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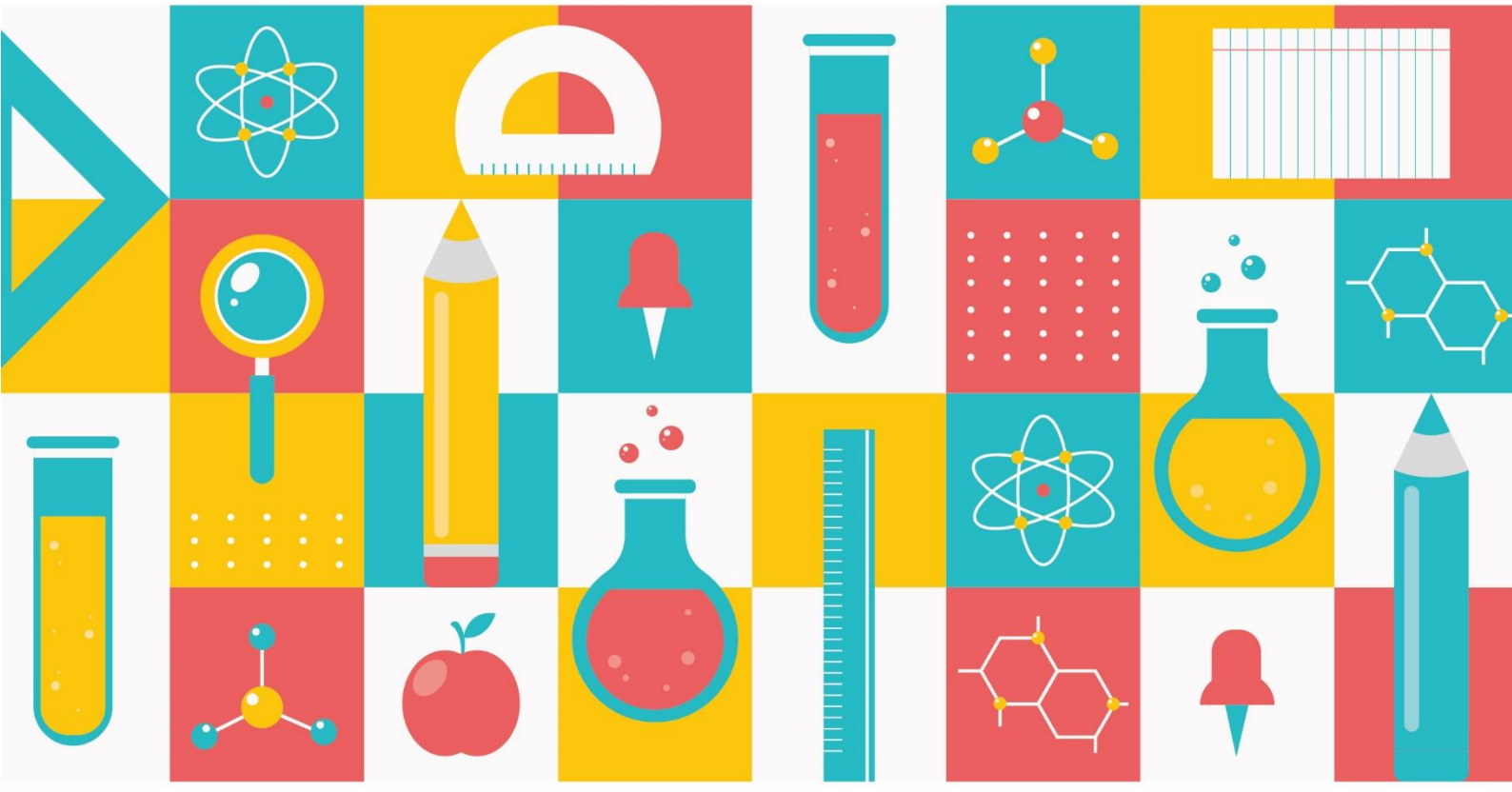

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Optimising Educational Outcomes: Data and Process Analysis Approaches with Attention to Self-Directed Learning

