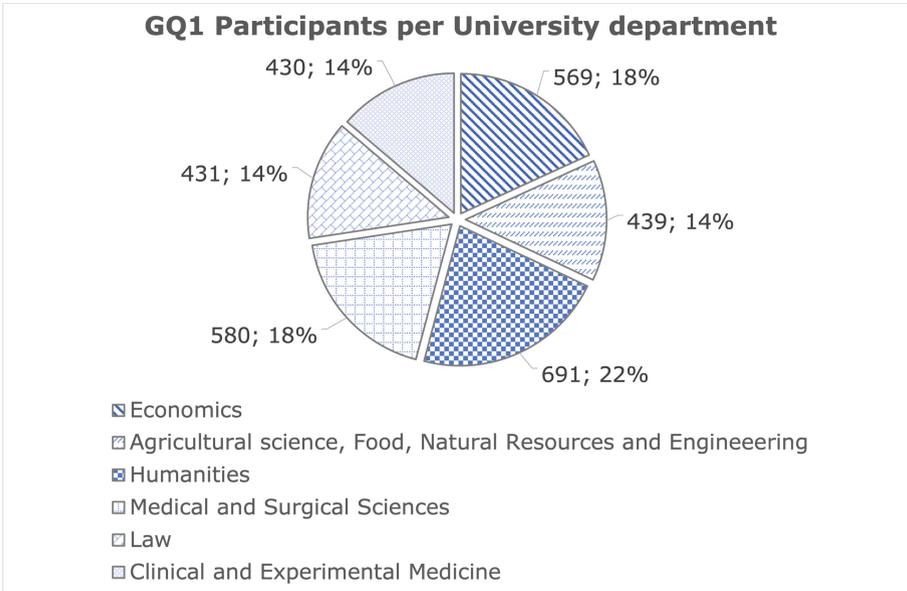
Fig. 3. Distribution of participants per Department at University of Foggia.

Table 3. Distribution of students by course degree and distance from Foggia

GQ2 *Typology of degree course*		
Bachelor	0.663	
Master	0.178	
Unique Cycle (Master)	0.157	
GQ4 *Distance from University of Foggia*		
Foggia	0.288	
≤50Km	0.378	
>50Km	0.330	

3.2   Analysis of Qs

The analysis of Qs (Table 2) is split into *descriptive* and *PMRF* analysis. In the following, we first dwell on the descriptive study and then on the one conducted with PMRF method.

Descriptive Analysis. For this analysis we have chosen boxplots. Boxplots are an effective way to display results, comparing the distributions of samples. The boxplot uses as main information for the structure of the graphic, the median and quartiles. The median is represented in the graphics of this work with the red line. The upper and lower limits of the white box represents respectively, the thid quartile and fist quartile. Thus, in the white box falls the 50% of the distribution. The whiskers encompass the values falling in a range of 1.5 of the
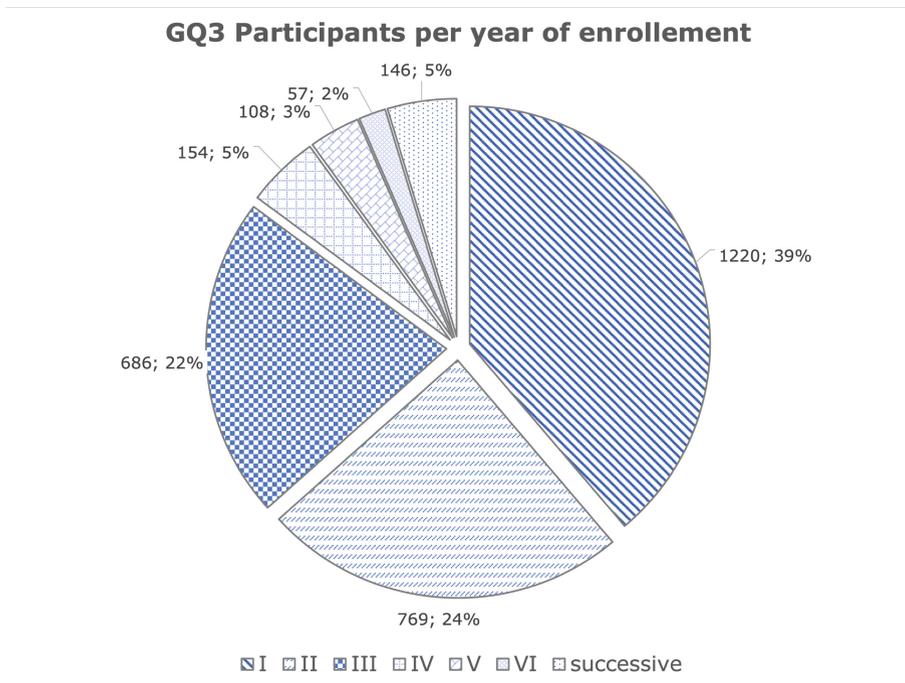
Fig. 4. Distribution of participants per year of enrollment at University of Foggia.

