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Perceptions of the Contribution Blended Learning Technologies and Teaching Practices Make to Student Success

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Abstract: Before the onset of the Covid-19 induced remote teaching and learning practices the University of the Western Cape (UWC) senate adopted an inclusive online teaching and learning practice. This practice adopted by UWC was aimed to advance the perception of student success and to diminish dropout rates. The primary objective of this research is to measure student success and also consider lessons learned in relation to the adoption of innovative teaching and learning practices. This ongoing research at UWC explores factors underpinning learning and teaching practices, as well as examine research on and notions about student performance, as these are shaped by the pandemic. With the abrupt transition in teaching and learning students had to make major adjustments to their lifestyle to adapt to remote learning and teaching styles. The aforementioned attributed to both emotional and environmental challenges and the perception of student success as UWC momentously responded to students lack of resources and adaption to their teaching and learning style, subject content and their perception of success. The researcher will explore student success trends across the university and the adoption of blended learning approaches across faculties at UWC. While access to online resources is important to facilitate learning, our society still has an insidious digital divide. The aforementioned underpins what CIECT is currently involved in by encouraging and promoting the adoption of emerging technologies and blended-learning approaches, that is: to support the successful transition from the traditional classroom to online classes that promotes student success.

Keywords: Blended learning technologies, Teaching and learning practices, Student success, Qualitative analysis, Quantitative analysis

Introduction

Online technologies, and in particular learning management systems provide universities with opportunities to

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introduce blended learning approaches to programmes and courses. Blended teaching and learning combine Information and Communications Technologies (ICTs) with a variety of media, learning resources and delivery methods. When it was still regarded as a new, innovative method, research on blended learning focused on the technology and platforms used to deliver learning materials and experiences. However, little research considered students' roles in their own success and in the successful application of the technology. Unless the individual learning needs of students can be considered and met, blended learning might not deliver the academic advantages originally envisaged.

The primary objective of the present research was to investigate the perceptions of students and lecturers of the value of using blended learning technologies as part of the delivery of programmes at the University of the Western Cape (UWC) in South Africa. The focus of the research was on the perceptions of student success as a result of using the technologies, and the lessons that had been learned from adopting these innovative teaching and learning practices. The researchers analysed the impact of using technologies in the Arts Faculty from the point of view of the Centre for Innovative Education and Communicative Technologies (CIECT) at UWC. The research underpins CIECT's involvement in encouraging the adoption of technologies and blended-learning approaches at the university. There is a need for research of this nature to add value to CIECT's effectiveness, and because the mandate of the Centre is to promote ways of improving teaching and learning at UWC. A critical analysis of perceptions and practices, such as the present research, should provide new insights into the impact that blended learning and teaching approaches have had, and on the perceptions of student success. The study also aimed to determine whether technologies, blended learning approaches, and perceptions of student success are interrelated. Although this was uncharted research at UWC, it supported CIECT's continual research on the efficacy of the blended teaching and learning practices that included the learning management system (LMS), iKamva.

The theoretical framework in this study was derived from a review of related literature. This framework was important to finding answers to the following question: *Does the facilitation of student interaction within online, blended learning environments impact the perception of student success?*

Literature Review

The scope of the literature review of this study is not intended to provide a comprehensive historical account of the perception of student success within online, blended learning environments. Instead, it focuses on literature published from 2010 on interventions and perceptions of students' success in relation to blended learning technology and emerging teaching practices. Inevitably, the dropout rate at any educational institution not only advances questions and perceptions regarding student success, but also determines the type of intervention that needs to be put in place to support students.

With the aforementioned in mind, in its 2018 Institutional Operational Plan (IOP), UWC envisioned plans to "develop an environment conducive to excellence in learning and teaching in support of student success and retention" (UWC 2018:10). In addition, UWC intended to focus on initiatives that would build an inclusive and supportive student environment. These initiatives saw an increase of activities, particularly directed at creating a culture of inclusivity at UWC, in the hopes of "incorporating multiple learning styles and strategies to facilitate student psychosocial support, retention and success" (UWC 2018:21). The Operational Plan created an awareness of and sensitivity to providing students with appropriate support and interventions that would contribute to their academic success. Such support included identifying at-risk students and directing interventions at vulnerable students, especially those in high-impact programmes (UWC 2018:36). In the discussions about technology in teaching and learning there was a perception that improving teaching practices and using new technologies would reinforce traditional face-to-face classroom engagement (UWC 2018:36).

The use of blended or hybrid learning across all faculties was acknowledged and had become standard practice. E-tools in use included course resources, tests, quizzes, polls and announcements (UWC 2018:36). In the 2018 academic year 1219 modules were developed on the institutional LMS, iKamva, by the CIECT (UWC 2018:37). This was a clear indication that faculties at the university were committed to supporting students' learning and success by engaging with technology (UWC 2018:37). Given the importance of the perceptions of student success, the office of the Deputy Vice Chancellor (Academic) developed a First-Year Experience (FYE) Framework and an FYE Student Success Model that was piloted in 2019. This initiative aimed at strategic programming and focused on positive academic transitions. Another aim was to develop learning communities that would provide meaningful experiences for undergraduates (UWC 2018).

The aim of the research reported here was to investigate the perceptions of student and lecturers of iKamva, as well as their participation in the blended teaching and learning initiatives enabled by using the LMS. Kintu, Zhu and Kagambe (2017:4) suggest that the success of blended teaching and learning depends largely on the confidence and capacity of students as well as teachers to use and apply computer technology and online applications.

A report of the Department of Higher Education and Training (DHET) outlines the success, throughput and dropout rate of students in South African universities between 2000 and 2016 (DHET, 2016:3). The intention of the report was to provide one set of data analytics as a resource when monitoring and evaluating Higher Education Institutions (HEIs), so that appropriate interventions could be sought to improve student success rates. In their analysis, the DHET concluded that students who studied through distance education should receive adequate support to provide them with a "reasonable chance of success" (DHET 2016:30).

Defining student success is not an easy task. Brunton et al. (2016:15) suggest that while the term is multifaceted and even problematic, it has positive connotations. Brunton et al. (2016:15) go on to describe student success as a process in which a student progresses through the early period of study and makes an informed decision either

to continue studying at an institution, or to drop out. As a result, a variety of models have been used to assess student success rates in blended learning environments. For the purposes of this literature review we examine three different models used in measuring both the success of e-learning systems (ELS) and perceptions on student success.

Hassanzadeh Kanaani and Elahi (2012:10963) applied a comprehensive model for measuring the success of ELS. Their study found that the better the technical quality of an ELS, the greater the level of student/user satisfaction. Similarly, Freeze et al. (2019:176-179) applied the Information Systems Success (ISS) Model to measure the impact made on individual students in an online environment. The ISS Model included six constructs or dimensions, namely system quality, information quality, systems use, user satisfaction, individual impact and organisational impact. These authors postulate that the aforementioned constructs are rudimentary components that can determine the perception of success by students enrolled in eLearning courses. They concluded that an ELS should provide students with "needed, relevant, up-to-date information through a user friendly and interactive system" (Freeze et al. 2019:179).

On the other hand, Manwaring et al. (2017) used Structural Equation Modeling to gain a holistic understanding of student engagement in blended learning environments. In addition, they measured the students' perceptions of their blended learning experiences. Structural Equation Modelling is designed to investigate longitudinal relationships between emotional and cognitive engagement, and to determine whether student perceptions influence their learning engagement. These authors concluded that their study had provided a valuable opportunity to gain a holistic understanding of student engagement and perceptions. Three of the findings of that study are significant to the present discussion. First, that the learning environment as well as the students' own perceptions influenced how students viewed success. They found that "while emotional and cognitive engagement were correlated and they both led to the outcome of students' perceptions of learning and getting better at something, they were each uniquely influenced by different aspects of individual student and classroom characteristics" (Manwaring et al. 2017:29). Second, the location of the learning activity was less important to engagement and student perceptions than the actual pedagogical elements designed by an instructor (Manwaring et al. 2017:30). Third, when students were offered choices, their overall development was enhanced:

> Learning activities that provide learner choices, develop sociality, are perceived as important to the student and are seen as relevant or related to existing student knowledge are all associated with higher levels of both cognitive and emotional engagement (Manwaring et al. 2017:31).

While the three models mentioned above seem to be different, they were all used to assess the perceptions of success that students might have of their learning experiences. Each one considered student perception of success from a different viewpoint. The first model considered a comprehensive model for measuring the success of eLearning systems and how it affected student user satisfaction. The second model measured the success of information systems and the impact they made on individual students in an online environment. The third model mapped a holistic understanding of student engagement in blended learning environments.

It is evident from the research cited above that social interaction, teaching and learning are large contributors to interaction in a blended learning course. To determine whether the facilitation of student interaction in online, blended learning plays a pivotal part, it is suggested that "strategies that increase students' self-efficacy and self-regulation can aid them in perceived success within courses" (Blaine 2019:39). From the insights provided by the authors referenced above, the theoretical framework of this study emerged to answer the question: *Does the facilitation of student interaction within online, blended learning environments impact the perception of student success?* Blaine (2019:40) suggests that both students and lecturers need guidance and training on interacting with and in online programmes and other environments. He goes on to advise lecturers and university administrators not to assume that students automatically flourish in an online environment, as this is not always the case.

In an informed review of the literature on the topic of student perception, Hung and Chou (2015) found that students' learning in online environments needed organisation from their lecturers. Precise goals and learning objectives, unambiguous learning programmes, as well as clear expectations and easily available course materials are necessary for student success (Hung & Chou 2015:322, 323). Suggestions for such detailed groundwork to create learning environments aligns consistently with other research done on this topic. Hung and Chou (2015:323) conclude that a wide variety of technological tools should be used to deliver course materials in order to assist students with their learning. Training lecturers to use the available technologies to enhance their online teaching should be the focus of education institutions.

Owston, York and Murtha (2012) examined the relationship between student perceptions of blended learning and achievement. Their study investigated four questions that served as a guide to determine the relationship between students' perception of blended learning and their own achievement. The four questions asked were:

(1) How do perceptions and satisfaction with blended courses relate to achievement?
(2) How do perceptions of the convenience afforded by blended learning relate to achievement?
(3) How do perceptions of engagement in blended learning courses relate to achievement?
(4) How do perceptions of learning in blended courses relate to achievement?

While the research team established that student perceptions are related to learning achievement, those findings led to more questions.

An increasing number of studies have found that, in blended courses students' perceptions, satisfaction and achievement influence their outcomes. The ease with which students can navigate an LMS also contributes to positive perceptions. Al-Busaidi (2012:14,15) concludes that there are four crucial factors that influence the success of LMSs in a blended learning environment, namely "perceived ease of use, perceived usefulness, actual use, and user satisfaction".

More recent evidence provided by Bager-Elsborg et al. (2019) suggests that the effective implementation of an LMS at a higher learning institution is a contributing factor to the perception of student success, and is related to

the teaching-learning environments (TLE) to which students are exposed. These authors suggest that students are motivated to succeed when the TLE meets their basic psychological needs of connection, aptitude and independence. Overall, TLEs that are most effective take high-quality curricula, competent lecturers and tutors, constant student supervision and accountability, as well as a positive social climate at the learning institution into account. These constants all induce a positive perception of students' success.

The most striking result to emerge from the literature consulted is that critical analysis of the perception of student success is necessary, together with the need to determine students' perceptions of their blended learning experience (López-Pérez, Pérez-López & Rodríguez-Ariza, 2011). These researchers (2011:819-820) tested three hypotheses to find out whether there is a relationship between blended learning experiences, students' perceptions of success, and their actual level of achievement. The hypotheses were "The application of blended learning has positive effects on students' outcomes"; "The objective outcome (final grade) derived from a blended learning experience is correlated with the subjective outcome (perception of utility, satisfaction and motivation)"; "The utility perceived by students, their motivation and degree of satisfaction, are explanatory variables of the objective results (final grade) achieved by students in a blended learning experience". The hypotheses were accepted and the researchers concluded that e-learning activities reinforce and complement face to face classes, and that "the joint effect of the blended learning activities" was positive and influenced both students' perceptions and their final results (López-Pérez et al. 2011:824).

Apart from the importance of a critical analysis of the perception of student success, the dropout rate in HEIs in South Africa is of great concern. Many South African researchers have addressed this issue. A recurrent focus of research has been to determine whether effective e-learning strategies could change the perception that it is ineffective learning strategies that influence the high student dropout rates, instead of other circumstance like students' social environments and economic situations. Inevitably, the dropout rate not only determines and advances questions regarding the perception of student success, but also raises urgent psychological, physical, institutional, biographical, social, financial and economic concerns. In order to understand 'dropout rate' in a South African context it is necessary to discuss research conducted by South African academics.

In response to the high attrition rates recorded by South African universities, in 2012 the University of Pretoria set up a steering committee to explore models to improve the success and retention rate at the university. The committee explored the possibility of designing a systems process to improve the whole student life cycle. Such an approach would demand the cooperation of the whole university as well as feeder high schools and external experts to improve the experience of undergraduates. In addition, it found that a combination of personal and academic factors accounted for the high dropout rate. These factors included affordability, lack of academic support, lack of career guidance, lack of self-discipline and commitment as well as individuals being first-generation students (Moodley & Singh 2015:95, 100). These authors believe that the themes that emerged from their investigation could contribute to the formulation of strategies and the ultimate reduction of dropout rates at all universities (Moodley & Singh 2015:110).

In another analysis on the dropout rates in South Africa, Ramrathan (2013) presents a conceptual framework to explore the personal, biographical and institutional concerns that influence student dropout in South African HEIs. Ramrathan's conceptual framework integrates a methodological orientation to inform the analysis of student dropout, with a conceptual mapping of the factors that potentially influence students to drop out, and the institutional policies of access and throughput management systems (Ramrathan 2013:214-215). That study included both a quantitative analysis of student patterns, trends, expectations, and predictability, and a qualitative analysis that focused on identifying factors that influenced individual student dropout. This mixed method approach allowed Ramrathan to understand student dropout from an "explanatory perspective of explaining particular patterns that may emerge through a quantitative analysis of this phenomenon or an exploratory perspective to establish the extent to which a particular factor or group of factors influences student dropout" (2013:215). Ramrathan (2013:218, 219) concludes that students should be regarded as individuals and not part of a group (rural, previously disadvantaged and so on) because each student is unique, and programmes need to be developed to suit the experiences of individual students. He suggests that using conceptual mapping will enable a shift of discourse from being race-based to focusing on students' experiences.

The book *Going to University: The Influence of Higher Education on the Lives of Young South Africans* (Case et al. 2018) contributes to the subject of student success. The authors highlight two issues that form the core of this book, namely that the success of the contribution made by Higher Education (HE) to society and student success is reciprocal or co-dependent, and that influences beyond an HE institution affect students' perspective of success or failure (Case et al. 2018:4, 5).

Methodology and Overall Research Design

As mentioned above, this study investigated the perception of student success in the blended teaching and learning environment of an LMS, namely iKamva, at the University of the Western Cape. The researchers sought to answer the following research questions:

> How have blended learning technologies and teaching practices impacted students' and lecturers' perceptions of student success?
>
> How can departments in the institution contribute to the discourse on the perceptions of student success?

A questionnaire was developed as the research instrument. There were no conflicting statements in the questionnaire so that students could respond according to their individual experiences in the different environments of e-learning. The questionnaire was made available online to elicit a response from students. Responses were measured using a 5-point Likert scale, namely, 1 = strongly disagree (never) to 5 = strongly agree (always). In addition, interviews were conducted with lecturers who were subject matter experts in order to explore their perceptions of the value of blended learning technologies in their disciplines. Through the open-ended interview questions, impartial and diverse responses were obtained.

The overall design of this research used a mixed-method approach, and triangulation was employed in which both qualitative and quantitative research components were explored. The study was exploratory with the intent to identify salient data that could assist in answering the research questions. In other words, different data collection techniques were applied, namely, asking respondents open-ended questions in interviews and a structured questionnaire. These data collection techniques were a useful way to observe and evaluate the student's online engagement. In addition, the data collected from the interviews was useful to observe and evaluate the teaching practices aligned to the perception of student success. The aforementioned purpose was triangulation. This means that both the quantitative and qualitative data were analysed independently to see whether they yielded similar results or to be mutually corroborated.

Sampling Procedure

A total of five groups of students, selected from the 780 students registered for five subjects in the 2017–2020 academic year, participated in the research. The sample of students selected to complete the questionnaire was obtained by taking the average number of students enrolled in five subjects across year levels in the Arts Faculty from 2017 to 2020. The sample of modules represented the entire population of 240 online modules in the Arts Faculty.

The subject areas selected were Anthropology, Sociology, English, Language and Communication Studies, and Geography. Six lecturers participated in the interviews, while 72 students completed the questionnaire. This research design was effective and could lay the groundwork that could lead to future studies investigating students' and lecturers' perceptions of the value of blended learning technologies and teaching practices to student success at UWC or any other institution of higher learning.

Data Analysis

The questions were designed to capture students' perceptions of the following areas of the iKamva web-based learning environment: co-participatory activities, information structure and design activities. We used the median to measure the most frequent responses and the interquartile range (IQR) to determine the respondents' opinions.

In the area of co-participatory activities (see Figure 1) the most frequent response (39%) indicated agreement with the idea that their online modules supported their learning experiences, which, in turn, effectively contributed to online discussions. Thirty percent remained neutral, while 31% did not agree with the idea that their online modules supported their learning experiences effectively (Mdn=3, IQR=2). Opinion seems to be divided with regard to co-participatory activities. Many respondents (31%) expressed strong disagreement, but a roughly equal number (39%) indicated that they either agreed or strongly agreed.

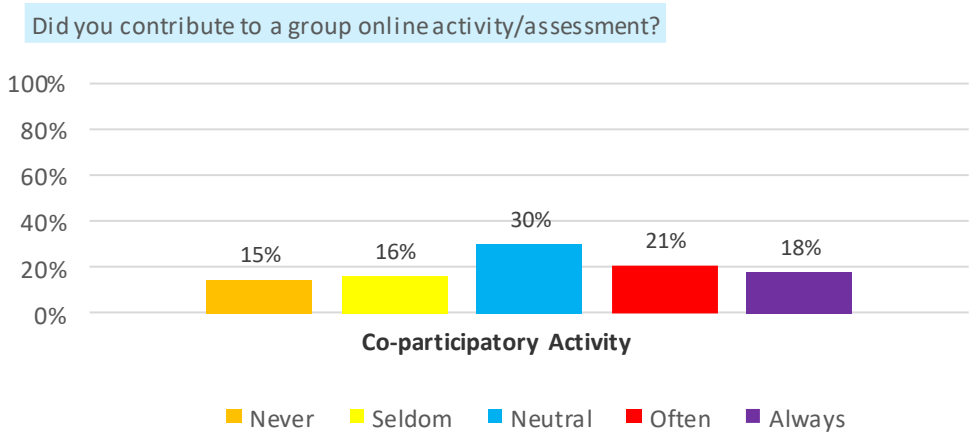

Figure 1. Co-participatory Activities

Students were asked if they had contributed to a group online activity/assessment in their module, if they responded "Always" to this question they were asked to comment on an example of an online group activity or assessment. The following aspects were highlighted in some responses: multiple perspectives were revealed; discussions with classmates provided comparisons that helped students to understand work; discussion topics provided opportunities to clarify questions which were facilitated by both tutors and lecturer; and discussion topics enabled reflection and engagement with module content. A large number of students who responded "Always" indicated that they could interact with other students via the discussion forum and also share their concerns on this platform. In addition, when asked if they had contributed regularly during online discussions the majority (60%) of respondents indicated that they had, whereas 40% indicated that they had not contributed to online discussions at all. When students were asked what medium they used to respond in their group discussions (co-participatory activities) the most frequent response (54%) was that they had contributed during online tutoring sessions. A significant percentage of students (33%) reported that they contributed during WhatsApp sessions, while just 13% contributed on discussion forums (see Figure 2 below).

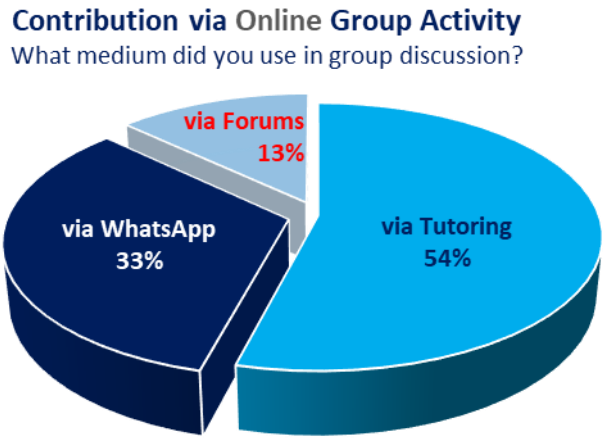

Figure 2. Contributions to Online Activities

In the area of information structure (see Figure 3 below) when students were asked if their online module was structured to support their online learning and was fully structured to support their learning style, the most frequent response (41%) agreed, 24% remained neutral, while 35% did not agree (Mdn=3, IQR=2). This suggests that there is divided opinion with regard to information and the structure of some modules.

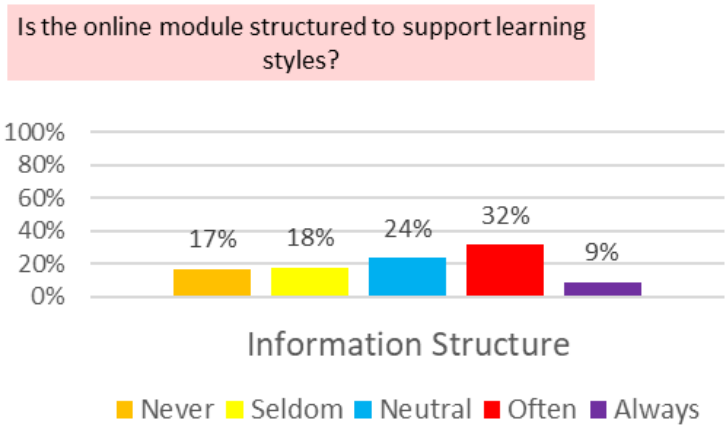

Figure 3: Information structure

In the area of design activities (see Figure 4 below) students were asked if the online design of their modules supported their face to face learning and teaching experiences and assessments. The most frequent response (56%) indicated that students agreed that the design activities were structured and supported their online modules and were aligned to specific assessment tasks in which multimedia (videos, podcasts, etc.) were used in the modules to support face-to-face lectures, 24% remained neutral, whereas 20% did not agree (Mdn=4, IQR=2).

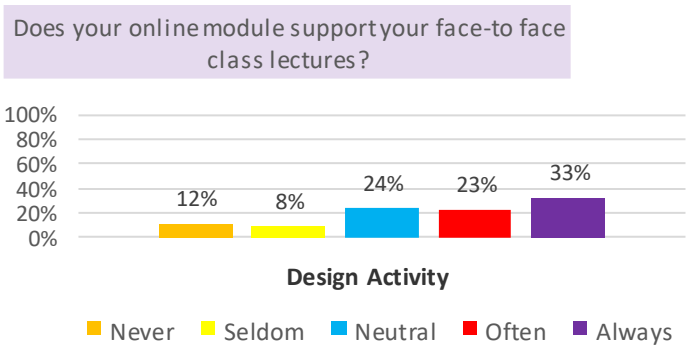

Figure 4. Design Activities

When students were asked if their lecturers had supported their learning experience with multimedia, the majority of respondents (77%) agreed, fewer than a third of the respondents (23%) disagreed; in addition, most respondents strongly agreed that the multimedia used had helped and supported their learning experience. It was

generally agreed that the inclusion of the multimedia facets assisted with making connections and gaining understanding of the topics and concepts being studied at the time. This corroborates the idea that adding podcasts and other facets do provide for a different way of learning, and it seems that for some students it is easier to understand something by hearing it.

What follows is a thematic content analysis of how blended learning technologies and teaching practices affected lecturers' perceptions of student success. In order to determine if lecturer perceptions of student success are related to blended teaching and learning technologies, interviews were conducted. If participants agreed that their practices had had an impact on student success they were asked to elaborate with specific examples. In addition, the participants were also asked on how the institutions eLearning department had supported their own online journey, in relation to the development of content, communication and assessment. These are discussed in detail below.

Initially, the participants were asked about their use of online resources that they had incorporated into their online instruction as opposed to resources used during face-to-face instruction. The participants were also asked to comment on specific blended learning and teaching practices they had implemented and that might have contributed to their perception of student success. In addition, they were asked about their engagement with blended learning and teaching practices, particularly when using iKamva.

The interviews revealed that the respondents held both positive and negative opinions about blended and technological teaching and learning practices that had been introduced into their online courses. It also became evident that the success of their online modules was related to both the quality of the institution's LMS and the high degree of user satisfaction. This finding agrees with those of Hassanzadeh et al. (2012) in their research on a comprehensive model for measuring the success of an LMS. In addition, the present study revealed that lecturers used a wide variety of technological tools to assist student learning, which substantiates research findings discussed in the literature review. Notably, Hung and Chou (2015:323) suggest that "instructors should consider using a wide variety of technological tools to deliver course materials and to assist with student learning", and increase the level of student success.

When lecturers were asked if they had found that their practices had impacted on student success, the overall response was positive. Participants indicated that by pursuing different teaching modalities they were able to meet different students' needs. This often meant that students responded positively and enthusiastically to the videos and audio aspects of the modules. Lecturers agreed that using the wide variety of tools found on the LMS had a positive impact on the success of students. Participants reported and affirmed that their usage of the iKamva tool helped them to have an impact on the success of their students. Lecturers validated the value of the LMS by reporting that the following had been applied in their course modules: short surveys to assess students' preferences; quizzes and assignment tasks; feedback on assessments; grading assessments; the Chat Room tool; and online exams (consisting of MCQ plus open-ended questions).

When lecturers were asked to provide specific examples of practices that had impacted on student success, the responses were generally very similar. The examples included a similar variety of resource tools on the LMS that they had incorporated into their teaching. One participant opined that the LMS had contributed toward student success because it made it possible for most students to have greater access to different course resources, such as PowerPoint slides from lecturers' notes, podcasts, and similar multimedia content.

In addition, lecturers thought that a blended learning approach, that is, the combination of online interactive educational materials and the use of a variety of modalities, was beneficial. It provided both lecturers and students with opportunities to determine and plan the following: their own time, place of work, path, and pace of teaching or learning. Lecturers said that using the various platforms on the LMS assists students in many ways, such as time and energy, and financial expenses. These platforms freed up time for students to read and do activities related to their teaching and learning experiences online.

Our results share a number of similarities with Al-Busaidi's (2012:15) findings mentioned above. Lecturers reported that students appreciated video lectures because they contributed to their direct engagement with the material. In addition, in the absence of face-to-face lectures, the videos had helped them not to feel disconnected and they could watch the videos repeatedly. They intimated that videos and audio recordings were valuable teaching resources, and that it was different from just having face-to-face lectures.

Concluding Remarks

The correlation between responses given by students and lecturers is worth mentioning. It is evident that both students' and lecturers' perceptions of the web-based learning environment correlated with each other in the areas researched in this study. The findings of this study indicate that the students' perceptions of the success of co-participatory activities, the information structure, and design activities correlated with the lecturers' perceptions of student success.

This paper has highlighted the importance of the effectiveness of interaction in online courses and other environments to increase students' self-efficacy and self-regulation to help them succeed in their courses. This substantiates the claim of Kintu et al. (2017) that the success of e-learning and blended learning depends on students' as well as lecturers' confidence and capability to participate in blended learning activities. It also agrees that being competent in utilizing and applying computer technology and online applications leads to success.

These findings add to a growing body of literature on our understanding of how blended learning technologies and teaching practices impact on students' and lecturers' perceptions of student success. In addition, the study contributes to information on how departments and/or faculties in HEI's can further contribute to the discourse on the perception of student success.

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Junior High School Teachers' Self-Efficacy Levels for STEM Practices: A Sample of Aydin City

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Abstract: Today, it is of great importance to establish a workforce with knowledge and skills in fields such as science, technology, engineering, mathematics and education in order to reach the level of developed society. STEM, as an integrated educational approach, is known as one of the effective methods in teaching such knowledge and skills. However, the success of this method requires teachers to be competent in the field of STEM and it is important to investigate teachers' self-efficacy levels regarding to STEM approach. Therefore, the purpose of this study is to determine junior high school teachers' self-efficacy for STEM practices. It was designed as a survey research within the quantitative research methods. The sample was made up of 38 voluntary teachers working in junior high schools located in the city center of Aydin, Turkey. The data were collected through a questionnaire including questions asking for participants' demographic characteristics and Teachers' Self-Efficacy Scale for STEM Practices. According to the findings, participating teachers, on average, had a moderate level of self-efficacy for STEM practices. No significant difference was found in their self-efficacy scores according to gender, work experience and reason for choosing teaching experience.

Keywords: STEM, Self-efficacy, Junior high school, Teachers

Introduction

Developments in information and communication technologies affect the social activities of all countries. As a result of these interactions, countries are trying to restructure their education systems and try to harmonize teaching practices with the ever-increasing use of technology. The STEM education model is seen as one of the most convenient approaches to achieve this harmony. With STEM education, it is aimed to raise students as individuals with advanced 21st century skills and technology literacy and as citizens who can do research, make sense of the world, and solve problems in different structures (Thomas, 2014).

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STEM is adopted as one of the most important advances in the field of education that has occurred in order to train the people needed in the 21st century (Land, 2013). It is an interdisciplinary approach that aims to integrate science, technology, engineering and mathematical sciences rather than teaching them one by one (Bybee, 2010). The STEM education approach aims to support solving real-life problems, primarily to gain 21st century skills, to increase awareness and professional interest in STEM fields, to raise qualified individuals that the workforce will need in the future, and to support economic growth (Thomas, 2014). The most important factor in the emergence and adoption of the STEM education approach is the need for countries to adapt to scientific and technological developments and to keep up with the economic competitive environment triggered by these developments.

In order for the aims and objectives of STEM education to be realized, several important elements must be put to work in harmony. The first is the adoption of an integrated curriculum approach. This element is the cornerstone of STEM, and it is a requirement that real-life problems are multidimensional, requiring multiple disciplines, and that product and service development today depends on interdisciplinary teamwork (Johnson, Peters-Burton & Moore, 2016). The second element is the use of appropriate pedagogical approaches. STEM applications require student-centered, open-ended, inquiry-based and experiential-oriented instructional design with engineering design thinking that helps students develop and test solutions to problems (Baran, Canbazoğlu Bilici, Mesutoğlu & Ocak, 2016). Such desired pedagogical approaches can be effective when teachers accommodate their classrooms with active learning activities such as peer learning, group work activities and collaborative argumentation (see Latifi & Noroozi, 2021; Latifi et al., 2020, 2021; Noroozi 2018, 2022; Noroozi et al., 2018; 2020; Valero Haro et al., 2019; 2022). Another element is the provision of a motivating and engaging environment that includes laboratories, workshops and technological tools where students can develop and use models, plan and conduct research, analyze and interpret data, and design solutions (Stohlmann, Moore & Roehrig, 2012). The most important element is that there are qualified teachers who bring all these elements together, apply and manage them (Johnson et al., 2016).

In the STEM Education Workshop Report, in which STEM education in Turkey was comprehensively evaluated with the participation of academics, experts, administrators and teachers, teacher competencies were shown among the top priority issues to be developed in the use of STEM (Akgündüz, Ertepınar, Ger, Sayı &Türk, 2015). Literature reviews on the factors that influence successful STEM practices highlight the key role of teacher self-efficacy (Green & Sanderson, 2018). Dedicated and organized teachers are shown as an important requirement for the implementation of effective STEM education (Stohlmann et al., 2012).

Self-efficacy is generally known as individuals' judgments about their own abilities for a particular performance and is seen as a predictor of the relevant performance (Bandura, 1987). It is known that people with high self-efficacy are characteristically more interested in their work, can work longer and more, have better time control and task focus, are flexible and less anxious (Pajares & Miller, 1997). In this context, it is expected that teachers' self-efficacy beliefs towards STEM applications, which involve a complex and difficult process, will

have a decisive role in their inclusion of STEM in their teaching processes. As a matter of fact, the limited number of studies conducted in this area show that teachers' perceived STEM self-efficacy levels are positively related to their attitudes towards STEM and their STEM practice (Lee, Hsu & Chang, 2019). These pioneering findings suggest that identifying teachers' self-efficacy beliefs towards STEM education practices is necessary both for the development of activities to support their self-efficacy levels and for a better understanding of STEM practice situations. In addition, it is important to determine the variables that may be related to teachers' STEM self-efficacy beliefs in this context. With these in mind, this study aimed to investigate junior high school teachers' self-efficacy level for STEM practices and its relationships with some demographics. In order to fulfill this purpose, the following research questions were formed:

- What is the level of teachers' self-efficacy for STEM practices?
- Do their self-efficacy levels for STEM practices differ across gender, work experience, and determining factors for choosing teaching career?

Method

Since this research explores the current state of junior high school teachers' self-efficacy levels regarding to use of STEM approach in education from a descriptive point of view, it was designed as a survey research model within the quantitative research methods.

The population includes teachers working in junior high schools located in the city center of Aydin, Turkey during the 2019-2020 academic years. Using a convenience sampling to overcome time and financial limitations, the sample comprised 38 volunteer and easily accessible teaches. The first author is a school manager of a junior high school in the city center. Therefore, the participants were those teachers working in either his school or nearby schools. Of the participants, 71% of them were male and 29% were female students. Regarding working experience, 15% have 1-10 years, 45% have 11-20 years and 40% have 21 or above years of teaching experience. The determinant of choosing teaching career was distributed as follow: centralized university entrance exam score (13%), the effects of social circle (37%), and personal factors (50%)

The data were collected through a paper-and-pencil type questionnaire including questions asking for participants' demographic characteristics and Teachers' Self-Efficacy Scale for STEM Practices developed by Yaman, Özdemir and Vural (2018). The scale was originally prepared to determine the self-efficacy beliefs of science teachers and prospective teachers towards the STEM approach. Yaman et al. (2018) started with an item pool containing 55 items, and as a result of expert examination and factor analysis, the scale reached its final form consisting of 18 items with a single factor.

The items in the scale were arranged according to a 5-point Likert-type rating scale and scored as "never=1, rarely=2, sometimes=3, often=4, and always=5". A composite score was made up of as the arithmetic mean of

the scores obtained from the items. A high score means that the teacher has a high self-efficacy belief in applying STEM in their lessons. Yaman et al. (2018) calculated the Cronbach Alpha reliability coefficient as .98 as an indicator of the scale's internal consistency. In this study, the Cronbach Alpha coefficient was determined as .96.

Results

Table 1 presents the descriptive statistics for the scores that participants obtain from the STEM self-efficacy scale. As can been seen, self-efficacy scores ranged from 1.44 to 4.28 with a mean score of 2.88, just above the midpoint of its scaling range. The standard deviation value was .72, which shows moderately narrow dispersions of the data, suggesting that participants' scores were closely clustered around the mean.

Table 1. Descriptive Statistics for STEM Self-Efficacy

Variable	Minimum	Maximum	Mean	SD
STEM self-efficacy level	1.44	4.28	2.88	.72

An independent-samples t-test was conducted to compare participating teachers' self-efficacy scores across gender (Table 2). There was no significant gender difference [$t_{(36)}$=.36, p>.05] in STEM self-efficacy scores.

Table 2. Comparison of Teachers' Self-Efficacy Scores by Gender

Variable	Gender	N	Mean	SD	t	p
STEM self-efficacy level	Male	27	2.81	.73	.36	.72
	Female	11	2.91	.79		

A one-way between-groups analysis of variance (ANOVA) was conducted to explore work experience differences in teachers' self-efficacy scores (Table 3). There was no significant difference [$F_{(2, 35)}$=.47, p>.05] in STEM self-efficacy scores among teachers with different years of experience. Similarly, another ANOVA test was conducted to explore determinant of teaching career differences in teachers' self-efficacy scores (Table 4). There was no significant difference [$F_{(2, 35)}$=.47, p>.05] in STEM self-efficacy scores among teachers with different reasons for choosing teaching career.

Table 3. Comparison of Teachers' Self-Efficacy Scores by Work Experience

Work experience level	N	Mean	SD	F	p
1-10 years	6	3.02	1.06	.47	.63
11-20 years	17	2.75	.83		
21 years and above	15	2.98	.55		

Table 4. Comparison of Teachers' Self-Efficacy Scores by Determinant of Teaching Career

Determinant of teaching career	N	Mean	SD	F	p
University entrance exam score	5	3.10	1.05		.67
Personal factors	19	2.78	.86	.39	
The effect of social circle	14	2.94	.51		

Conclusion

The study shows that participating junior high school teachers, on average, had a moderate level of self-efficacy for STEM practices. In parallel with this finding, Dadacan (2021) reported in his study with science and preschool teachers that their self-efficacy, awareness and orientation towards STEM education are generally at a moderate level. Similarly, Yaman and Aşılıoğlu (2022), in their study examining awareness, attitude and in-class practice self-efficacy perceptions for STEM education, reported that their awareness, attitude and classroom practice self-efficacy for STEM education were moderate. This finding can be interpreted as the participant teachers see themselves as neither too ready nor too lacking in using STEM in their lessons. In other words, it can be said that teachers are undecided about their own potential at the point of applying STEM.

Another conclusion is that teachers' self-efficacy levels for STEM practices are independent of gender, work experiences and determinant of teaching career. Consistently, in the study conducted by Biçer, Uzoğlu and Bozdoğan (2019), there was no difference in teachers' self-efficacy perceptions in terms of working time. Ciğerci (2020), on the other hand, reported in his study that teachers with more than 16 years of seniority had significantly higher STEM awareness and self-efficacy compared to other years of seniority. Similarly, in Dadacan's (2021) study, it was seen that there was no significant difference in the self-efficacy, awareness and orientation of science and pre-class teachers towards STEM education in the variables of gender, university, and the faculty they studied. The lack of gender differences in this study is thought to be due to the similarity of their social and cultural structures. The fact that no significant difference was determined according to seniority and the reasons for choosing the profession is thought to be a result of the participants having a close/similar social environment.

Recommendations

The research offers several recommendations for future researchers and practitioners. STEM content and applications of teachers' in-service training programs can be expanded in a way to increase self-efficacy. Teachers can be encouraged to attend STEM-related activities to get early experiences which in turn trigger higher interest and further experiences. Future research may explore the effect of other demographic and occupational factors (age, branch, school type, academic career, etc.). Experimental or longitudinal studies can be conducted to find out what kinds of conditions/interventions are influential on self-efficacy.