interquartile range (third quartile minus first quartile) out of the upper and lower margin of box. Values outside this range are represented a outlier points.

In Fig. 6, we display the boxplots answers for questions Qs based on participants home distance from University of Foggia. In particular, we split between those living in Foggia city, those living within a radius of 50 km from Foggia, and the ones living more than 50 km far from Foggia (including foreign students).

Overall, the figure shows how the majority of questions have received positive answers towards remote and blended learning (according to the positive and negative formulation of the question) by all three groups of participants. The most extreme results come from the question Q4, about the *utility of recorded lessons*, and secondly from question Q1, about the *easiness of e-learning platform*. Questions about the *increased class attendance* (Q3), *Instructor proficiency for remote teaching* (Q5), and *possession of adequate devices and connection* (Q6) show a wide positive accordance among groups. Few students had *difficulties in finding didactic material* (Q2) and all the three groups showed a high *overall satisfaction for remote teaching* (Q7). While all three groups experienced a *improvement in time management* (Q8), as we could expect the answers are more positive for students living outside Foggia city. The reasonable explanation is that these students have spend more time traveling to Foggia with traditional learning. This gap between students living in Foggia city and other cities
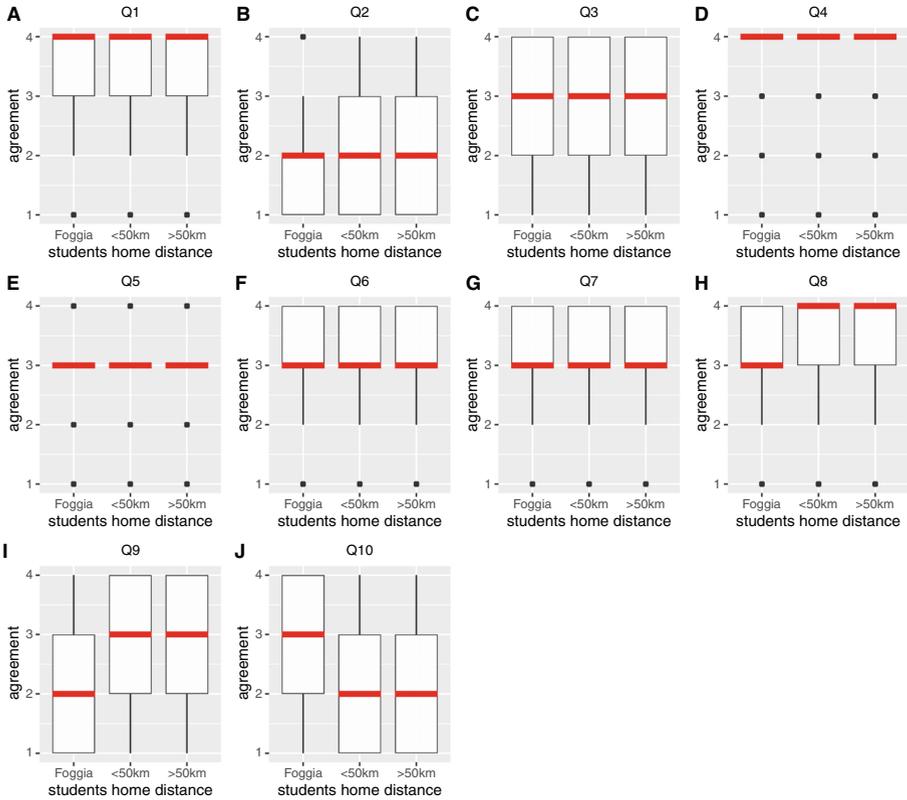
Fig. 5. Participants' answers by their home distance from University of Foggia. Foggia = Students that live in the University's town, <50 km = students living within a radius of 50 km from University of Foggia, >50 km means students living more tha 50 km far from University of Foggia.