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SWOT Analysis in Entrepreneurship Based Mathematics Learning Planning

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Abstract: The era of economic recovery after the Covid-19 pandemic has made entrepreneurship a skill that everyone is expected to have from an early age. In the implementation of learning, quality schools will introduce entrepreneurship both as an extracurricular activity and in their learning activities, not least in learning mathematics. The planning of learning mathematics at MBS Zam-Zam Cilongok Junior High School is planned to be inserted with entrepreneurial skills. The purpose of this study is to analyze the planning of entrepreneurial-based mathematics learning through SWOT analysis. The research method used is qualitative research by describing the phenomena that are in the research location. The subjects of this research are students, mathematics teacher, and principal of MBS Zam-Zam Cilongok Junior High School. The results of the research are SWOT analysis in planning entrepreneurship-based mathematics learning at MBS Zam-Zam Cilongok Junior High School, Indonesia, namely strengths in the form of quality teacher and student factors, weakness in the form of lack of facilities and funds, opportunities in the form of opportunities to get sponsored funds and opportunities to become excellent schools, threats in the form of the health of teachers and students that cannot be predicted during a pandemic.

Keywords: SWOT analysis, Mathematics learning, Enterpreneurship

Introduction

In human life, education is important in educating mankind for the better. In the process of educating mankind, an educational management is needed so that it is more systematic and can achieve educational goals. Educational management is activities to achieve a goal or process of organizing work to achieve a goal in educational institutions (Andi Rasyid, 2017: 7). The new paradigm of education management gives broad authority to schools in planning, organizing, implementing, monitoring, and controlling education in schools. In addition, today's world developments make school institutions adapt to dynamic developments. School institutions are no longer able to accept a change as it is, but must respond to that change into something more useful for schools, students, and society. The key for educational institutions to survive in the midst of change, is to understand the position, and what is going on, as well as readiness to be part of a new world that is undergoing change. The world is currently in a recovery period after a major disaster in the form of the Covid

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19 pandemic, so the factors that support the survival of mankind are also in the recovery process, namely economic recovery. The era of economic recovery after the Covid-19 pandemic has made entrepreneurship a skill that everyone is expected to have from an early age. In the implementation of learning, quality schools will introduce entrepreneurship both as an extracurricular activity and in their learning activities, not least in learning mathematics. So that in early recognition, the entrepreneurial spirit grows in students.

According to Buchari (2000: 35) currently competition in the world of work is getting tougher and unemployment in Indonesia is also increasing. This is coupled with the increasing number of companies, both large and small, that are terminating their employment, retiring their employees early, and even closing or relocating their businesses to other places. This makes the level of competition among college graduates to get a job even tighter. Relying entirely on the government to create new jobs is not possible. Waiting for investors from abroad to invest in Indonesia takes a long time, and expecting domestic investors in the current conditions is very difficult. For this reason, the education sector is expected to play a role in changing the mindset and paradigm of students so that they are oriented towards creating jobs, not looking for work.

In educational institutions, educators play a role in educating students through a learning process, both inside and outside the classroom. Learning is a process of interaction between students and educators and learning resources in a learning environment. Learning is assistance provided by educators so that the process of acquiring knowledge and knowledge, mastering skills and character, and forming attitudes and beliefs in students can occur. In other words, learning is a process to help students learn well (Moh Suardi, 2018: 7). In learning the entrepreneurial spirit, students can also learn through the material obtained while studying at educational institutions. These further supports students to learn entrepreneurship if educators introduce and apply it in the learning process. No exception in learning mathematics. In the 2013 Curriculum (K-13) mathematics lessons that are currently being implemented, where the learning process is no longer teacher-centered, but student-oriented, the use of teaching methods and approaches is very necessary, as stated in the Curriculum Technical Instructions guide 2013 mathematics that: "The understanding of mathematics teachers will be more interesting if delivered with innovative and creative methods, for example by using information and communication technology, such as the internet, teaching aids, other multi-media tools." The use of these learning media will create a pleasant learning atmosphere for students and can solve problems independently (Rahmiati and Didi Pianda, 2018:9). Mathematics learning which is dominated by arithmetic is considered appropriate if it is inserted with the introduction of entrepreneurship for students. Of course, this can also be analyzed in advance when planning learning by looking at strengths, weaknesses, opportunities, and challenges. Through an analysis that is in accordance with the SWOT (Strength, Weakness, Opportunities, Threats) analysis, the entrepreneurship-based mathematics learning will identify strengths, weaknesses, opportunities, and threats.Through observations made by researchers to one of the educators in a school institution, namely SMP MBS Zam-Zam Cilongok Indonesia, it was found that in the analysis of entrepreneurship-based mathematics learning planning, it has advantages in strengths and opportunities, while less in weaknesses and threats. So that researchers will discuss more clearly about SWOT analysis in entrepreneurship-based

mathematics learning.

Method

Types of Research

The research method used is qualitative research by describing the phenomena that exist in the research location. Qualitative research is research that is descriptive and tends to use an inductive approach to analysis. The research process utilizing the theoretical basis is carried out so that the research focus is in accordance with the facts on the ground. In addition, the theoretical basis is also useful for providing an overview of the research background and as a material for discussing research results (Rukin, 2019:8). The research method used by researchers in this study is a qualitative approach with a descriptive method. The research method used is a qualitative method. "Methodology is the process, principles, and procedures that we use to approach problems and seek answers" (Mulyana, 2008: 145). According to Sugiyono (2007: 1), qualitative research methods are research used to examine natural objects where the researcher is the key instrument, data collection techniques are carried out in a combined manner, data analysis is inductive, and qualitative research results emphasize meaning rather than generalization. . Qualitative research aims to maintain the form and content of human behavior and analyze its qualities, instead of turning them into quantitative entities (Mulyana, 2008: 150). The purpose of this descriptive research is to make a systematic, factual and accurate description, picture or painting of the facts, characteristics and relationships between the phenomena being investigated.

Data Source

According to Lofland in Moleong (2006:157), qualitative research main sources are words, actions, the rest are additional data such as documents and others. The data in this study were collected through interviews, observation, and through documentation. The data that must be collected are in the form of primary data sources (primary data) and secondary data sources (secondary data).

Research Target

In the research entitled "SWOT Analysis in Planning for Entrepreneurship-Based Mathematics Learning" the research targets were students, mathematics teachers, and the principal of MBS Zam-Zam Cilongok Junior High School, Indonesia. In this study, the data taken were the results of observations, interviews, and documentation, namely data regarding the implementation plan of entrepreneurship-based mathematics learning.

Research Instruments

The instrument of this research data is to use a list of questions (attached) so that the interview process can take place well. With the procedure for making the instrument as follows, first it is necessary to prepare several

questions that represent the SWOT analysis, then expert validation is needed to produce questions that have a basis for knowing the causal factors in the research problem.

Data Collection Technique

Data collection is an important step because the collected data will be used to solve research problems. The data collection techniques used in this study were interviews, observation, and documentation. An interview, also called an interview or an oral questionnaire, is a dialogue conducted by the interviewer (interviewer) to collect information from interviewees (Arikunto, 2010:155).

Observations were made to find out the incident directly to the incident and the behavior of the subject. So that the data obtained through observation as additional data from the data that has been obtained. The data obtained through documents are internal and external data related to research. Then the data is processed and presented in writing. Data obtained from documentation is done by asking for archives, as well as personal documents, and from photos taken by researchers.

Data Analysis Technique

Descriptive data analysis is an in-depth study of the SWOT analysis of mathematics learning planning in grade 7th MBS Zam-Zam Cilongok Junior High School and draws conclusions from the results of the interviews. In general, descriptive research is non-hypothetical research so that in this research step it does not require a hypothesis. So the data analysis technique used is a comparative descriptive technique, which aims to generalize a fact in determining the unit or unit of study of a case study.

Research Steps

The steps in this research consist of research planning and research implementation. Research planning is in the form of submitting a research application to the mathematics teacher of SMP MBS Zam-Zam Cilongok, preparing research equipment consisting of: mobile phones, cameras, and stationery. Prepare and arrange interview procedures. Then the procedure for conducting research is in the form of procedures for conducting research. In this study, the research seeks to obtain information and collect complete data from various sources that can be accounted for through interviews, observations and documentation of several objects under study. Data collection is not limited, as long as it is possible to collect data, during that time data collection activities are carried out.

Results

From the results of observations, interviews and documentation that have been carried out, researchers found

data relating to Strength, Weakness, Opportunity, and Threats (SWOT) in planning entrepreneurship-based mathematics learning at MBS Zam-Zam Cilongok Junior High School, Indonesia.

Strength

The strengths possessed in planning entrepreneurship-based mathematics learning at MBS Zam-Zam Cilongok Junior High School Indonesia based on the results of interviews with school principals and mathematics teachers can be described as follows:

Teacher Quality

The quality of Mathematics Teachers at MBS Zam-Zam Cilongok Junior High School is said to be good, this can be seen from the recruitment of teachers who have met the criteria for experience in the field of learning mathematics, with a bachelor's degree in Mathematics Education. This was confirmed by Mr. Drs. M. Djohar, M.Pd, as principal of the MBS Zam-Zam Cilongok Junior High School: "Students at MBS Zam-Zam Cilongok Junior High School are taught by math teachers who are experienced in mathematics and have the appropriate qualifications, namely Bachelor of Mathematics Education" With good quality trainers, it will strengthen them to carry out entrepreneurship-based mathematics learning.

Entrepreneurship Spirited Students

MBS Zam-Zam Cilongok Junior High School students have started to have an entrepreneurial spirit, this is proven by the presence of students, namely Taufan Hisbulloh and his friends who managed to make a product in the form of young coconut pudding which won the competition. This was confirmed by Mrs. Hepy Nanda Rahmawati, S.Pd.: "There are several of our students who have won an entrepreneurship competition by making young coconut pudding in 2020, namely Taufan Hisbulloh and his friends" With students who have entrepreneurial spirit, it will strengthen them to carry out entrepreneurial-based mathematics learning.

Weakness

Weaknesses in planning entrepreneurship-based mathematics learning at MBS Zam-Zam Cilongok Junior High School based on the results of interviews with mathematics teachers and students are as follows:

Learning Facilities and Infrastructure

The learning facilities and infrastructure owned by MBS Zam-Zam Cilongok Junior High School for the implementation of entrepreneurship-based mathematics learning are still inadequate, especially the classrooms that are not too large. This was clarified by Mrs. Hepy Nanda Rahmawati, S.Pd.: "Students' classrooms are not

too wide, only enough for learning, so in entrepreneurship-based mathematics learning, we need to prepare classes in such a way as to be able to practice buying and selling." With this explanation, it is evident that the quality of the class area has not received special attention from the school. Whereas a large class will be freely used for the implementation of entrepreneurship-based mathematics learning.

Fund

One of the weaknesses in the implementation of entrepreneurship-based mathematics learning is funding. There is no special funding from the school to support this practice. Students will collect funds and set aside their pocket money for the purposes of practicing entrepreneurship-based mathematics learning. This was confirmed by one of the students, namely Atha Favian Farras: "We set aside pocket money for the implementation of practices related to entrepreneurship, and if there will be entrepreneurship-based mathematics learning then we will also set aside money, there is no budget from schools for practical programs like this" With this explanation, it is evident that there is no special funding from schools to support this practice. Whereas funds from schools for the implementation of entrepreneurship-based mathematics learning will increasingly support and encourage teachers and students to carry out entrepreneurial-based mathematics learning.

Opportunity

Opportunities, every school has the opportunity to develop everything that is in the school. Similarly, planning for entrepreneurship-based mathematics learning at MBS Zam-Zam Cilongok Junior High School also has opportunities, namely:

Opportunity to Get Sponsor

Sponsorship is also important for coaching in schools because with sponsors it can increase income funds for the development of entrepreneurship-based learning, entrepreneurship-based mathematics learning planning at MBS Zam-Zam Cilongok Junior High School has a great opportunity to achieve this sponsorship because entrepreneurship at MBS Zam-Zam Cilongok Junior High School has many achievements and does not yet have a main sponsor so it has the opportunity to get a main sponsor in the development of student entrepreneurship in learning mathematics.

Opportunity to Become an Excellent School

Being a superior school is a dream for every school, indirectly becoming a superior school can be a reference that the student is successful in developing the potential of the players owned by the school. Likewise, the existence of entrepreneurship-based mathematics learning at MBS Zam-Zam Cilongok Junior High School can also bring opportunities for this school to become an excellent school for entrepreneurship. This is evidenced by

several students who won entrepreneurship competitions and were able to make innovative products.

Threat

Threats or obstacles that are owned in planning entrepreneurship-based mathematics learning at MBS Zam-Zam Cilongok Junior High School based on the results of interviews with mathematics teachers, namely.

Unpredictable Health of Students and Teachers During a Pandemic

The form of threats or obstacles faced in planning entrepreneurship-based mathematics learning at MBS Zam-Zam Cilongok Junior High School is the unpredictable health of students during a pandemic, this is certainly one of the threats or obstacles in entrepreneurship-based mathematics learning at MBS Zam-Zam Cilongok Junior High School. As explained by Mrs. Hepy Nanda Rahmawati, S.Pd. as a math teacher: "As teachers, although we have tried to maintain health and always remind students to maintain health during the pandemic, but sometimes we neglect cleanliness and health so that we or students get sick and cannot carry out learning according to plan" Based on this information, it was explained that the planning of entrepreneurship-based mathematics learning at MBS Zam-Zam Cilongok Junior High School could not be carried out when some students were sick or even the teacher was sick.

Discussion

To get a broad picture of the strengths, weaknesses, opportunities and threats or obstacles that are owned in planning entrepreneurship-based mathematics learning at MBS Zam-Zam Cilongok Junior High School, the researchers will analyze SWOT. In accordance with the formulation of the problem and research objectives, the results of research on SWOT analysis are obtained as follows:

Strength

The strength factor is a superior factor that can be developed or maintained in conducting coaching in order to achieve maximum achievement. From the results of the study, it can be seen that the strength or superiority factor in planning entrepreneurship-based mathematics learning at MBS Zam-Zam Cilongok Junior High School is the quality of teachers and students who meet the qualifications in implementing entrepreneurship-based mathematics learning.

Teacher quality is one of the strength factors in planning entrepreneurship-based mathematics learning at SMP MBS Zam-Zam Cilongok. A teacher plays a major role in the success of the students he guides, besides that the teacher must also be required to master several disciplines such as mathematics and entrepreneurship to support a career as a teacher. This is in accordance with the theory of Darmadi (2018: 5) teachers are the spearhead of

education, because they directly try to influence, foster, and guide students. As the spearhead, teachers are required to have the basic skills needed as educators, mentors, and instructors. This ability is reflected in the teacher's competence.

Students who are talented in entrepreneurship and have achievements are also one of the strength factors in entrepreneurship-based mathematics learning planning at SMP MBS Zam-Zam Cilongok. This is in accordance with the theory of Mirna Apriyani Lestari (2020:42-43), someone in this case a student, in carrying out activities has a lot to do with the abilities he has. High ability because it continues to be trained, the tendency of someone's achievement will be high as well. For this reason, the planning of entrepreneurship-based mathematics learning at MBS Zam-Zam Cilongok Junior High School is expected to be carried out with the strengths or advantages that exist in the school.

Weakness

The weakness factor in planning entrepreneurship-based mathematics learning at MBS Zam-Zam Cilongok Junior High School is the learning facilities and infrastructure, especially classrooms which are still not wide enough in the implementation of entrepreneurship-based mathematics learning. Whereas the factors of good training facilities and infrastructure also affect the quality of learning implementation. This is in accordance with the theory of Ardhariksa Zukhruf Kurniullah (2021: 27) that one of the factors that support the success of educational programs in the learning process is facilities and infrastructure. Facilities and infrastructure are one of the resources that become a benchmark for school quality and there is a need for continuous improvement in line with the development of science and technology.

In addition, funds are also one of the weakness factors in planning entrepreneurship-based mathematics learning at MBS Zam-Zam Cilongok Junior High School. The lack of funds can hinder the learning process and fostering entrepreneurial achievement. This is in accordance with the theory of Isjoni (2006: 103) to support the implementation of a new paradigm in the education system and human resource development, it is necessary to carry out research and development activities, especially in terms of curriculum and learning models that support academic and skills education, the use of electronic media and communication in education, education quality assessment and control systems, staff training and development (HR) systems, school-based education management, education financing systems, and other relevant innovations.

The recapitalization program includes the provision of funds to support research and development activities, including the implementation of pilot projects on educational innovation, or the development of superior model schools, and so on. This program is to be implemented by the institution. education (schools) and universities. With these weaknesses, the planning of entrepreneurship-based mathematics learning at MBS Zam-Zam Cilongok Junior High School will be constrained or even impossible, this must be immediately eliminated or other alternatives are sought so that the planning of entrepreneurship-based mathematics learning at MBS Zam-

Zam Cilongok Junior High Schools can run and are able to foster students in entrepreneurship-based mathematics learning.

Opportunity

The opportunity factor in planning entrepreneurship-based mathematics learning at MBS Zam-Zam Cilongok Junior High School is the opportunity to gain sponsorship and become a leading school in entrepreneurship-based mathematics learning by creating students who are able to excel in mathematics and entrepreneurship. If this school becomes a flagship, it will certainly attract sponsors to work together for mutual benefit. This is in accordance with Fathul Mujib and Tutik Saptianingsih's theory (2020: 80) school brands should use a character base as an identity that is specifically owned by the school.

At the final stage of the communication transaction, what happens is the realization of collaboration between school expectations and stakeholder interests. For that, create a message that is able to educate stakeholders to work together through display materials that are needed by prospective users specifically. For example, such as the school's flagship program that is able to jump-start students and its supporting "sponsors" who have a positive image so that stakeholders become interested in supporting them.With these opportunities, it is hoped that the planning of entrepreneurship-based mathematics learning at MBS Zam-Zam Cilongok Junior High School can develop opportunities for the achievement of better entrepreneurship-based mathematics development.

Threat

Threats or obstacles in planning entrepreneurship-based mathematics learning at MBS Zam-Zam Cilongok Junior High School are very influential in the implementation of entrepreneurship-based mathematics learning at MBS Zam-Zam Cilongok Middle School. The obstacle faced is the unpredictable health of teachers and students. The way to anticipate threats in planning for entrepreneurship-based mathematics learning at MBS Zam-Zam Cilongok Junior High School is to implement health protocols during a pandemic and always think positively to live a healthy life so that you are motivated and have no fear during a pandemic. This is in accordance with the theory of Ardi Ansah Rambe (2021: 118) in order for the learning and teaching process activities during the pandemic to remain safe, there are several things that all school members need to do, namely implementing health protocols and maintaining health. The school community referred to here are teachers, students, and everyone in the school environment.

If the existing obstacles are not immediately minimized, the implementation of entrepreneurship-based mathematics learning planning at MBS Zam-Zam Cilongok Junior High School will be hampered, making it difficult to achieve the goal of achieving achievement in mathematics and entrepreneurship.

From the results of the above discussion, it can be concluded that the factors of strengths, weaknesses, opportunities and obstacles are very influential on the achievement of Hayam Wuruk Trengg's football school planning entrepreneurship-based mathematics learning at SMP MBS Zam-Zam Cilongok. And this is in accordance with the SWOT analysis which is based on the logic that the dominance of strengths and opportunities becomes a supporter of entrepreneurship-based mathematics learning planning at MBS Zam-Zam Cilongok Junior High School then weaknesses and threats can be minimized and alternatives are sought together by the school community, so that learning planning Entrepreneurship-based mathematics at MBS Zam-Zam Cilongok Junior High School is feasible.

Conclusion

From the results of the research and discussion, the SWOT analysis of entrepreneurship-based mathematics learning planning at MBS Zam-Zam Cilongok Junior High School is strength in the form of quality teachers and students, this can be seen from the recruitment of teachers who have met the criteria for experience in the field of learning mathematics, with an undergraduate degree. Mathematics Education, while MBS Zam-Zam Cilongok Junior High School students have also started to have an entrepreneurial spirit, this is proven by the presence of students, namely Taufan Hisbulloh and his friends who succeeded in making a product in the form of young coconut pudding which won the competition. Weaknesses in the form of lack of facilities and funds, such as the lack of provision of classrooms and the absence of funding for the practice of learning mathematics based on entrepreneurship. Opportunities in the form of opportunities to get sponsored funds through sponsors who are interested in entrepreneurship-based mathematics learning and opportunities to become excellent schools through student achievements in the field of entrepreneurship-based mathematics. Threats are in the form of unpredictable health of teachers and students during a pandemic due to neglect of health protocols.

Recommendations

Researchers can recommend some suggestions on the results of the study, namely: Planning for entrepreneurship-based mathematics learning at MBS Zam-Zam Cilongok Junior High School when it will be carried out must evaluate better and more structured coaching, in order to maximize strengths and opportunities and minimize weaknesses and challenges. Then, the planning of entrepreneurship-based mathematics learning at MBS Zam-Zam Cilongok Junior High School is expected to be carried out in real terms by considering the results of the SWOT analysis that the researchers did in order to advance and develop entrepreneurship-based mathematics at MBS Zam-Zam Cilongok Junior High School, Indonesia.

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Institute of Applied Culture and Arts for Children: "Environmental Literacy with Art"

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Abstract: In this study, it is aimed to gain the ability to transform what nature offers into a work of art by using traditional methods. The study has two main aims. Its first purpose is to present ways to transfer environmental literacy skills through art education, as a value that should be acquired at an early age. The second is to contribute to the development of hand skills, to gain creativity, to acquire individual skills and to develop basic social skills such as self-confidence, through artistic activities to be applied to the target audience. The participants of the research were carried out with 124 students studying in the 7th and 8th grades of Süleyman Demirel Secondary School located in Gonen District of Isparta. The analysis of the data was carried out using the SPSS 25.00 statistical program using descriptive statistics and simple correlation analysis. In the study, the application methods of traditional handicrafts were combined with materials obtained from nature for the purpose of the study. According to the results obtained; It has been observed that awareness about how nature is transformed into an art object through artistic activities. The activities within the scope of the study were planned as a result exhibition and a total of 13 activity titles under two categories, conceptual and artistic. In artistic activities, it is planned to carry out activities for the transformation of materials collected from nature by using the methods and techniques of traditional handicrafts. In addition to materials that can be collected from nature such as mud, stone and cones, art materials such as felt, wool, natural stone and similar art materials obtained from nature were used in the activities.

Keywords: Art, Literacy, Environment

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Introduction

In recent years, it is seen that environmental awareness and art intersect in art research and art productions. Artists focus on creating a perception towards the preservation of the ecological and environmental integrity of the world through their works. In the same way, in parallel with these ecological art productions, it is seen that art educators also attempt to create a theoretical structure by focusing on environmental issues in the context of ecology and sustainability. In this endeavour, advanced technological innovations and pedagogical design principles for creating active learning environments (inclusion of peer learning, peer feedback, collaborative learning) could play a major role (see Latifi & Noroozi, 2021; Latifi et al., 2020, 2021; Noroozi 2018, 2022; Noroozi et al., 2012; 2022; Valero Haro et al., 2019; 2022). These initiatives have taken their place in the literature with names such as "Community-based ecological art education" (Neperud, 1997), "Ecological art education" (Hollis, 1997) and "Environmental education through art" (Stankiewicz and Krug, 1997). It can be said that the environmental art movements that started at the end of the 1960s and the increase in interdisciplinary interactions in the curriculum on the basis of social constructivist approaches in education and sustainable development education underlie this orientation.

Nature, as it is commonly used, refers to the material world itself outside of us. This material world is independent of consciousness and exists outside of it. It is in a constant dynamism and change (Ulaş, 2002). In many sources, nature is defined as the environment that has not been altered by human hands and preserves its natural structure, as nature, or as the whole of things that exist spontaneously, as opposed to products of the human mind such as art and culture (Akalın et al. 2005). All these definitions exclude man according to nature and nature according to man, and make a distinction between what nature creates and what man builds against nature.

Suzi Gablik “Beliefs that are accepted in our culture, that the subject of art is purely aesthetic and that it can never change the world, are beliefs that reduce the creative thinking and action capacity of most artists. The critic Arthur C. Danto describes this situation as “the deprivation of rights of art”. Because the hidden constraints of an art-for-art philosophy that is morally neutral force artists to be marginalized into society. Has Modernism Failed to question this mythology for myself? I started with writing the text, and a lot has changed since then. Nature is falling apart, time is running out, and there is not much done.” (Gablik, 1998) He criticized this belief system and emphasized the role of art and the artist that needs to change.

Theoretical and practical research on sustainable development education in Turkey has increased in the last 10 years (Alkış, 2007; Öztürk Demirtaş, 2011; Kaya and Tomal, 2011, Tanrıverdi, 2009; Teksöz, Şahin, & Ertepınar, 2010). It is seen that these studies are focused on social studies, geography and teacher education and are mainly aimed at determining the level of awareness about curriculum review or sustainability. Therefore, it is clear that more focus should be placed on the practical approaches of sustainable development education in order to guide educators and arts educators.

The aim of this study is to convey environmental and climate sensitivity through art as a value that should be acquired at an early age. It is aimed to indirectly convey the causes and consequences of environmental and climate changes and consciousness through artistic activities. The expected effect of the project is to contribute to environmental literacy and environmental attitude skills. It is aimed to raise awareness about environmental pollution, the negative effects of climate changes on nature and human life, and sustainable living conditions.

Within the scope of the study, environmental pollution, climate change, biodiversity reduction problems were discussed. It was supported to raise awareness about the factors causing these problems and to be participants in the measures that can be taken at individual and social level and in the management of the change process. In line with these purposes, answers to the following sub-problems were sought:

1-Does the environmental behavior of the participants vary according to gender, class, socio-economic level, educational status of parents?

2- Do the participants' perceptions of the environment change according to gender, class level, socio-economic level, education level of parents?

3- Is there a relationship between environmental behavior and perception scale?

Method

This research was carried out using the survey technique, one of the quantitative research methods. Relational screening model was used in the research. The screening model provides a quantitative description of the universe through research on the sample selected from the determined population (Cresswell, 2012, p. 376). Correlational research tries to find out to what extent some type or types of relationship exist. In this approach, it is essential that the researcher does not affect the process except for the application of the tools necessary to collect the desired data (Büyüköztürk et al., 2018, p.16).

In studies using relational screening model, it is aimed to determine the relationship between two or more variables. The participants of the research were carried out with a total of 124 students, 53 girls and 71 boys, studying in the 7th and 8th grades in Gönen district of Isparta province. Environmental behavior scale (CLS) and environmental perception scale (CIAS) were used as data collection tools. Analysis of the data using spss 25.00 package program, independent t-test, anova and correlation analyzes were performed.

Results

When Table 1 is examined, it is understood that the environmental behaviors of the participants differ significantly in favor of men (t_{124}=-0.238, $p<0.05$) according to the gender variable. Accordingly, it can be said that the environmental behavior of boys is higher than that of girls.

Table 1. T-test results of participants' environmental behaviors by gender

Dimension	Gender	N	x̄	Ss	t	p
CLS	Girl	53	2,1748	17,35	,-0,238	,01
	Boy	71	2,2046	16.73		

When Table 2 is examined, the environmental behavior of the participants according to the class level was found to be F_{120}=0,71 p<0.05; It is understood that there is a statistically significant difference. Accordingly, according to the class level of the participants, it can be said that the 6th and 5th grade students have a higher environmental behavior level than the 7th and 8th grade students.

Table 2. ANOVA results of environmental behaviors by grade level

Dimension	Class Level	N	x̄	Ss	Sd	F	p	Significant Difference
CLS	5. class	22	2,23	17.01	3/120	0,71	.00*	Medium-Low High-Low
	6. class	34	2,28	16.80				
	7. class	42	1,19	17,53				
	8. class	26	2,02	16,32				

*$p<0.01$

When Table 3 is examined, it is seen that the environmental behaviors of the participants according to their socio-economic status were found to be F_{120}=2.46 p<0.05; It is understood that there is a statistically significant difference. According to this, it can be said that the environmental behavior of the participants, according to their socio-economic status, is higher for those with an income level of over 4500 TL compared to those with a lower income level.

Table 3. ANOVA results of environmental behaviors according to socio-economic level

Dimension	Socio-Economic Status	N	x̄	Ss	Sd	F	p	Significant Difference
CIAS	Below 2500 TL	38	0,05	17.01	3/120	2,46	.00*	Medium-Low High-Low
	Between 2500-4500 TL	50	2,14	16.80				
	Over 4500 TL	36	2,39	17.53				

*$p<0.01$

Table 4. ANOVA results of environmental behaviors according to maternal education level

Dimension	Mother Education Level	N	x̄	Ss	Sd	F	p	Significant Difference
CLS	Illiterate	20	2,23	17.01	3/120	1,38	.01*	Medium-Low High-Low
	Primary school	31	2,18	16.80				
	Hıgh School	58	2,22	15.01				
	University	13	1,9	13,44				
	Master- doctorate	2	1,5	17,1				

*$p<0.01$

When Table 4 is examined, the environmental behaviors of the participants were found to be F120=1.38 p<0.05; It is understood that there is a statistically significant difference. According to this, it can be said that the environmental behavior of the participants is higher than the ones with a lower education level compared to the mother's education level.

Table 5. ANOVA results of environmental behaviors according to father's education level

Dimension	Father Education Level	N	x̄	Ss	Sd	F	p	Significant Difference
CLS	Illiterate	1	2,23	17.01	3/120	1,38	.01*	Medium-Low High-Low
	Primary school	34	2,18	16.80				
	Hıgh School	43	2,22	15.01				
	University	34	1,9	13,44				
	Master- doctorate	12	1,5	17,1				

*$p<0.01$

When Table 5 is examined, the environmental behaviors of the participants were found to be F_{120}=1.38 p<0.05; It is understood that there is a statistically significant difference. According to this, it can be said that the environmental behavior of the participants is higher than the ones with a lower education level compared to the father's education level.

Table 6 T-test results of perceptions of the environment by gender

Dimension	Gender	N	x̄	Ss	t	p
CIAS	Girl	53	2,6532	14,43	-1,619	,10
	Boy	71	2,8558	16.49		

When Table 6 is examined, it is understood that the perceptions of the participants towards the environment differ significantly in favor of men (t_{120}=-1.619, p<0.05) according to the gender variable. Accordingly, it can be said that boys' perceptions of the environment are higher than girls.

Table 7. ANOVA results of their perceptions of the environment by grade level and level

Dimension	Class Level	N	x̄	Ss	Sd	F	p	Significant Difference
CIAS	5. sınıf	22	2,87	17.43	3/120	2.191	.00*	Medium-Low High-Low
	6. sınıf	34	2,97	14.56				
	7. sınıf	42	1,61	15,43				
	8. sınıf	26	2,65	16,49				

*$p<0.01$

When Table 7 is examined, according to the class level of the participants' perceptions of the environment, $F_{120}=2.191$ $p<0.05$; It is understood that there is a statistically significant difference. Accordingly, according to the class level of the participants, it can be said that the 6th and 5th grade students have higher environmental perception levels than the 7th and 8th grade students.

Table 8. The results of ANOVA results of perceptions of the environment according to socio-economic level.

Dimension	Socio-Economic Status	N	x̄	Ss	Sd	F	p	Significant Difference
CIAS	Below 2500 TL	38	2,69	16.21	3/120	4,63	.01	Medium-Low High-Low
	Between 2500-4500 TL	50	2,61	15.83				
	Over 4500 TL	36	3,05	17.94				

*$p<0.01$

When Table 8 is examined, according to the socio-economic status of the participants' perceptions of the environment, $F_{120}=4.63$ $p<0.05$; It is understood that there is a statistically significant difference. According to this, it can be said that the environmental perceptions of the participants according to their socio-economic status are higher than those whose income level is above 4500 TL compared to those with a lower income level.

Table 9. ANOVA results of environmental perceptions according to maternal education level

Dimension	Mother Education Level	N	x̄	Ss	Sd	F	p	Significant Difference
CIAS	Illiterate	20	2,75	15.13	3/120	2,491	.04	Medium-Low High-Low
	Primary school	31	2,96	14.46				
	Hıgh School	58	2,77	15.45				
	University	13	2,27	12,64				
	Master- doctorate	2	3,05	15,15				

*$p<0.01$

When Table 9 is examined, it is seen that the participants' perceptions of the environment according to the mother's education level were found to be F120=2.491 $p<0.05$; It is understood that there is a statistically

significant difference. According to this, it can be said that the perceptions of the participants towards the environment are higher than those with a lower education level compared to their mother's education level.

Table 10. ANOVA results of environmental perceptions according to father's education level

Dimension	Father Education Level	N	x̄	Ss	Sd	F	p	Significant Difference
CIAS	Illiterate	1	3,19	15.01	3/120	1,160	.332	
	Primary school	34	2,93	14.73				Medium-Low
	Hıgh School	43	2,76	16.18				High-Low
	University	34	2,69	14,54				
	Master- doctorate	12	2,49	15,3				

When Table 10 is examined, according to the father's education level of the participants' perceptions of the environment, F_{120}=1.160 p>0.05; It is understood that there is no statistically significant difference. According to this, it can be said that there is no difference in the perceptions of the participants towards the environment according to the father's education level, compared to the ones with a lower education level and those with a higher education level.

Table 11. Results of correlation analysis between environmental behavior and perception scale

Dimension	N	x̄	SD	p	CIAS	CLS
CIAS	124	2,19	0,68	,00		,521
CLS	124	2.76	0,69	,00	,521	

When Table 11 is examined, it is seen that there is a moderately significant positive correlation (p<0.05) between the participants' perceptions of the environment and their behaviors towards the environment.

Discussion, Conclusion and Recommendations

According to the results of the research, it was observed that the environmental behavior scale scores of the participants were significant in favor of girls according to gender. According to the class level of the participants, it can be said that the 6th and 5th grade students have a higher environmental behavior level than the 7th and 8th grade students. According to the socio-economic status of the participants, it can be said that those with an income level above 4500 TL have a higher level of environmental behavior than those with a lower income level. It can be said that the environmental behavior of the participants is higher than the ones with a lower education level compared to the mother's education level. It can be said that the environmental behavior of the participants is higher than the ones with a lower education level compared to the father's education level.

It can be said that the perceptions of the participants towards the environment are higher than the girls. According to the class level of the participants, it can be said that the 6th and 5th grade students have higher environmental perception levels than the 7th and 8th grade students. According to the socio-economic status of the participants, it can be said that those with an income level above 4500 TL have a higher level of perceptions towards the environment than those with a lower income level. It can be said that the perceptions of the participants towards the environment are higher for those with a lower education level than those with a higher education level. It can be said that there is no difference in the perceptions of the participants towards the environment compared to the father's education level, compared to the ones with a lower education level and those with a higher education level. It is seen that there is a moderately significant positive correlation between the participants' perceptions of the environment and their behaviors towards the environment.

With the curriculum renewed in 2004 in our country, environmental education has found a place in various disciplines. In addition, the Ministry of National Education [MEB] prepared an Elective Environmental Education Course curriculum for Secondary Schools in 2015. This program (MEB, 2015) is based on the principles of the 1977 Tbilisi Conference declaration and the prototype environmental education program for sustainable development education presented by UNESCO Environmental Education Unit in 1994. Many subjects within the scope of this prototype curriculum have been included in many courses, especially Science, Life Sciences and Social Studies courses, with an interdisciplinary approach.

Research and applications conducted by the TEMA foundation on the teaching of ecological literacy, with research aimed at increasing the awareness of the ecological footprint of students, which is one of the indicators of sustainable life in our country (Karakaş, Doğan, & Sarıkaya, 2016), have increased in recent years. In addition, TÜBİTAK supports science and society projects to make students aware of their negative effects on nature. The aim of these 4004 coded projects is to focus children on scientific issues through out-of-school activities and practices. Among these science and society projects are many projects that support ecology-based sustainable environmental education.

For example; All activities in the Ecology-Based Summer Camp Project, which was carried out in cooperation with Niğde University and TÜBİTAK in order to convey the love of nature and environmental awareness to the participants, included the students together with their teachers. In this interdisciplinary project, he took part in activities aimed at the integration of nature and art (Karataş and Aslan, 2012).

In this research, with the thought that sustainable development cannot be achieved without a sustainable environment, the curriculum is predominantly structured in the context of environment and nature. In order to lead students to contextual and intuitive thinking, nature and environment-based artist studies, the choice of natural and waste materials in production, and various application studies in nature are associated with issues such as intergenerational equality, recycling policies, use of water and land, consumption habits.

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Popular Course: A Preparation for ENEM

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Abstract: Brazil is a country that does not invest enough in basic education, thus leaving a gap in the knowledge of young people studying in public schools and jeopardizing their future. One of the main ways to get into college in Brazil is through the National High School Exam (ENEM), a multiple-choice test administered by the National Institute of Educational Studies and Research. In the project: Popular Course: a preparation for ENEM, students from the Federal University of Technology – Paraná, Apucarana campus volunteered to offer online tutoring of basic content in: biology, physics, geography, history, mathematics and chemistry, from Monday to Friday, during thirteen weeks. The main objective of these virtual meetings was to help interested students enrolled in the program to prepare for ENEM, in a dynamic and freeway. The volunteers were free to use the means they considered most appropriate for each content, from online physics experiments to game-based learning platforms, which contributed positively to the learning of the students enrolled in the project and consequently to a better performance in the tests.

Keywords: High school, ENEM, Educational technology

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Introduction

In Brazil, college, besides being seen as a source of knowledge and personal improvement, ends up being mainly seen as a way to improve one's life, according to the educator Paulo Freire, "if education alone does not transform society, without it society doesn't change either", showing the importance of knowledge in people's lives. Despite this being common sense, the country does not have a good management of the investment given to the area of education, generating several problems for public servants who feel unmotivated with the neglect of the government in relation to delayed salaries, poor infrastructure and lack of materials, leaving professionals dissatisfied with the profession (Oliveira et al., 2016). This feeling is shared with public school students, who, in turn, even indirectly, end up being influenced not to follow the same career and also contribute to the school environment still being seen as something where students do not want to be, which taking into account the said conditions, it is easy to understand the reasons (Tartuce et al., 2010).

One of the main ways to get into college in Brazil is through the National High School Exam (ENEM), a multiple choice test applied by the National Institute for Educational Studies and Research where students from all over the country test all their knowledge for two entire afternoons on two sundays where they must answer ninety questions each day and develop an essay based on the theme presented in the exam and according to the score achieved can enroll in one of several colleges in the country. In the project, Cursinho Popular: A Preparation for ENEM, students from the Universidade Tecnológica Federal do Paraná, Apucarana campus, volunteered to give free dynamic online classes from Monday to Friday during thirteen weeks. The classes were given through the Google Meet platform and lasted for two hours, during which time the volunteers explained about the subject of the day and answered questions from the registrants. Because the classes were online, it was possible for people from different parts of the country to participate, most of the enrolled students were from the 1st to the 3rd year of high school, but there were also some who had already graduated, but were not enrolled in higher education (see Figure 1).

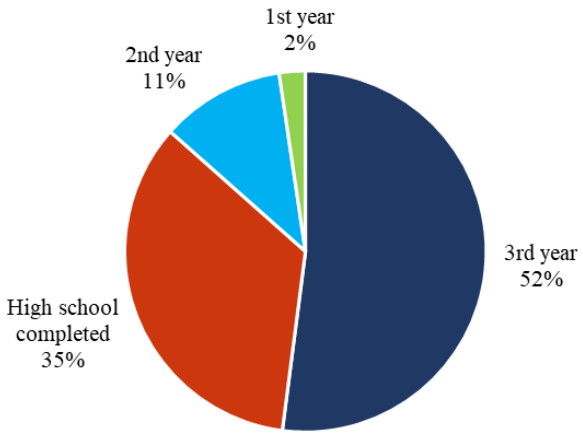

Figure 1. Percentage of students in each year of high school

Note: Own authorship, Google Forms (2021).

During the classes, the volunteers were free to explain the day's contents in any way they saw fit, from exercise solving, videos, to online experiments and game-based learning platforms, which contributed positively to the students' learning and a better performance in the exams.

Thus, the project emerges as a great opportunity for college student volunteers to have a closer experience of what it is like to be a teacher and to become interested in the career, as well as to be able to share tips and knowledge to those enrolled in the project, who may already have a contact with the college and mainly fill a gap in their knowledge so that they are prepared to enter higher education.

Method

For the project to happen it was made a preparation since June, where it was necessary to analyze which were the most recurrent subjects of each subject that were charged in ENEM, organize the lists of exercises for each subject, make the class schedule, create a google form so that people interested in watching and participating in the classes could sign up and disclose the project to reach more people. As the project happened totally online, some measures had to be taken so that the volunteers could talk to each other and to the registered students, for this, two groups were created in the WhatsApp application, one where only the volunteers helped each other and another with the volunteers and the students to send study materials and links to the classes.

The classes started in August, and went on until November, lasting a total of thirteen weeks. The means by which the students participated in the classes was through the Google Meet platform, starting at seven o'clock in the evening and ending at nine o'clock at night. All the classes were recorded and made available for the students to watch again. Besides the recorded classes, every week the volunteers created a study schedule for the students, where there were links to video classes, exercise lists and other materials such as summaries.

In addition, two online mock exams were performed with the objective of preparing the students for ENEM, since many times they never had contact with the exam, which would harm their performance. By doing the mock exams it was possible for them to have greater control of their time, discipline, and begin to adapt to the style of the questions on the exam.

During the classes, the volunteer responsible for the subject to be discussed was free to teach the subject in the way that he or she thought would be the most dynamic and that would get the most out of the class. During chemistry and physics classes, for example, it was common to show videos where an experiment was performed that would contribute to a better understanding of the subject or even make use of learning platforms based on games. With this it was possible for students to become more interested in the subject and consequently understand more about it, besides being able to see where it was present in their daily lives.

Results

Analyzing the figure 2, the project, Popular Course: A preparation for ENEM, had a great return from the students, considering that when the research was done most of the students had not yet taken the exams.

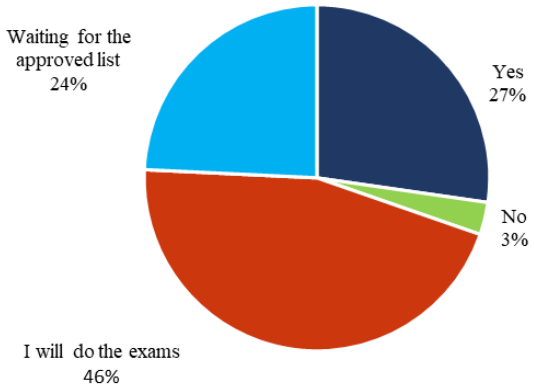

Figure 2. Percentage of approved students in higher education

Note: Own authorship, Google Forms (2021).

Although some students have not yet taken the exams, it is possible to see that there have been many approvals in relation to those who have not managed to enter higher education, and it is also possible to see that approximately 24% are still waiting for the list of approved students to be published, so it is to be expected that the approval numbers will increase as students take the exams and their results come out.

Another very important piece of data that must be taken into account is the evaluation done by the students in relation to what they thought of the project, so that it is possible to improve and have a return on the activities.

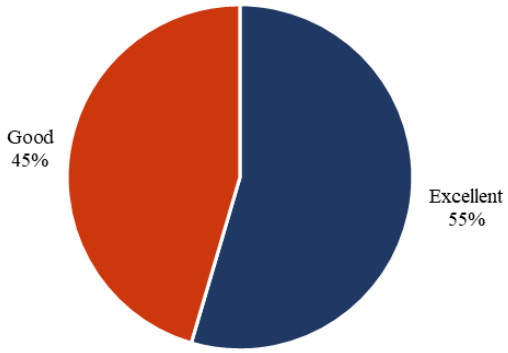

Figure 3. Evaluation of the project by the students

Note: Own authorship, Google Forms (2021).

Figure 3 shows that, in general, people were satisfied, since 55% found the way, the project was excellent and 45% found it good. Nevertheless, the Popular Course has some points where it can be improved, since, according to Figure 4, some students did not have a very good experience with the online classes, 15% of the votes had a regular experience with the classes in this format, showing that there are some aspects that need to be improved.

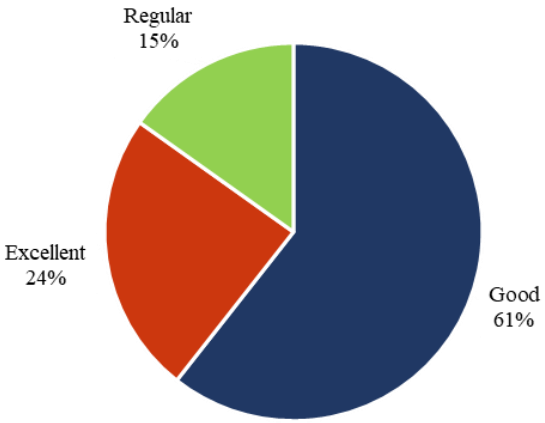

Figure 4. Experience with classes in an online format

Note: Own authorship, Google Forms (2021).

Also, in this satisfaction survey conducted with the project participants, general feedback was obtained for each subject, thus being possible to see specifically in which subjects it is necessary to improve and in what to improve, as for example in the feedback about the geography classes (Figure 5).

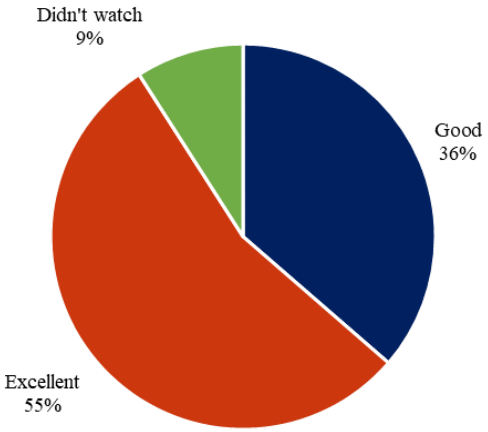

Figure 5. Feedback about the geography classes

Note: Own authorship, Google Forms (2021).

Although some people did not participate in the geography lessons, they are an example where the students enjoyed it well and liked the way the lessons were taught. This positive feedback did not only happen with these classes, but there are also classes where the students did not fully enjoy the lessons, for example, the math classes (Figure 6).

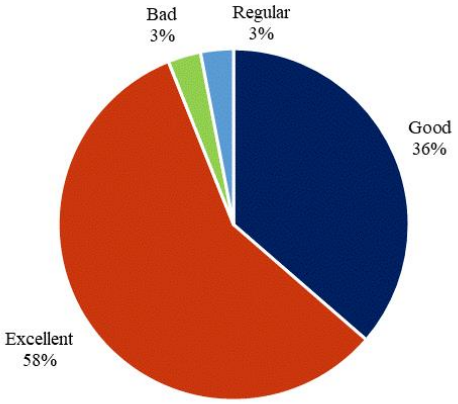

Figure 6. Feedback about the mathematics classes

Note: Own authorship, Google Forms (2021).

Discussion

Based on the evaluation made by the students, it can be seen that the project managed to achieve its main objective of transmitting knowledge to the population in a free and dynamic way. However, it is a fact that there are some points that can be improved and that it was only through the survey answered by the people who participated that it was possible to get to know them so that in future editions the project will always continue to improve.

From Figure 4, it can be seen that some students were not entirely satisfied with the online format classes, this is due to some factors, such as the inexperience of the student volunteers in teaching remotely and the limitations that this format brought, besides the fact that the sound, image and internet quality affected the students to participate in the classes.

Teaching online brings limitations that the students are not used to having in a regular classroom, because the direct contact with the teacher is as important for the students to pay more attention as it is for the teacher to be able to identify more easily if the students are understanding the topic. In the same way, this format also has its positive sides, since only through it was possible to meet people from different parts of the country and also bring together a group of people who could hardly fit in a classroom.

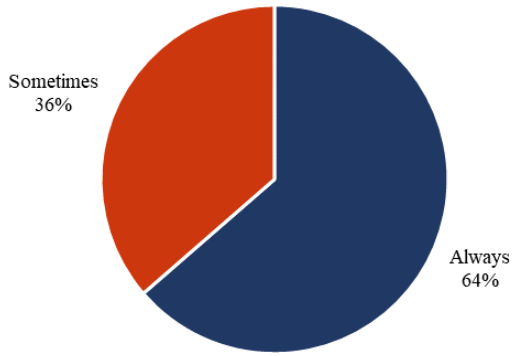

Figure 7. Frequency with which students used the study schedule

Note: Own authorship, Google Forms (2021).

According to Figure 7, the weekly study schedules were used a lot, indicating that it is a good option to continue doing it in the next editions, because it helped the students to know who would be the monitor responsible for the subject of the day, as well as to use the suggested study materials, such as videos, exercise lists and summaries.

On the other hand, other available resources were not used as much, as is the case of the recorded classes, which, even though there was a portion of students who did not use them, as shown in Figure 8, was important so that those enrolled in the project who could not follow the live classes could have the same opportunity and, on top of that, review the subject as many times as necessary, thus, it is a measure that even if not used by everyone, it is essential that it continues to be done in the coming years.

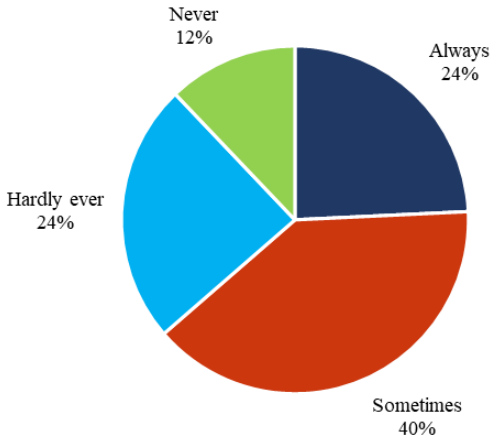

Figure 8. Frequency with which students used the recorded classes

Note: Own authorship, Google Forms (2021).

Still, according to the suggestions of the registered students, some improvements can be made, such as including classes and tips on writing, since it is something very important for the exams to enter higher education, and everything possible will be done so that in the next editions of the project this demand is satisfied. In addition, there were requests for the classes to start earlier, as some students felt tired because the classes were held at night, which will also be taken into consideration.

Conclusion

The Popular Course: A preparation for ENEM project obtained satisfactory results in terms of approvals in higher education and mainly in sharing knowledge with the population. Being totally online was a challenge both for the students, who overcame their tiredness and participated in the classes even after an exhausting day at school and at work, and for the volunteers, who had to adapt their routine in the middle of college and work so that the classes could be as good as possible.

Overcoming the difficulties that the online format brought was the first step so that the volunteers could enjoy all its benefits, which made a total difference in the students' learning, whether through the games or the online experiments that added and made the class lighter and more dynamic. Just because the classes were held remotely, it was possible to meet people from different parts of the country and even bring together a group of people who could hardly fit in a room.

Besides being very important for the participants, the project helped the volunteers to have a closer experience with teaching, contributing to the students' interest in the career by sharing knowledge, tips, and also developing their skills in areas such as public speaking and organization.

There are points where it is possible to improve and suggestions from the students themselves that will be analyzed so that in the next editions the project continues to evolve and is able to bring knowledge and the opportunity to conquer the dream of entering higher education. Thus, with the success of the remote classes, it was decided to keep this format and resume face-to-face classes when it is safe for the students, thus serving even more the population that can choose which format is more suitable to their routine.

Recommendations

For the next editions of the project, it is important to continue with the support materials that have worked and helped the students, such as the recorded classes and the study schedules, as well as always trying to improve and meet the population's demand for new classes and class schedules. With the research carried out in the 2021 project, data was obtained only from the online classes, in the next few years the project will have both online and face-to-face classes, which is a great way to start evaluating which of the two class models the students have the best performance in.

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Metaphorical Perceptions of Social Studies and Classroom Teachers on the Concepts of Non-Governmental Organizations and Global Citizenship

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Abstract: In this study, it is aimed to reveal the perceptions of social studies and classroom teachers about the concepts of global citizenship and non-governmental organizations through metaphors. Phenomenology design, one of the qualitative research methods, was used in the study. Turkey in different cities in the working group's 2020-2021 fall semester, depending on the Ministry of Education and Research, who served 33 classroom teachers constitute 30 social studies teachers. 63 teachers who made up the participants were included in the study on the basis of volunteering. The data of the research were collected using the metaphor form sent to the participants via Google Forms. The data obtained were analyzed using the content analysis method. The metaphors produced in line with the specified purpose were categorized according to their meanings. It was observed that the participants produced 38 different metaphors for the concept of global citizenship and 45 different metaphors for non-governmental organizations. Among the metaphors produced regarding the concept of global citizenship, the ones with the highest frequency are in the form of sky, air, forest, water, wind, bird; Among the metaphors produced regarding the concept of non-governmental organizations, the ones with the highest frequency came to the fore in the form of water, vehicle, light, bridge and tree. As a result of the research, it was determined that the teachers who participated in the study interpreted the metaphors they produced regarding the concept of global citizenship under different categories and the metaphors they produced regarding the concept of non-governmental organizations under similar categories. While primary school teachers defined global citizenship as a constitutional citizenship, social studies teachers defined it as a global citizenship. It has been observed that both branches define non-governmental organizations as organizations

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aiming to cooperate in a similar scope. In the light of this information, it was concluded that the interpretation of the two concepts was insufficient, so it was suggested that action research for the concept of global citizenship and partnership with organizations for the concept of non-governmental organizations were proposed.

Keywords: Metaphor, Non-governmental organizations, Global citizenship, Social studies teachers

Introduction

The developments in the world, the rapid progress of science and technology, the proliferation of communication tools, the easier communication and the loss of importance of distances between people have increased the interaction of people with each other. Such rapid changes has consequences for communication among people and transformation of education as well. For example, with advances in educational technologies, nowadays teachers tend to adapt active learning activities such as peer learning, group work activities and collaborative argumentation (see Latifi & Noroozi, 2021; Latifi et al., 2020, 2021; Noroozi 2018, 2022; Noroozi et al., 2018; 2020; Valero Haro et al., 2019; 2022). In the same vein, with the rapidly changing world, some concepts have emerged and developed (Kan, 2009; Kaya and Kaya, 2012). Globalization, which is too strong to ignore these concepts; brought with it the concepts of non-governmental organizations and global citizenship.

According to Delanly (2009), the concept of globality first appeared in an academic publication in America in 1966 (cited in Kaya and Kaya, 2012). After the 1980s, the concept of globalization gained momentum in the social structure with the advancement of technology. Globalization has always been the subject of discussion by thinkers due to its different dimensions and the problems it poses. In its most general definition, we can define globalization as getting out of the locality in social, cultural, economic and political issues and reaching the international dimension (Çermik et al., 2016).

Although there is no agreed definition of what globalization is, the dependence of countries on each other in international relations has increased with globalization, and the problems that have arisen have begun to affect countries not only at the local level but also at the international level. The change process created by this interaction has increased the importance of the concepts of "Global Citizenship" and "Civil Society Organizations", and it has brought cultural, economic, political, social, etc. It has brought up the necessity of individuals' need for awareness and solidarity in coping with problems in many fields.

Individuals who can adapt to the change and development that occur with globalization, produce solutions to the negative effects of this process, have awareness and feel the responsibility to take action have begun to be needed (Katzarska-Miller et al., 2012). This universal citizenship model, which is needed and desired to be created, is called “Global Citizenship” (Kan, 2009). Global citizenship does not refer to the form of national identity belonging to a nation, but refers to world citizenship categorized within its field of application (Oxley & Morris, 2013).

Morais and Ogden (2011) discussed global citizenship in three dimensions as "social responsibility, global competence and global civic participation". Social responsibility, perceiving social events, observing events from different perspectives, respecting the environment and identifying and being aware of social problems; global competence, respecting international cultural differences, having effective communication skills in intercultural relations, having knowledge about events and emerging problems in the world; global civic participation can be explained as taking action towards global problems, being the voice of the society, and participating in non-governmental organizations voluntarily (Morais & Ogden, 2011).

The global citizen is willing to participate in local and global social organizations both to counter social inequalities and injustices and to create a sustainable democratic world. At this point, being a member of non-governmental organizations is important for an individual who is a global citizen, because one of the most basic pillars of globalization, which is the symbolic name of events and situations in the world in the 21st century, is civil structures (Talas, 2011). Civil society is a social living space created by voluntary citizens in a modern sense, productive, self-sufficient, planned, having a function outside the state and connected to the legal order in which there are rules (Brand, 2001).

The concept of civil society brings to mind a community separate from the state. It evokes a concept in which humanity is at the forefront, far from politics and an economic society. Today, a community that takes a place between the individual and the state comes to mind. With democracy, an environment has emerged where people can express their opinions more easily. Over time, non-governmental organizations have become the unheard voice of the people. The existence and effectiveness of non-governmental organizations is an important tool in understanding the level of democracy of a country. NGOs have become an important bridge between the individual and the state, away from personal interests (Karakuş, 2006).

According to Gözübüyük Tamer (2010), how can solutions be brought to existing problems, how can it be better, what can be done? While their questions make sense of the existence of non-governmental organizations; How can a healthier civil society structure be built? The question has become the subject of discussion in the world, and the method utilized at this point has been democracy. The quality of democracy is measured by its ability to articulate social issues and to solve the problems that the issues raise. Non-governmental organizations directly intervene in many problems and ensure that the problem is solved. They are organizations that strengthen the social structure with a specific mission, where every citizen has the opportunity to defend their ideas and protect their interests, to be the voice of the society with the awareness of active and participatory citizenship (Johns, 2005).

We can explain the importance of the role of Non-Governmental Organizations in the globalization process and in raising awareness of global citizenship with the following reasons (cited in Şahin & Öztürk, 2011):

- ❖ The state may be insufficient in combating the destruction caused by terrorism, epidemics, armament, nuclear threats, environmental pollution and natural disasters that arise in the process of

globalization. In these cases, the activities of Non-Governmental Organizations constitute a solid foundation for the society.

❖ The cooperation of the state, which has difficulty in responding to the needs of the society in the face of inequality, poverty, lack of education and lack of political trust, that has emerged with globalization in the society we live in, provides positive results for the countries.

❖ Non-Governmental Organizations help increase social welfare by disseminating technology, facilitating communication and facilitating access to information in regions that have difficulty keeping up with advanced technology.

❖ It contributes to the introduction of the concepts of democracy, justice, rights and freedom into our lives, raising awareness and directing the societies on these issues and creating a spirit of solidarity.

Metaphors are an alternative way to describe a situation or phenomenon with similar qualities by comparing it with another situation, expression and phenomenon and to reveal perceptions. metaphor; It is a symbolic expression tool used to compare items and concepts with similar qualities (Kara and Bozbayındır, 2019). In this study, metaphorical perceptions of social studies and classroom teachers about the concepts of non-governmental organizations and global citizenship were examined.

The purpose of this research is to reveal the knowledge of primary school teachers and social studies teachers about the concepts of global citizenship and non-governmental organizations using metaphors. For this purpose, answers to the following questions were sought:

- What metaphors do primary school teachers and social studies teachers use when describing the concept of global citizenship?
- Under which categories is the concept of global citizenship defined by classroom teachers and social studies teachers?
- What metaphors do primary school teachers and social studies teachers use when describing the concept of non-governmental organizations?
- Under which categories is the concept of non-governmental organizations defined by classroom teachers and social studies teachers?
- How are the conceptual categories created according to the branch distribution?

Method

Research Design

In this study, phenomenography research design, which is one of the qualitative research methods, was used. Phenomenography is a research method that deals with what people perceive, understand and experience about the phenomena they encounter in the universe they live in. People do not understand a given phenomenon in the same way. Therefore, there is diversity in people's experience or understanding of a phenomenon (Orgill, 2000; cited in Türkeli Şandır, 2006). Phenomenographic research tries to identify the key points of this diversity

(Trigwell, 2000). For this reason, the study was carried out with a phenomenographic design.

Working Group

In this study, the study group was determined according to the criterion sampling method, which is one of the purposive sampling methods. Criterion sampling is a sampling method that aims to study situations that meet the determined criteria and considers the determined criteria of the researcher (Büyüköztürk et al., 2020). In the fall semester of 2020-2021, 63 teachers, consisting of classroom teachers and social studies teachers working under the Ministry of National Education, were reached and data were collected in different cities of Turkey. Participants were included in the study group on a voluntary basis. Demographic information of the study group is shown in Table1.

Table 1. Demographic Information of the Working Group

	Variable	f	%
	Woman	31	49,2
Gender	Male	32	50,8
	22-25	14	22,2
Age	26-30	15	23,8
	31-35	11	17,5
	35 and above	23	36,5
	Classroom teaching	33	52,4
Branch	Social studies teacher	30	47,6
	0-5 years	25	39,7
Service time	6-10 years	13	20,6
	11-15 years	8	12,7
	16-20 years	5	7,9
	20 years and above	12	19,4
	Licence	57	90,48
	Degree	6	9,52
	Doctorate	0	0
	TOTAL	**63**	**100**

When Table 1 is examined, 31 of the teachers participating in the research are female and 32 are male. 22.2% of the participants are in the 22-25 age range, 23.8% are in the 26-30 age range, 17.5% are in the 31-35 age range, and 36.5% are 35 years old and over. 52.4% of the teachers participating in the study are primary school teachers and the remaining 47.6% are social studies teachers. 39.7% of the teachers participating in the research have 0-5 years of service, 20.6% of them have service years between 6-10 years, 12.7% of them have service years between 11-15 years, 7.9% of the participants had a service period between 16-20 years and lastly,

participants with a service period of 20 years or more constitute 19.4% of the study. Finally, when the education level of the participants is examined, 90.48% of them are undergraduate graduates. While there are no participants at the doctoral level, there are 6 teachers with master's degrees. These constitute 9.52% of the study.

Data Collection

In this study, data were collected using the metaphor interview form created by the researchers. The questions prepared in order to understand the demographic characteristics of the people participating in the study were included in the first part of the form. The interview form is like "non-governmental organizations …… through Google Forms. Because……", "Global citizenship is like ……. Because ……." was formed and delivered to the teachers, and a purposeful explanation was made at the beginning of the form. In order to understand the study correctly, a sample sentence for metaphor was given by the researchers.

Analysis of Data

In the study, the data collected with the Google form were subjected to the content analysis method. Content analysis is an analysis method that works with the code-sub-theme in which the content is classified in depth and the categories from which the themes are extracted. In order to reflect the accuracy of the results obtained as a result of the analysis, the answers given by the participants were directly quoted and included in the findings section. The metaphors obtained in the study were listed and examined, and after the necessary arrangements were made, 38 different metaphors for the concept of global citizenship and 45 different metaphors for non-governmental organizations were produced by 63 teachers, and the categorization stage was started.

The frequency and percentage values of the metaphors collected under the categories were tabulated and included in the findings section. While categorizing the metaphors produced by the teachers, the way they explained the metaphor was taken into account and direct quotations were included. Since the direct quotations given will be compared by the classroom teachers and social studies teachers later, in order to avoid confusion, classroom teachers are in the form of S(S)/1, S(S)/2, S(S)/3..., and social studies teachers are S(S). SB)/1, S(SB)/2, S(SB)/3….

Results

In this study, the metaphorical perceptions of classroom teachers and social studies teachers towards the concepts of "non-governmental organizations" and "global citizenship" are discussed.

Table 2. Metaphors Formed by Classroom Teachers and Social Studies Teachers Regarding the Concept of Global Citizenship

Global Citizenship Metaphors	f	%	Global Citizenship Metaphors	f	%	Global Citizenship metaphors	f	%
Heterogeneous	1	2.17	Live	1	2.17	Monochrome Rainbow	1	2.17
Mirror	2	4.34	Hemp	1	2.17	Impartiality	1	2.17
Sacrifice	1	2.17	Equality	1	2.17	Need	1	2.17
Internet	2	4.34	Friendship	1	2.17	World	1	2.17
Key	1	2.17	Moon	1	2.17	Comb	1	2.17
Tree	1	2.17	Weather	2	4.34	Stork	1	2.17
Utopia	1	2.17	Money	1	2.17	Brain	1	2.17
Forest	2	4.34	nest	1	2.17	Book	1	2.17
Compass	1	2.17	Bridge	1	2.17	**Total**	**46**	**100**
Sky	2	4.34	River	1	2.17			
Transparency	1	2.17	Peace	1	2.17			
Migratory Birds	1	2.17	Bird	2	4.34			
This	2	4.34	Locksmith	1	2.17			
Wind	2	4.34	Chameleon	1	2.17			
Liquid	1	2.17	Lamp	1	2.17			

When Table 2 is examined, the total number of metaphors created by 63 teachers is 46. While 4 of the teachers stated that they did not know what the concept of global citizenship was, there were 13 teachers who could not explain why they created the metaphor they created. For this reason, 17 metaphors were eliminated from the concept of global citizenship and 46 metaphors were obtained. Considering the same ones among these metaphors, it is seen that a total of 38 different metaphors were created.

Table 3. Conceptual Categories of Metaphors Formed by Classroom Teachers and Social Studies Teachers Regarding the Concept of Global Citizenship

Categories (f=12)	f	%	Metaphors (f=46)	f	%
Global citizenship as a Common Heritage Element	10	21.73	Air (2), Forest (2), Water (2), Wind (2), Alive (1), Earth (1)	6	15.78
Global citizenship as Awareness/Effectiveness Aspect	7	15.21	Mirror (2), Sacrifice (1), Hemp (1), Bird (2), Brain (1)	5	13.15
Global citizenship as a universal element	6	13.04	Heterogeneous (1), Equality (1), Monochrome Rainbow (1), Sky (2), Comb (1)	5	13.15
Global citizenship as a Functional Aspect	6	13.04	Key (1), Tree (1), Money (1), Locksmith (1), Chameleon (1), Lamp (1)	6	15.78
Global citizenship as an Accessibility Aspect	4	8.69	Compass (1), Friendly (1), Bridge (1), River (1),	4	10.52
Democracy - Global Citizenship as an Element of Freedom	3	6.52	Migratory Birds (1), Stork (1), Liquid (1)	3	7.89
Global Citizenship as an Ideological Aspect	2	4.34	Utopia (1), Book (1)	2	5.26

Categories (f=12)	f	%	Metaphors (f=46)	f	%
Global citizenship as Trust/Love/Support/Power Factor	2	4.34	Peace (1), Need (1)	2	5.26
Global citizenship as an Objectivity Element	2	4.34	Impartiality (1), Transparency (1)	2	5.26
Global citizenship as a Technology Aspect	2	4.34	Internet (2)	1	2.63
Global citizenship as a Common Denominator of Solidarity	1	2.17	Slot (1)	1	2.63
Global Citizenship as an Element of Constancy	1	2.17	month (1)	1	2.63
Total	**46**	**100**	**Total**	**38**	**100**

When Table 3 is examined, the metaphors created by primary school teachers and social studies teachers regarding the concept of global citizenship are grouped under 12 conceptual categories. These categories were categorized according to their frequencies: global citizenship as a common heritage element (f=10), global citizenship as an awareness/effectiveness element (f=7), global citizenship as a universal element (f=6), and global citizenship as a functional element (f=6). , global citizenship as an element of accessibility (f=4), global citizenship as an element of democracy, freedom (f=3), global citizenship as a technology element (f=2), global citizenship as an ideological element (f=2), trust, love, support power We can list global citizenship as an element of global citizenship (f=2), global citizenship as an objectivity element (f=2), global citizenship as a common denominator of solidarity (f=1) and global citizenship as an element of immutability (f=1).

Table 4. Metaphors Formed by Classroom Teachers and Social Studies Teachers About Non-Governmental Organizations

Civil Society Founding metaphors	f	%	Non-Governmental Organization Metaphors	f	%	Non-Governmental Organization Metaphors	f	%
Roof	1	1.88	Vehicle	2	3.77	Friend	1	1.88
Agenda	1	1.88	Food	1	1.88	Book	1	1.88
Microorganism	1	1.88	Bank	1	1.88	Chain	1	1.88
This	3	5.66	Plaster	1	1.88	Medicine	1	1.88
Hand feet	1	1.88	Helping hand	1	1.88	Building Skeleton	1	1.88
Building Columns	1	1.88	Peace	1	1.88	Torch	1	1.88
Lifebuoy	1	1.88	Spring	1	1.88	Daisy Leaf	1	1.88
Light	2	3.77	Love	1	1.88	house	1	1.88
Shopping centre	1	1.88	Political Party	1	1.88	nest	2	3.77
food	1	1.88	Fruit tree	1	1.88	Stairs	1	1.88
Iron Chain	1	1.88	Bridge	3	5.66	Bird	1	1.88
Flower	1	1.88	Teacher	1	1.88	Grandma	1	1.88
Weather	1	1.88	Umbrella	1	1.88	Cake	1	1.88
Mom	1	1.88	Tree	2	3.77	**Total**	**53**	**100**
Father	1	1.88	Heart	1	1.88			
Batman	1	1.88	Nature	1	1.88			

When Table 4 is examined, the total number of metaphors created by 63 teachers is 53. While 2 of the teachers stated that they did not know what the concept of non-governmental organizations was, there were 8 teachers who could not explain why they created the metaphor they created. For this reason, 10 metaphors were eliminated from the concept of global citizenship and 53 metaphors were obtained. Considering the same ones among these metaphors, it is seen that a total of 45 different metaphors were created.

Table 5. Conceptual Categories of Metaphors Formed by Classroom Teachers and Social Studies Teachers About Non-Governmental Organizations

Categories (f=9)	f	%	Metaphors (f=53)	f	%
Trust Love Support Power Element	18	33.96	Roof (1), Building Columns (1), Life Buoy (1), Flower (1). Mother (1), Daddy (1), Bath Band, (1), Helping Hand (1), Peace (1), Spring (1), Love (1), Bridge (3), Grandmother (1), Batman (1), Skeleton (1), House (1)	16	35.55
Basic Need Element	10	18.86	Microorganism (1), Water (3), Food (1), Air (1), Food (1), Tree (2), Heart (1)	7	15.55
Common Denominator Solidarity Element	7	13.20	Shop (1), Umbrella (1), Nest (2), Cake (1), Friend (1), Daisy Leaf (1)	6	13.33
Complementary Element	5	9.43	Hand-Foot (1), Iron Chain (1), Chain (1), Medicine (1), Ladder (1)	5	11.11
Element of Hope	3	5.66	Light (2), Lantern (1)	2	4.44
Production Element	3	5.66	Bank (1), Nature (1) Fruit Tree (1)	3	6.66
Education Element	3	5.66	Agenda (1), Teacher (1), Book(1)	3	6.66
Democracy Freedom Element	2	3.77	Political Party (1), Bird (1)	2	4.44
A Tool in Reaching the Purpose	2	3.77	Tool (2)	1	2.22
Total	**53**	**100**	**Total**	**45**	**100**

When Table 5 is examined, the metaphors created by classroom teachers and social studies teachers regarding the concept of non-governmental organizations are grouped under 9 conceptual categories. These categories are classified according to their frequencies as non-governmental organizations (f=18) as an element of trust/love/support and power, non-governmental organizations as an element of basic need (f=10), non-governmental organizations as a common denominator/solidarity element (f=7), Non-governmental organizations as a complementary element (f=5), non-governmental organizations as an educational element (f=3), non-governmental organizations as an element of hope (f=3), non-governmental organizations as a production element (f=3) we can list non-governmental organizations (f=2) as a tool element and non-governmental organizations (f=2) as an element of democracy/freedom.

Table 6. Distribution of Metaphors Related to the Concept of Global Citizenship by Classroom Teachers and Social Studies Teachers

	Classroom Teachers		Social Studies Teachers	
Categories (f=12)	**f**	**%**	**f**	**%**
Global citizenship as a Common Heritage Element	6	13.04	4	8.69
Global citizenship as a universal element	3	6.52	3	6.52
Global citizenship as an Accessibility Aspect	3	6.52	1	2.17
Global citizenship as an Objectivity Element	2	4.34	0	0
Global citizenship as a Functional Aspect	2	4.34	4	8.69
Global Citizenship as an Ideological Aspect	2	4.34	0	0
Global citizenship as Awareness/Effectiveness Aspect	2	4.34	5	10.86
Democracy - Global Citizenship as an Element of Freedom	2	4.34	1	2.17
Global citizenship as a Technology Aspect	one	2.17	1	2.17
Global citizenship as Trust Love Support Power Factor	0	0	2	4.34
Global citizenship as a Common Denominator of Solidarity	0	0	1	2.17
Global Citizenship as an Element of Constancy	0	0	1	2.17
Total	**23**	**50**	**23**	**50**

Looking at Table 6, half of the metaphors (23) made about the concept of global citizenship were made by classroom teachers and the other half (23) by social studies teachers. Classroom teachers and social studies teachers have created metaphors about global citizenship in a 50% equal distribution. While primary school teachers evaluated global citizenship under the category of common heritage element, social studies teachers evaluated it under the category of awareness/effectiveness.

Table 7. The Metaphor Regarding the Concept of Non-Governmental Organizations Distribution by Classroom Teachers and Social Studies Teachers

	Classroom Teachers		Social Studies Teachers	
Categories (f=9)	f	%	f	%
NGO as Trust Love Support Power Factor	11th	20.75	7	13.20
NGO as a basic need	3	5.66	7	13.20
NGO as Common Denominator/Solidarity Aspect	3	5.66	4	7.54
NGO as Complementary Element	2	3.77	3	5.66
NGO as Element of Democracy/Freedom	2	3.77	0	0
NGO as an Educational Aspect	2	3.77	1	1.88
NGO as a means to reach the goal	1	1.88	1	1.88
NGO as Hope Element	1	1.88	2	3.77
NGO as Production Factor	1	1.88	2	3.77
Total	**26**	**49**	**27**	**51**

Classroom teachers have seen global citizenship as a humanist element and accessibility element after the common heritage element. Social studies teachers, on the other hand, saw global citizenship as a common heritage element and functional element after the awareness/effectiveness element. While the primary school

teachers did not produce any metaphors for the categories under the elements of common denominator/solidarity, trust/love/support/power and stability, social studies teachers did not produce any metaphors for the categories under the ideological element and objectivity.

Looking at Table 7, 26 of the metaphors related to the concept of non-governmental organizations were made by classroom teachers and 27 by social studies teachers. Classroom teachers created metaphors with a distribution of 49% and social studies teachers 51%. Classroom teachers evaluated non-governmental organizations mostly under the category of trust/love/support/power, while social studies teachers evaluated them under the category of trust/love/support/power and basic need. Classroom teachers have seen non-governmental organizations as a basic need and common denominator/solidarity element after the element of trust/love/support/power. Social studies teachers, on the other hand, saw non-governmental organizations as a common denominator/solidarity and complementary element after trust/love/support/power and basic needs. While primary school teachers produced metaphors for each category, social studies teachers did not produce any metaphors for the category under the element of democracy/freedom.

Discussion

The aim of this research is to reveal the metaphors created by classroom and social studies teachers regarding the concepts of global citizenship and non-governmental organizations. 33 classroom teachers and 30 social studies teachers participated in the research, and 46 metaphors related to the concept of global citizenship and 53 metaphors related to the concepts of non-governmental organizations were produced. While the metaphors created for the concept of global citizenship were grouped under 12 categories, the metaphors created for non-governmental organizations were grouped under 9 categories. Considering the length of service and gender in the study group consisting of classroom teachers and social studies teachers, it is possible to say that there was sufficient diversity, a balanced distribution, and that teachers' professional experiences were reflected in their metaphor perceptions. In this study, we can see how teachers process the concepts they know in their minds. According to the metaphors produced by the teachers participating in the study; It was concluded that the participants defined global citizenship as individuals who are sensitive to the developments in the global world we live in, conscious people who are aware of their responsibilities towards all humanity and nature, and individuals who do not discriminate between societies and cultures, embracing everyone equally. While teachers mostly saw the concept of global citizenship as an element of common heritage and awareness, they saw the least common denominator as an element of solidarity and immutability. While they see non-governmental organizations mostly as an element of trust/love/support/power and basic needs, they see democracy as a means to reach the goal and democracy as an element of freedom the least.

The distribution of the metaphors produced for the concepts of global citizenship and non-governmental organizations under the conceptual categories created was examined by comparing them according to the branch. Classroom teachers produced 50% (25 metaphors) for the concept of global citizenship, and social

studies teachers produced 50% (25 metaphors) metaphors. While primary school teachers evaluated global citizenship under the category of common heritage element, social studies teachers evaluated it under the category of awareness/effectiveness. From this, we can conclude that social studies teachers are more aware of global citizenship than classroom teachers. We know that the learning areas such as "Active Citizenship" and "Global Connections" in the social studies curriculum of MEB (2018) directly involve non-governmental organizations and the concept of global citizenship. As a matter of fact, Göl (2013)'s study, which aimed to examine the global citizenship attitude levels of social studies teacher candidates in terms of different variables, concluded that the level of knowledge of social studies teacher candidates is high due to the inclusion of global citizenship in the courses given during the education process. In this case, we can say that the awareness and experience of social studies teachers are also provided by the curriculum.

When the metaphors produced by classroom teachers about global citizenship are examined, we can conclude that the reason why they see global citizenship as a common heritage element that should be in every country in general is that they perceive global citizenship as a more inclusive and general concept due to the wide dimensions of the concept of citizenship. Another striking detail in the study is that while primary school teachers perceive global citizenship as an ideological element, social studies teachers do not produce a metaphor in this category. This situation may create the idea that classroom teachers look at the concept of global citizenship from a more political and political perspective. If we look at the concept of non-governmental organizations; Of the metaphors made regarding the concept of non-governmental organizations, 49% (26 metaphors) were made by classroom teachers, and 51% (27 metaphors) were made by social studies teachers. Classroom teachers and social studies teachers produced the most metaphors for non-governmental organizations under the category of trust/love/support/power. Again, according to the metaphors produced by the teachers participating in the study, non-governmental organizations; They are defined as organizations that bring people together for the same purpose, bring people closer to each other, work for the benefit of the society, support when needed, provide benefits, give confidence, increase solidarity in the society, and make the society stronger. In the civil society perception research in Turkey conducted by Eryılmaz et al., (2018), it is seen that philanthropy, cooperation and humanitarian aid are among the most connoting concepts when it comes to non-governmental organizations. Teachers and students perceive NGOs as social assistance groups.