is substantially suppressed by remote learning. The question Q9, about *better conversation with teacher*, shows a higher variance among groups. In particular, students living in Foggia city perceived a worsening of interaction "quality" with teachers during COVID-19 pandemic, while students outside experienced an improvement. Speculation about this difference may settle in the facts students from Foggia city always had better opportunity to attend class dialog with teachers directly, while students from outside experienced more limitation due to public transportation time constrictions and generally more difficulties in attending classes. The question Q10, about the *negative impact on the emotional state*, also highlight that students living in Foggia city were more negatively impacted from remote learning. The reasons may lie in the advantages and easiness of reaching the University facilities and higher opportunities in establishing relationship with other students.
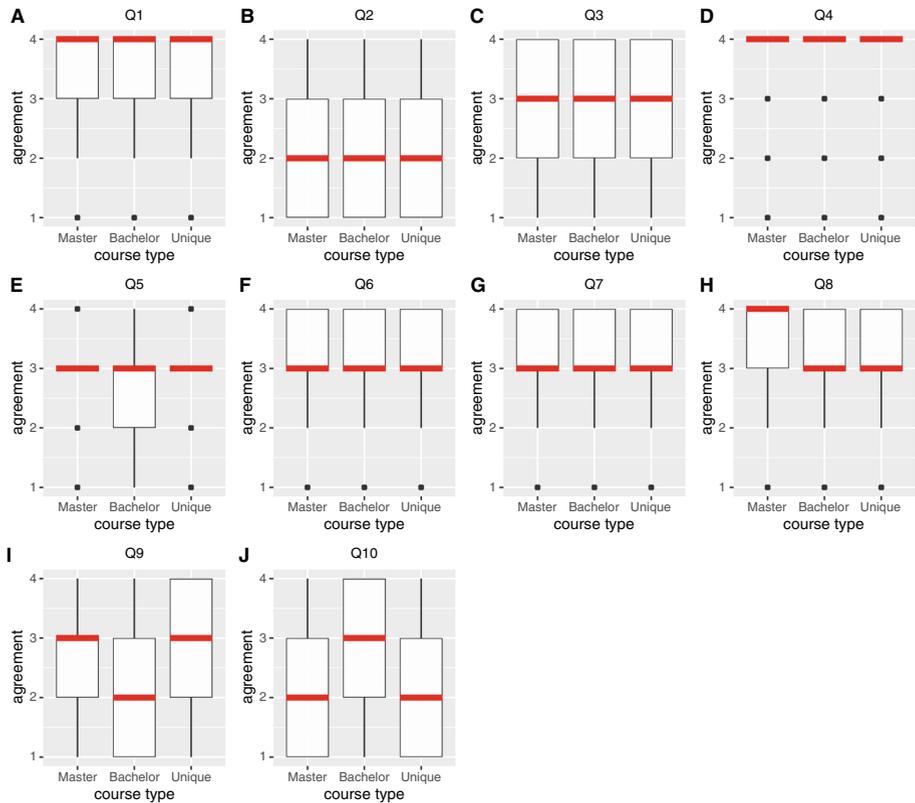
Fig. 6. Participants' answers by typology of degree course. Unique = Unique Cycle Master course.

In Fig. 6, we display the answers boxplots for questions Qs based on which typology of degree course the participants are enrolled in. In particular, we split between Bachelor, Master, and Unique Cycle (Master degree). In red, we depict the median. Overall, the figure shows how the majority of questions have received positive answers towards remote and blended learning (according to the positive and negative formulation of the question) by all three groups of participants.

The most extreme results come from the question Q4, about the *utility of recorded lessons*, and secondly from question Q1, about the *easiness of e-learning platform*. Questions about the *increased class attendance* (Q3), *Instructor proficiency for remote teaching* (Q5), and *possession of adequate devices and connection* (Q6) show a wide positive accordance among groups. Few students had *difficulties in finding didactic material* (Q2) and all the three groups showed a high *overall satisfaction for remote teaching* (Q7). While all three groups experienced an *improvement in time management* (Q8), Master's students showed a more significant improvement. Possible explanation settles in the long experience of such students in managing studying activities and because they often

have a job or internship. Question Q9, about *better conversation with teacher*, shows a high variance among groups. In particular, Bachelor students perceived a worse kind of interaction with teachers during the COVID-19 pandemic. The main reasons for this difference maybe they are less experienced and new in the University environment, and the bachelors' courses are usually more crowded, affecting more the possibility of a fruitful interaction on an e-learning platform[6]. Lastly, Q10 indicates that Bachelor students had the most *negative impact on the emotional state.* This is not unexpected, considering that most of the participants in our questionnaire were enrolled on the first year (Fig. 4). These students experienced the shifting from High schools to University during the COVID-19 emergency and subsequent restrictions. Therefore, they had few opportunities to settle in the environment and establish a relationship with other students.

PMRF Analysis. Figure 7 and Fig. 8 shows the graphs created according to the methodology described in Sect. 2. The edges in the graphs indicate the presence of a connection between answers of the questions, over the threshold of 0.15, empirically chosen as equilibrium point between *informativity* and *legibility.* The thicker the edges, the stronger is the connection between the variables. The blue edge color indicates a direct connection between the questions, i.e., a higher(lower) score of question A matches a higher(lower) score of question B. Instead, the red edge color indicates an inverse connection between the nodes, i.e., a higher(lower) score of question A matches a lower(higher) score of question B. A particularly prominent example of inverse connection in our work is the relation between node Q8 and Q10. Q8 asks the student to provide a higher score when remote learning improved his/her time management – a positive feature for remote learning. On the other hand, Q10 asks to provide a higher score if the remote learning negatively affected her/his emotional state – a negative feature for remote learning. Although the two questions ask about two different features of remote learning, some sort of connection between them is reasonable, as the emotional state can impact time management and vice versa. The way the question has been asked imply that if students are in a negative(positive) attitude toward remote learning they (should) give a lower(higher) score to Q8 and higher(lower) score to Q10. In doing this, participants create an inverse connection reflected trough the red edges in the graph. One or more latent factors likely impacted the student's answers to the questionnaire; however, the questionnaire has not been structured to be managed with proper methodologies relative to the detection of the latent factors.

In Fig. 7 the three graphs have been generated filtering questionnaires based on where the participants declared to live. International students have been merged with the group of students living more than 50 km far from the University of Foggia. This segmentation is because students from Foggia have reduced problems in getting to the University facilities. Instead, students living in a town

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[6] High schools classrooms are usually smaller in terms of students (15–30); therefore University newcomers are more used to face-to-face conversations with the teacher than what happens at University.

within a radius of 50 km are likely to be commuters and have more difficulties reaching the university facilities, as they need to spend more time traveling. The last group are the students coming from town distant more than 50 km. These are likely to be off-site students, with typical challenges of young students living in other cities far from relatives and hometown-friends.