In the study conducted by Karataş (2013), which is similar to this study, it was seen that the sixth-grade students explained the non-governmental organization with the values of "volunteering" and "help". Non-governmental organization managers also reflected that they see CSOs as “charity organisations”. In the study conducted by Director-Balaban and Çoban-İnce (2015), it is seen that participation in volunteering activities is low in Turkey. It was concluded that the reason for this was the low participation rate due to the lack of information/information. In the study of Özan et al., (2015), it is seen that teachers differ in the necessity of the existence of non-governmental organizations. According to the study conducted by Balbağve Türkcan (2017), it was concluded that teachers describe global citizenship as universality, different people and identity, and the participation rate of teachers in non-governmental organizations is low. and being open to innovations, and few

teacher candidates are members of non-governmental organizations. Looking at the study by Çermik et al., (2016), teachers described global citizenship as equal rights and responsibilities of all people, playing a role in solving problems in the world, respecting differences, common values and freedom. It was concluded that it was similar to the current study.

In general terms, the metaphors produced by primary school teachers and social studies teachers regarding the concept of non-governmental organizations showed a harmonious distribution among the categories. When we examine the metaphors produced by the teachers under the category of trust/love/support/power element, it is concluded that they do not know the multidimensional structure and functions in the functional sense, that they look at the non-governmental organizations with a stereotyped point of view, which they consider as an organization that heals, helps and protects the wounds. In addition, in the metaphors examined, it was seen that non-governmental organizations are one of the keystones of society, and it was concluded that non-governmental organizations were of great importance for the country and were accepted as a basic need by the participants. Another striking factor is that social studies teachers did not include the word democracy while creating metaphors and they did not produce a metaphor under this category. However, democracy is of great importance in the development and functioning of non-governmental organizations. At this point, it has been concluded that teachers are insufficient in making sense of non-governmental organizations.

Recommendations

1- Since primary school teachers do not have sufficient knowledge of the concept of global citizenship, it can be determined as a seminar subject in schools with the cooperation of universities related to this subject so that they can recognize and make sense of global citizenship.

2- In order to enable primary school teachers and social studies teachers to better know, understand and actively participate in non-governmental organizations, partnerships can be made with non-governmental organizations in provincial/district national education directorates.

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Please provide acknowledgements or notes in a separate section at the end of the article before the references.

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Didactic Sequence with the Theme "Drugs" for the Teaching of Nitrogen Functions

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Abstract: The present work is the report of an intern, who through the theme:"Drugs" shows the importance of the use of didactic sequence in the teaching of chemistry for the construction of concepts. The content was applied in classes of the 3rd year of high school, in a public school, in the city of Apucarana - PR. In this sense, the main types of drugs known in daily life were contextualized, soon after the properties of organic compounds and nitrogen compounds have been addressed. The relationships established through the theme resulted in a greater interest of the students in the didactic content, since it was possible to see practical results. Some did not know much about the chemical composition of the drugs, others even had contact, or knew someone who has already used some substance. The theme is part of the day-to-day and in this way, they were able to build and develop critical thinking at the end of the process.

Keywords: Didactic sequence, Supervised internship, Organic compounds, Drugs.

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Introduction

Education is responsible for the intellectual transformation and social development of the masses and, for this, we highlight the importance of the future teacher in mediate knowledge with the way of applying. According to Cury (2005), even if it causes anguish and tears, even if young people are not the best examples in the present, education is the hope of a better future.

Therefore, the teacher assumes an extremely important and at the same time challenging role. Challenging in the search for tools that help in stimulating students, so that they have a critical view and build their point of view through scientific foundations. According to Pereira and Júnior (2016), a confluence between teacher and school environment is necessary, to provide the student with an appropriate environment in such a way that it is introduced into society already with the ability to discern and understand the medium to which it is inserted.

In this sieve, it is necessary to reflect pedagogical methodologies and practices that would help to mitigate the deficit learning routines of students in general, that is, inserting these methodologies, based on active methodologies, sharpening the student to solve problems and developing the cognitive power to work with current situations (Farias, 2016).

One of the practices applied in the educational context is the use of ICT (Information and Communication Technologies), this tool that in the educational environment has been gradually ascending (Prensky, 2010). Offering quality science education in educational institutions is of paramount importance, as it aims to improve the nation's education. This scenario is then part of the supervised stage, that provides a direct contact of the knowledge acquired during the course with the reality experienced in the classroom. According to Oliveira and Cunha (2006), supervised internship is an activity that opportunities the student to acquire professional experience and make contact with the teaching career, which is important for its future insertion in the labor market. During the internship period, the student can see education with another look, and seeks to understand both the reality of the school and the behavior of the students, teachers and professionals who make up that environment (Januário, 2008).

According to Maldaner (2006), undergraduate courses that do not propose the problematization of specific knowledge, teachers who will work using old programs, handouts, notes and textbooks, that their teachers provided when they were in high school. This is what keeps the vicious circle of archaic teaching. The main objective of the Supervised Internship is to provide the student with the opportunity to apply their academic knowledge in situations of professional practice, creating the possibility of exercising their skills. It is expected that, with this, the academic acquires a critical view of his area of activity and become a professional able to understand the needs of students and their work environment.

Method

The research

This work was conducted by an intern of the Undergraduate Chemistry course offered by the Federal Technological University of Paraná, in the city of Apucarana and was based on the application and analysis of a didactic sequence that aimed to teach the properties of organic compounds and nitrogen compounds to third year high school students, contextualizing the theme: Drugs. To carry out the discussion, four classes of fifty minutes each were necessary, in a third-year class of the evening period, being two classes in each of the days: 18/09/2018 and 25/09/2018.

Venue

The Teaching Sequence was applied at the State School Professor Izidoro Luiz Cerávolo, located in the central region of Apucarana, Paraná, in the neighborhood of 28 de Janeiro. The school operates in three shifts, offering elementary school, regular high school and vocational high school.

Staff

The class chosen for the application of the didactic sequence belongs to the third year of high school offered in the evening period. In all, 25 students participated in the classes, which were supervised by the teacher of Internship 3 and by the regular teacher of the school in question.

Authorizations

Through the Pedagogical Residency program, prior authorization was obtained from the school administration. In agreement with the subject teacher, the regular teacher, and the students, the class and the times were made available for the didactic sequence.

Choice of theme

The theme was chosen due to its increasing appearance in school environments, in order to make young people aware of the harmful effects that drugs cause to human beings. To this end, a school-society bond is created to clarify doubts and the consequences that drugs can bring to a citizen's life. The target audience that was taught the classes is in an age group that, according to statistical data, is the period in which most of them have their first contact with some kind of drug. Therefore, a preventive approach becomes effective in the sense of pausing at that moment the use of any narcotic. Social problems, social insertion, acceptance, rule transgression, among others, are the main causes for the adolescent to seek drugs.

As the school environment is the place where a student spends most of his time, and there he is eager for new knowledge and open to learning, the traditional subject is contextualized with experiences and instructs them on the proper use. Being present in the students' daily lives, the proposal is that they identify with the theme, thus arousing their interest in the Organic Chemistry classes, more specifically in the content of Nitrogen Functions, which is often approached in a traditional way, only addressing the nomenclature of compounds.

The sequence

The sequence was divided into four lessons, and the activities used are described in Table 1.

Table 1. Lessons Description

1st lesson	2st lesson	3st lesson	4st lesson
Division of the class into groups Application of texts with historical aspects about some types of drugs and beginning of a debate; Resolution of a problematization questionnaire (identification of the group in the structural formula of the Drug); Debate some experience on the subject.	Lesson on amines, amides, nitriles, nitro compounds in Datashow. (Traditional Organic Chemistry) with the use also of Molecular Model Kit.	Lesson on Drugs (types, effects, use, awareness).	Lesson on Drugs (types, effects, use, awareness). Class on Drugs (types, effects, use, awareness).

Elaborated during the planning stage the pedagogical didactic organization in Table 2.

Table 2. Didactic-Pedagogical Organization

Context Dimensions Dimension	
Title Dimension	Dimension Description
What do students consider drugs?	It works a scientific concept allied to a social issue, elucidating the main psychotropic effects of use, as well as the main problems that the use of drugs can cause for those who engage with it.
Organic functions and nomenclature of amines/amides and nitriles	Basic concepts of Organic Chemistry.

In the Table 3 discriminates the types of content covered during the lesson.

Table 3. Didactic-Pedagogical Organization

Type	Description
Factual	Assist the student in the construction of knowledge through playful activities on organic subjects such as amines, amides and nitriles, for introduction to the main theme that answers the problematizing question, which would be about Drugs.
Conceptual	Concepts, structural formulas and organic functions of amines, amides and nitriles.
Procedural	With prior knowledge that all the common drugs are organic substances, students are asked to read educational texts with historical contexts and with the main formulas of the active principles of some drugs, such as: nicotine (cigarette), THC (marijuana), benzoylmethylcgonin (cocaine and crack), heroin, morphine, codeine, lysergic acid diethylamine (LSD) and N-Methyl-3,4-ethylenedioxyamphetamine (ecstasy).
Athesinal	Relate the concepts acquired about organic compsotos to the knowledge of the day-to-day, related to use, family problems, and others.

Also elaborated a conceptual map for better assimilation of content, in addition to working an evaluation process with students (see Figure 1).

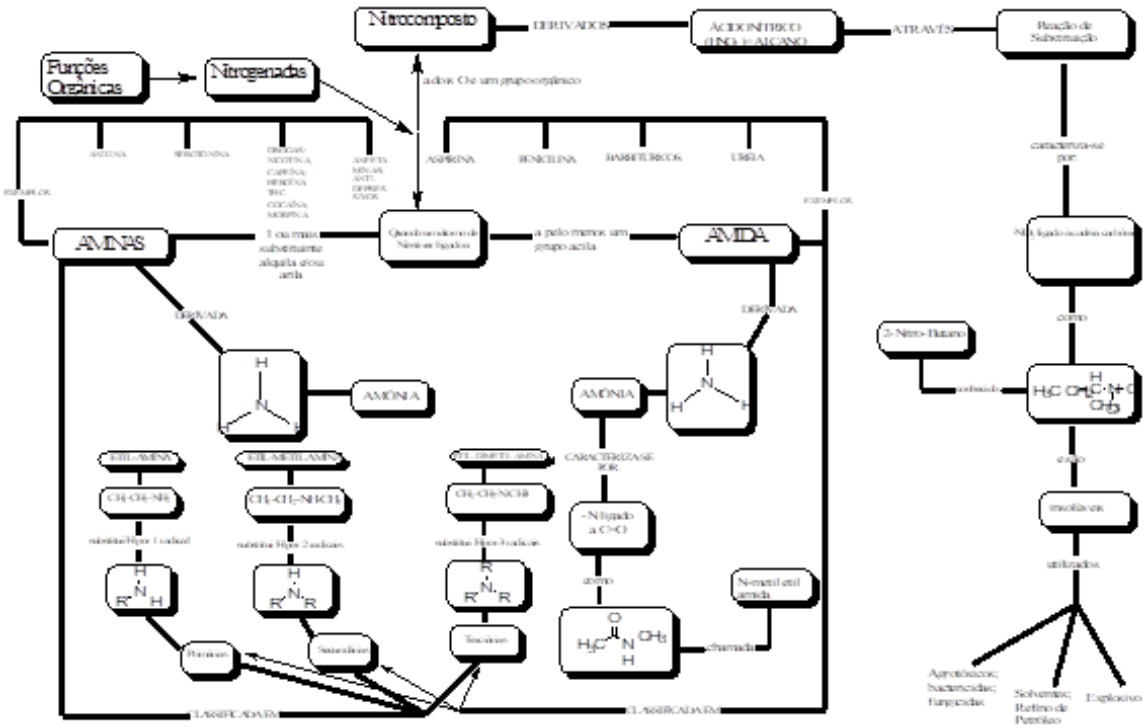

Figure 1. Conceptual Map

Description of the activities

First lesson

First, the classroom was divided into four groups, in order to launch a debate on the subject and distributed texts on some types of drugs, listing their historical aspects, physical, chemical and biological properties, with an exercise in which students debated the risks, experiences and also if they could identify the organic functions of the molecule, and discussed the initial problematization, which would be what do you understand by Drugs? It was important that everyone participated in the discussion. At this moment of debate the room remained a little excited, due to the desire to interact and tell about some kind of experience that each one had lived with some family member or even themselves with the referred theme. After the explanations about each type of drug, there was an exercise for the students to relate the type of carbonic function, and also to relate their experience with the said drug.

Second lesson

The second class was in a more traditional way, despite the use of resources for better understanding. Slides on the content covered and the molecular model kit (see Figure 2) provided by the Federal Technological

University of Paraná – in the Apucarana city, were used for better visibility and understanding of the types of amines and amides. The contents covered were: amines, amides and nitriles, with greater emphasis as requested by the professor of the subject in nomenclature.

Figure 2. Molecular Model Kit

Third lesson

The third class inserts the contextualized part. Thus, the main types of drugs are listed, as well as their effects and consequences. The third class had as its main objective to make the students aware of the incorrect use of some types of drugs, as well as to warn about the main risks that they can cause. For this, the main types of drugs and their effects were presented through slides. As a complement, it was sought from sources, through professionals of the Military Police of Paraná, which the trainee is also part of the professional staff, references of the Educational Program of Resistance to Drugs (Proerd), which aims to develop in young students skills in order to avoid influences to drugs and violence, as well as to promote protection factors. The awareness work was done mainly by the age group in which the students are inserted. The contextualization with organic chemistry made the students take interest in the subject itself.

Fourth Lesson

The fourth class was a continuation of the third class, and ending with nomenclature exercises f some compounds done on the blackboard, requested by the subject teacher, with the purpose of a future evaluation by the teacher.

General description of the activities

Main difficulties encountered in carrying out the activities

Some difficulties were encountered during the preparation of the classes taught. These difficulties made the trainee focus more on some very important topics related to the theme, as well as the organic material requested by the teacher. To this end, we sought with professionals who lecture in schools on the subject, materials that would complement the knowledge about drugs. Also, regarding the contextualization and historical aspects, it was searched in didactic materials, especially books, about the subject and the main types of drugs, relating them to the students' daily lives.

Considerations about the preparation and development of the didactic activity proposed by the school

The teacher of the subject asked me to review the content and focus mainly on the topic of Drugs, aiming for a better understanding and an educational nature regarding them, since the age group of the students was inserted in the phase in which the curiosity to use some narcotic substance is heightened, the class being more educational and preventive, showing the effects that Drugs can cause to the body.

Evaluation of the activities developed, highlighting the positive and negative points

Among the activities developed, the one that drew the most attention was when the students were asked if anyone knew or had ever used any type, all felt intimidated, or even repressed or ashamed to talk about. Some said that they had used a legal drug, such as cigarettes or medicines. Others questioned why only the harmful effects that illicit drugs cause, such as marijuana, were talked about. It was then passed on to them, that Marijuana is also used for medicinal purposes, however, because it is an illicit drug, and induces people to addiction, besides sustaining trafficking, which is prohibited in our country, we tried to clarify the issue in a clearer way to make them aware of the harm. Another positive factor was the use of the molecular model kit, where the students could see more clearly the molecule itself. Regarding the debate at the beginning of the class, one of the negative points would be the number of students and the question of structural organization of the room to launch the debate. The texts were difficult to read, due to the fact that the room was an auditorium, and all the students in each group could not read the text.

Self-evaluation

The Internship is the moment when we put into practice all the theory acquired during our academic life at the University. To seek new learning and to assume that we are not endowed with all the knowledge and that every day we learn new things makes us better able to face the challenges of everyday life. Living in the school environment has shown how much we need to dedicate ourselves more every day to learn and pass on the knowledge we have acquired. During the internship I learned to deal directly with the students, the school

management, and the teachers.

How the Pedagogical Residency program can contribute to the initial formation

The Pedagogical Residency through its integration actions, induces a better practical training for undergraduate students, inserting the student directly in the school. This insertion gives the student experience in his teaching area. It aims to improve, leading the student to leave the theory behind and apply the knowledge acquired in practice. It is of utmost importance that the student understands and experiences the reality of the educational institutions where he will work in the future.

Results

First lesson

Initially, the class was divided into groups and made a reading and discussed the initial problematization: What are Drugs? To do so, some supporting texts were listed with some types of drugs, in which the texts listed historical aspects, chemical composition, structural formula, and the damage they can cause when used. After reading the problematization, there was some kind of commotion, there was a common posture among the students, and then it was said to them that they could debate and question other teams about the main doubts about the substance they chose, without being afraid of making mistakes, since they were there to learn, drawing a parallel to the question of the problematization. After the debate started, some students opened up and said they had already had problems with family members and some even said they had already used narcotic substances. It was then questioned the main factors that lead the human being to enter the world of drugs and, as it is a well-known subject among the students, several of them mentioned situations that lead the human being to enter this world. There was also some curiosity about the historical aspects of some drugs. At the same time, each team had questions pertinent to the theme, which related the context and mainly to the content of the class, which was about Nitrogenated Compounds. There was then, during the lesson presented on slides, the recognition of the structural formula to identify the type of amine found in each drug. However, the readings of the texts at the beginning of the class served to obtain a greater participation from the students and it was observed that during the debate, some of them listed examples and situations from everyday life, and the theme is much discussed nowadays, without showing much difficulty in assimilating the content, since the students are used to the traditional method, where the teacher speaks and the student copies and memorizes the content. During the course of the debate the students started to participate more effectively in the discussions.

Second lesson

The second class went over the organic chemistry content, about amines, amides, and nitriles. The main focus was on the types, nomenclature and the main examples of each. A traditional slide show class covered all the main points mentioned above. It was also used the Molecular Model Kit, made available by the University,

which made the students assimilate the content better. The students had a good knowledge of the nomenclature in terms of the number of carbons, and only the nomenclature of amines, amides and nitrogen compounds needed to be reinforced.

Third Lesson

Because it was a more expository class, few questions were asked while going over the content. Some curiosity was generated among the students, which aroused their interest in knowing the consequences that some drugs cause in the body. The slides also showed some technical terms, such as tachycardia, tachypnea, mydriasis, sweating, hyperthermia, which were asked during the presentation and answered their doubts. A graph of tolerance x sensitization was used, which was also understood by the students. One of the factors that called attention was that the students already had some knowledge about some types of drugs, and one student questioned the question of only passing on the harmful effects of illicit drugs, and was answered that they can also use them for medicinal purposes, as long as they are controlled and supervised by a competent professional, until then, the drugs serve to sponsor trafficking and destroy the lives of human beings, when not consumed properly.

Fourth Lesson

In the fourth, some fixation exercises of the subject were performed, as a focus on nomenclature of compounds. Some organic exercises were passed to the students on the blackboard, and all of them were solved before the end of the class and corrected together with the students, where few had difficulties, because they didn't ask for help to solve them.

Conclusion

It was concluded that the use of the didactic sequence allowed students to better assimilate knowledge, since it was possible to contextualize the chemical concepts with the theme: Drugs. This relationship also helped them to understand the content more easily, since the class addressed day-to-day issues and is so commented on in the age group in which they are inserted. It was possible to observe the students' participation during the development of the activities. Thus, it is considered that the didactic strategies applied during the sequence allowed the social interactions in the classroom, since the students already had prior knowledge of the subject addressed in the contextualization.

Therefore, the theme selected and developed in front of different teaching strategies such as: use of resources, reading, discussion and debates, audio visual resources, among others, can be an efficient strategy to show the relationships between chemical knowledge, technology, society and environment.

Recommendations

From the applied didactic sequence, that new research on this theme will be studied and applied in educational institutions for the purpose of awareness and a didactic way of teaching organic chemistry.

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Access and Use of ICTs by Albanian Natural Science Students

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Abstract: Information and communication technologies (ICTs) are a powerful tool for training and developing new abilities and a suitable mechanism to create educational stimulation. This study aims to evaluate the access and use of ICTs by Albanian natural science undergraduate students. Four hundred ninety-one students studying at the Faculty of Natural Sciences, University of Tirana, participated in an e-questionnaire based-study. The findings show that about 83 per cent of students use the smartphone for their studies, and only half of them own and use a laptop. The software skill level was related to the academic performance and the program of study ($p=0.001$). Students find the course managing platforms and the recorded video lectures very helpful. Less than 10 per cent of students' state to have attended a Massive Open Online Course (MOOC), and students with a lower English level were less likely to have attended an online course ($p<0.0001$). In light of this findings, it is important to create and follow through with a plan to tackle students' main issues with technology access and use.

Keywords: ICTs, natural sciences students, Online learning, Software skills

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Introduction

Information & communication technologies, the "phenomenon of the millennium" (Homiakova et al., 2017), refers to technologies such as radio, television, cellular phones, computers, network hardware & software and satellite systems that supply information through communications (Khan et al., 2015; Khan et al., 2011). The ICT literacy is the ability to solve problems using technology, and the ability to use ICT tools to access, and communicate information (Katz and Macklin, 2007).

A large area where ICT is used is certainly, education. "ICT is a powerful tool for training and developing the abilities, as well as bringing up the human being talents and a suitable mechanism to create educational stimulation" (Hu et al., 2018; Samari & Atashak, 2011). The ICT role in education is growing rapidly and will continue to expand in the 21st century. The first attempt to use ICTs in educational institutions was made in the 1960s (Katz, 2001). Whereas, regarding Albanian Universities, the level of ICT usage is lower compared to SEE countries and EU countries (Bekteshi, 2015). Implementation of the technology provides information retrieval, communication between students and teachers, and allows access to many abundant sources of information. Nowadays, with advances of ICT, teachers tend to adapt active learning activities such as peer learning, group work activities and collaborative argumentation (see Latifi & Noroozi, 2021; Latifi et al., 2020, 2021; Noroozi 2018, 2022; Noroozi et al., 2018; 2020; Valero Haro et al., 2019; 2022) which influence students' learning processes and outcomes (see Noroozi & Mulder, 2017; Noroozi et al., 2013, 2016, 2020).

Studies have shown that Information and Communication Technology has positively affected lesson delivery, learning outcomes such as conducting research, disseminating information, and student assessment (Dzakpasu & Adom, 2017). ICT also helps students learn autonomously, increase cognitive capacities and develop collaboration & sharing. Furthermore, the benefits of ICT are comprehensive for all students; as discussed in Lidström & Hemmingsson, (2014), students with physical disabilities use ICT to help with writing, spelling and communication. Despite, some studies report that helping students acquire ICT skills can increase their learning ability, other studies conclude that it distracts their learning (Abbas et al., 2019). Furthermore, many difficulties are encountered related to ICTs access in education, such as technological barriers, teacher-level barriers, institutional, technological system barriers and students-barriers (Suryani, 2010; Salehi & Salehi 2012).

This study aims to assess ICT access, usage, and literacy among Albanian students of Natural Sciences spanning the time-frame of the online learning period due to COVID-19 pandemic restrictions, namely social distancing and self-isolation protocols.

Method

Data Collection and Participants

The population of interest were undergraduate students studying at the Faculty of Natural Sciences, University

of Tirana (Albania). Students are invited via email to fill out an online questionnaire. The questionnaire was formulated based on other survey studies and had twenty-two closed questions, organized into two sections. The first section included eight questions on the students' demographic and academic characteristics, e.g., the study program, year of studies, age, gender, job status, infrastructure for online education. The second section asked students about their perception of technology-based learning. It included 14 questions on students' access and use of ICTs and their effect on their academic performance and learning experiences.

The questionnaire was first sent to 35 students to test and validate. After this step, the survey is finalized. The web-based survey was sent to students via email during the online learning period, May 16 2020, to May 17 2021. By May 17 2021, 491 students from natural sciences programs such as biology, biotechnology, chemistry, physics, mathematics, and computer science had participated in the study. The response rate was 15.1 % (491 out of 3252 invitations sent).

The respondents' average age was 19.9 ± 1.4 years, 83.3% were females, and 16.7% were males. The majority (64.6 %) never worked during the studies, 20.2% used to be employed previously during their studies, but there were no longer, 8.8 % of students work part-time, and 6.5% of them have a full-time job. The majority of participants (62.1%) had an average academic performance. The English language level was beginner for 8.1% of students, intermediate for 58.5% and advanced for 33.4%. Most of the respondents' study biology and biotechnology (see Table 1). The distribution between years of study was about the same, with first-year students representing 36.3% of the sample, second-year students 31.2 %, and third-year students 32.6%.

Table 1. Study Program and Academic Performance of Students Who Participated in This Study

		Academic performance			
		Low	Average	High	Total
Study program	Biology	24 (4.9)	117 (23.8)	34 (6.9)	175 (35.6)
	Biotechnology	4 (0.8)	39 (7.9)	14 (2.9)	57 (11.6)
	Physics and Mathematics	31 (6.3)	39 (7.9)	7 (1.4)	77(15.6)
	Chemistry	26 (5.3)	64 (13)	18 (3.7)	108 (22)
	Computer science	16 (3.3)	46 (9.4)	12 (2.4)	74 (15.1)
Total		101 (20.6)	305 (62.1)	85 (17.3)	491 (100)

Statistical Analysis

The statistical analysis is performed in SPSS 26.0. The analysis is run after the preprocessing step and data exploration, using frequencies, descriptive statistics, and data visualizations. The Chi-square test is used to test the relationships between demographic features of the respondents and nominal variables in the questionnaire. The nonparametric Mann Whitney test is run to test the difference between the medians of two groups for the

Likert scale questions (1 to 4 scale), considered as ordinal variables. The Kruskal Wallis test with pairwise comparisons is performed to test the difference between the medians of more than two groups for the Likert scale questions.

Results

Access to Internet and Technology Devices

Most of the respondents state they own a smartphone (84.7%), about 58.7% of them own a laptop, and 22.6% hold a personal or desktop computer (Fig. 1). About 76% of students have unlimited internet access, and the rest have limited internet provided by mobile companies. More than eighty per cent of the respondents state they access the internet and online materials, classes, via their smartphone (Fig. 1). It is interesting to see that unless 22.6% own a personal computer, only 1.2% state to access internet and online classes via it.

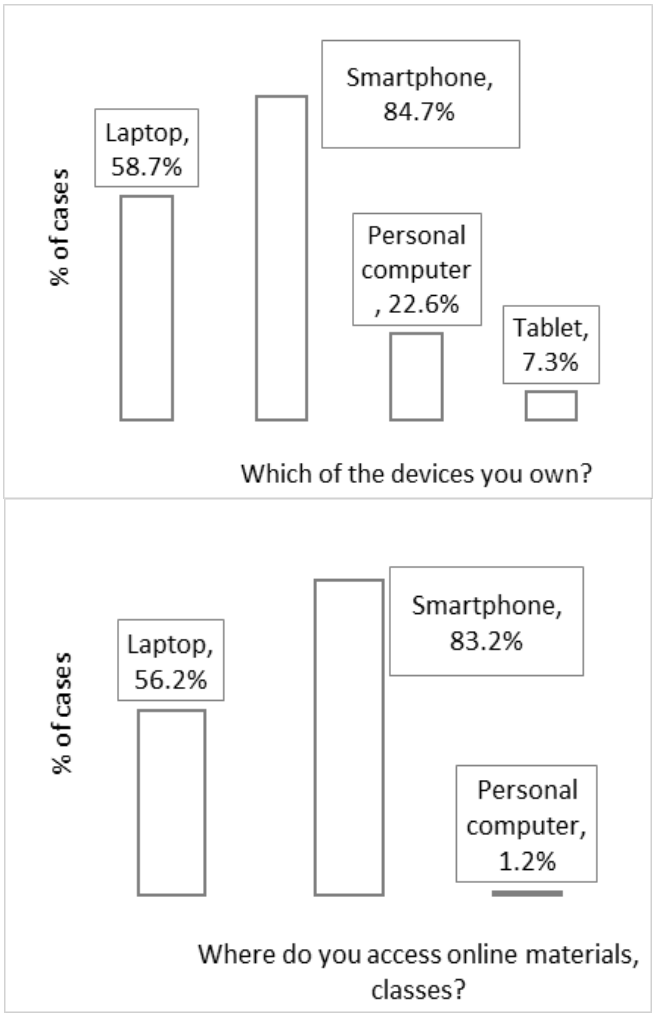

Figure 1. Devices Owned by Students and Access to Online Materials, Classes, and Internet.

A total of 156 students (31.8%) state they have no addiction to the internet, the rest is moderately or strongly addicted. There was a relationship between time spent on the internet and the addiction to the internet (Chi-square test, $\chi^2_{(8)}$=113.4, p<0.0001).

About 6.3 % did not spend time on social media every day, 19.1% spent less than one hour per day, 45.6 % spent 2 to 3 hours, 20.6% spent 4-5 hours, and 8.4% spent more than 6 hours. Time spent on social media is moderately correlated with the total time spent online (rho=0.43, p<0.0001). The most frequent social media is Instagram, with 86.5% of students using it. Twitter is used by 13.1 % of students, LinkedIn by 11.2%, and ResearchGate by 5.3%. There was no difference between males and females, study programs, academic performance levels, and work status categories for the time spent on internet and social media (p>0.05).

Software Skills and Attitude toward Technology-based Education

More than half of the students find the course managing platforms and the recorded video lectures helpful to very helpful (Fig. 2). The software skills were low to moderate for most of the participants (Table. 2) and related to the program of study (Kruskal Wallis test, $\chi^2_{(4)}$=18.66, p=0.001). The computer science students had a higher level of software skills compared to the other programs, which according to pairwise comparisons, showed no difference with each other (p>0.05). The findings show that the higher the academic performance, the higher the software skills level (Kruskal Wallis test, $\chi^2_{(2)}$= 48.11, p<0.0001). Pairwise comparisons showed that the software skills were significantly different for all groups (Fig. 3). Students seem to heavily lack programming skills with around 50% being not literate with it and only 11.4 % being good users. A limited use of online libraries and journals as well as eBooks is observed from the results (see Table. 2).

Table 2. Use and Experience with Software and Online Applications

	I do not use	Limited use	Good use	Very good use	
Statement	**% (N)**	**%(N)**	**%(N)**	**%(N)**	**Median**
Microsoft Word	50 (10.2)	36 (7.3)	160 (32.6)	245 (49.9)	3.0
Microsoft Excel	60 (12.2)	146 (29.7)	185 (37.7)	100 (20.4)	3.0
Microsoft PowerPoint	31 (6.3)	77 (15.7)	165 (33.6)	218 (44.4)	3.0
Programming software	246 (50.1)	112 (22.8)	77 (15.7)	56 (11.4)	1.0
Statistical software	160 (32.6)	170 (34.6)	125 (25.5)	36 (7.3)	2.0
Plagiarism software	311 (63.3)	99 (20.2)	69 (14.1)	12 (2.4)	1.0
Google apps	61 (12.4)	99 (20.2)	172 (35)	159 (32.4)	3.0
Searching engines	50 (10.2)	51 (10.4)	134 (27.3)	256 (52.1	4.0
Online libraries/journals	236 (48.1)	130 (26.5)	89 (18.1)	36 (7.3)	2.0
eBooks	194 (39.5)	141 (28.7)	98 (20)	58 (11.8)	2.0

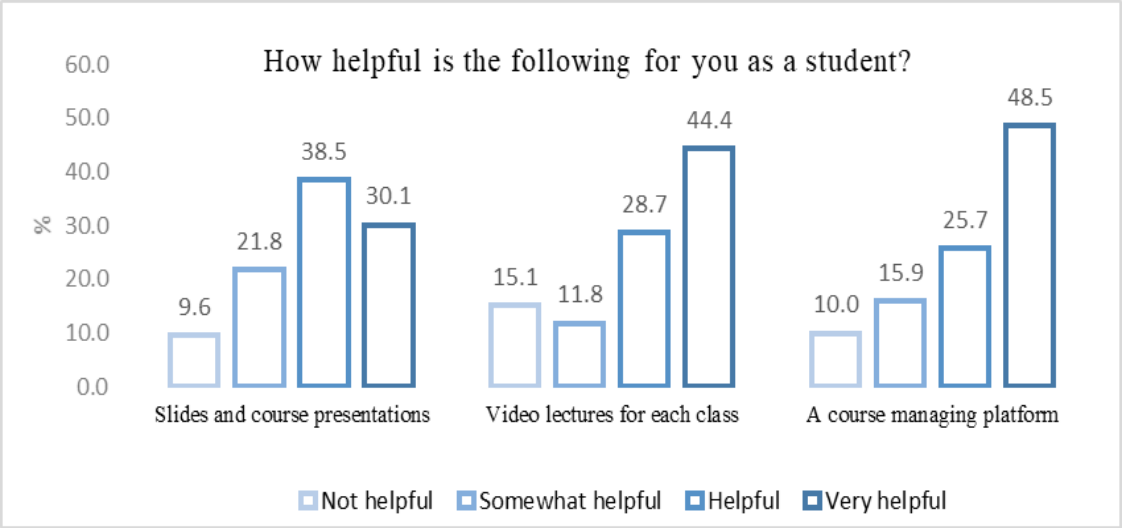

Figure 2. Students' Perception of Technology-Based Education

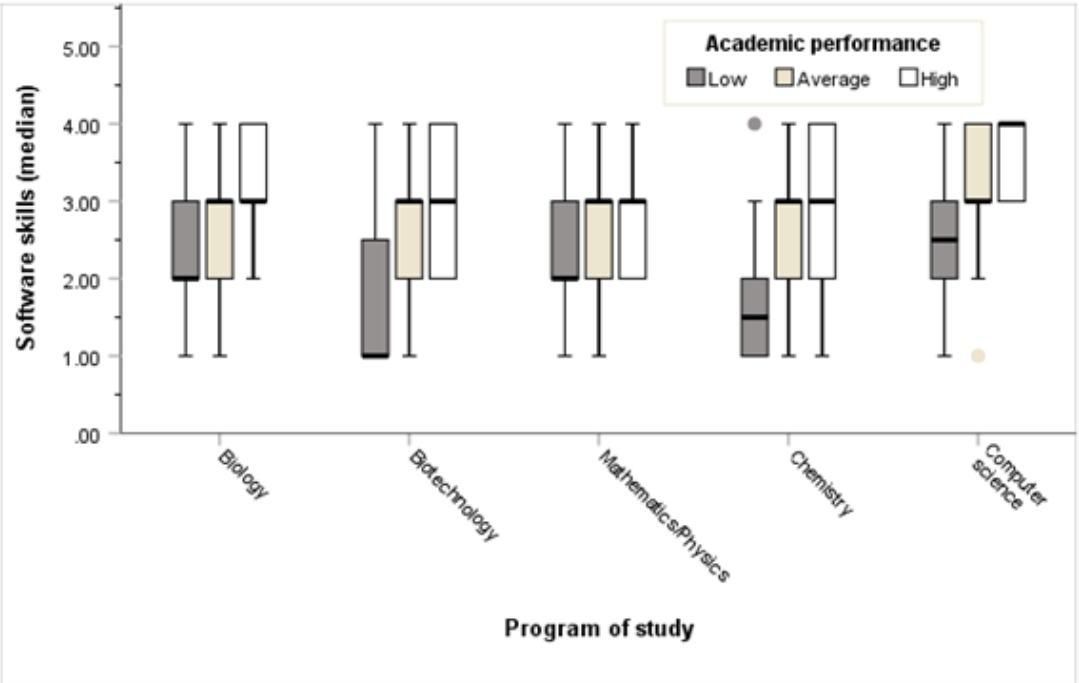

Figure 3. Software skills (median for all software) by study program and academic performance

Less than 10 per cent of students state to have attended a Massive Open Online Course (MOOC); the majority had never heard of an online course and have no information that they exist. Computer science students showed a higher level of MOOC attendance compared to other programs ($\chi^2_{(12)}$= 48.201, p<0.0001; Fig. 4). The English level seems to impact the attendance of MOOCs. Students with lower English levels are more likely to have attended an online course ($\chi^2_{(9)}$= 31.41, p<0.0001).

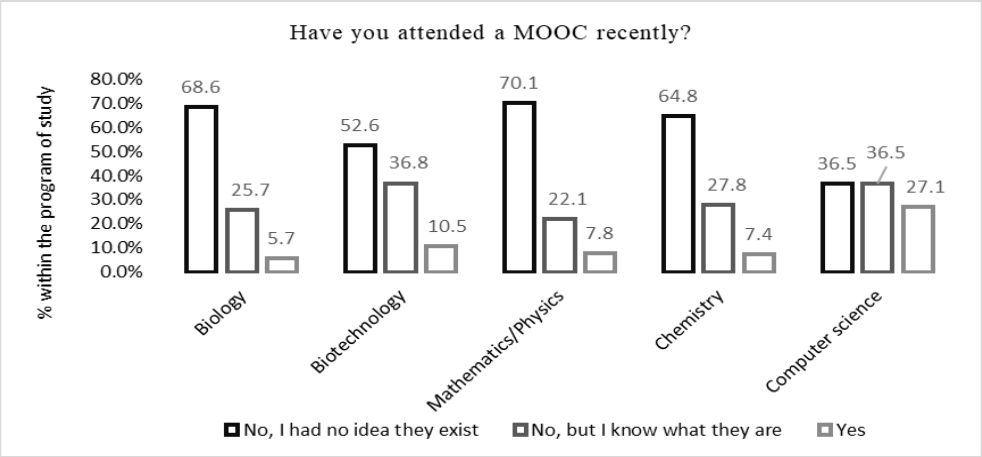

Figure 4. Attendance of Massive Open Online Courses (MOOCs) by Study Program.

Discussion

This study was conducted to assess ICT use and literacy among Albanian natural sciences students of during the online learning period due to COVID-19. The most popular device used by students is the smartphone (84.7% own it), followed by the laptop and the desktop PC. A vast percentage of surveys admit to accessing the internet and online class sessions primarily via smartphone, despite increased perplexities in typing, revision, and researching, resulting from the generally smaller size of the screen and lower processing power along with minimum memory (in comparison to higher-end devices). These differences may negatively impact the overall online education and classroom experience (Xhelili et al., 2021; Lorente et al., 2020). New skills have become essential to fully leverage the power of computer systems, specifically software skills, which allow users to perform tasks and duties through applications and programs. In our survey, the link between software skills and the program of study was evident. As expected, students in Computer Science programs had an easier time getting around computer software than other students. A relation was also apparent regarding academic performance, with higher levels of academic performance being tied to higher levels of software skills. Many studies have reported the positive role of ICT use in student academic performance (Sendogdu and Koyuncuoglu, 2022; Huang et al., 2021; Chiao & Chiu, 2018; Flores et al., 2013), but there are also studies that have concluded that its impact is weak and related to other factors as well (Hu et al., 2018; Zhang & Liu, 2016).

Students show a positive attitude towards technology-based education, with most stating that course managing platforms and recorded video lectures are of great help. However, only a few students have attended a Massive Open Online Course (MOOC), most of which were part of Computer Science programs. Moreover, many had never attended a MOOC and were unaware of their existence. MOOCs may seem like a better option for Computer Science students because of their unlimited implementations on computer-based systems and seamless experience beyond the borders of the physical classroom. In contrast, students pursuing a degree in Biology, Biotechnology, Mathematics, Physics, and Chemistry may have an adverse experience with MOOCs given the irreplaceable in-person instruction needed to master concepts in these subjects, notably through

practical work in labs and facilities. Despite the huge information provided by MOOCs for student's achievement (Zhang et al., 2019; Zutshi et al., 2013), studies have reported that the majority of students who attend MOOCs are already graduated and come from highly developed countries (Reich & Ruipérez-Valiente, 2019). Students with lower English proficiency levels were also more likely to have attended MOOCs. This shows that low to moderate English proficiency levels is a problem for Albanian students and serve as an additional reminder to constantly push in reducing the barriers of language. This raises the importance of MOOC based local education, as reported by Ruipérez-Valiente et al., 2019.