The node numbers in the graphs match the questions of Table 2 and the features reported in Table 4. In all three graphs of Fig. 7, a strong connection between some features is evident. For example, the edge between Q5 and Q7 shows a connection between the score of *Instructor proficiency for remote teaching* and the *overall satisfaction for remote learning*. The edge between Q3 and Q8 indicates a strong connection between the *increased class attendance* and the *time management improvement* as expected. Nodes Q8 and Q9 indicate a connection between the *improvement in time management* and the *conversation with the teacher*. The edge between Q8 and Q10 indicates an inverse connection between *time management improvement* and the *negative impact on the emotional state*. Likewise, the edge between Q9 and Q10 indicates an inverse connection between *improvements in conversion with the teacher* and the *negative impact on the emotional state*. Figure 7b and 7c shows commuters and offsite students have a higher inverse connection between Q7 and Q10, i.e. the *overall satisfaction for remote and blended learning* and the *negative impact on the emotional state*, and also a negative correlation between Q2 and Q5, i.e., *difficulty of finding didactic material* and *Instructor proficiency for remote teaching*. For students living more than 50 km far from University of Foggia (Fig. 7c) there is also a stronger connection between Q8 – *time management improvement* – and Q3 – *increased class attendance*. Moreover, Q3 is also inversely connected with Q10 – *the negative impact on the emotional state*. These connections may be because many students very distant from university do commuters or often do not attend class. Students living within a radius of 50 km from the University of Foggia in Fig. 7b, shows a higher connection between Q1 – *easiness of e-learning platform* – and Q5 – *Instructors proficiency for remote learning* –, and also a connection between Q3 – *increased class attendance* – and Q7 – the *overall satisfaction for remote learning*. Students living in Foggia in Fig. 7a, showed a higher connection between Q4 and Q7, *utility of recorded lessons* and *the overall satisfaction for remote learning*, and between Q7 and Q9 – *better conversation with the teacher*. Both students living in Foggia and a town within a radius of 50 km from Foggia showed an inverse connection between the easiness of the e-learning platform and the difficulty of finding didactic material.

Figure 8 shows the three graphs generated filtering questionnaires based on the type of course attended by students. We can expect the students attending a bachelor are less experienced than Master degree students. They are younger, and usually, they just come directly from high schools. On the other hand, master degree students are more experienced in the university environment and probably more used to the University of Foggia itself. Finally, there is a more complicated category, i.e., Unique cycle students, that encompasses new students and older

Table 4. List of feature measured with the questions (Q) about online/remote learning posed to students at University of Foggia. The exact corresponding questions are indicated in Table 2

Identifier	Feature
Q1	*Easiness of e-learning platform*
Q2	*Difficulty of finding didactic material*
Q3	*Increased class attendance*
Q4	*Utility of recorded lesson*
Q5	*Instructor proficiency for remote teaching*
Q6	*Possession of adequate devices and connection*
Q7	*Overall satisfaction for remote and blended learning*
Q8	*Time management improvement*
Q9	*Better conversation with the teacher*
Q10	*Negative impact on the emotional state*

(a) Students from Foggia.   (b) Students living in a city within a radius of 50km from Foggia.   (c) Students living more than 50Km far from Foggia
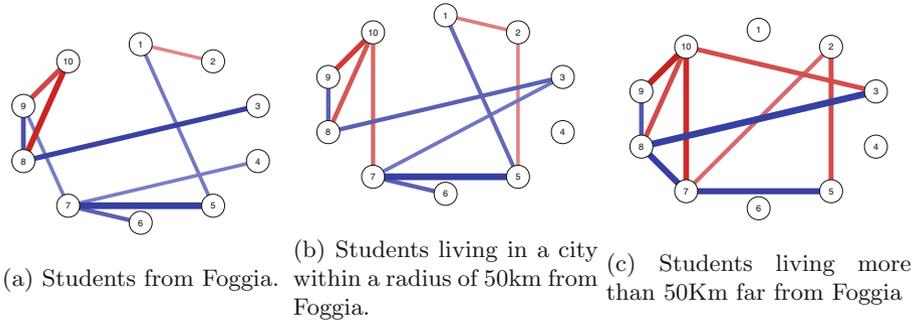
Fig. 7. Relation between the questions based on participants home distance from University of Foggia. Nodes represent questions (Q) – see Tables 2 and 4. Blue edges indicate a direct relation between the questions, red edges indicate an inverse relation between the questions. The thicker the edges the stronger relation between the questions. (Color figure online)

ones. However, these students are mainly enrolled in the program of Law and Medical and Surgical Sciences.