The time spent on the internet was related to the level of addiction or maladaptive behaviors. In addition, time spent on social media and time spent online resulted in being correlated. A popular social networking site among students is Instagram which is frequently accessed and used by 86.5%. These findings are unsurprising, given the young age of our sample, 19.9 ± 1.4 years on average. According to the Institute of Statistics (2019), 93.1 per cent of the Albanian youth population used ICTs daily to explore and collect resourceful information. Nearly half of the kids, teens and young adults of this generation have been estimated to log about 6-10 hours a day online. Inevitably, they are expected to show better technology proficiency than previous generations, earning them the nickname "digital natives" (Meade, 2020).

Conclusions and Recommendations

Our findings show that the majority of the Albanian natural sciences students use the smartphone for their studies, and only half of them own and use a laptop. The software skill level is low to moderate and seems to be related to the academic performance and the program of study. Most of the students find the course managing platforms and the recorded video lectures very helpful, despite they had low levels of MOOC attendance.

In the light of our findings, it is important to create and follow through with a plan to tackle the main issues Albanian students face the uptake of ICT-based services and goods with further socio-economic growth in mind. Government incentives and subsidies can help prioritize technology-based education in schools and universities and set concrete actions to enhance the availability, affordability, and accessibility of ICTs in education. Additionally, the supply of relevant and local online content in the Albanian language would be favorable, especially to students looking for sources of academic materials without having to face the constraint of language barriers. It would only be fair for Albanian youth to reap the benefits of technology at their own pace and comfort.

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Development of Logical Reasoning Activities for Children at the "Lar Sagrada Famílıa", in Apucarana - Pr

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Abstract: Logical reasoning is very important in the child's development, increasing their performance in learning as a whole, improving their concentration and decision-making when solving problems. The introduction of this tool and stimulus from the first years of education is necessary for children to grow up with a broad and more critical view, being able to argue, create, express and assimilate everyday situations. This work was developed in accordance with the needs found in the "Lar Sagrada Família" shelter located in the city of Apucarana, Paraná, where we could observe that the stimulus for this skill, even though it is a fundamental tool for the children housed there, was not being properly addressed. Educational games adapted to each age were made so that children could learn by playing. At the beginning, there was a difficulty in arousing the interest of those involved, as they are needy children and just wanted affection and attention. Over time, with the carrying out of the activities, it was possible to verify a great advance in concentration, evolution in interest, and also, expectations were generated for the next day. The work resulted in the children's cognitive development in a more logical way, contributing to their personal and social growth.

Keywords: Logical reasoning, Skill, Children.

Introduction

When talking about logical reasoning, it is natural to associate it only with mathematics, but this is not true, since it applies to all sciences and also to our daily lives, because through it we can make more intelligent

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decisions. In addition, this subject, little addressed in schools, has been increasingly important at the time of tests such as public examinations and even the ENEM, the main way to enter the public university.

The study of this area can be approached in different ways, but it often leaves an abstract understanding in children causing difficulty and discouragement, so it is necessary to approach it in a more playful and fun way, arousing interest and curiosity.

Educational games help in intuitive understanding, and can become a great ally in pedagogical work in general, as they stimulate logical reasoning, increase concentration and help in decision-making, thus enabling the student's development in their learning and knowledge construction.

Method

The work was carried out in two stages:

First stage: making educational games, based on some books used for early childhood education, by authors Márcia Honora and Mary Lopes Esteves Frizanco. The games, Stop spoken, “Who am I?”, direction, “What's missing?”, treasure hunt, among others, were made in a simple and easy way to play.

Figure 1 e 2 – Material Used as a Basis for a Project at Lar Sagrada Família

Source: Authors, 2022

Second stage: it was the presentation of the games in the shelter “Lar Sagrada Família” that was carried through in the period of six months one hour weekly and working the games according to the difficulty found each week.

Figure 3, 4 e 5- Educational Games Used for Children's evelopment.

Source: Authors,2022.

Results and Discussion

Based on the games prepared for the presentation of the discipline, the return and progress was significant, even though there were some difficulties such as the constant exchange of children in the workshops (only two children remained the entire period) and the difficulty in arousing their interest, since they are children. needy and wanted only affection and attention. There was also a discrepancy of knowledge on the part of the students causing difficulty when performing some activities that required different knowledge such as reading.

Figure 2: Treasure Hunt Game Held at Lar Sagrada Femília.

Source: Authors, 2022

With the weekly activities, it was possible to verify a great advance in concentration and interest, generating expectations for the next day. It is noted that, in order to have a better follow-up, it would be important for everyone to participate in all the workshops, as the progress in the students who participated throughout the period was more significant than the others.

Conclusion

Being an area of extreme importance for the personal knowledge of all human beings, we can say that this stimulus motivated students to be better, to think more logically, through participatory knowledge, seeing, listening and manipulating, contributing to personal and Social.

Recommendations

Due to the difficulties presented by the participants and the special needs that some showed, it is clear that projects with this purpose would be of great value to the institution and its children.

Acknowledgements

We are especially grateful to “Lar Sagrada Família”, for providing the space and its students.

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Complexity Analysis of Integrated Science Test Item Global Competence on Environmental Sustainability Content

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Abstract: This qualitative descriptive analysis aims to interpret the complexity of the science items that are integrated with environmental sustainability content. This research was conducted on science test items in the 2013 Curriculum student science textbooks released by the Ministry of Education and Culture of the Republic of Indonesia. This study focuses on finding out the complexity of the scenario-based science test contained in science textbooks based on the complexity category indicators of the 2018 PISA global competency test. The data was obtained using an instrument adopted from the test complexity indicator and environmental sustainability content indicators contained in the 2018 PISA Framework. The data analysis technique uses the percentage formula to determine the proportion. The results of this study indicate that the proportion of science test items is different from the standard proportion of the 2018 PISA global competency test. The subdomains measured in the 2018 PISA global competence are; the resource risk subdomain and subdomains of policies, practices, and behaviors for environmental sustainability. However, science test items cover only the resource risk subdomain. Therefore, the researcher recommends further research to develop science test items that consider the complexity of the test according to the goals of students' global competence.

Keywords: Complexity, Environmental sustainability, Global competence.

Lasminawati, E., Jumadi, Wilujeng, I., & Firmanshah, M.I. (2022). Complexity Analysis of Integrated Science Test Item Global Competence on Environmental Sustainability Content. In P. Dankers, M. Koc, & M.L. Ciddi (Eds.), *Proceedings of ICEMST 2022-- International Conference on Education in Mathematics, Science and Technology* (pp. 94-103), Antalya, TURKEY. ISTES Organization.

Introduction

To succeed in this new global era, students not only need capacities that include reading, mathematics and science, but they must be much more knowledgeable and curious about world regions and global issues, aligned with diverse perspectives, able to communicate across cultures with other languages, and tend to act for the common good (Mansilla et al, 2013). In PISA 2018, in addition to measuring mathematical literacy, reading, scientific literacy, and financial literacy, PISA also measures students' global competence. Strengthening global competencies is essential for students to thrive in a rapidly changing world (Hu & Hu, 2021). Global competence is still considered a relatively young construct in a scientific context. Relevant and significant research findings have only been written in recent years (Salzer, 2018). Global competence refers to the acquisition of in-depth knowledge and understanding of international issues, appreciation and ability to study and work with people from diverse linguistic and cultural backgrounds, proficiency in foreign languages, and skills to function productively in an interdependent world community (Van, 2010).

According to Pentury (2019), global competence is the ability to continuously communicate with others, knowledgeable, respectful, understanding ability, having a personality as an important figure, able to think diversely, have different opinions, able to work in a team, and able to solve problems and provide solutions. . There are several functions of global competence, including being able to help ensure the new generation cares about global problems and finds solutions to social, political, economic and environmental problems (OECD, 2019). It is important that preschool through college students begin to develop a deeper understanding of the world's economic, social, and political issues. Global competence in the 21st century is not a luxury but a necessity (Van, 2010). Simply put, to prepare students to participate fully in todays and future world demands, it is necessary to maintain their global competence which is here defined as the capacity and disposition to understand and act on important global issues (Mansilla et al, 2013).

Based on the OECD (2019), there are four dimensions that are measured in the global cognitive competency test, namely: 1) students' ability to understand global and intercultural problems. 2) the ability of students to recognize different perspectives by considering the context (culture, religion, region). 3) students' ability to understand the context of norms and communication. 4) the ability of students to understand the possibility of action on global issues and consider the consequences. However, the results of the 2018 PISA test which measures students' global competence in the cognitive dimension show that Indonesia is among the countries with the lowest scores because the proportion of students' correct answers does not reach 30 percent, along with Albania, Kazakhstan, Morocco, Panama, the Philippines, and Thailand, in contrast to Singapore which shows the largest proportion of answers (OECD, 2020).

Schools play an important position in assisting the younger generation in developing global competencies. Schools must provide opportunities for students to truly evaluate global growth (Bennett, 1993). In this case, schools that want to develop global competencies must focus on clarity and learning objectives. This means

engaging all educators to concentrate on globally significant topics for teaching. This can be seen from the results of Lawless' research (2015), which shows that the implementation of the global education curriculum shows positive changes in students' self-efficacy in writing, priorities in exploring potential possibilities for science education, and students' scientific work performance. Learning activities that emphasize global competence integrate ongoing social topics as student learning topics. This has a positive impact on students. Bednar et al (1992) also say that for decades, researchers have shown that using interdisciplinary contexts such as social science provides students with opportunities to solve actual problems that can improve student understanding. In addition, to grow global competence, students can be given knowledge strengthening through continuous learning (Kim, 2017).

One of the things that need to be considered for significant learning to develop students' global competencies is learning resources because this is very influential in the learning process. Gay (2013) states that student textbooks can be sensitive in terms of student cultural and ethnic differences related to the development of student competencies globally so teachers and students must analyze their textbooks critically. Therefore, this study tries to analyze the tests contained in science textbooks based on their support for the development of students' global competencies. Global competence was well evaluated in the 2018 PISA cognitive test through a scenario-based test (OECD, 2019). Scenarios focus on global issues and intercultural situations where there are different perspectives, and voice these different perspectives. Students will work on several short scenarios, and thus will be able to demonstrate their capacity to think about various issues that have been deemed meaningful, relevant and accessible to 15-year-olds around the world, as determined by experts and by PISA countries who reviewed the test material (Piacentini, 2017).

One of the global competence domains is environmental sustainability content (OECD, 2020). This domain focuses on the risk of resources, so that in this study an analysis was carried out on testing on subjects related to the content of environmental sustainability. In this regard, in this study, an analysis of the complexity of the test on science subjects for junior high schools was carried out which was integrated with global competence, especially in the content of environmental sustainability.

Method

This research is a qualitative descriptive study using the document study method. This study describes the complexity of the test items and the scope of integration of Global competencies that refer to the 2018 PISA test. The test items are obtained from students' science textbooks released by the Ministry of Education and Culture of the Republic of Indonesia. The test items analyzed are questions that are integrated with global competence. Questions that are integrated with global competence are selected by looking at the content of the test item. One of the global competency contents is Environmental Sustainability, so that the test items analyzed are taken from certain learning materials, namely materials that are in accordance with the global competency content (Environmental Sustainability content) based on PISA 2018. Therefore, the topic chosen is

Environmental Pollution (Science Textbooks grade 7), Global Warming (science textbooks grade 7), Soil Pollution (science textbooks grade 9) and Environmentally Friendly Technology (science textbooks grade 9). Of the four topics, this study focuses on scenario-based test items, adapted to the type of Global PISA 2018 competency questions.

The data was obtained from the analysis of science test items and strengthened by the teacher's perspective obtained through in-depth interviews with science teachers as data triangulation. The instrument used to analyze the items was adopted from the complexity category indicators of the 2018 PISA global competency test. The research procedure includes 1. Researchers determine science textbooks to be analyzed, 2. Select topics based on the integration of PISA 2018 global competencies (environmental sustainability content), 3. Selecting scenario-based science test items on the chosen topic, 4. Analyzing science test items, 5. Conducting interviews with teachers. The data analysis technique of this research is to use the percentage formula to determine the proportion of integration of global competence and the complexity of the test items and the category of complexity of the science test items.

Results

The Environmental Sustainability Domain consists of: a) resource risk subdomain and, b) environmental sustainability policy, practice, and behavior subdomain. The results showed that the science test items covered topics according to the global competency content in the subdomain of resource use risk. However, the science tests did not find any items measuring policy, task, and behavioral subdomains for ecological sustainability that focused on what policymakers and individuals can do to reduce overexploitation and deal effectively with environmental threats. The results also show that not all science test items contained in science textbooks are scenario-based. The results showed that the scenario-based test questions were less than 50% in both grade 7 textbooks and grade 9 textbooks. The data can be seen in Figure 1 and Figure 2.

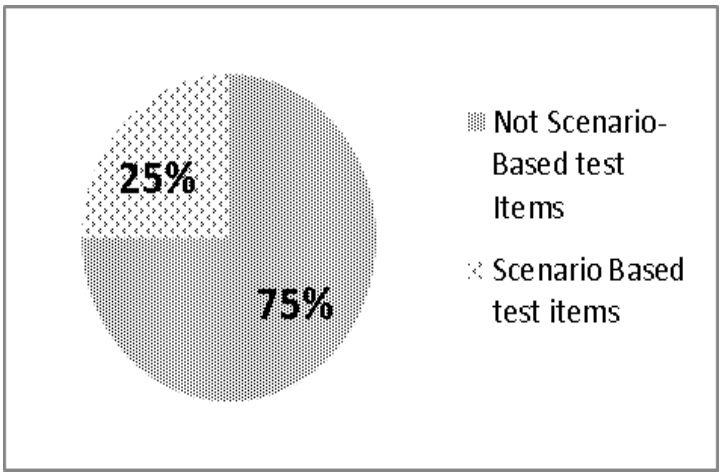

Figure 1. Percentage of Scenario-based Science Test Items (7th Grade)

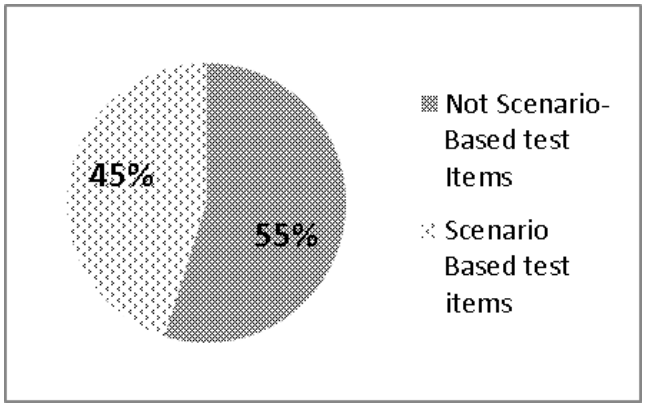

Figure 2. Percentage of Scenario-based Science Test Items (9th Grade)

The results also show that when compared, the test items contained in textbooks are different from the proportion of standard PISA 2018 global competency test items. The following is the complexity standard of the 2018 PISA test which can be seen in Table 1.

Table 1. The Standard for Complexity of the PISA 2018 Global Competence Test Unit

Complexity Indicators	Low	Medium	High
Specific Knowledge	Around 40%	Around 40%	Around 20%
General Knowledge	Around 60%	Around 30%	Around 10%

The indicator of the complexity of the Global competency test items based on the 2018 PISA Global Competence framework consists of aspects of specific knowledge and general knowledge. In the aspect of specific knowledge, the complexity of science questions in textbooks can be said to be disproportionate if it refers to the standard proportion of the 2018 PISA test. This is because science test items have a complexity percentage range that is much different from the complexity of the PISA test items. When compared, the IPA test items with medium complexity exceed the percentage of PISA test items, while the items with low and high complexity are less than the percentage standard of PISA test items. The comparison of the percentage of complexity between the science test items and the PISA global competency test items in more detail can be seen in Figure 3.

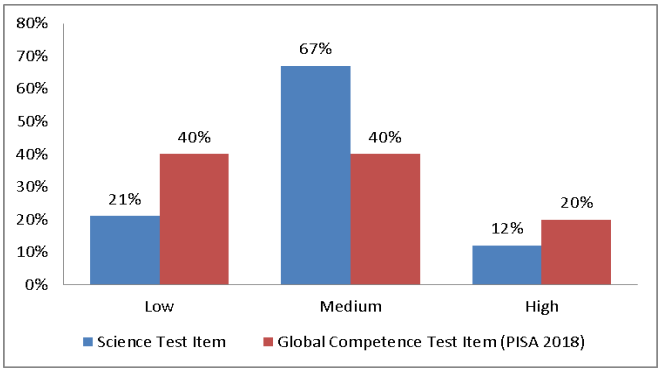

Figure 3. Complexity of Science Test Items on the Specific Knowledge Indicator

Science items are dominated by test items with moderate category complexity, namely the topics/problems used in the test items are mostly known by students but not all topics are naturally popular for them. This is reinforced by the results of interviews, where the teacher said that the content of the material used in the science test items was not diverse and tends to make students bored, the context in the question does not introduce students to a wider context. Meanwhile, the percentage of test items in the high and low complexity categories has not yet reached the proportion of the 2018 PISA test standards. The test items included in the low complexity category are the topics used in the unit tests are very simple and are familiar to most students. Meanwhile, the test items included in the high complexity category are when most of the students have heard about the topic/problem, however, only a small number of students can understand the test topic.

Similar to the category of test items based on specific knowledge indicators, the complexity analysis of science test items based on general knowledge indicators (language and text) is also different from the proportion of complexity of PISA 2018 test items. This can be seen in Figure 4.

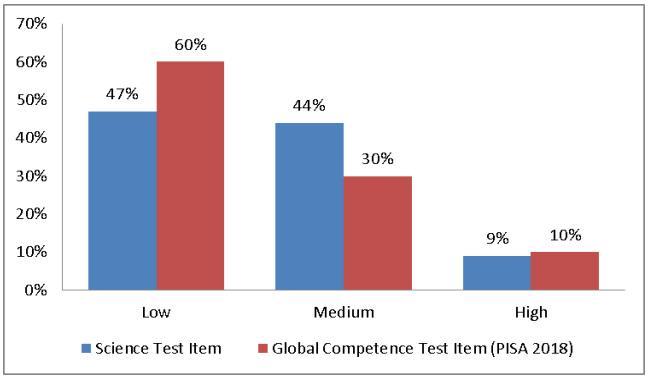

Figure 4. Complexity of Science Test Items on the General Knowledge Indicator

The language and texts used in the science test items are dominated by test items with low complexity categories, namely the scenarios in the test items using very simple language, without words or technical expressions that are typical of certain socio-cultural or demographic groups. However, when compared to the PISA 2018 global competency test items, the percentage of test items with low complexity has not yet reached the PISA test item standard, test items with moderate complexity exceed the standard percentage of PISA test items, while the percentage of IPA test items with high complexity is in accordance with the complexity of the test items. global competence PISA 2018.

The category of moderate complexity characterized by the language in the scenario is familiar to most 15-year-old students. Word choice is typical of communication addressed to a non-specialist audience. The high complexity category is characterized by scenarios in the test items using more complex language which is typical of formal writing or professional conversation, and may include a limited amount of technical or content-specific vocabulary.

Discussion

This study specifically analyzes scenario-based IPA test items that are integrated with environmental sustainability content. In scenario-based unit tests, students read about a problem and respond to test material that assesses their ability to understand multiple perspectives from the various factors involved. Scenario problems describe various situations and test students' ability to apply their experiences and cognitive abilities to analyze situations and suggest alternatives. The test item instructions ask students to critically analyze statements and information so that the results of students' answers will provide relevant information about the student's capacity.

Scenario-based test items in science textbooks were analyzed based on the complexity of the test items. The category complexity of the PISA 2018 global competency test items consists of 3 categories, namely the low category, medium category, and high category (OECD, 2019). The indicator for categorizing the complexity of the items is divided into two components, namely specific knowledge and general knowledge. Specific knowledge is the topic domain covered in the test items, while general knowledge is about the language and texts used in the test items. The results show that the science items contained in the science textbooks have varied complexity, but are very different from the proportion of the complexity of the 2018 PISA items used to measure students' global competence.

The results show that the science test items on the special knowledge component are dominated by items in the medium complexity category, but there are still few test items with high complexity topics. The scenarios in the test items should represent diversity so that students can be aware of global problems or investigate the complexities of cultural relationships (OECD, 2019). This may be one of the factors for the low global competence of students in Indonesia because they are not accustomed to working on test questions with high complexity, namely with a wider context of diversity.

In addition, although language and text are not integral components of global competence, the language used in the test item scenario will definitely affect the level of difficulty of the test item. The low global competence of students may be influenced by the support of teaching materials, including test items that are usually done by students. One of the learning resources used in the learning process is teaching materials (Syam, 2017). Teaching materials are an arrangement of materials that have been collected and derived from various sources that are made systematically (Prastowo, 2011). Learning resources are components of the instructional system which include messages, people, materials, techniques and the environment that can affect student learning outcomes (Duludu, 2017). Textbooks are dominant as a learning resource, of course, textbooks greatly determine the direction of learning implementation (Lasminawati, 2019). From some of these explanations, it can be said that the textbooks and test items contained in the textbooks affect student learning outcomes. In order for students to have good global competencies, global competencies must also be integrated in student learning resources.

Global Competence consists of several domains, one of which is the domain of environmental sustainability content. Environmental Sustainability Domain consists of: a) resource risk subdomain and, b) environmental sustainability policy, practice, and behavior subdomain. The results showed that the science test items only covered the subdomain of resource use risk. Within the subdomain of environmental sustainability policy, practice and behavior, the scenario should ask students to focus on existing instruments and items (eg, standards, taxes, subsidies, education), promoting sustainable consumption and manufacturing, how environmental issues are shared in the media; how the government sees the threat of environmental degradation when making economic policies, as well as environmental concerns about how sustainable development is understood (OECD, 2019).

The absence of science test items that integrate policy and practice will certainly affect students' global competence. Students will be less trained in providing scientific arguments regarding their opinions on global issues related to policies issued by the government. This influence can also be seen from the results of Lawless's research (2015) which shows that the results of implementing a curriculum that integrates global education shows positive changes in students' writing self-efficacy, interest in pursuing science education opportunities in the future, and the quality of students' scientific arguments. The integration of global competencies in learning resources and science test materials can greatly help students have good global competencies.

Conclusion

The results of the study indicate that there are science test items that are integrated with global competencies, especially those related to environmental sustainability in science textbooks for junior high school students. The proportion of complexity of science questions varies, namely low, medium, and high, but it is not the same when compared to the percentage of PISA 2018 global competency test items that do not meet the standard for the proportion of test component complexity used in the 2018 PISA Global competency test. Based on the specific knowledge component indicators, the percentage of questions Science in textbooks with low complexity is 21%, medium complexity is 67%, high complexity is 12%. In addition, based on indicators of general knowledge components (language and text), the percentage of science questions in textbooks with low complexity is 47%, moderate complexity is 44%, high complexity is 9%.

Recommendations

The recommendation from the results of this study is that it is hoped that in the future the science test items that will be developed pay attention to the complexity of the science test items with the right proportions, and integrate global competencies that not only integrate environmental sustainability material in theory but also integrate activities and attitudes in management of the environment, focus on what governments and policymakers and individuals can do to reduce wastage of resources and better address environmental risks. With learning resources that contain policies, practices, and environmental sustainability behavior, it is hoped

that students will be better trained to give arguments and try to describe opinions and solutions from various perspectives.

Notes

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Use of the Game "Mathematical Rods" in the Teaching and Learning of Basic Education in Brazil

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Abstract: As imperceptible as it is, mathematics is fundamental and is present on several occasions in our daily lives, but among 65 countries Brazil still ranks 53rd in education. The lack of investment in primary education has affected students learning since the early years. From this perspective, this paper proposed to verify teaching/learning in mathematics discipline for elementary school students through playful games, a fun method that can be used at various times and aims to review and fix the content in a practical way and interactive. For this, a game named "Mathematical rods" was elaborated a renewal of the hobby "Cat rods". The operations present in the game are simple, focused on basic mathematics and can still be adapted depending on the level of knowledge of the students. The game was applied to three groups of six 9th grade students of the State College Professor Izidoro Luiz Ceravolo, located in the city of Apucarana, Paraná in Brazil. Therefore, in addition to dynamic and creative, we conclude that this educational interpretation is easy and accessible, a tool that can be used in any public institution, contributing to the learning process of students.

Keywords: Games, Learning, Teaching, Mathematics

Introduction

As we already know mathematics is present in our daily lives, it is everywhere and at the most different moments of our lives, as imperceptible as it is, mathematics is in the most common acts of our daily life, in the

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most basic accounts as the counting of time, something that is currently so necessary and discussed. Thus, it is essential to highlight that a good teaching of mathematics is indispensable for a learning more efficient and meaningful, and it is extremely important that everyone learns the content and fix at least the basics while they are in school, even considering that mathematics is one of the subjects that, in general, students present greater difficulty. This fact can be observed in Brazil since the country ranks 53rd in education, however Nacarato (2005) states that the use of differentiated means in the teaching of mathematics began in Brazil around 1920, where recreational activities were already used with apprentices, this is due to the lack of investments in basic education that affects learning students since the early years, being reinforced by Kamii and Devries (1991), young children acquire better knowledge through games than with traditional lessons and exercises.

Thus, the game used as an educational and learning tool can be seen as a strategy that is often ignored by schools that maintains a traditional role, as if this playful activity does not importance and functionality in the learning process (PIAGET, 1998), being confirmed by Santana(2008), the use of games can contribute to the learning, as well as making the process fun and interesting. Contrary to this perspective, several authors have already proven the effectiveness of the use of games and play in the classroom as Falkembach (2006) which says such activities encourage the logic and stimulate the creativity of the participants. According to the analyses of Isidoro and Almeida (2003), in addition to the student creating techniques and strategies through games, it will also train social interaction and the diverse ways of dealing with the social conflicts that a rise during execution of this activity, and add that it is among games with similar pairs, whether in the social or cognitive condition, that development has its maximum expression. Similarly Gardner(1961, p.187), a recreational mathematician also states that, “you can say that mathematical games or “recreational mathematics” are mathematical -no matter what kind- loaded with a strong component playful”, are excellent tools that used in the correct way aim in a positive way to complement the good training of the student.

Kishimoto (1995) argues that the game always happens in a certain space and time, and that they contain a sequence of its own, adds on the various possibilities that the word game brings us, and the many questions that arise in the interwining of the game and learning. For the author, the game is seen in three different senses: first as “the result of a linguistic system that works within a social context” (p.48), which explains that the game is not something simple, that to understand it is necessary to take into account the language that is used as an instrument of a social group, “as a social fact, the game takes on the image, the meaning that each society attributes to it. This is the aspect that shows us why depending on the place and the season, games take on different meanings”, therefore [...] “each social context builds a game image according to its values and way of life, which language” (p.48). The second meaning of the game cited by the author concerns the rules, a sequential structure which at the same time differentiates on game from the other also allows for the trickiness. The last sense is the materialized game, seen as an object.

Based os these ideas, the game presented in this project brings all these meanings, and focuses on adolescents, students who attend teaching in public schools. Thus, the work was elaborated through a literature review and

has as main objective to work with the use of playful games in teaching math learning, as well as, present a game created to train some mathematical skills, directed and applied for three groups of six 9th grade students of the State College Professor Izidoro Luiz Ceravolo, located in the city of Apucarana/PR in Brazil, the operations present in the game are simple, focused on basic mathematics and can still be adapted depending on the level of knowledge of students. The aim is to demonstrate that it is possible to have an exchange of knowledge between students and teachers on a more effective and ate the same time pleasant for both of them. Rogers (2001) mentions the idea that it is possible to build and discover new knowledge through a pleasurable learning for those who teaches, as for those who learn.

Method

The game used on this project is titled “Mathematical Rods” being an innovation of the classic game “Cat Rods”, in which each player must should pick up a maximum number of bast without messing with any of the others. This is an easy and affordable educational version due to its tow cost material. The game consists of chips made with colored papers (pink, green, yellow and orange), sticks painted according to the plugs (and may be replaced by crayons or any other material of the proposed colors), a table of values and also by a response card (a table that contains all accounts and their results for the calculation conference). Each color, in addition to the amount of point still establishes a different purpose as revealed in table 1.

Table 1. Score and details about the game.

Colors	Values	Accounts
Pink	15 points	Square root
Orange	10 points	Potency
Green	5 points	Division
Yellow	1 point	Addition and Subtraction

In the game must also have a judge, being he one of the participants, who must be chosen to check if the other will answer the accounts correctly, or also if any of the other rods will move while the player tries to capture the chosen one. To play, just shuffle and play the sticks so that all are randomly scattered on top of each other, the goal of the game is to be able to catch only one rod at a time without moving the others, following all the rules of the game. Basically, the rules of this hobby are: if when trying to catch the stick stir one of the others passes the time, and if you do not resolve or settle the account the rod must be returned to the others and you do not earn any points.

Figure 1- Educational game "Mathematical Rods", manufactured by the author.

After shuffled, if you can pick up any rod without moving the other ones should take u respectively the same color of the captured stick, each of these papers have some kind of basic mathematical account to be resolved, when answered correctly the player must save the rod until the end of the game for somatoria of the points. The game ends when all the sticks of the game are collected, and thus the counting of the point is made according to the values of the table present next to the are collected, and thus the counting of the points is made according to the values of the table present next to the material where all the beads appear, their colors, is value and its respective results so at the end of the game see who is the real winner, thus predicting the amount of sticks collected do not determine the winner of the game, but rather the count of their respective points.

Table 2. Score Table and Conference of the Accounts Present in the Game.

Yellow-1 point	Green-5 points	Orange-10 points	Pink-15 points
6+9=15	8÷4=2	$1^{15} = 1$	$\sqrt{9} = 3$
15+16=31	9÷3=3	$1^{10} = 1$	$\sqrt{16} = 4$
17-5=12	18÷2=9	$2^{4} = 16$	$\sqrt{25} = 5$
18-9=9	24÷2=12	$2^{6} = 64$	$\sqrt{36} = 6$
34-11=23	25÷5=5	$2^{7} = 128$	$\sqrt{49} = 7$
36+24=60	44÷2=22	$3^{4} = 81$	$\sqrt{64} = 8$
45+45=90	45÷5=9	$3^{3} = 27$	$\sqrt{81} = 9$
50+45=95	50÷10=5	$4^{4} = 256$	$\sqrt{100} = 10$
78-45=33	63÷3=21	$5^{3} = 125$	$\sqrt{121} = 11$
78-56=22	64÷2=32	$6^{2} = 32$	$\sqrt{144} = 12$
89-8=81	66÷2=33	$7^{1} = 0$	$\sqrt{169} = 13$

96-56=40	81÷3=27	$8^2 = 64$	$\sqrt{196} = 14$
125+125=250	84÷2=42	$9^2 = 81$	$\sqrt{225} = 15$
150+150=300	85÷5=17	$10^6 = 1$ million	$\sqrt{400} = 20$
230+245=475	95÷5=19	$18^1 = 0$	$\sqrt{900} = 30$
256-25=231	125÷5=25		
300-150=150	150÷5=30		
340+150=490	196÷4=49		
740+22=726	300÷2=150		
820-300=520	486÷2=243		

The proposed activity was developed specifically for elementary school students, with simple questions focused on basic mathematics that is used in day-to-day problems such as addition, subtraction, division and multiplication (square root and power). The target audience of the application of the mathematical game were the students of the 9th grade elementary school classes of the State College Professor Izidoro Luís Ceravolo located in the city of Apucarana, Paraná- Brazil.

Figure 2. Educational Game "Mathematical Rods" During Application.

Figure 3- Directors of the State College Professor Izidoro Luis Ceravolo where the application of the game "Mathematical Rods" took place.

Figure 4. Educational Game "Mathematical Rods", Being Applied to Elementary School Students.

Results

In the school period of February 9 and 10, 2022, the game was applied and the analysis was performed on the given classes, the students were divided into 3 groups of 6 people each. The first group “team 1” was formed by five girls and one boy, they finished the game answering the total of 37 questions, including 30 answered correctly and 7 wrong, with a girl as the winner. The second group “team 2” contained four girl and two boys, and ended up having a result similar to the first group with 37 questions, however, there were 28 said veridically and 9 inveridly, with a boy as the winner. The third and final group “team 3” composed of five boys and one

girl, finished the game with 35 of the contested contents, 29 hits and 6 hits, with a winning boy. All teams were able to finish the game with an average of 40 minutes, having an excellent performance to solve the issues and obtained great results with the learning that the game provided. Remembering “little rules” and mathematical tolls to solve the problems they had already forgotten. However, some students had difficulties the main related root accounts square and power, as we can see in detail in table 3:

Table 3. Scores and Details About the Application of the Game.

	Team 1	Team 2	Team 3
Duration	40 min	40 min	40 min
Questions	37	37	35
Corrects	30	28	29
Wrongs	7	9	6
Difficulties	Square root	Potency	Potency

Discussion

Undoubtedly, in the “game, one never knows the directions of the player’s action, which will always depend on internal factors, personal motivations and external stimuli, partners” (KISHIMOTO, 1995, p.53). But above all, it is necessary to take into account its positive effects, mainly as a tool learning and developing cognitive and social skills. Some students raised the fact that they could not remember the materials and present difficulty with some basic math accounts present in the game, thus awakening the interest of seeking to study more about the subjects dealt with, refreshing the memory and remembering issues already applied in the past that ended up being forgotten over time or considered irrelevant ant that time.

That’s why De Paulo (2017) said, games positively change the image of the discipline of mathematics, because they motivate, stimulate reasoning and also by be playful to study, that main positive point of the application of this project was to really awaken the interested and pleasure of the students who end up studying and learning without even realizing that this is actually happening in that moment of play relaxed with classmate. Already applied in the past that ended up being forgotten over time or considered irrelevant at that time.

Vygotsky (1991) discusses that play creates zones of proximal development and that these provide qualitative leaps in the development and child learning. Likewise, Kamii and Devries (1991) claim that young children acquire better knowledge through games than with traditional lessons and exercises.

Conclusion

In view of the research reported in this study, we were able to verify the veracity of the student’s high

development with the use of playful games in teaching mathematics learning, unlike the theoretical classes worked on a day-to-day basis. Cunha (2004), believes that games are a pedagogical option that can be used ate various times in the classroom, such as, in order to explain the content, illustrate, review or even to evaluate what has been learned. In addition to this type of play being fun and stimulating, it "contains a reference to the adult's childhood time with representations memory and imagination" (KISHIMOTO,1995, p.51), awakening the deepest effective memories. Therefore, the game created in this project addition to being worked only with elementary school students with the content of basic mathematics, it also has the possibility of being changed to high school students or even to other subjects, having a lost of very flexible questions the difficulty selected by the applicator, because the use of play can be an extremely efficient tool and used in all modalities and levels of education, whether public or private.

Therefore, in addition to dynamic and creative this educational interpretation is extremely easy accessible, due to its low cost manufacturing material, which can be changed by material that are already easily accessible, that is, a tool that can be used in public schools, contributing to the process of students ensuring accessibility and learning for all, because according to Balbinot, Timm and Zaro (2009) the costs of these games can make its application is not feasible and, in addition, Silva (2006) learning takes place in an extended period, which begins in childhood so that it is possible to fix what is being studied and so that you do not forget easily.

Recommendations

In view of everything that has been pointed out and proven with the use of the proposed playful game, we can perceive that if worked since childhood in schools as a method of teaching present, children may have better personal development in the future with their studies, also a better fixation of the contents during his student career in addition to working a better interest in school and studies for the relaxed and fun way of playing, all of which are reflected in the future of their lives.

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Students' Mathematical Problem-Solving Ability: Mathematics Teachers' Perception in Sumatra

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Abstract: This study aims to obtain a picture of the perception of mathematics teachers related to students' mathematical problem-solving abilities. This research method is qualitative research with a case study approach. The subject of this research is a mathematics teacher in Sumatra. A total of 32 mathematics teachers were involved in this study. The data collected in this study used a questionnaire. The questionnaire used was validated by one mathematics education lecturer and three mathematics teachers. Then, the results of the questionnaire data were analyzed using Miles and Huberman analysis which consisted of data reduction, data presentation, and drawing conclusions. The results of this study indicate that the teacher's perception of the ability to solve mathematical problems as measured by the Polya stages ranges from 63% to 77%. In addition, there are differences in students' mathematical problem-solving abilities during online and offline learning. The impact of this research can add to existing references and be considered to improve and evaluate math problem-solving abilities in both public and private schools in Sumatra.

Keywords: Mathematical problem-solving, Polya stages, Teacher perception

Introduction

Problem-solving ability is an important point in learning mathematics. In mathematics, problem solving is essentially a high-level reasoning process (Sari et.al, 2019). Since its inception as a relatively new subject of inquiry, problem solving has been one of the key issues in mathematics education research (Carotenuto, 2021). NCTM (2000) states that there are 5 important components of mathematics, including problem-solving skills, mathematical connections, mathematical representation, reasoning, and communication. Supported by the opinion (Sitorus & Sutirna, 2021) that this problem-solving ability must be possessed by students. Because of this ability is one of the skills that must be possessed in the 21st century.

Wulansari, P., & Jupri, A. (2022). Students' Mathematical Problem-Solving Ability: Mathematics Teachers' Perception in Sumatera. In P. Dankers, M. Koc, & M.L. Ciddi (Eds.), *Proceedings of ICEMST 2022-- International Conference on Education in Mathematics, Science and Technology* (pp. 113-129), Antalya, TURKEY. ISTES Organization.

In addition, this problem-solving ability is a benchmark in assessing student abilities internationally (PISA) and national assessment (AKM). Several studies state that students' mathematical problem-solving abilities are low (Ardiana et.al, 2019). Reinforced based on the results of PISA, it is stated that the problem-solving and reasoning abilities of students in solving PISA questions are low. There are several studies related to students' mathematical problem-solving abilities in the last 5 years as follows: research by Apriani et al. (2017) regarding mathematical problem-solving abilities in terms of initial mathematical abilities and gender differences. Then, Buranda & Bernard's research (2018) with the article title analysis of mathematical problem-solving abilities in junior high school students' circle material based on gender. After that, the research of Saputri & Mampouw (2018), with the article title of problem-solving ability in solving fractional problems by junior high school students is viewed from the Polya stage.

Furthermore, Zakiyah et.al's (2019) research regarding the analysis of problem-solving abilities and responses to mathematical transitions from junior high school to high school on SPLTV material. Then Fitriani's research (2020), with the title of the article on the problem-solving abilities of junior high school students. After that, Darmawan & Ramlah's research (2021) with the article title analysis of students' mathematical problem-solving abilities in solving TIMSS questions based on Polya stages. Based on the research above, it can be concluded that research related to students' problem-solving abilities is often the object of research.