The consideration above pushed to explorer if these differences could affect the connection of the question. Many of the general considerations about the connection between questions made above for Fig. 7 still apply in this case. In particular, it mainly holds true for the nodes Q5, Q7, Q8, Q9 and Q10. However, it is relevant to shed light on some relations for Master students in Fig. 8b. There is a stronger connection between Q6 and Q7, i.e., *possession of adequate devices and connection* and the *overall satisfaction for remote learning*, deserving deeper future investigation, and inverse connection between Q2 and Q5, i.e., *difficulty of finding didactic material* and *Instructor proficiency for remote teaching*. Par-

ticularly interesting is the network of students enrolled in a Unique cycle Master program depicted in Fig. 8c, which shows more edges than the others. For example, the edge between Q1 and Q5, highlight a connection between the *easiness of the e-learning platform* and the *Instructor proficiency for remote teaching*. The edges between Q3 and Q10 indicate an inverse connection between *increased class attendance* and *negative impact on the emotional state*, while the edge between Q5 and Q8 also shows an inverse connection between *Instructor proficiency for remote teaching* and *time management improvements*. Lastly, there is a connection between Q4 – *utility of recorded lessons* – and Q7 – *overall satisfaction for remote blended learning*.

It is worth highlighting that the edges shown in this section's graphs have to be interpreted only in terms of connection and not as indicators of a more positive (or negative) factor for one students' group with respect to the others.

| (a) Bachelor | (b) Master | (c) Unique cycle (Master) |
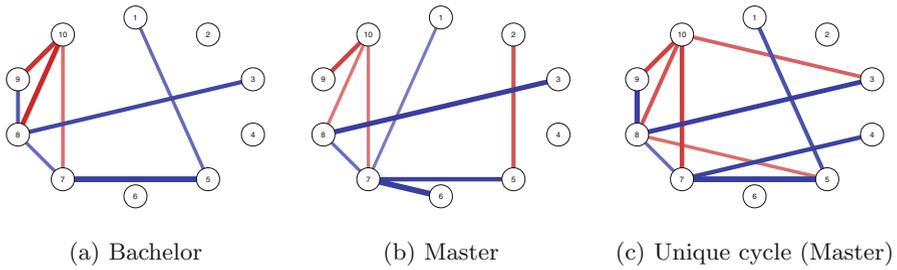
Fig. 8. Relation between the questions based on participants' type of course. Nodes represent questions (Q) – see Tables 2 and 4. Blue edges indicate a direct relation between the questions, red edges indicate an inverse relation between the questions. The thicker the edges the stronger relation between the questions. (Color figure online)

3.3 Analysis of LQs

In this section, we analyze the two LQs (Table 2).

The LQ1 question asked students what type of teaching methodology would they choose in future.

Figure 9a shows the distribution of participants answers by where they live. For students living in Foggia city, the most relevant answer are *Traditional learning only* and *Bledended learning, with more than $\frac{1}{10}$ but less than $\frac{2}{3}$ of lessons*. In contrast, students living within a radius of 50 km from Foggia prefer *Bledended learning, with more than $\frac{1}{10}$ but less than $\frac{2}{3}$ of lessons*, and students living more than 50 km far from Foggia prefer *Online learning only*. The different propensity of the three groups can be easily justified by the difficulties these students face in reaching the University facilities: clearly, this impacts more students living outside Foggia.
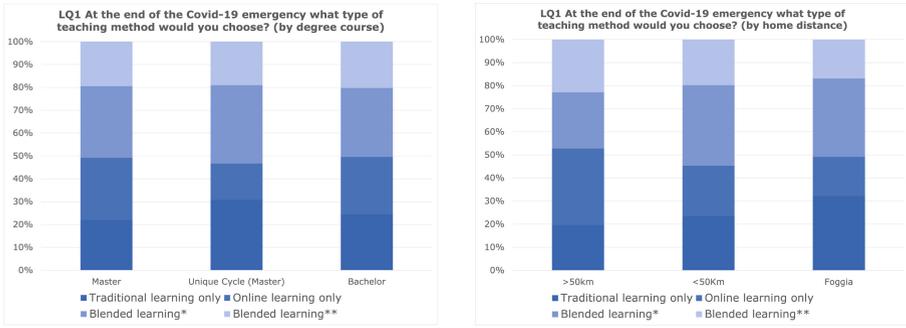
(a) By typology of degree course.