In this day and age, since the COVID-19 virus spread, learning in schools has changed. Learning is done through distance or online learning. In this phase, distance learning media can be developed by the government (Wijaya, 2020). Online learning is a new challenge for teachers and students because they have to replace their usual learning (Cao et al, 2021). So, this is certainly the process of learning and thinking of students, especially in solving mathematical problem-solving problems. However, there is still a lack of research related to the perceptions and views of teachers on students' mathematical problem-solving abilities, and also whether there are differences in students' mathematical problem-solving abilities before the pandemic and during the pandemic.

Therefore, the purpose of this study was to describe the mathematics teacher's perception of students' mathematical problem-solving abilities based on the teacher's experience. The mathematics teacher's perception of mathematical problem-solving abilities includes the teacher's knowledge and understanding of the types of questions given, students' difficulties in solving mathematical problem-solving problems, and mathematics topics that are often used. Furthermore, it describes the differences in students' mathematical problem-solving abilities before the pandemic and during the pandemic. The impact of this research is to add references or can be used as a consideration for teachers or the government in improving students' mathematical problem-solving skills through the important points discussed in this study. In Table 1, several variables of teacher perception criteria are as follows:

Table 1. Table of Teacher Perception Criteria

Variables		N
Teaching Level	SD	8
	SMP	11
	SMA/MA/SMK	13
School Origin	Public school	17
	Private school	15
Gender	F	20
	M	12
Total		32

Method

This research is qualitative research with a case study approach (Yin, 2009). The subjects in this study were mathematics teachers in Sumatra. A total of 32 mathematics teachers were involved in this study. The level of teaching mathematics teachers from elementary, junior high school, and high school (equivalent). The data collected in this study used a questionnaire. The questionnaire used was validated by one mathematics education lecturer and three mathematics teachers. Data analysis was carried out by analysis of Miles and Huberman (1994) which consisted of data reduction, data presentation, and conclusions.

Results

Mathematics teachers' perceptions of problem-solving abilities are viewed from the experience of teachers who teach in public schools or private schools. This result discusses 4 points, including the perception of mathematics teachers on knowledge and understanding related to students' mathematical problem-solving abilities, teachers' perceptions of students' mathematical problem-solving abilities, teachers' perceptions of students' difficulties in solving mathematics problems, and mathematics teachers' perceptions of mathematical problem-solving abilities of students before the pandemic and during the pandemic.

Teachers' perceptions of their knowledge related to students' mathematical problem solving

The teacher's perception of his knowledge related to matters relating to students' mathematical problem solving is described in Figure 1 which contains the teacher's perception of the difference between routine and non-routine questions, how often to give routine and non-routine questions, the teacher knows the level of the type of questions from Bloom's taxonomy, how often the teacher gives questions of types C4, C5 and C6 to students, as well as students' difficulties in solving math problems. Following is in Figure 1 the percentage of teachers' perceptions of their knowledge related to matters related to solving mathematical problems

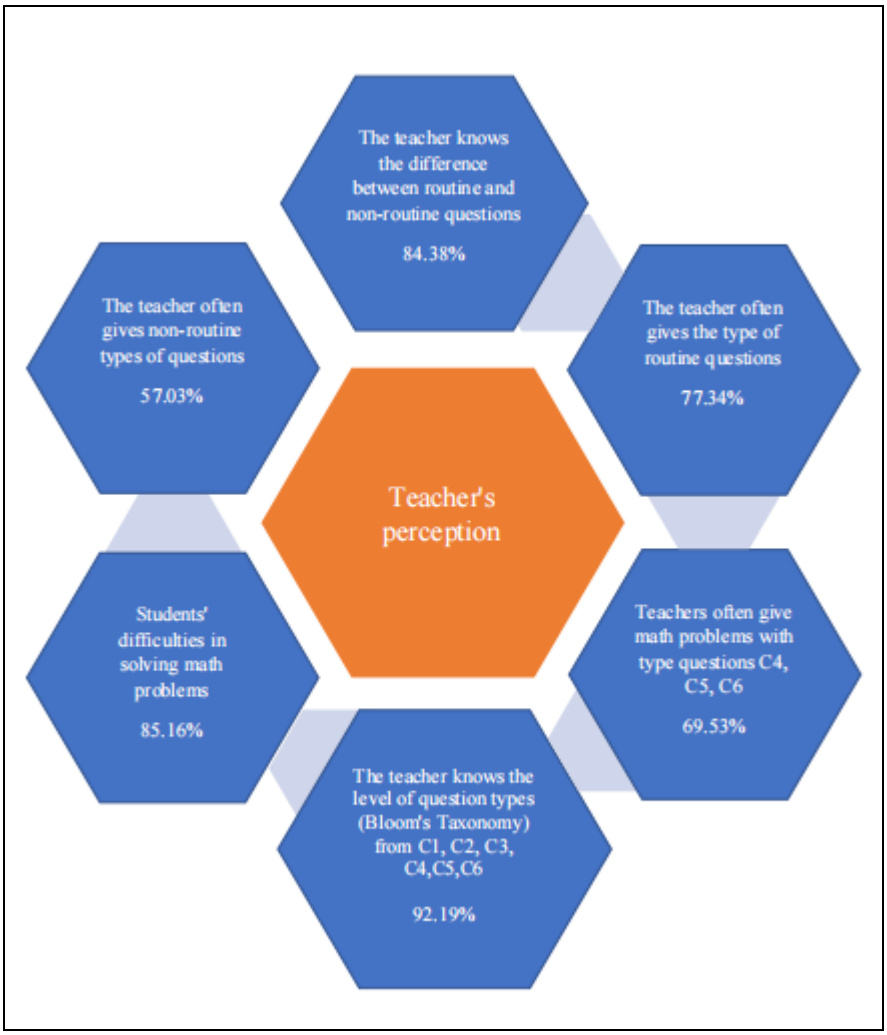

Figure 1. The teacher's perception of his knowledge regarding matters related to solving mathematical problems

Based on Figure 1, the teacher's perception of his knowledge related to matters related to solving mathematical problems, among others, the teacher knows the difference between routine and non-routine questions 84.38%, teachers often give questions to students with the type of routine questions 77.34%, teachers often give questions to students with non-routine types of questions 57.03%, teachers' perceptions of students who often have difficulty in solving math problems 85.16%, teachers know the level of question types (Bloom's Taxonomy) from C1, C2, C3, C4, C5, and C6 that is 92.19%, and the teacher often gives math problems to students with the type of questions C4, C5, C6 that is 69.53%.

In addition to the above aspects, the mathematics topics that are often used by teachers to give routine and non-routine questions to students are as follows in Table 2:

Table 2. Math Topics for Routine and Non-Routine Questions

Math topics	
Algebra	13
Number	6
Data and Uncertainty	3
Geometry	6
Others	6

Based on Table 2, shows that mathematics topics that are often given to students, both routine and non-routine questions consist of algebra, geometry, numbers, data and uncertainty, and others. In addition to discussing math topics that are often given, the teacher's perception of students' difficulties in solving math problems becomes important. In Table 3, the teacher's perception of the points of difficulty experienced by students in solving mathematical problems is discussed as follows:

Table 3. Students' Difficulties in Solving Students' Math Problems

Students' difficulties in solving students' math problems	
Understanding and analysis of basic concepts	❖ Do not understand the concept ❖ They are not used to the problems they face. So they do not know where to start and use any concept to solve the problem.
Understanding the problem & types of questions	❖ Understand and analyze the meaning of the question. ❖ Students are not careful in reading questions. ❖ Understand math story problems and fractional number material. ❖ Interpret and translate the mathematical language of the questions into their understanding to answer the questions.
Problem-solving procedures/steps, the student reasoning process	❖ Choose a problem-solving procedure, converting the problem into a mathematical representation. ❖ Development of existing formulas to solve different problems. ❖ Convert story problems to mathematical form and perform division operations. ❖ Students are less able to find methods of solving problems directly, there needs to be an inducement first.

Operation	❖ Students are still difficult in arithmetic operations. ❖ Multiplication of fractions in algebra. ❖ Basic operations on fractions and negative numbers.
Problem solving on story problems	❖ When dealing with story problems or questions related to everyday life. ❖ Troubleshooting story problems.
Math topics/materials	❖ Algebra and Numbers

Based on Table 3 above, there are six points of student difficulty in solving math problems, including understanding and analyzing basic concepts, understanding problems & types of questions, problem-solving procedures/steps & students' reasoning processes, operations, problem-solving on story problems, and topics/materials mathematics.

Teacher's Perception of Students' Mathematical Problem-Solving Ability

The teacher's perception of the ability to solve mathematical problems is measured based on Polya's stages, namely understanding, planning, implementing, and re-examining. The following is in Figure 2 regarding the percentage of teachers' perceptions of students' mathematical problem-solving abilities as follows:

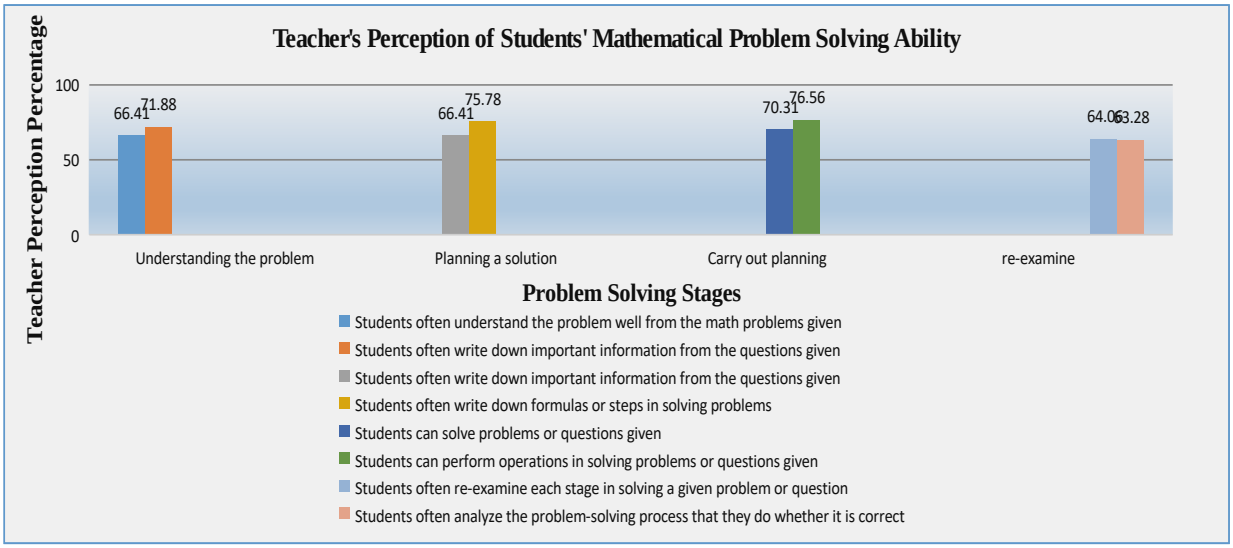

Figure 2. Teachers' Perceptions of Students' Mathematical Problem-Solving Abilities

Based on Figure 2, the teacher's perception of the ability to solve mathematical problems, namely:

1. Stages of understanding the problem: students often understand the problem well from the math problems given 66.41% and students often write down important information from the questions given 71.88%.
2. Stages of planning a solution: students can plan problem-solving well when given 66.41% of questions; students often write formulas or steps in solving problems 75.78%.
3. Stages of implementing the plan: students can solve problems or questions given 70.31% and students can perform operations in solving problems or questions given 76.56%.
4. Stages of re-checking: students often re-examine each stage in solving problems or questions given 64.06% and students often analyze the problem-solving process that they do whether it is correct 63.28%.

Teacher's Perception of Mathematical Problem-Solving Ability before the Pandemic and During the Pandemic

The table above has previously discussed the teacher's perception of mathematical problem-solving abilities. However, what is the teacher's perception of mathematical problem-solving skills before the pandemic and during the pandemic? In Figure 3 below, the percentage of teachers' perceptions of math problem-solving skills before the pandemic and during the pandemic.

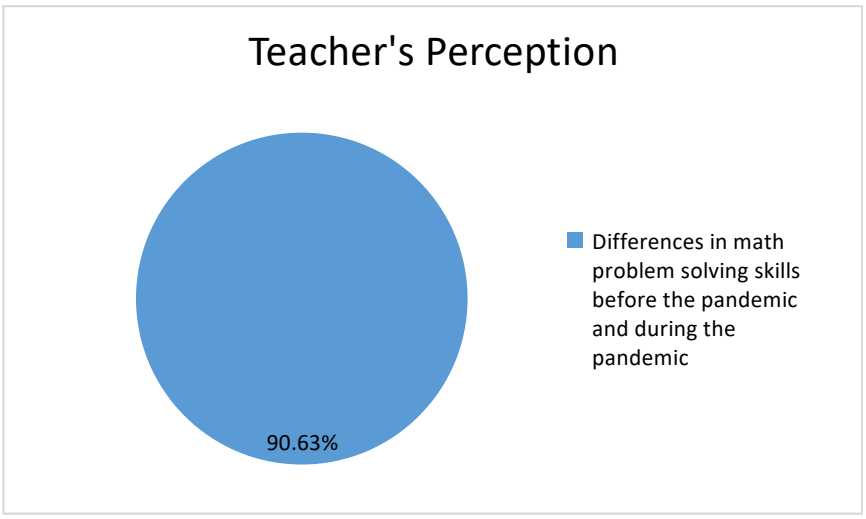

Figure 3. Teacher's Perception of Math Problem-Solving Ability

Based on Figure 3, the percentage of teachers' perceptions of differences in math problem-solving abilities before the pandemic and during the pandemic was 90.63%. The most significant differences between students' mathematical problem-solving abilities before the pandemic and when the pandemic occurred are described in Table 4, including:

Table 4. Significant Differences in Students' Mathematical Problem-Solving Abilities

The significant difference in students' mathematical problem-solving abilities before the pandemic and during the pandemic	
❖ Lack of student motivation. ❖ Students' thinking ability. ❖ Before the pandemic, students were able to solve math problems with good steps, but during the pandemic, students were less able to neatly write information about the math problem. ❖ Many students make mistakes, in addition, subtraction, multiplication, and division operations. ❖ Before the pandemic, students' problem-solving abilities were quite good, after the pandemic, students were more concerned with the answers available in applications such as Branly or the like so that the problem-solving abilities of students decreased. ❖ The ability to reason and think critically. ❖ The ability of students is not better. ❖ The difference is in analyzing the problem, before the pandemic, students in the analyzing stage could discuss with their friends or teachers, but during this pandemic, students were less enthusiastic in completing the tasks given, especially in analyzing the problems given. ❖ Very drastically decreased. ❖ The media used during the learning process. ❖ Before the pandemic, students' problem-solving abilities could be seen clearly because learning took place in the classroom so that the teacher knew	❖ Reasoning in solving problems. ❖ Able to understand the problem. ❖ Students are slow in arithmetic operations due to long online learning. ❖ During a pandemic, in solving problems, students often guess at different solutions. ❖ Students have more difficulty understanding material during the pandemic because they study online, whereas before the pandemic students were quite good at solving math problems. ❖ During the pandemic, students were not focused on learning and solving problems before the pandemic, on the contrary, students were more focused on learning and could solve math problems. ❖ Students do not understand how to solve a mathematical problem. ❖ If they are online they are not free to ask if there is something they have not understood, but it is different from in-class they can ask questions until they understand the desired solution to the problem to the teacher or friends who already understand. ❖ Less effective learning methods when BDR or online schools make understanding problem solving difficult for students to understand. ❖ Understanding of the questions given. After the pandemic, students studied

which students understood and which did not. Meanwhile, during the pandemic, students' abilities cannot be fully trusted because there is a possibility that their assignments will be done with their parents. It was concluded that before the pandemic the students' abilities were better than during the pandemic. ❖ Students have difficulty understanding the questions. ❖ It's quite different because, during a pandemic, students understand better in solving problems directly, learning offline, but during a pandemic, they learn online. Sometimes it is the signal that decides the student's focus so that the student's problem-solving ability is reduced. ❖ Students are lazy to read story problems. ❖ Study time. ❖ Students become less active. ❖ Availability of time to learn practice questions so that the material studied by students is more complex.	online so that the delivery of the material was often hampered by network constraints and others. ❖ It seems that the understanding of the matter is not good. Learning online during a pandemic must be admittedly ineffective, due to reduced study time and communication problems between students and teachers that some students may experience in various regions. So that the opportunity for students to study the material in depth is reduced, this also happens because there is a reduction in basic competencies as the minimum achievement of students during the pandemic based on the candy about learning during the pandemic. ❖ The level of understanding is decreasing and the understanding that has been previously obtained quickly fades. ❖ Students are lazy to think when given new questions and even the questions are the same as the daily test questions that are tested during PTS (Mid-semester assessment) and PAS (End of semester assessment).

In addition to the teacher's perception of the differences in students' mathematical problem-solving abilities before the pandemic and during the pandemic, the following is in Figure 4 regarding the teacher's perception of the media/tools used to improve students' mathematical problem-solving skills before the pandemic and during the pandemic.

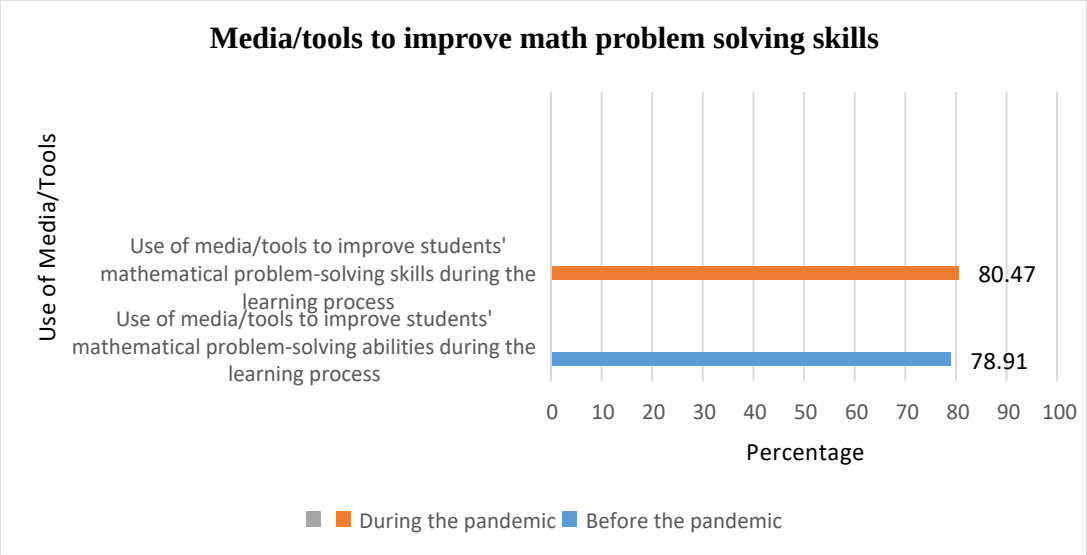

Figure 4. Teachers' Perceptions of The Use of Media/Tools to Improve Math Problem Solving Skills

In Figure 4, the percentage of teachers' perceptions of using media/tools to improve math problem-solving skills, namely before the pandemic period, teachers using media/tools to enhance students' math-solving abilities during the learning process were 78.91%, and during the pandemic period, teachers using media/tools to improve math problem-solving skills of the students during the learning process were 80.47%. The teacher's perception of the learning model or method used to improve students' mathematical problem-solving abilities before the pandemic is as follows in Table 5:

Table 5. Models Or Methods Used by Teachers to Improve Students' Mathematical Problem-Solving Skills Before the Pandemic

The model or method used by teachers to improve students' mathematical problem-solving skills before the pandemic	
❖ Problem-based learning ❖ Scientific ❖ Problem-solving method ❖ Props ❖ Cooperative learning and CTL ❖ Drill ❖ PMRI, RE ❖ Jigsaw ❖ Inquiry model ❖ Study in groups, using props on certain materials ❖ Quantum teaching	❖ Discovery learning ❖ Open-ended ❖ Question and answer ❖ A learning method that emphasizes a lot of practice questions in the school manual ❖ Direct learning model ❖ It can't be specific. The method used may be a more direct explanation from the teacher or class discussion. ❖ Lectures and discussions.

Based on Table 5, various models or learning methods are used to improve students' mathematical problem-solving skills, some of which are problem-solving methods, inquiry models, open-ended, question and answer, PMRI, jigsaw, CTL, cooperative, PBL, direct learning, and discovery learning.

Furthermore, the teacher's perception of the learning model or method used to improve students' mathematical problem-solving abilities during the pandemic is shown in Table 6 follows below:

Table 6. Models or methods used by teachers to improve students' mathematical problem-solving skills during a pandemic

Models or methods used by teachers to improve students' mathematical problem-solving skills during a pandemic	
❖ Learn online by giving assignments ❖ Online - learning videos ❖ Problem-solving ❖ Hybrid learning ❖ IT ❖ One of them is Blended learning using YouTube ❖ Scientific ❖ CTL ❖ Learning modules and learning videos, through one-way learning by watching videos that have been uploaded on personal YouTube ❖ Using Zoom including PowerPoint ❖ Scientific	❖ Independent study ❖ Problem-based learning ❖ Web-based Learning ❖ Discovery learning ❖ Lectures and discussions ❖ Project-Based Learning ❖ Learning methods that emphasize a lot of practice questions not only from school books but also from analyzing questions from the internet. ❖ Students learn online through Gmeet or WA (video or voice notes) so the methods or learning models used are often non-specific or even non-existent.

Based on Table 6, some teacher perceptions regarding the models or methods used to improve students' mathematical problem-solving skills during a pandemic include giving online assignments, making learning videos, zooming in with PowerPoint, blended learning using YouTube, hybrid learning, web-based learning, etc.

Teacher's Perception of Students' Difficulties in Solving Mathematical Problems

Many students have difficulty solving math problems. The following is in Table 7 the aspects that become difficulties for students based on teacher perceptions:

Table 7. Teachers' perceptions of students' difficulties in solving math problems

Students' difficulties in solving math problems	
❖ Determine what steps to use to solve the problem. ❖ The teacher uses too high a language when explaining. ❖ At the stage of working on the question. ❖ Quadratic equation material. ❖ The lack of literacy in students makes students less able to read the questions first. ❖ There are differences in the process of brain development of each child. ❖ Basic knowledge of mathematics.	❖ Students are difficult to understand the problems and lack of practicing math problems. ❖ Mastery of concepts or students' understanding of the problem. ❖ Students do not understand the context of the problem. ❖ Questions and answers and student self-discipline. ❖ Students are not familiar with problem-solving problems.

Based on Table 7, teacher perceptions related to students' difficulties in solving mathematical problems include problem understanding, concept mastery, planning and implementing problem-solving, students are not familiar with problem-solving problems, and others. Then, Table 8 also discusses the teacher's perception of the steps or actions that must be taken to improve student's problem-solving abilities during offline learning (before the pandemic) as follows:

Table 8. Teachers' Perceptions of the Efforts That Must Be Made to Improve Mathematical Problem-Solving Skills

Actions/steps that teachers must take to improve students' problem-solving skills during offline learning (before the pandemic)	
❖ Using a method or approach that invites students to find existing problems and be able to solve them. ❖ Approach students who do not understand. ❖ Provide a joint discussion of hard math problems. ❖ Focus on learning and how to learn. ❖ Teachers must change the way of teaching and motivate students to be more enthusiastic in doing math problems.	❖ The teacher gives many different types of questions. ❖ Teachers often give non-routine questions and use the guided discovery method. ❖ Re-checking their arithmetic operations. ❖ Take a certain approach to better know the students' problems first. ❖ Using a variety of learning methods that make students comfortable and happy to learn mathematics.

❖ Students must be taught to think for themselves and to solve problems based on context. ❖ Explain in simple language. ❖ Familiarize with problem solving problems using the PBL model in learning. ❖ By using simulations or by learning directly from real-world items. ❖ Understanding of concepts and lots of practice questions (case studies). ❖ Using the PMRI method. ❖ Creating interactive learning media. ❖ Varying media and teaching models ❖ The teacher increases the education of questions and their solutions.	❖ teachers use appropriate learning methods. ❖ Teachers should give more open-ended questions to students so they can think further so that there are many ways to solve math problems. ❖ The teacher participates in the MGMP regarding the discussion of HOTS questions. ❖ The teacher provides special skill-oriented learning. ❖ The teacher must use a prior approach to students, both an individual approach and the use of a learning approach. Apply the habit of reading (literacy) then do numeracy exercises.

Furthermore, Table 9 discusses the teacher's perception of the steps or actions that must be taken to improve student's problem-solving abilities during online learning (during a pandemic) as follows:

Table 9. Teachers' Perceptions of the Efforts That Must Be Made to Improve Mathematical Problem-Solving Skills

Teachers' perceptions of the efforts that must be made to improve mathematical problem-solving skills during the pandemic	
❖ The teacher gives assignments that can improve students' abilities. ❖ The teacher makes ICT-based learning media. ❖ The teacher explains through the video. ❖ Teachers make the learning process more meaningful and guided. ❖ Teachers must actively provide material in the form of soft files, give some practice questions, as well as motivate students to be more enthusiastic in working on math problems. ❖ The teacher gives a lot of quizzes.	❖ Adjusting student conditions, because students can only use group WA as a learning tool. This causes learning, especially mathematics, to be difficult to do. ❖ Using methods/models that are appropriate to the environment/conditions where students live. ❖ Conducting face-to-face learning is limited because students find it more difficult to solve math problems when studying online.

❖ The teacher often gives questions. ❖ Learn attractively with media/tools. ❖ The teacher gives non-routine questions for practice. ❖ Teachers must be able to use learning methods that support students in terms of improving problem-solving. ❖ The teacher gives examples of reasoning questions. ❖ Aiming at learning videos. ❖ Learning modules and question and answer media, which are adequate. ❖ Improving the ability of teachers in the IT field, especially the use of learning applications. ❖ Give a habit to students so that students will easily remember, such as reading habits (literacy) and numeracy. ❖ Provide learning videos on each material to be studied. ❖ The teacher often gives practice questions (case studies). ❖ The teacher uses interesting and relevant media.	❖ The teacher uses a method that is suitable for the student's condition. ❖ Immediately carry out offline learning. ❖ Take a webinar about Troubleshooting. ❖ Use of supportive media for online learning. ❖ Be more serious when learning so that students' understanding is maximized. ❖ Familiarize with problem-solving problems. Using problem-based learning in learning, and using interesting online learning media with learning resources that are easily accessible to students. ❖ Use as much as possible existing technology and use the environment as a learning medium. ❖ The teacher invites students to be creative by direct practice to real objects such as making cubes for lanterns. ❖ Understand the problem and its important points. ❖ Creative teachers in packaging learning to be easy to understand and not boring.

Discussion

Based on the results of the research that has been presented above, the teacher's perception of mathematical problem-solving abilities as measured by the Polya stages ranges from 63% to 77%. Polya's stages in this study include 4 stages, including understanding the problem, planning problem solving, implementing problem-solving, and re-examining (Polya, 1973). The research by Zakiyah et.al (2019) showed that students' mathematical problem-solving abilities ranged from 50.53% to 94.74%. In addition, Fitriani's research (2020) shows that the percentage of students' mathematical problem-solving abilities starting from the stage of

understanding the problem, planning, implementing, and re-examining is 56.72% to 90.44%. Furthermore, Afandi et.al's research (2020) shows that the percentage of mathematical problem-solving abilities based on the Polya stage is 5.36% - 76.79%. While the research by Sari et.al (2021) presented the results that the ability to solve mathematical problems according to the Polya stage was categorized into 5 levels, namely very good, good, quite good, not good, and bad. The percentages of these five categories in each stage of Polya in this study include the stages of understanding the problem which has a percentage ranging from 0% to 40.57% and the stages of problem-solving planning whose percentage ranges from 5.79% to 28.98%. Furthermore, at the stage of carrying out problem-solving, the percentage ranges from 5.79% to 42.02%. Then, the percentage at the re-examination (evaluation) stage is 2.89% - 62.31%. In addition, based on research that has been done, shows that there are differences in students' mathematical problem-solving abilities during online and offline learning. The difference lies in the media/tools used in the learning process, the methods or models used during the learning process, and the efforts or actions that must be taken by the teacher in improving students' mathematical problem-solving abilities before the pandemic and during the pandemic.

Conclusion

Based on research that has been done that teachers' perceptions of students' mathematical problem-solving abilities in schools in Sumatra are as follows: Stages of understanding the problem, students often understand the problem well from the math problems given 66.41% and students often write down important information from the questions given 71.88% ; Stages of planning completion, students can plan problem-solving well when given 66.41% of questions and students often write formulas or steps in solving problems 75.78% ; Stages of problem-solving, students can solve problems or questions given 70.31% and students can perform operations in solving problems or questions given 76.56% ; Stages of re-checking, students often re-examine each stage in solving problems or questions given 64.06% and students often analyze the problem-solving process that they do whether it is correct 63.28% ; The percentage of teachers' perceptions of differences in mathematical problem-solving abilities before the pandemic and during the pandemic was 90.63%, meaning that there was a significant change between students' mathematical problem-solving abilities before the pandemic and during the pandemic ; Furthermore, this research has limitations in certain cases such as the perception of teachers in Sumatra, so this research cannot generalize as a whole.

Recommendations

Based on the results of this study, more in-depth research can be conducted on similar research by adding variables such as age and gender factors. Then, other researchers can conduct the same research on the perception of mathematics teachers on students' mathematical problem-solving abilities in other areas such as Java, Kalimantan, Sulawesi, Papua, or even covering the whole of Indonesia.

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Conceptual Misunderstanding in Senior High School Algebra among Senior High School Mathematics Teachers', Prospective Teachers' and Students

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Abstract: This study aimed at exploring Senior High School Mathematic Teachers, Prospective Teachers and Student's conceptual misunderstanding on Senior High School algebra with an intent to uncover the errors they make as a result of conceptual misunderstanding. A test consisting of fourteen (14) tasks was used for data collection. A sample of 210 consisting of sixty (60) prospective senior high school mathematics Teachers from mathematics education department of University of Education Winneba forty (40) SHS mathematics teachers and one hundred and ten (110) senior high school students from four (4) selected senior high schools in Ashanti region of Ghana. The study employed convenience, purposive and simple random sampling as sampling techniques and descriptive survey design as the research design. The data collection tools used were test and semi structured interview guide. Constructivism and behaviourism theories were employed as the theoretical frame work for the study. The study identified seven (7) categories of conceptual misunderstanding in Senior High School algebra among the prospective teachers and the students' whiles six of these seven were also found among the teachers. The seven conceptual misunderstanding identified were on algebraic variables, algebraic expressions, algebraic equations and algebraic word problems. The study recommends that teachers, prospective teachers and students should be aware of the existence of conceptual misunderstanding in teaching and learning of algebraic concept. The study also recommends that, heads of schools should organize workshops and refresher courses for mathematics teachers on sensitive topics like conceptual misunderstandings in mathematics.

Keywords: Conceptual Misunderstanding, Algebra, High School, Mathematics

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Introduction

The relevance of mathematics in one's life as an individual, society and national development cannot be undermined (Fletcher, 2016). According to Fletcher (2016), difficulty in mathematics is a serious issue. Success or failure in mathematics at school has a decisive influence on the choice of further education and career. Algebra is a branch of mathematics that is one of the major areas covered to enhance the acquisition of mathematical knowledge. Difficulty in algebra affects performance in mathematics since algebra is said to be the mother of mathematics. There have been several studies (internationally, continentally and locally) on errors and conceptual misunderstanding on algebra (Olivier, 1989; Allen, 2007; Egodawatte, 2011; Makonya, 2011; Chamundeswari, 2014; Makhubele, 2014; Mutunge 2016; Adu, Asuah & Asiedu-Addo, 2015; Adu, 2016; Bintu 2018), these studies aimed at addressing the issue of errors and conceptual misunderstanding in algebra that affect mathematics performance. Most of these studies focused on only students alone and very few were on prospective teachers (on pedagogical content knowledge) and on teachers (teaching methods). They also considered one or two aspects of algebra (i.e., either on algebraic variable or, expression, or equation or in word problem).

Allen (2007) in students thinking found that students' conceptual misunderstanding in algebra is one facet of mathematics in general. Certain conceptual relations that are acquired may be inappropriate within a certain context. Such relations are termed as conceptual misunderstandings and these may be due to inaccurate or incorrect thinking. In turn, student conceptual misunderstandings cause teachers' immense frustration about why their teaching isn't getting through. Conceptual misunderstandings, once rooted in the student's memory, are hard to ease. It is very important to organize student conceptual misunderstandings and re-educate students to correct mathematical thinking (Zwart et al., 2017, 2020, 2021, 2022). Conceptual misunderstandings in mathematics by students are in, Arithmetic, Number sense, Exact verse approximate, Fractions, Magnitude for negative numbers, Order of operations, Powers, Square roots – definition, Square roots – with sums, Simplification/factorization of algebraic expressions, Using the definition of the absolute value function, particularly for negative numbers, inequalities, Expansion of algebraic expressions, Exponential – properties, Exponential functions, Logarithm – Properties, Logarithm – solving equations, Functions, Functions – asymptotes, Translational errors. Some of the difficulties students have on simplification of fractions include: Incorrect cancelling of $\frac{ab+c}{b}$ to obtain $a+c$ and mmisunderstanding of "invert and multiply" rule for dividing fractions.

Egodawatte (2011) also found that, most students have difficulty in identifying like terms in algebraic fractions simplification. Example of wrong simplification carried out was when students simplifying $\frac{xa+xb}{x+xd}$ was $\frac{xa+xb}{x+xd}=\frac{a+b}{d}$, Instead of $\frac{xa+xb}{x+xd}=\frac{x(a+b)}{x(1+d)}=\frac{a+b}{1+b}$. According to Egodawatte, the wrong simplification was as a result of conceptual misunderstanding students have on algebraic fractions.

Mangrosi et al (2014) researched students' conception of algebraic properties and their effect on performance in algebra. Their research aimed at investigating the conception of senior high school students of selected public schools in the province of Maguindanao and Lanao del Sur. Their study which used the qualitative-quantitative design on forty-four students as primary participants, one of their findings was that the students showed common patterns of misconceptions in algebraic properties such as misreading and unfamiliarity of terms of the concept in algebra. They concluded that misconception of algebra in like terms identification also contributes to students' poor performance in algebra, hence in mathematics. According to STR (1997), conceptual misunderstandings arise when students are taught scientific information in a way that does not provoke them to confront paradoxes and conflicts resulting from their preconceived notions and non-scientific beliefs. To deal with their confusion, students construct faulty models that usually are so weak that the students themselves are insecure about the concepts. For example, a student might believe that objects float in water because they are lighter than the water.

The West Africa Examination Council (WAEC) chief examiner's report on mathematics performance (2014 and 2015) also shown that students normally make errors which depict some form of conceptual misunderstanding in answering algebraic problems. Examples of such conceptual misunderstanding in simplifying algebraic fraction is: $\left(4\frac{3}{5}-1\frac{5}{6}\right)\div 1\frac{1}{24}\times\left(1\frac{2}{3}+2\frac{1}{2}\right)$.In the simplification, they were not able to convert the mixed fractions into improper fractions and manipulated them correctly.

The observation by the researcher through literature, classroom observation and diagnostic test on errors in algebraic concepts which depict conceptual misunderstanding such as converting mixed fractions to improper fraction ($3\frac{1}{2}=3\times\frac{1}{2}=\frac{3\times1}{2}=\frac{3}{2}$.), simplification of algebraic expressions and equations was the rational that motivated the researcher to carry out this study.

Methodology

This study used the descriptive survey design to investigate senior high school mathematics teachers, prospective teachers' and students' conceptual misunderstanding in senior high school algebra. Convenience, purposive and simple random sampling were employed as sampling techniques. The sample involves one hundred and ten (110) second-year senior high schools' students, forty (40) SHS mathematics teachers in four selected senior high schools in Kumasi metropolis and Ejisu municipal in Ashanti region of Ghana and sixty (60) final year (level 400) in the Department of Mathematics Education of the University of Education, Winneba (UEW).

The diagnostic algebraic test was the main test instrument for the study. A 2 hours diagnostic algebraic test consisting of 14 items were administered to the one hundred and ten (110) students and the sixty (60)

prospective teachers to answer after which photocopies of the solution scripts were given to the teachers to mark using their prepared marking scheme. The answered test papers from the students and the prospective teachers, and the marking schemes prepared by the teachers were marked and analyzed. The test items and errors found were identified. These errors were scrutinized and analyzed to determine the ones due to conceptual misunderstanding. A sample of five (5) students, three (3) prospective teachers and two (2) teachers were interviewed. The interview was conducted as another means which helped in confirmation of an error as a conceptual misunderstanding or carelessness (mistake/ slip). The findings were presented and discussed.

Findings

The analysis revealed seven categories of conceptual misunderstanding that were prevalent among teachers, prospective teachers and students. These were

1. Recognizing or thinking of like terms as different terms in tasks involving simplification of algebraic fractions

The analysis revealed that 28% of the prospective teachers and 48% of the students depicted this form of conceptual misunderstanding on task 1 and 2. Tasks 1 and 2 of the tests (see Box 1) required the participants to recognize that the terms in the algebraic fractions (terms in both the numerator and denominator) are the same, hence in their simplification they only have to cancel out to obtain the answer 1.

(1) $\frac{2x}{2x} = \frac{\cancel{2x}}{\cancel{2x}} = 1$ (2) $\frac{2+x}{2+x} = \frac{\cancel{2+x}}{\cancel{2+x}} = 1$

The participants who demonstrated conceptual misunderstanding in recognizing or thinking of like terms as different terms in tasks involving simplification of algebraic fractions used different methods to do the tasks. Examples of their solutions and reasons to their procedure;

Participants A wrote. $\frac{2x}{2x} = \frac{2x}{2x} \times \frac{2x}{2x}$ and $\frac{2+x}{2+x} = \frac{2+x}{2+x} \times \frac{2+x}{2+x}$

Interviewer: Can you e*xplain your procedure?*

Participants: Yes *"it is an algebraic fraction, and to simplify it, one needs to rationalize the denominator hence the multiplication of both the numerator and the denominator by 2x in 1 and 2+x in 2."*

Participants B wrote $\frac{2x}{2x} = (2x) \div (2x) = (2x)(-2x) = -4x^2$.

Interviewer: Can you e*xplain your solution?*

Participants: *"The division was changed into multiplication, and then simplified. In changing division into multiplication, the denominator becomes negative"*

Participant C wrote $\frac{2+x}{2+x} = (2 + x) \div (2 + x) = (2 + x)(-2 - x) = -(x^2 + 4x + 4)$.

Interviewer: Can you e*xplain your solution?*

Participant: *"The division was changed into multiplication, and then binomial expression was expanded"*

2. Seeing or thinking of algebraic variables as symbols which are only assigned to names or labels or constants

75% of Students, 57% of Prospective teachers and 15% of Teachers of the participants demonstrated this form of conceptual misunderstanding.

The solutions from the participants on task 3 is shown below.

Task 3: $Simplify \quad x\left(\frac{a}{b}\right)$

Participant A wrote $x\left(\frac{a}{b}\right) = \frac{ax}{bx} = \frac{a}{b}$.

Interviewer: Can you e*xplain your answer?*

Participants: *"the bracket can be removed by multiplying through by the x outside the bracket and this is done by multiplied both the numerator and the denominator by the* x*"*.

Other solutions on task 3 were;

Participant B wrote $x\left(\frac{a}{b}\right) = \frac{xb+a}{b}$.

Interviewer: Can you e*xplain your answer?*

Response: $x\left(\frac{a}{b}\right)$ *can be simplified by finding the L.C.M for the denominators 1 and b which is b. after finding the LCM you continue to the simplification to obtain* $\left(\frac{xb+a}{b}\right)$

Participant C wrote $x\left(\frac{a}{b}\right) = \frac{a^x}{b^x}$.

Interviewer: Can you e*xplain your answer?*

Response C: $x\left(\frac{a}{b}\right)$ *is the same as* $\left(\frac{a}{b}\right)^x$ *so removing the bracket will be expanded as* $\frac{a^x}{b^x}$

Participant D and E wrote $x\left(\frac{a}{b}\right) = \frac{ax}{b}$ and then simplified it further as $\frac{ax}{b} \Rightarrow x = \frac{a}{b}$.

Interviewer: Can you e*xplain your solution?*

Response: I compared left hand side and right-hand side of the equation $x\left(\frac{a}{b}\right) = \left(\frac{ax}{b}\right)$ to obtain $x = \frac{a}{b}$.

3. Seeing or thinking of algebraic variables as symbols which are only assigned to names or labels or constants

77% of Students, 65% of Prospective teachers and 15% of Teachers showed this for of conceptual misunderstanding after the analysis.

Tasks 4, and 5 of the test required the participants to recognize that the variables in the tasks represent a varying quantity or a unit. Some participants had them wrong largely because they think of algebraic variables as symbols which are only assigned to names. Example were;

Task 4: Bernice sells x *oranges*, Priscilla sells three times as many oranges as Bernice. An orange cost $GH₵0.25$. If the oranges are of the same size; *a)* how many variables can be formed from this problem? b) give the name/s of the variable

Participant wrote $Bernice = x \text{ and } Priscilla = y$

Interviewer: Can you e*xplain your answer?*

Response: "*x should represent the name Bernice while y represents the name Priscilla for names in a question should take variables in other to simplify"*

Task 5: A shirt cost c cedis each and a pair of shoe cost d cedis if Mr. Appiah buys 5 shirts and 4 pairs of shoes. Explain what $5c + 4d$ means or represent? And simplify further if possible

Participant wrote $c = shirt,\ d = shoes\ \ hence,\ 5c + 4d = 9cd$

Interviewer: Can you e*xplain your answer?*

Response: *"9cd means 9 items bought comprising of shirts and shoes"*

Other solutions include;

Participant wrote: $5c + 4d = 9(c + d)$.

Interviewer: Can you e*xplain how you arrive at this answer?*

Participant: *"*$\mathbf{5}c + \mathbf{4}d$ *can be simplified further by first grouping like terms. So the numbers part were grouped by adding 4 to 5 (4+5) to get 9 and the variables were also grouped by adding c and d to get* $c + d$ *, but* $c + d$ *cannot be simplified further because they are different variables and it cannot be added".*

Participant wrote: $5c + 4d = 9cd$.

Interviewer: Can you e*xplain your answer?*

Participant: *I added the numbers 4+5 to get 9 and simplify* $c + d$ *further to obtained cd because adding c and d will give you cd*

4. Using arithmetic reasoning in mathematizing algebraic expression.

63% of Students, 52% of Prospective teachers and 15% of Teachers see mathematical equation as similar to mathematical expression.

In these tasks (6, 7 and 8) the participants are required to, expand or explain or form a mathematical expression to arrive at correct solution.

Task 6: Explaining what xy means

Participant wrote: $xy\ is\ an\ equation$

Interviewer: Can you e*xplain your answer?*

Response; *"because there are two different variables involve. That is whenever there are two variables irrespective of the sign (+, −, ×, ÷) between them it is an equation".*

Task 7: Expand and simplify $(P - Q)^2$ if possible

Participant wrote $(P - Q)^2 = (P - Q)(P - Q) = 0 \Rightarrow (P - Q) = 0 \ \therefore P = Q$

Interviewer: Can you e*xplain your answer?*

Participant: *"$(P-Q)^2$ is the same as $(P-Q)^2=0$*

After equating it to zero, I expanded the LHS and continued the simplification"

Other Solutions were:

Task 8: Kofi's age is subtracted from ten and the result is multiplied by two. Write the expression for the statement

Participant wrote $2x-10=x-2 \Rightarrow x=8$

Participant wrote $10-x=2x \Rightarrow x=\frac{10}{3}$

Participant wrote $10-x=0 \Rightarrow x=10$

Interviewer: Can you e*xplain your answer?*

Participants: *To find the age an equation must be formed*

5. Using arithmetic reasoning in interpreting algebraic expression.

90% of the students, 84% of the Prospective Teachers and 20% of the Teachers used arithmetic reasoning in mathematizing algebraic expression.

Tasks 9 and 10 required the participants to recognize the relational relationship and equivalency in variables when mathematizing word problem. Those with wrong solutions largely because they use arithmetic reasoning in mathematizing algebraic expressions. Example of such solutions were;

Task 9: Mr. Asare shared some money to his two sons and a daughter, Ben, John and Mary. Mary received 5 times the amount than Ben, and 4 less than John received. The amount received by Ben and John is Gh₵ 22.00. How much did Mr. Asare gives to each child

Participant wrote: *Ben*; *John*; *Mary* in a ratio of $x:5x-4:5x$

Interviewer: Can you e*xplain your answer?*

Participants: *"the cue word "sharing" calls for the use of the concept ratio and proportion and there are three people sharing money, hence the ratios".*

Task 10: Mr. Adu bought 8 books and 12 pens from a shop. A book cost him Gh₵ 0.50 more than a pen. If he spent GH₵ 94 altogether, how much did a book and a pen cost

Participant wrote: "More than (>), hence" $8x > 12$

Interviewer: Can you e*xplain your answer?*

Participants: *"The symbol was from, the cue word 'more than' because 'more than' symbolically represent " >" in mathematics"*

6. Using arithmetic reasoning in interpreting algebraic expression.

85% of the students, 61% of the Prospective Teachers and 7.5% of the Teachers used arithmetic reasoning in interpreting algebraic expression.

Tasks 11 and 12 required the participants to recognize the relational relationship and equivalency in interpreting algebraic expression. Those with wrong solution largely because they use arithmetic reasoning in interpreting algebraic expressions. Examples of their solutions due to this conceptual misunderstanding includes the following;

Task 11: When a number is subtracted from six, the result is two times five less than the number. Find the number

Participants wrote: $let\ the\ number\ be\ x, hence\ x - 6 = 2 \times 5 < x$

Interviewer: Can you e*xplain your answer?*

Participants: *"The word problem was translated base on some cue words (like less than;<) in the statements and according to the order these words appear in the statement"*

Task 12: The letter n represent a natural number given $\frac{1}{n}$ and $\frac{1}{n-1}$ which one is more? Explain your answer

Participants wrote $\frac{1}{n} > \frac{1}{n-1};\ becuase\ n > n - 1$

Interviewer: Can you e*xplain your answer?*

Participants:." *is because n being a natural number say 8* $(n = 8)$*, is greater than* $n - 1$ *(8-1=7)"*

7. Seeing or thinking an equal sign as only a step marker to indicate the next step of procedure.

81% of the students, 45% of the Prospective Teacher and 35% of the Teachers sees equal sign as only a step marker to indicate the next step of procedure.

Tasks 13 and 14 required the participants to recognize the equivalence property of the equal sign in simplification. Those with wrong solution largely because they see the equal sign as a step maker to indicate the next step of procedure.

Task 13: $a = \sqrt[3]{\frac{y}{5}} = \left(\sqrt[3]{\frac{y}{5}}\right)^3 = \frac{y}{5}, \ \therefore y = 5a$

Interviewer: Can you e*xplain your answer?*

Participants: *"in solving, the cube root at the RHS was remove by raising it to the power of 3"*.

Task 14: Find the value of *x* $if \sqrt{(x^2+9)} = 5$

Participant wrote $5 = \sqrt{x^2+3^2}$

$5 = (\sqrt{(x+3)(x-3)}\,)^2$

$5 = (x+3)(x-3) \Rightarrow x = 3, \ x = 8$

Interviewer: Can you e*xplain your answer?*

Participants: *"solving for the variable, I removed the square root sign at the RHS of the equation by squaring that side and continued with the simplification"*.

Discussion

The algebraic tasks 1 and 2 required the participants to recognize that the terms in the algebraic fractions (terms in both the numerator and denominator) are the same, hence in their simplification they only have to cancel out to obtain the answer 1. Most of the students and the prospective teachers in their simplification recognize that the like terms in the algebraic fraction were different and this conceptual misunderstanding led to the use of

different methods which were wrong in the simplification of tasks. Some participants used rationalization of denominator in their simplification whiles others employed domain determination for algebraic fractions and concept of modulo arithmetic as well as other forms of simplifications which were wrong methods on these tasks. The solution process and their reasons given based on the interview revealed their conceptual misunderstanding on these concepts. Example was rewriting of $\frac{2+x}{2+x}$ **as** $\frac{2}{2}+\frac{x}{x}$ was from $\mathbf{3}\frac{\mathbf{2}}{\mathbf{5}} = \mathbf{3}+\frac{\mathbf{2}}{\mathbf{5}}$. All these wrong simplification methods used by the participants on the algebraic fraction with like terms was as result of incorrect separation of terms in algebraic expression (Matz, 1980; Allen, 2007; Egodawatte (2011).

Task 3 which required the participants to recognize that the variable *x* is of denominator one, hence in their simplification they only have to multiply the *x* by the numerator *a* to get the correct answer. The wrong method used in their working was due to the conceptual misunderstanding of not recognizing that the denominator of the variable *x* is 1. For correct solution one need to apply the concept of multiplying two fractions where by the numerators and denominators are multiplied separately. In the inquiry to the process in the simplification as $x\left(\frac{a}{b}\right) = \frac{ax}{bx} = \frac{a}{b}$, It was observed that the variable x is taken as a scalar and $\frac{a}{b}$ as a vector, so the concept of scalar multiplication of vector was wrongly applied to this context. This happened because these participants were not able to identify the difference between (a, b) and $\frac{a}{b}$. According to Egodawatte (2011), when algebraic fraction has to be multiplied by a variable, students often use cross multiplication although it is not appropriate.

The simplification of tasks 4 and 5 required the students, prospective teachers and the teachers to recognize that the variable in these tasks represent a varying quantity or a unit but wrong methods were employed due to their conceptual misunderstanding of seeing algebraic variables as symbols which are only assigned to names, or labels or constants. The simplification made on task 5 as $\mathbf{5}c+\mathbf{4}d=\mathbf{9}(c+d)$ **and** $\mathbf{5}c+\mathbf{4}d=\mathbf{9}cd$ by some of the participants reveal that they may have drawn on previous knowledge or other subjects that do not differentiate between joining and adding such as adding oxygen to carbon gives CO_2 in chemistry (Kurian,1990). Also, there is a conceptual misunderstanding that expression $c+d$ or $x+y$ cannot be the final answer hence the need to simplify the expression further. Thus *c+d* as an incomplete answer (Booth,1988). Also, the letters *x* and *y* were assigned to the names Bernice and Priscilla whiles *c* and *d* were also assign to shirt and shoe because a variable can only represent a label or name or thing but not a task.

The wrong solutions to tasks 6, 7 and 8 by the participants was as a result of the conceptual misunderstanding of seeing mathematical expressions as similar to mathematical equations. The solutions "*xy being an equation"* and the simplification $(P-Q)^2 = (P-Q)(P-Q) = 0 \Rightarrow (P-Q) = 0 \ \therefore P = Q$ shows the difficulty in differentiating between algebraic equation and algebraic expression stated by Allen (2007). The explanation on task 8 that *"the equations were formed because it is the only way to evaluate the variable''* depict their conceptual misunderstanding on equation and expression.

The fifth conceptual misunderstanding identified that 90% of the students, 84% of the prospective teachers and 20% of the teachers used arithmetic reasoning to mathematize algebraic expressions when answering tasks 9 and 10. On this conceptual misunderstanding, most of the reasons by the participants to their solutions were based on some words as cue in the mathematizing algebraic expression and more of these cue words in their mathematizing was incorrect. For example, five times a number is eight more than the number, find the number? Stating $5x > 8$ because of the cue word "more than" is incorrect arithmetic reasoning. The sixth conceptual misunderstanding identified was using arithmetic reasoning in interpreting algebraic expression on tasks 11 and 12. 85% of the students, 61% of the prospective teachers and 10 % of the teachers used arithmetic reasoning in interpreting algebraic expression. Some of the reasons for their answers were as a result of static and syntactic translation (Clement, 1982) and assigning of mathematical symbols to some words. The seventh conceptual misunderstanding identified was seeing or thinking the equal sign as only a step marker to indicate the next step of procedure on tasks 13 and 14. 81% of the students, 45% of the prospective teachers and 35% of the teachers were not able to get correct solution because they did not see the equivalence property of the equal sign, hence in simplifying this task only one side of the equation was considered. This suggests the aspects of arithmetic instruction which is contributing to their difficulties in algebra.

Conclusion

It can be concluded based on the findings from this study that senior high school teachers, prospective teachers and student have some conceptual misunderstanding on senior high school algebra. Six (6) out of the seven (7) conceptual misunderstanding identified among the students and the prospective mathematics teacher were with the in-service teachers. The observed consistency between students', prospective teachers and teachers' conceptual misunderstanding is likely to influence the teaching that many students experience in learning algebra. The results of this study indicated that the prospective teachers and some teachers' conceptual understanding of algebra is not good enough to assist learners to understand algebra. The ability to teach and apply their algebraic concepts clearly without conceptual misunderstanding was limited.

The study consistently indicate that conceptual misunderstanding is deeply-seated and not easily removed. In many instances, learners appear to overcome a conceptual misunderstanding only to have the same conceptual misunderstanding reappear later. This is probably a result of the fact that, when individuals construct learning, they become attached to the notions they have constructed.

Recommendations

One important requirement in eliminating those conceptual misunderstandings is that learners must actively participate in the process of overcoming their conceptual misunderstanding. For the conceptual misunderstanding to be eliminated completely, it is essential that in teaching algebraic concepts, teachers should

be aware of possible conceptual misunderstandings student may have and also provide students with classroom learning environments that help them develop both conceptual and procedural knowledge so that they construct correct conceptions right from the start to the end of the concept.

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The Use of Gamification and Digital Activities in A Foreign Language Online Class

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Abstract: Since the covid 19 Pandemic and the developing of online teaching, it was important to find some alternative teaching solutions to keep the learners motivated and focused on their learning processes. In this purpose, gamification, mainly *Kahoot*, as well as some digital activities were introduced in my French as a foreign language course. The aim of this study is to examine the students' attitude and perception regarding the use of *Kahoot* and digital activities. This study is undertaken in a French language elective course at the university. 160 beginner students are enrolled. The study implements a survey approach that regroups quantitative and qualitative data collected from a 24-question-questionnaire. The results show that a big portion of the respondents like using *Kahoot* as it brings fun, challenge and motivation to the class. The digital activities are appreciated as well as they permit to the students to have more practice.

Keywords: Gamification, Kahoot, Digital activities, Online teaching, French as a foreign language.

Introduction

Many educational institutions moved to the online teaching after the Covid-19 Pandemic. One of the biggest challenges we have to face is keeping the learners engaged in their learning processes. Case studies, flipped learning, social media, gamification are new methods of non-traditional teaching (Safapour, Kermanshachi & Taneja, 2019). They all aim to make students more active in their learning process.

In my French as a foreign language (FFL) elective class at the university, the flipped learning methodology was implemented. In order to motivate the students to prepare for the session, gamification was introduced as well. The game-based student respondent system *Kahoot* was used on regular basis as well as some digital activities that were created to help the students practicing more.

In this presentation, I will focus on the learners' attitude and perception regarding the gamification used in class (*Kahoot*) and outside the class (the digital activities). First, I will start by presenting the gamification, and review some studies that focused on the use of *Kahoot*. Then, I will present the questionnaire given to my

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students to assess the learners' approach regarding *Kahoot* and the digital activities I created. Next, I will present the results. Finally, I will discuss the results and present some recommendations for further research.

Gamification and digital activities

Definition

Gamification is usually identified as '*the use of game-design elements in non-game context*" p.2425 (Deterding, Sicart, Nacke, O'Hara, & Dixon, 2011). The puspose is to "*improve user experience and user engagement in non-game services and applications*" (p.2426) (Deterding, Sicart, Nacke, O'Hara, & Dixon, 2011). It was first introduced in marketing and then in education to teach different subjects as pharmacy (Jones & Wisniewski, 2019), economics (Wardoyo, 2021), maths (Jagušt, Botički, & So, 2018), social and civic skills (Campillo-Ferrer, Miralles-Martínez, & Sánchez-Ibáñez, 2020) and languages (Ebadi, Rasouli, & Mohamadi, 2021).

Gamification involves the integratiom of game patterns in educational context (Buckley & Doyle, 2016). A variety of forms of gamification can be used in education: narratives to change the context around a typical activity, social competition, incentivizing through pontification, leaderboard, are some examples of games the learners can play (Hanus & Fox, 2015). The leaderboard shared with all the players creates a competitive atmosphere. Indeed, the ranking system motivates the participants that can see immediately their effort rewarded (Buckley & Doyle, 2016). The reward system is a part of the game. Each learner/player receives a reward for achiving a goal or passing to an upper level (Buckley & Doyle, 2016). Not only rewards but different game mechanics can be applied in teaching and learning such as points, levels, progression, notification (as acknowledgment of successfully completed) (Mohamad, Salam, & Bakar, 2017).

While playing, learners can go through a wide range of emotions: frustration, pride, joy, optimism (Lee & Hammer, 2011). Gamification is linked not only to success but to failure as well, however, giving prompt feedback to the learner, allowing him/her to play again as many times as needed, helps to maintain a "positive relationship with failure" (p. 1164) (Buckley & Doyle, 2016) which is not considered as and ending anymore but as a step in the learning process.

Literature Review

Many studies revealed the positif effect of gamification in the learning process. Some sholars (Buckley & Doyle, 2016) note that gamified learning has a positif impact on students' learning, However, the students motivation (intrinsically and extrasically) has an important impact on the results. In another study conducted with English language learners, (Hwang, Hsu, Lai, & Hsueh, 2017) note that the gaming methodology benefited the students at 2 levels: their learning achivement and also their motivation. In flipped learning classes, (Huang, Hew, & Lo, 2019) notice that students that had gamified learning had better results. Besides, the gamification enhance students engagement as students were more likely to complete the pre-class activities. However, some

studies recommand not to use gamification permanently (Sanchez, Langer & Kaur 2020). The "wear out effect" can reduce the students' engagement (Wang, 2015).

Many platforms are available online, most of them for free, to help instructors introducing gamification in their classes. Quizzlet, Socrative, PollEverywhere and *Kahoot* are some examples. Many studies conducted on the use of *Kahoot* highlite the positif effect of the platform on the classes. (Wang, Zhu, & Sætre, 2016) notice a significant improvement in the student's motivation, engagement, concentration and enjoyment. However, they did not find any significant improvement in the learning process.

Several advantages of *Kahoot* are mentioned by (Campillo-Ferrer, Miralles-Martínez & Sánchez-Ibáñez, 2020): It encourages creativity, increases students motivation and engagement, contributes to a better understanding of the content (social and Civil skills), has a friendly user interface / easy to use. Besides, it is easily accessible (laptop, phone, etc.) and allows a synchronous interaction. The scholars also note that this game improves concentration and helps the users to revise the learning content. Students who play *Kahoot* often have better results. Nevertheless, using *Kahoot* in class brings some extra work for teachers that have also to integrate the digital content into the lesson plans. The authors mention also that not all students like to play an active role in class. A fear of making mistakes in public may block some students. In addition, (Licorish, Owen, & George, 2018) notice that the use of *Kahoot* in the class improve students' learning experience. Students are less distracted and more engaged. In another study conducted on 54 students larning English for media and using *Kahoot* weekly during 14 weeks, (Tan Ai Lin, Ganapathy, & Kaur, 2018) note that *kahoot* reinforced the students' knowledge, challanged the learners and captivated them.

Another learning application available for free on internet is *LearningApps.org*. It allows the creation of different activities such as word matching, crosswords, ordering, the millionaire, etc. The instructor can create a wide panel of activities and can chose how to reward the students: points, levels, forbid moving to the next question unless you give a correct answer, smiles, feedback, incentive sentence, congratulation, etc. Learners can fail and repeat, restart and play again (Hanus, Fox, 2015). This possibility to repeat and solve again increases their engagement (Lee & Hammer, 2011). Besides, it allows the students with low participation in class to do online activities with gamification techniques (da Rocha Seixas, Gomes, & de Melo Filho, 2016).

Methods

Participants

160 students enrolled in my French language course in Fall 21 (some of them dropped the course). This university elective course is a foreign language course for beginners and remains a full semester (we met twice a week during 15 weeks). The classes are given online. Flipped learning methodology is applied in this course: students prepare the content of the course before the session. They have to solve some Preparatory Activities

(PA) before attending the session. Once we meet, we practice and focus on their questions and the difficulties they are facing.

During the semester, students prepared 20 PA. They had one session on *Kahoot* at the beginning of the class to check if they prepared the PA and if they understood and to check their weaknesses (questions are from the PA). A second quiz on *Kahoot* comes at the end of the class (questions are from the practise). A five-question quiz was presented at each session on *Kahoot*. Students had 30 seconds to answer to each question while listening to a motivating music. Each student gets immediately feedback on the correctness of the answer given, the points earned and the ranking. At the end of the game, the names of the five top students and the total points earned appear on a leaderboard and are shared with everyone. The forty-two *Kahoot* games presented (40 quizzes linked to specific content and 2 revision sessions made of 15 questions each) have not been made public to encourage the students to play during our class time. As the classes are recorded, students can watch the games again (but not play them another time).

On another hand, 25 Digital Activities (DA) have been created (7 in Liveworksheets / 18 in LearningApps). Students were free to solve the ones they wanted, whenever they desired and as many times as they needed. They are available in the Discussion forum on the MLS we are using to offer the online course, Blackboard.

Purpose of the study

The purpose of this study is to assess the learners' experience regarding *kahoot* and digital activities used in the course. Two research questions are set:

RQ 1: What are the students' attitude and perception regarding Kahoot?

RQ2: What are the students' attitude and perception regarding digital activities?

Data collection

A questionnaire was prepared to answer the research questions. Students were invited but not obliged to fill it. The answers were anonymous. The questionnaire was presented at the end of the semester and available for two weeks on the LMS used for our classes: Blackboard.

A survey made of 24 questions was designed to assess students' attitude and perception regarding *Kahoot* and DA. The questions were distributed as following:

- 1 - four scales question (population / Student's year)
- 10 - Five-scales questions (*Kahoot!*)
- 4 - Five-scales questions (DA)
- 1 - ordering activities (DA)
- 2 / Five-scales questions (FL)
- 3 open questions (*Kahoot!)*

- 2 open questions (DA)
- 1 open question (general)

Some questions were inspired from Tan Ai Lin, D., Ganapathy, M., & Kaur, M. (2018). As their questionnaire was tested with some other students enrolled in an English for media course at a university in Malaysia, I thought that having some close questions could allow some comparisons.

Results

The first question asked allowed us to know the level of the students that enrolled in the FFL class: 33 % of the respondents are senior students, 31% are Junior, 19 % sophomore and 17 % freshman. Most of the students have experienced the university live and took already many courses at the university.

Table 1. Students' Attitude Regarding *Kahoot*

Statement	Strongly agree	Agree	Disagree	Strongly disagree	Neither agree nor disagree
1. I look forward to playing *Kahoot!*	73	21	1	0	5
2. I am eager to learn via *Kahoot!*	58	29	9	0	4
3. I prepare the AP in order to win in *Kahoot!*	46	36	4	3	11
4. I focus on the items or questions in each *Kahoot!* session.	62	32	4	0	2
5. I am motivated by the prospect of winning in these *Kahoot!* sessions.	64	23	4	1	8
6. I feel more motivated when I earn points in *Kahoot!* session.	67	26	3	0	4
7. I respond to each item or question in each *Kahoot*! session.	64	33	2	0	1
8. I respond as accurately as possible to each item or question in each *Kahoot*! session.	63	35	0	0	2

73 % of the students "strongly agree" and 21 % agree on the statement "*I look forward to playing Kahoot*!". They like *kahoot* and they are looking forward to playing it. Most of the respondents focus on each question (62 % strongly agree and 32 % agree). Only 4 % of the respondents disagreed on that statement. Globally, the respondents answered to each item (64 % strongly agree and 33 % agree) and they responded as accurately as possible (63 % strongly agree and 35 % agree). The respondents are motivated by the prospect of winning in *Kahoot* (64 % strongly agree and 23 % agree). When they earn points on *Kahoot*, the respondents feel more motivated (67 % strongly agree and 26 % agree).

To the statement "*I prepare the AP in order to win in Kahoot"* 46 % of the respondents strongly agreed and 23 % agreed. However, 4 % disagreed and 3 % strongly disagreed, while 11 % of the respondents neither agree nor disagree.

Table 2. Students' Perception Regarding *Kahoot*!

Statement	Strongly agree	Agree	Disagree	Strongly disagree	Neither agree nor disagree
There is a value in using *Kahoot!* for teaching and learning purposes.	73	24	0	0	3
Kahoot ! helps me in my learning process.	66	29	3	1	1

73% of the respondents strongly agree and 24 % agree that using *Kahoot* for teaching and learning purposes adds a value. 66 % strongly agree and 29 % agree that *Kahoot* helps them in their learning processes only 3 % of the respondents disagree on that statement and 1 % strongly disagree on it.

Table 3. Students' Perception Regarding *DA*

Statement	Strongly agree	Agree	Disagree	Strongly disagree	Neither agree nor disagree
The use of interactive activities (in BB / Discussion) helps you learning.	68	26	3	2	3
The forum (Discussion) is useful	59	34	5	0	2

Respondents agree (68 % strongly agree and 26 % agree) on the fact that the DA help them learning and practicing. Only 3 % of the respondents disagree on that statement and 2 % strongly disagree.

Table 4. Students' Grading of the DA

Statement	5	4	3	2	1
On a scale of 1 to 5 (where 5 is the highest), you would rate the use of interactive activities as:	60	24	7	2	1

On a scale of 1 to 5 where 5 is the highest 60 % of the respondents rated the DA 5 and 24 % rated it 4. 7 % of the respondents gave a medium rate 3, and 2 % rated it 2.

Table 5. Students' Attitude Regarding DA

Statement	Very often	Often	Not that often	Very few times	Never
How often do you solve the interactive activities posted on BB / Discussion?	33	42	18	5	2

The respondents use the DA very often (33 %), often (42 %) and not that often (18%). Only 5 % of the respondents said using them very few times and 2 % never.

In the first open question, the respondents were free to write whatever they felt regarding the advantages of

using *Kahoot*. Their answers are regrouped into several categories (Table 6). Some quotations from students' answers are selected as examples. The respondents stated that *Kahoot* is motivating. It encourages them to learn and help them to focus while playing. Some other respondents said that *Kahoot* helps them to memorize and to better understand as "*It clarifies the topics for me and with it I can make sure I really understood the topics*". Some respondents appreciate also the challenge spirit *Kahoot* brings and like the "*healthy competition between students*". Some respondents like the fun part of *Kahoot* and some others appreciate the energy it brings to the class.

Table 6. What are the Advantages of Using *Kahoot* ?

Topic	**Quotation / Example**
Motivating	"It motivates me to learn more and do the APs to get the first place" "Get excited to solve more and if I have some question wrong so I go back and correct it" "To win in *kahoot* we should study and it helped me to study" "Motivates me to study more" "It encourages me to stay on track and study for the course material day by day" "Encourages everyone to try their best"
Focus	"Helps me a lot to focus and learn how to solve quickly". "Since we are learning online sometimes, we get distracted, with *kahoot* I am fully focused" "Help us stay to apply what we learned and stay focused"
Energy	"It adds colors and energy to the class"
Challanging	"You can challenge yourself while using *Kahoot*"
Understand	"It clarifies the topics for me and with it I can make sure I really understood the topics"
Memorize	"Makes the information learnt more memorable" "Makes the information stick and I never forget it"
Test the knowledge	"*Kahoot* helps me study and test my knowledge"
Fun	"It makes studying more fun" « Fun way to learn »
Competition	« Healthy competition between students » « Motivating, creation competition feelings, fun and enjoyable language learning".
Learn	"It helps me learn faster, and never forget the information" "It makes the learning easy as I am a visual learner"

In a second open question, students were invited to state what the disadvantages of *Kahoot* are according to them (Table 7). Most of the respondents said they do not see any disadvantage. Some respondents complained about the connection issues (internet interruption) that prevent them of playing *Kahoot*. Some others consider that 30 seconds to answer a question is not enough. Some respondents consider the competition as a disadvantage as they have to answer very fast. In that hurry they may select wrong answers. Some students would like to see the name and ranking of all the players not only the winners (5 first ones). Another student sees as a disadvantage the fact that they cannot keep a version of the questions. I decided to keep the *Kahoot* sessions private to motivate the students to participate to the "unique" session. Some respondents noticed that sometimes they are not prepared: this disadvantage here is linked to the Flipped learning methodology not really to *Kahoot.*

Table 7. What Are the Disadvantages of Using *Kahoot* ?

Topic	Quotations / Examples
None	"No disadvantages" "I don't think there are any!" "Nothing they are really very helpful"
Internet connexion	"There may be sudden connection issues from students' side that prevent them from participating in the *Kahoot*".
Time	"It is very fast paced and lags sometimes" "The time for each question is not enough sometimes"
Competition	"I must answer quickly to get points because we are competitive with each other to have the best place as better as we can, and that makes me hurry and I will answer wrong answers sometimes" "Unfair regarding points counting since it depends on time and when I give the correct answer and get low points I get discouraged"
Layout	« No leaderboard but show everyone's rank » "Questions are not displayed on the app". "We as students do not have a way to keep a version of the question"
Not prepared	"Sometimes some of us are not prepared"

In a last open question linked to *Kahoot*, students were asked to state whatever they feel about this experience (Table 8). The respondents stated that the experience was efficient. Some respondents whished being able to use *Kahoot* in some other courses as they could notice the benefit of this game in their learning processes. One respondent concluded "more *Kahoots*!".

Table 8. Please State Any Comment You Wish to Make About This Experience with *Kahoot!*

Topic	Quotations / Examples
Using it in other courses	"I wish all doctors used *kahoot* more often, it is an excellent interactive teaching and learning method".
Experience	"keep using *kahoot* its very interactive and fun for students, it was a very nice experience" "French is the only course where the Drs use *Kahoot* (or any interactive games) and I can really see how I'm benefiting from it compared to the other courses that don't have *Kahoot* sessions"
Efficient	"It's a good way to let us practice and its fantastic" "overall very fun and the way it is used in this course plays an efficient and effective roll in the learning/teaching process" "Interactive, competitive, fun, their music!"
	« more *kahoots!* »

Table 9. What Are the Advantages of Using *DA*?

Topic	Quotations / Examples
Practicing	"Learn from it and test myself after studying" "Gives you helpful activities to practice and improve at your own pace". "It's a good source of practice and really helpful" "Can be solved many times and at anytime" "Hepls me know what my weak points are"
Memorizing	"Good for practice, helps with the memory" « Helps learn faster »
Revision of exams	« Preparation for exams » "They are amazing as a practice quiz before exams or quizzes" "They are an excellent way to test yourself before any sort of quiz to know what you need to work on more"
Accessible	« Very fun and easily accessible »
Check the answers	"We can check our answers, if they are wrong we can ask the Dr. to clarify in the next session" "It really made me know my mistakes"
Layout	"They depend on visuals, thus sometimes I remember the answers in exams because of remembering the pictures and colors"

In another open question, students were invited to present the advantages of DA according to them (Table 9). Many respondents stated that DA help them to practice. Learners appreciate the fact that the DA are accessible and they can solve them as many times as they want. Checking the answers is another advantage they find. The

respondents like having the possibility to know immediately their mistakes. It is a good preparation for exam according to some respondents. Some others appreciate the fact that DA depend on visual. It helps them to memorize.

On a last open question regarding DA, students were asked to present the disadvantages of using these activities (Table 10). Almost all the respondents said they do not see any. One student regrets not having feedback from a human: these activities '*are not very social'* according to him /her.

Table 10. What are the Disadvantages of Using *DA*?

Topic	**Quotations / Examples**
None	"I don't think there are any!" "Nothing they are really very helpful"
No feedback from a human	"They are not very social because I don't get feedback from human"

Discussion

The questionnaire presented to the students allows us to assess their opinion regarding the use of *kahoo*t and DA in the course. Different DA were created using *LearningApps* and *Liveworksheets* (7 *Liveworksheets* / 18 *LearningApps*). 60% of the respondents rated these activities the maximum: 5/5 and 24% rated them 4/5. Only 2 % of the respondents said they have never used these activities. The respondents appreciated these activities. They liked the fact that they "*depend on visuals*" which helped them for memorization. Besides, the respondents found these activities "*easily accessible*" and helpful for practicing and preparing the quizzes and exams. Unfortunately, I did not find studies conducted on the use of activities created in *LearningApps*. I cannot compare with other results.

Besides, as I used a lot *Kahoot* in my online classes (42 *Kahoot* sessions during the term), I was afraid that students felt bored and gave up. Their engagement in the course as well as their motivation could have been affected. However, the answers given by the students confirm the opposite. Indeed, the general trend is by far: students enjoyed using *Kahoot* in the course and were looking to playing it. Students appreciated using this platform. In the open questions, most of the respondents stated that *Kahoot* motivates them, helps them to focus and challenges them. It also brings fun to the session according to the respondents.

Still, preparing the PA to win in *Kahoot* does not seem to be a motivation. The respondents are motivated to win *Kahoot* but 7% said do not prepare the PA to win *Kahoot.* Wining *Kahoot* does not seem to motivate them enough to prepare PA. To the statement 'I *prepare the PA in order to win in Kahoot*' 46 % strongly agreed, 36 % agreed, 11% neither agreed nor disagreed and 4 % disagreed and 3 % strongly disagreed.
As disadvantages for using *Kahoot*, technical problems have been raised by the respondents: internet issues and

disconnection from *Kahoot*. Some other students find that 30 seconds to answer to the questions are not enough. They find this 'short' time as a disadvantage. If I give them more time and make it 1 minute (which is the next amount of time we can offer by question), it will be too much time and the challenging spirit may disappear. Students may feel bored at that time waiting for the minute to end. In one open question, where students were free to state whatever, they wish regarding *Kahoot*, none of them have said they do not like this platform, nor complained having too much *kahoot*. In the contrary, some respondents said whishing using this platform in some other courses. Another student asked not to stop using *Kahoot*, and another one said '*more Kahoot'*.

Further, as I said previously, some of the questions asked in this questionnaire are inspired from Tan Ai Lin, D., Ganapathy, M., & Kaur, M. (2018). If we compare the results of this questionnaire with ours, we notice the same trend. Students enjoy using *Kahoot*. We notice in our questionnaire that more students strongly agree to the statement "I *look forward for playing Kahoot*" 73 % in our study and 64 % in the other study. Besides, more respondents are strongly agreeing to the statement '*I am motivated by the prospect of wining Kahoot'*. 64 % in our study, 51 % in the other one. Yet, we notice that more students strongly agree to the statement "*I respond as accurately as possible to each item or question in each Kahoot ! session*". 63 % in our study, 43 % in the other. However, the results of my questionnaire have to be taken with caution. Not all the students that were invited to fill the questionnaire did it (as they were invited but not forced to do it). 94 students out the 158 responded. I will present again the same questionnaire to another group of students to get more reliable results, this term SP22, I kept using the Flipped learning methodology and introduced *Kahoot* and the digital activities as well. I will ask the students to answer the same questionnaire and will compare the results.

Conclusion

The purpose of the study is to check the attitude of students taking a French as a foreign language course regarding the use of DA and *Kahoot* in this online course. The main contribution of this study is confirming that students do not get tired of using *Kahoot* nor the digital activities created. The respondents are motivated and engaged. They appreciate these challenging games that help them to memorize and practice.

The limitation of this study is related to the percentage of respondents. 60 % of the students enrolled in the course respondent. A further study where the same questionnaire is presented to some other students taking the same course and in which the same procedure is followed should be done.

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Comparison of Two Exam Evaluation Methods for Objectivity

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Abstract: The object of research is a statistics exam that contains problem tasks. One examiner performed two exam evaluation methods to repeatedly evaluate the exam. The goal was to compare the methods for objectivity. One of the two exam evaluation methods we call a serial evaluation method. The serial evaluation method assumes evaluation of all exam tasks of an individual student in sequential order, so evaluation "student by student". Unlike that, a parallel evaluation method assumes the "task by task" evaluation of exams for the whole group of students. A paired samples analysis of exam results indicates a statistically significant difference between methods. Further analysis showed a statistically significant difference in results obtained by the serial evaluation and the repeated serial evaluation, while the difference in results obtained by the parallel evaluation and the repeated parallel evaluation turned out not to be statistically significant. Furthermore, our research gave evidence that the repeated parallel evaluation changes result significantly less than the repeated serial evaluation. Consequently, we consider the parallel evaluation a more objective tool in exam evaluation than the serial evaluation.

Keywords: Exam evaluation, Serial evaluation, Parallel evaluation, Paired samples analysis

Introduction

Nowadays, teachers employ active learning activities such as flipped classrooms, peer learning, group work activities, collaborative argumentation, formative assessment (see Latifi & Noroozi, 2021; Latifi et al., 2020, 2021; Noroozi 2018, 2022; Noroozi et al., 2016; 2020; Valero Haro et al., 2019; 2022). This is also the case with written exams. While Ortega-Sanchez (2016) poses a question on how effectively are we using written exams, here we confront two methods in the critical analysis of how objectively do we evaluate written exams. Certainly, each teacher spends a lot of time designing a written exam and balancing different levels of difficulty of the exam tasks to distinguish between low and high levels of students' knowledge. For all that not to be in vain, attention must also be paid to methods that lead to better objectivity in the exam evaluation. When we searched for literature on this subject, we hardly found some. Lack of literature on the topic indicates we pay

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very little attention to the subject of objectivity in exam evaluation. How come this question on subjectivity/objectivity of exam evaluation is not a subject of much research? In this research, we hope to throw a little light to the dark corner of the subject of objectivity in exam evaluation.

Most opinions on exam evaluation emphasize its formative role: to communicate and inform teaching and improve learning (Liljedahl, 2010, Mitchell and Neill, 1992). But, it is rare in the practice of exam evaluation in higher education. When a university teacher constructs an exam, it is with a prime goal to measure student achievements and assign them grades. So, in the practice of higher education, exam evaluation plays mostly a normative role. Therefore, exam evaluation must be objective (McTighe, Ferrara, 1998).