(b) By distance from University of Foggia.

Fig. 9. Participants' preferences for the future learning approach. ***** More than $\frac{1}{10}$ but less than $\frac{2}{3}$ of lessons and other teaching activities are held in traditional learning modality; the rest are held online. ****** More than $\frac{2}{3}$ of lessons and other teaching activities are held online.

Figure 9b shows the distribution of participants answers by the typology of degree course they are enrolled in. The preferred answer for all the three groups is *Bledended learning, with more than $\frac{1}{10}$ but less than $\frac{2}{3}$ of lessons.* For Master students, there is also a strong preference for *Online learning only*, while Unique cycle Master students highly prefer *Traditional learning only*. Overall, by analysing the results obtained, blended learning approaches are the more prominent among all groups. The predilection of master students for online learning may be justified by the need to conjugate study with a job.

LQ2 is an open-ended question, inquiring students to provide further observations. Five hundred students answered this question with comments whose length varied from just one word to long comments. Figure 10 shows the word cloud of the top-100 words used by students in their comments on this question. The comments cover different areas and topics. Many of them contain an appreciation for remote learning (in particular for recorded lessons). Such comments come mainly from commuters and students with a job. They stated they benefited from remote learning and wish to continue to benefit in future.

Other comments focus on appreciation for the e-learning platform and how the University of Foggia managed it. On the other hand, others complain about issues experienced with the platform. Moreover, some comments provided suggestions to improve the management and experience of remote learning. Lastly, several students manifested discomfort for remote learning approach, complaining about the lack of interaction and relationship with students, apathy and alienation of attending class from a device, anxiety and discomfort in taking exams online, and unsuitability for matters requiring practical assistance experience.

In summary, the comments suggest that remote learning may be a viable and appreciated way to deliver classes but does not fit all the students' needs.

Fig. 10. *Wordcloud* of the top keywords (uni-grams) used in answers to the open-ended questions concerning "Further observation" in the questionnaire.

4   Conclusion

In this work, we performed an exploratory analysis of the impact of remote and blended learning methodologies due to COVID-19 on the students' community at the University of Foggia. For this reason, we surveyed students perceptions with a questionnaire whose items aimed to provide to the University a feedback about the quality of the implementation of the e-learning platform and teaching, how these modalities have been accepted by students and the students' propensity for the next future to the different learning approaches.

The analysis showed how the overall opinion of students about the experience offered is positive. However, despite the global feedback, the analyses showed how different students' segments had slightly or substantially different experiences. In particular, students living outside Foggia city have benefited a lot from remote learning, while students living in Foggia experienced more difficulties and reduced human contact with the online learning approach. These aspects have been also confirmed by the different preferences these segments expressed about the future learning modality at University.

Moreover, the students enrolled in Bachelor programs had more difficulties integrating into the university environment due to their direct transition from high school to University with e-learning and COVID-19 restrictions.

The Pairwise Markov random field analyses provided insights on some peculiar interactions between the measured factors specific for some segments of students. However, this analysis has been limited by the shortcomings of the questionnaire adopted, with too limited values of Likert items, and lacking some crucial questions to better segment the students and more fine-grained questions targeting students' psychological experience. On the other hand, the insights gained through this survey and the speculation inherent some exciting results provide the foundation to elaborate more sophisticated research, aiming to answer some of possible emerged research questions.

In summary, the data lead us to consider that the implementation of remote learning at the University of Foggia was successful, despite some difficulties. However, the appreciation and the emotional experience diverges across different segments of students. This means that remote learning cannot be the ultimate solution to fit the complexity of learning needs, but more tailored programs and learning strategies have to be implemented to cope with the needs of different students at the University of Foggia and in Italy in general.

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