According to Baehr (2004) there are four steps in the process of exam construction and evaluation: 1) to define learning outcomes that will be tested, 2) to have in mind evidence of learning outcomes achievement, 3) to set up a scale of points such that all learning outcomes are adequately scored, and 4) to assign grades through objective exam evaluation. We focus on the last step. Although in 1975 L. J. Herbst made the statement: "*70s are likely to be a decade in which objective testing will be firmly established in higher education,"* today we still struggle with objective exam evaluation. For example, Romagnano (2001) states: "*Objectivity, like the mythical pot of gold at the end of the rainbow, would be wonderful if we could have it, but it does not exist."* Further, Liljedahl (2010) claims that all assessments of students' mathematical understanding are subjective. We agree with both and nevertheless search for an objective exam evaluation method.

Literature Review

The matter of objectivity in exam evaluation is rarely addressed in scientific research. Mostly, authors state the necessity of objective exam evaluation (E. Hoosain and B. Naraine, 1999), but there is a lack of instructions on concrete actions to achieve objectivity. One research that addresses the subject was done in 2011 by Kriauziene, Krylovas, and Kosareva. In the research student's exams were independently verified by six teachers and some disagreement in results was found. Further, L. J. Herbst (1975) reports that even "*repeated marking of the paper* ***by the same examiner*** *is likely to show significant variability*," referring to essay-type exams. Contrary to them, math exams are considered far more objective. Indeed, the evaluation of deterministic tasks like "*2+2=*" doesn't depend on any subjective judgment of a teacher, but things change in exams that contain problem tasks. White (2019) distinguish between objective and subjective exams; objective exams have either a right or a wrong answer, while subjective have answers in-between the right and the wrong answer. Exams that contain problem tasks are definitely subjective. Further, the evaluation of mathematical exams with problem tasks tends to be subjective.

To evaluate problem tasks, one must have clear scoring lists organized in rubrics. That is exactly what Guat Poh et al. (2015) emphasize when they suggest creating a marking scheme rubric. Evaluators should indeed have details of scoring of characteristics steps of a solution to credit, not just exact solution, but also student's attempt

to solve the problem. But, if there are many ways to the correct solution, even rubrics can become incomplete, and then scoring must be adapted *ad hoc* to an individual case one faces. Firm, detailed and comprehensive scoring criteria are, indeed, necessary, but not at all sufficient to ensure objectivity in exam evaluation. We claim that the choice of the exam evaluation method also plays a substantial role in the objectivity of evaluation.

Evaluation Methods Description

We use to grade exams "student by student". It means to take an individual student exam sheet, go through it in its entirety, and assign points to each task according to prescribed criteria before passing to another exam sheet. We name this procedure a *serial evaluation.* It assumes going through the entire evaluation criteria over and over again.

From time to time we noticed that we scored the same solutions with a different number of points. So, we spotted subjectivity in exam evaluation. Then we started to wonder: maybe the evaluation of just one task at a time for the whole group would lead to better consistency in results, i.e. to higher objectivity? Namely, it is a common practice in team evaluation that a single examiner grades a single problem (or a few) for all students rather than the whole exam for a subgroup of students. The reason for this is obvious: to reduce the impact of different criteria or grading practices examiners have. The question is: can we trust more the objectivity of just one examiner?

The principle of the evaluation method that we call *a parallel evaluation* is exactly the evaluation of exams "task by task". In the parallel evaluation, just one task at a time is evaluated for the whole group. Practically, it involves grading each student's submission for a single task before moving to the next.

We are confident that teachers use both, serial and parallel evaluation methods extensively. However, the search for the terms "the serial evaluation" and "the parallel evaluation" gave results only in the fields of medicine and data mining. We choose names for evaluation methods miming terms in electrical circuits (connecting resistors, for example), based on the order of steps performed in the evaluation procedure (illustrated in Figure 1).

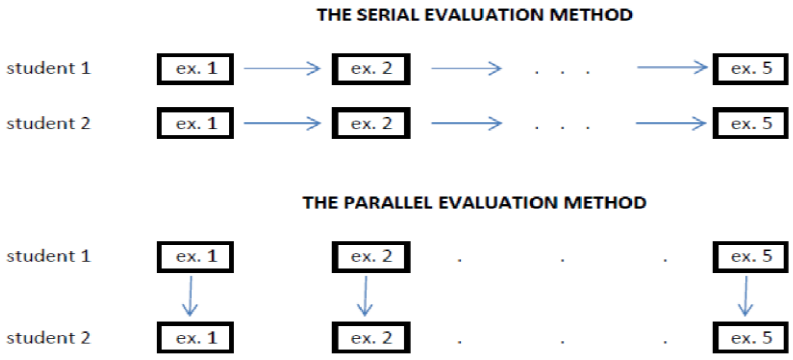

Figure 1. Schemes of Steps performed in the Serial and the Parallel Evaluation

The serial evaluation assumes looking at scoring criteria of all tasks for each exam sheet. If one meets some unusual solution, a new decision on scoring must be made. In the parallel evaluation, a teacher has just one evaluation criterion in mind at a time, and the scoring criterion stays firm for the whole group. If the examiner deals with just one task at a time, he/she can spot more easily different ways to the correct solution and then adopt scoring criteria to include them all.

Research Subject, Methodology, and Hypotheses

The subject of the research was one exam in a university statistics course. It consisted of five problem tasks on descriptive statistics and the basics of probability theory. There were a total of 35 students that year, and we included all their exams in the research. Exam sheets of all students were evaluated by the same evaluator four times over nearly one and a half years, two times with serial and two times with parallel evaluation method. The time gap between evaluations was long enough to ensure that the evaluator recalls no previous scoring.

The research was performed as follows. The initial idea was to see if there is a statistically significant difference in the results of the serial and the parallel evaluation methods. The exam in question was already evaluated with the serial evaluation method and the results were available. By results, we mean the total number of points for an individual student ranging from 0 to the maximum of 40 points. Approximately half a year later the evaluator evaluated the exam with the parallel evaluation method. Old scoring criteria were available and reused, and before that evaluation, the third party made all previous scoring invisible. Obtained data gave evidence that there is a statistically significant difference among results.

Next, we wanted to check how the results of both methods change over time. For that purpose, the examiner repeated evaluation with both methods. The repeated serial evaluation was performed four months after the parallel evaluation and the repeated parallel evaluation some five months after the repeated serial evaluation. We ensured a sufficient time gap to prevent any possibility of recollection of the previous scoring. Also, before each evaluation, the same precaution measures were applied as before to guarantee that no previous results are visible. The same scoring criteria were used repeatedly in all evaluations.

Scoring the Problem Task – an İllustration

To check students understanding of the classical probability definition, the following task was given:

> "*Dice is thrown two times. From the obtained numbers one forms a fraction: the number that fell first becomes a numerator and the number that fell second is a denominator. What is the probability of obtaining a reducible fraction?"*

The correct answer is 13/36 because among 36 possible fractions there are 13 reducible ones. To obtain the probability, students were expected to list and count reducible fractions and divide the obtained number with 36, the number of all possible fractions. As one could expect, some lists were incomplete. According to the scoring

criteria, the correct solution was assigned with eight points, and this maximum was lowered by one for each missing or extra fraction; however, the maximal reduction was four points. Further, for very poor lists students could get two points if they wrote the number of all possible fractions and one more if they wrote probability as a fraction. Below are some pictures to illustrate different solutions: there is the correct solution and partially correct ones with different degrees of accuracy given in Figure 2.

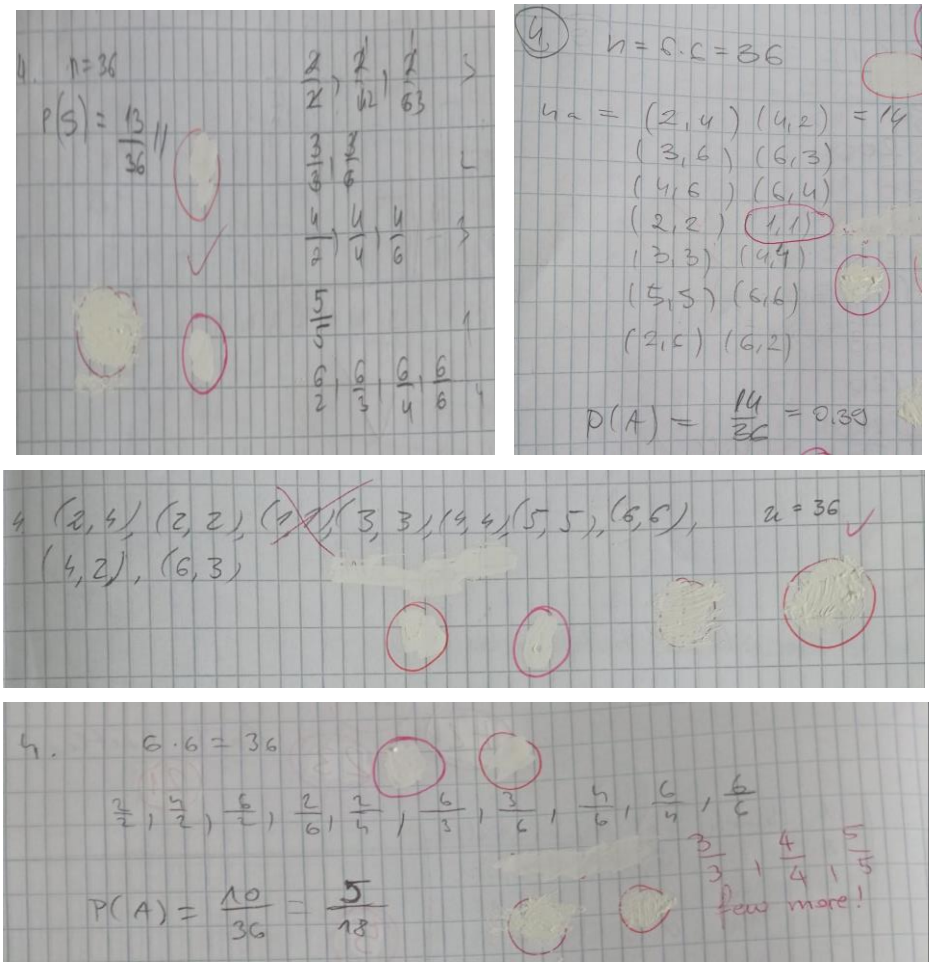

Figure 2. Some Pictures of Problem Solutions (Empty circles on each picture witness removal of old scoring in each new evaluation.)

Data set

At the end of all evaluations, we had four sets of exam evaluation results obtained by the use of the serial evaluation (S), the parallel evaluation (P), the repeated serial evaluation (RS), and the repeated parallel evaluation (RP). Having all those, we further calculated absolute values of differences between results of the serial and the repeated serial evaluation (|S-RS|), and absolute values of differences between results of the parallel and the repeated parallel evaluation (|P-RP|). Namely, the order of first and second evaluation of the same type is of no importance, one is interested only in absolute differences. The data set is given in Table 1.

Table 1. Student Results obtained by the Serial (S), the Repeated Serial (RS), the Parallel (P), the Repeated Parallel Evaluations (RP) with Absolute Values of Paired Differences (|S-RS|) and (|P-RP|).

Student	S	P	RS	RP	|S-RS|	|P-RP|
1	35	30	32	31	3	1
2	32	30	30	29	2	1
3	30	27	27	27	3	0
4	24	21	23	23	1	2
5	36	33	33	33	3	0
6	30	30	29	29	1	1
7	41	38	39	39	2	1
8	24	23	23	24	1	1
9	32	28	26	26	6	2
10	23	18	18	18	5	0
11	25	19	23	20	2	1
12	26	22	22	25	4	3
13	39	37	38	37	1	0
14	23	23	26	24	3	1
15	34	27	31	31	3	4
16	22	22	21	21	1	1
17	32	32	31	31	1	1
18	33	25	25	26	8	1
19	31	29	32	32	1	3
20	31	32	31	31	0	1
21	32	25	25	26	7	1
22	31	29	31	31	0	2
23	34	34	33	33	1	1
24	17	15	19	16	2	1
25	31	31	30	32	1	1
26	19	18	18	19	1	1
27	38	33	32	29	6	4
28	25	21	21	25	4	4
29	29	27	30	29	1	2
30	32	30	34	30	2	0
31	10	11	11	10	1	1
32	34	34	34	32	0	2
33	34	29	31	31	3	2
34	34	34	34	34	0	0
35	16	16	17	16	1	0
mean	29.11	26.66	27.43	27.14	2.31	1.34

The data set is a typical example of paired samples since each data refers to the same individual so we chose paired sample analysis to check the following four hypotheses:

H_1 – there is no statistically significant difference between results obtained by the serial and the parallel evaluation.

H_2 – there is no statistically significant difference between results obtained by the serial evaluation and the repeated serial evaluation.

H_3 – there is no statistically significant difference between results obtained by the parallel evaluation and the repeated parallel evaluation.

H_4 – absolute differences between results obtained by the parallel evaluation and the repeated parallel evaluation are significantly greater than the absolute differences between results obtained by the serial evaluation and the repeated serial evaluation.

The last hypothesis was set up to see if the repeated parallel evaluation changes result significantly less over time compared to the parallel evaluation than the repeated serial evaluation compared to the serial evaluation.

Results

Tests of all hypotheses were performed in "The R Project for Statistical Computing" at the 5% significance level. For each test all pairs: S and P, S and RS, P and RP, as well as |S-RS| and |P-RP|, form typical paired sample data. Therefore, we performed a paired t-test for the equality of means to test all hypotheses. To check the paired t-test assumption that the differences of the matched pairs follow a normal probability distribution, we used appropriate normal Q-Q plots (Figure 3).

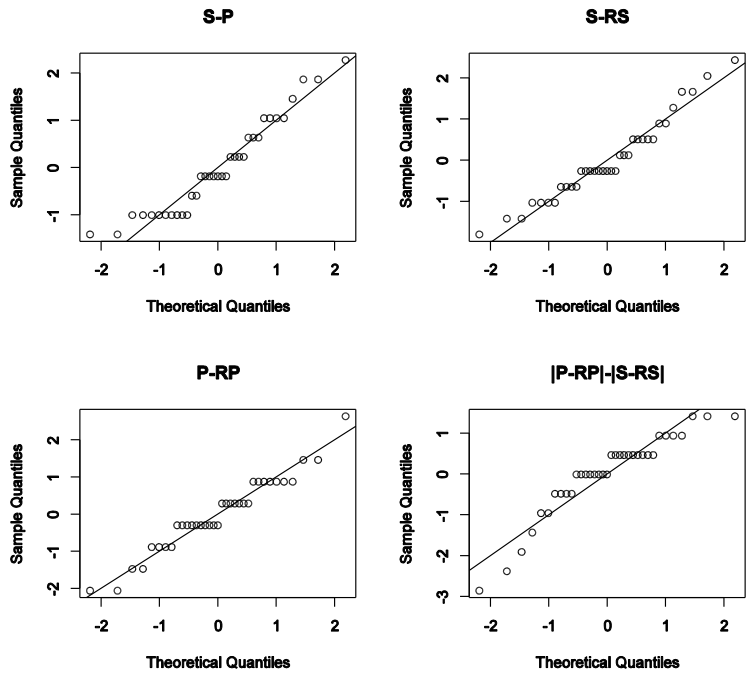

Figure 3. Normal Q-Q Plots for Differences of Results in All Four Tests

The 5% significance level in paired sample tests gives the two-tail critical point of 2.03. For H_1, the test showed that the null hypothesis should be rejected because the test statistic was 5.9538, with a p-value of 9.888×10^{-7}. There is a strong indication of a statistically significant difference in the results obtained by the serial and the parallel evaluation.

To test hypothesis H_2, we performed a paired t-test for the equality of means for results obtained by the serial evaluation and the repeated serial evaluation. The test statistics 3.8382 was greater than the two-tailed critical point 2.03 with the p-value of 0.00051. So, the difference in the results of the serial evaluation and the repeated serial evaluation is statistically significant.

A paired t-test for the equality of means for the results obtained by the parallel evaluation and the repeated parallel evaluation showed that data are in favor of the null hypothesis, i.e. there is no statistically significant difference in the results of the parallel evaluation and the repeated parallel evaluation. Namely, the test statistics -1.6862 belong to the acceptance area [-2.03, 2.03], with a p-value of 0.1009.

To test hypothesis H_4, we performed a paired t-test on the null hypothesis that the mean of the absolute differences of the parallel evaluation and the repeated parallel evaluation is greater than the mean of absolute differences of the serial evaluation and the repeated serial evaluation. The test suggested that this null hypothesis should be rejected because the test statistic -2.7273 is smaller than the one tail critical point -1.69 with the p-value of 0.005. So, we conclude that the absolute differences of the results of the parallel and the repeated parallel evaluation are significantly less than the absolute differences of the results of the serial evaluation and the repeated serial evaluation.

For easier visibility, a row with the means of all samples is provided in the last row of Table 1 above. Relations between means are visible the best on the boxplots of samples given in Figure 4.

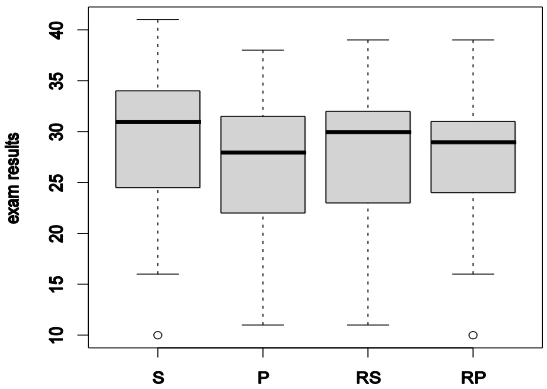

Figure 4. The Comparison of Boxplots of S, P, RS, and RP Data Sets

Figure 5 gives the boxplots of absolute differences |P-RP| and |S-RS|. One can observe smaller variability of absolute differences of results of the parallel and the repeated parallel evaluation methods.

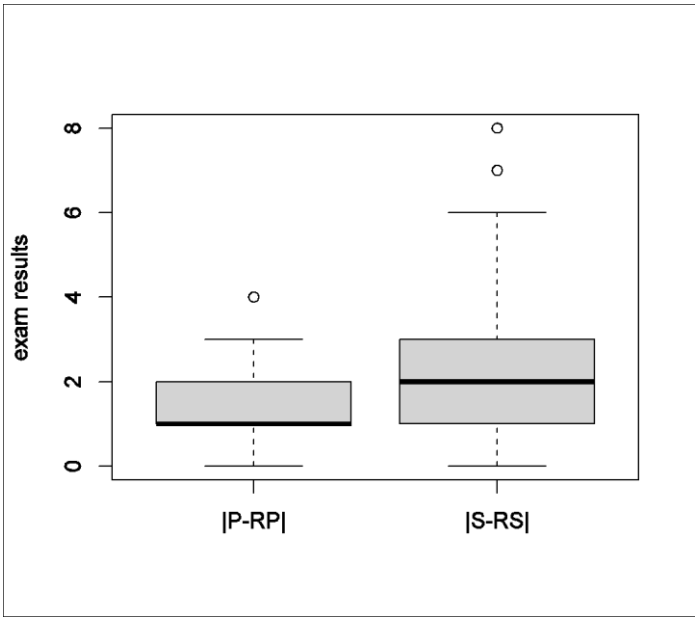

Figure 5. The Comparison of Boxplots of |P-RP| and |S-RS| Data Sets

Discussion and Conclusion

In higher education, there are high stakes in exam results. Therefore, every teacher should aim at consistent and objective exam evaluation. The objectiveness of exam evaluation is not at all an issue in exams that contain only tasks of an objective type, but it becomes a great issue in exams that contain problem tasks.

This research was done to compare two exam evaluation methods, the serial and the parallel evaluation method for objectivity exactly on the exam with problem tasks. Data give evidence of a statistically significant difference in exam results obtained by the two methods, so we consider them different. Further, data show no statistically significant difference in the results of the parallel evaluation and the repeated parallel evaluation, but they do establish the existence of a statistically significant difference in the results of the serial evaluation and the repeated serial evaluation. Further, statistical analysis confirms that the absolute differences of the results of the parallel and the repeated parallel evaluation are significantly less than the absolute differences of the results of the serial evaluation and the repeated serial evaluation. Consequently, we conclude that the parallel evaluation leads to more objective results compared to the serial evaluation.

We argue that, although judgments and decisions one makes in the exam evaluation are inevitably subjective, objectivity can be increased by the use of the parallel evaluation method. In our experience, the parallel evaluation takes more time than the serial evaluation, but it is a small price to pay to achieve higher objectivity. Anywhere applicable, we recommend the evaluation of exams with the parallel evaluation method.

We are aware of the fact that this research alone just starts a discussion on objectiveness in exam evaluation. Results obtained here are yet to be confirmed in more thorough research. Although our research was done on a mathematical exam, we are confident that conclusions stay valid for any exam with problem tasks. Hopefully, this research will start a discussion on ways to ensure higher objectivity in exam evaluation, a topic far, far under-discussed in literature and scientific research.

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IT and Technology & Design Teachers Views on Utilizing Robots in Instruction

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Abstract: Robots are useful tools for teaching mathematics and physics and engineering subjects in K-12 setting; they can be utilized in classrooms for explaining difficult and complex concepts because they capture the imagination of students. Rapid developments robotics technology in recent decade, institutions and researchers have employed robots to support K-12 education. Furthermore, Educators are increasingly interested in the potential of robots in education for learners. Due to its multidisciplinary nature, robots are considered a gateway to STEM education. Researchers in educational field are looking answers of Can robots in classroom reshape K-12 STEM education, and foster new ways of learning? In the present study, IT and Technology & Design Teachers' views on utilizing robots in instruction was investigated. Furthermore, teachers' willingness to use robots in diverse learning settings. The findings of the research revealed that most of the teachers were not employed robots in their teaching. However, overwhelm majority participants expressed their willingness of using robots in their education specifically in STEM education. Teachers reported that robots can be utilized as an instructional support tool in the classroom.

Keywords: Robots, IT teachers, STEM, Technology and Design, Education

Introduction

Autonomous or pre-programmed electromechanical tools are called robots. They can generally be controlled by a computer. It is possible to control the robots with a remote control. According to the definition of robot made by the American Robotics Institute in 1979, a robot is a programmable, multi-functional machine that carries goods, parts, tools or special devices from one place to another or performs certain tasks in order to perform certain tasks.

The word robot was first used in the theater play "Rossum's Universal Robots" written by the Czech writer Karel Capek Rossum in 1921 (Hemal & Menon, 2018). The word "robota" in Czech means "forced worker, slave". Isaac Asimov used and popularized the term robotics in his science fiction novels and short stories. Asimov was a visionary in the 1930s who envisioned a positronic brain to control robots. Asimov stated in his "Three Laws of Robotics" that the purpose of robots is to serve human beings, and that a robot can never choose

Demirbilek, M. (2022). IT and Technology & Design Teachers Views on Utilizing Robots in Instruction. In P. Dankers, M. Koc, & M.L. Ciddi (Eds.), *Proceedings of ICEMST 2022-- International Conference on Education in Mathematics, Science and Technology* (pp. 169-174), Antalya, TURKEY. ISTES Organization.

its own goals over people's. The articles of this law can be summarized as follows:

1. A robot may not harm or injure a human.
2. A robot does not comply with the orders given to it by humans that do not conflict with the 1st Law. must obey the process.
3. A robot must protect its own existence as long as it does not conflict with the 1st and 2nd Laws.

There are various reasons why robots are preferred in industry and education. In general, robots are preferred in the following situations. However, when making this choice, costs are always considered.

- Jobs with high labor costs
- Works requiring extreme attention
- Risky and dangerous work in terms of health and work safety in cases where it is done by humans
- Jobs that require very high heat
- Non-hazardous but repetitive and boring work

Today, the usage areas of robots are becoming more and more widespread. This situation also raises concerns that people will lose their jobs.

Second Robots in Education

The use of robots in education began in the 1960s with Seymour Papert's Logo (programming language) Turtle (robot). Lego/Logo is an environment where design can be done in the classroom. Logo is a computer program material for designing their own machines with Lego parts consisting of toy motors and sensors and for controlling the machine. Resnick, Ocko Papert, stated that for Logo it is not just lego pieces and software, but also a special learning and unconsidered (Gaudiello& Zibetti, 2016).

Educational robots enable students of all ages to become familiar with and deepen their knowledge of robotics and programming, while at the same time learning other cognitive skills (Khanlari, 2016). Robots in instruction may motivate students in order to support interdisciplinary learning activities in STEM education (Barak & Assal, 2018). Educational robots can easily be adopted into engineering, science, technology and mathematics based teaching activities (Karaahmetoglu, 2019).

Robots emerged as helpers supporting humans in their first reflections on social media and history. Today, robots are used in many fields, from industry, space exploration, military defense, medicine, education to treatment or rehabilitation to entertainment. Successful results are obtained at a high rate from the studies carried out with robot types (Şişman, 2016).

Şişman (2016) investigated the level of interaction of children with autism with a socially interactive robot and the success of the robot in teaching children with autism to sing. Four children with high-functioning autism, aged 7-9 years, were included in the study. During the application, the robot was guided by a researcher

remotely via the web application. Robot sing a song called "Our Body" and repeating it four times in each lesson, using body movements according to the words of the song. The application was carried out in the form of both individual and group activities. As a result of the research, it was determined that one child could sing the whole song in accordance with the rhythm, the other child could sing half of the song by himself, and he sang the rest of the song with the help of the teacher.

Cincioglu, et al. (2015) in his study on the effect of robotic technology use on foreign language, he observed that the materials used in the field of robotics are effective on students' understanding and speaking while providing foreign language education.

Method

This research is a qualitative study to investigate IT and Technology & Design Teachers' views on utilizing robots in instruction. It was assumed that the teachers participating in this study had sufficient knowledge about robotics. In this study, a semi-structured interview form consisting of 8 open-ended questions was used for IT and Technology & Design teachers. The answers given to the questions in the interview form used were used in the research by making content analysis. Interview is the most frequently used data collection tool in qualitative research. In order for the interview to be used as an effective and efficient data collection method, it is necessary to understand the main features, strengths and weaknesses of this method, to prepare an interview form that will facilitate access to qualitative data and to adopt the principles recommended to be taken into account in the process of conducting the interview (Yıldırım & Şimşek, 2008).

The semi-structured interview form that was prepared was presented to two experts working in the Department of Computer Education and Instructional Technologies at Süleyman Demirel University, Faculty of Education, of which I am a student, in order to get the opinions of the experts. After the expert opinion was taken, necessary arrangements were made and took its final form. The semi-structured interview form used in the research was gathered by open ended questions form with listed on a paper the IT and Technology & Design teachers in Isparta in person. Teachers allowed enough time to write their answers. The study group of the research consists of 10 IT and Technology & Design teachers working in Isparta. A semi-structured interview form was applied to 10 information technology teachers participating in the research.

Participants

10 information technology teachers participated to the study. 9 of the 10 teachers interviewed are male. The average age of the interviewed teachers is 39.9. The average years of experience of the interviewed teachers is 12.5. 6 of the 10 teachers interviewed had not used a robot before.

Results

The opinions of the participants about the robots were combined under four compiled headings. The analysis was made and entered as numerical data in the computer environment.

Table 1. Participants' keywords about robots

Keywords	Frequency	%
Mechanical tool	4	40
Artificial Intelligence	2	20
Military & Industry	2	20
Programmed vehicles	2	20

When the data obtained in the analyzses were examined, 40.0% (n=4) of the participants identified robots as a mechanical device, while 20.0% (n=2) associated robots with artificial intelligence. At the same time, while 20.0% (n=2) of the participants thought that robots were used in industry and military rather than education, the remaining 20.0% (n=2) said that the robots were pre-programmed and would act at the level we programmed (see Table 1).

Participants' response to "have you used an educational robot before?"

Table 2. Participants' use of educational robots

Use of robot	Frequency	%
Yes	4	40
No	6	60

While 40.0% (n=4) of the participants answered yes to the question of whether they used a robot, 60.0% (n=6) answered no.

The opinions of the interviewees about how to use robots in education were compiled under two headings. The analysis was made and entered as numerical data in the computer environment.

Table 3. Participants' response for "How robots can be used in instruction?"

How to use	Frequency	%
Auxiliary tool	9	90
Assistive technology	1	10

While 90.0% (n=9) of the participants stated that they could use robots as an auxiliary element, 10.0% (n=1) answered that they can only be used to support students with disabilities in learning.

Table 4. Participants' response to "Would you consider using an educational robot related to your field?"

Use of robot	Frequency	%
Yes	8	80
No	2	20

80.0% of the participants (n=8) answered that they were considering using a robot related to its field, while 20.0% (n=2) were hesitant to use it.

P6 reported that "I would only use robot to reinforce learning". On the other hand, P9 reported to the questions as "No, I didn't think. I don't think robots will be useful when even human interaction is so difficult, but maybe for course repetition." The opinions of the participants on the field of education that robots would be useful in were compiled and combined under two headings. The analysis was made and entered as numerical data in the computer environment.

Table 5. Participants' response to "In which fields can robots be useful in education?"

	Frequency	%
In all subjects	7	70
Limited subjects	3	30

P1 reported to the question as "It can be useful in language and special education." P8 reported as "It can be used to embody abstract concepts and teach analytical thinking." The opinions of the interviewees about the problems they may encounter while using robots in the lessons were compiled and combined under two headings. The analysis was made and entered as numerical data in the computer environment.

Table 6. Participants' response to "In Which Fields Can Robots Be Useful In Education?"

	Frequency	%
Mechanic & Technical issues	8	80
Distractibility	2	20

While 80.0% (n=8) of the participants thought that Mechanical and Technical errors would cause problems, 20.0% (n=2) answered that they would cause distraction.

Discussion & Conclusion

The results of this study indicate that robots are perceived by IT and Technology & Design Teachers to be a useful tool for teaching and learning. Regarding the positive effects of robotics as an assistive technology and foreign language learning, this study concurs with Cincioglu, et al. (2015) and Şişman (2016).

Participants perceive that robots can be integrated into curriculum to teach foreign language and can be used as

an assistive technology. However, it is surprising for the researcher that the majority of participants perceive robots can pose mechanical and technical problems while utilizing them in teaching and learning environments. Robots can provide visual and hands-on activities to students in problem solving through Problem-Based Learning. They can also provide an opportunity for students to connect the robotic lessons with their real-lives experiences.

The findings of the research revealed that most of the teachers were not employed robots in their teaching. However, overwhelm majority participants expressed their willingness of using robots in their education specifically in STEM education. Teachers reported that robots can be utilized as an instructional support tool in the classroom.

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Secondary School Students' Hopes and Goals for STEM Education

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Abstract: The STEM education concept, abbreviated to the initials of science, technology, mathematics, and engineering disciplines, is one of the key approaches on the agenda of many countries. The past literature on the subject indicates that STEM education has positive effects on 21st-century skills such as critical thinking, problem-solving, and scientific creativity. Hence, this study aims to evaluate secondary school students' hopes and goals for STEM education in terms of various variables. The data of the research, which was designed using the surveying model as one of the quantitative research methods, were collected from secondary school students with the "Hopes and Goals Survey for STEM Education" The findings obtained as a result of the research analyzes were discussed based on the literature, and some relevant suggestions were given.

Keywords: STEM education, hopes and goals, secondary school student

Introduction

STEM education is a trend approach that focuses on science, technology, mathematics, and engineering disciplines and has recently been on the agenda of many countries. Countries that want to lead in the economy, industry, and military, especially the USA and China, have made remarkable reforms in their education systems (Breiner et al., 2012). A huge number of resources have been created in this sense (Dennon, 2021) since these countries know the importance of having individuals with productive, creative, critical and problem-solving skills. To that end, STEM education plays a fundamental role in the development of 21st-century skills (Bybee, 2013).

There are different definitions of STEM education. In general, STEM education is an integrated approach that includes formal and informal education processes from preschool to higher education (Gonzalez & Kuenzi, 2012), aims to develop 21st-century skills, and puts the student at the center (Bybee, 2013; Morrison, 2006). The main purposes of STEM education are explained by Thomas (2014) with the following four items:

1. Labor force with STEM literacy
2. Maintaining existing jobs in the disciplines of STEM
3. Developing innovative products that provide economic value for countries
4. Training skillful individuals for tomorrow's business areas

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In addition to academic achievement, STEM education aims to keep the countries' economies strong and have a say in international competition (Hebebci, 2019). Moreover, it is vital for STEM education to raise qualified individuals to produce innovations that provide an economic advantage for these countries and keep up with the times (Eroğlu & Bektaş, 2016).

Studies on STEM education in the literature are continuously increasing (Chiang et al., 2022; Godec et al., 2022; Li et al., 2020; Wan et al., 2021). However, there is a limited number of studies related to the hopes and goals of STEM education (Douglas & Strobel, 2015; Timur et al., 2022; Yaman et al., 2019). These studies are usually based on scale development and adaptation research. Besides, secondary school is a period in which individuals' professional preferences are formed (Hirsch et al., 2007; Knight & Cunningham, 2004). Thus, there is a need to examine the hopes and goals in the context of STEM education (Douglas & Strobel, 2015). The level of hope of students contributes to academic achievement (Ciarrochi et al., 2007; Snyder et al., 2002). Hence, it is important to determine the goals and objectives of students for STEM education.

Problem and Sub-Problems

The research question of this study is "What are the hope and goal levels of secondary school students for STEM education?"

1. What are the professional tendencies of the students regarding STEM disciplines?
2. Do students' hope and goal levels for STEM education differ by gender?
3. Do students' hope and goal levels for STEM education differ by their awareness of STEM education?

Method

This research was conducted in the descriptive survey model as one of the quantitative research methods (Büyüköztürk et al., 2013).

Data Collection Tools

Developed by Douglas and Strobel (2015) and adapted into Turkish by Yaman et al. (2019), the "*Hopes and Goals Survey for K-12 STEM Education*" scale and demographic information form were used in this study. The reliability level of the scale, which consists of 18 items and 4 factors, was 0.86 for the EFA sample and 0.87 for the CFA sample.

Study Group

The study group of the research consists of 102 students at the 6th, 7th, and 8th-grade levels. The demographics of the participant students are given in the table below.

Table 1. Demographics of the students

Variable	Classification	f	%
Gender	Male	26	25.5
	Female	76	74.5
Grade	6	30	29.4
	7	30	29.4
	8	42	41.2

Table 1 shows that there are more female students in the group. However, in terms of grades, there is a more balanced distribution.

Data Analysis

The Kolmogorov-Smirnov test suggested that the data were normally distributed (p>.05). For this reason, parametric tests were used in the analysis of the data. In this context, descriptive statistics and independent samples t-test were used in the analyzes made within the scope of the research.

Results

The frequency and percentage values of students' STEM career preferences are shown in Figure 1.

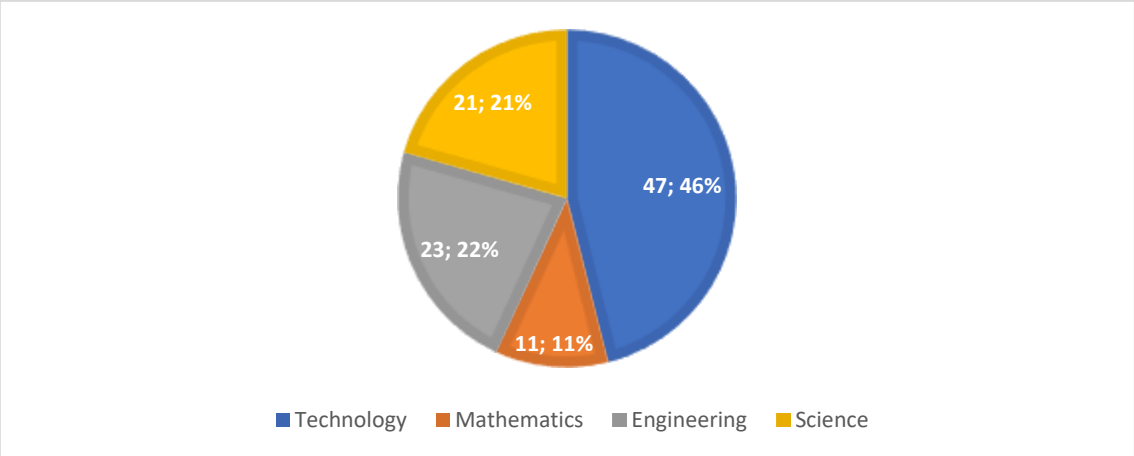

Figure 1. Professional tendencies of students regarding STEM disciplines

Figure 1 indicates that approximately half of the students have a professional tendency toward the field of technology. Science and engineering fields have values close to each other. Mathematics is the least preferred field.

Independent samples t-test results of students' hope and goal levels for STEM education by gender are shown in Table 2.

Table 2. Independent samples t-test results of hope and goal levels for STEM education by gender

Gender	N	$\bar{X}$	S	sd	t	p
Female	76	63.54	10.86	100	1.505	0.136
Male	26	59.46	14.67			

Table 2 suggests that the scores of females ($\bar{X}$=63.54) are four points higher than those of the males ($\bar{X}$=59.46). However, there is no significance between this score difference ($t_{(100)}$=1.505, p>.05).

Table 3 shows the independent samples t-test results according to the students' hope and goal levels for STEM education and their awareness of STEM education.

Table 3. Independent samples t-test results of hope and goal levels for STEM education according to awareness of STEM education

Gender	N	$\bar{X}$	S	sd	t	p
Unaware	88	61.06	11.48	100	3.178	.002
Aware	14	71.57	11.60			

Table 3 points out that the scores of those who are unaware of STEM education ($\bar{X}$=61.06) are significantly lower than those who are aware ($\bar{X}$=71.57) ($t_{(100)}$=3.178, p<.05).

Discussion and Conclusion

This study examined students' hope and goal levels for STEM education. The literature highlights that the studies in this field are limited. In addition, it is notable that these studies are generally in the form of scale development/adaptation (Douglas & Strobel, 2015; Timur et al., 2022; Yaman et al., 2019).

The first result obtained from the research is that the majority of the students' professional goals are in the field of technology. This result may be due to the attractiveness of the large market in the software industry. There are studies with similar results in the literature (Karakaya et al., 2018). However, some studies also reported adverse results (Bozkurt Alan et al., 2019; Kurt, 2019).

Additionally, the hope and goal scores of female students for STEM education are higher than male students. However, there is no significance between the scores. Timur et al. (2022) also reached a similar conclusion in their study. According to Karakaya et al. (2018), on the other hand, female students are more interested in STEM professions than males. However, contrary to this result, there are studies showing that men have higher

interests (Christensen & Knezek, 2017; Sadler et al., 2012).

When the hope and goal scores for STEM education were examined by students' awareness of STEM education, it was concluded that those who were aware of STEM education had a significantly higher average score than those who were unaware, which is an expected result. As a matter of fact, students who are aware of STEM education are expected to score higher than other students.

Suggestions

The number of studies with different methods, sample sizes, and qualities for the hopes and goals of STEM education must increase in the future.

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