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Abstract

The swift advancements in technology and the corresponding job market impose increasingly challenging and dynamic requirements on workers. This is a significant obstacle for higher education institutions in adequately preparing their students for contemporary expectations and equipping them to tackle future difficulties. Today's students are "digital natives", and they distinctly absorb knowledge and employ new strategies to learn compared to earlier generations. Hence, it is of utmost significance for higher education institutions to comprehend the student learning process. Learning management systems (LMS) can offer substantial assistance in this endeavor, as they facilitate comprehension of students' learning process, while log files also offer unbiased insights into individual adaptation. This study aims to investigate the learning mechanisms of Business Informatics students at Corvinus University of Budapest by analyzing Moodle's educational data. The objective of the study was to acquire a more comprehensive understanding of the learning patterns exhibited by students in higher education through the utilization of an extensive collection of log files. The central idea revolved around examining the behavioral, motivational, and interest-related dimensions of learning as indicators of self-directed learning. These were examined using two primary methodologies: data analysis and process analysis. The findings indicate that distinct learning patterns exist regarding data and learning processes. Additionally, there are variations in time management and information consumption habits. The results of this study have practical implications for identifying learning patterns and developing tailored interventions to enhance educational achievements.

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Introduction

The profound impacts of global megatrends such as Industry 4.0 and digital, COVID-19 and economic crisis, and conflict fundamentally alter our lifestyles, employment patterns, and social interactions. The increasing importance of adaptability and conscious response to continuous and complex change in individual, organisational, and societal development highlights the crucial role of learning. Learning enables young people and adults to engage actively and benefit from change rather than passively enduring it. By harnessing transformational capacities, learning empowers individuals to become agents of change.

As work skills requirements are undergoing significant changes, it is worth noting that one-fifth of adults lack the essential competencies necessary for daily life (World Economic Forum, 2023). This also highlights the deficiencies and issues with the current standardised education system. The calibre of education exerts a definitive influence on the calibre of society in its entirety, and a broad spectrum of research demonstrates a causal connection between the calibre of education and economic and social progress. Inadequate education has a negative impact on individuals, society, and the economy, but high-quality education can lead to substantial advancements. Investing in education yields benefits in policy domains beyond education, such as employment, health, and social inclusion.

Future Skills for the Workplace Demands and New Generation

Technological and economic transformations most visibly affect the employment market and working conditions. The advent of digitalisation and automation is not yet supplanting but profoundly altering how individuals engage in work. Conventional career trajectories will be interrupted. New employment and the evolving skill requirements of current jobs will necessitate frequent updating in low-status positions and high-skilled and high-prestige occupations. The labour market estimate for 2035 by the European Centre for the Development of Vocational Training (CEDEFOP) affirms that there will be a significant increase in demand for highly skilled people while the number of medium-skilled workers will remain relatively constant.

On the other hand, the occupation of low-skilled workers is expected to fall (European Centre for the Development of Vocational Training, 2023). According to the estimate provided by the Organization for Economic Cooperation and Development (OECD), millions of workers may soon need to acquire new skills and change occupations (OECD, 2023). The World Economic Forum's 2023 skills projection (World Economic Forum, 2023), which surveyed 803 organisations, predicts that by 2027, there will be a significant increase in the demand for creative thinking, analytical thinking, and technology literacy, in addition to industry-specific knowledge. Additional essential abilities encompass social and emotional attributes such as

inquisitiveness and continuous learning; the ability to bounce back, adapt, and be nimble; and drive and self-awareness. This indicates that companies place significant importance on the adaptability of their employees, as well as their openness and eagerness to acquire new knowledge.

Education has a crucial role in enhancing human skills and competencies. Education can contribute to reducing inequality in the labour market by aligning learning results with the needs of the labour market and making training programs accessible to a broad audience. Digital technologies have the potential to either cause significant disruptions or bring about transformative changes in the labour sector. Multiple studies examine the elements that influence the transformation of job roles and offer a set of techniques to forecast future jobs. Meanwhile, digital technologies provide education establishments with options to utilize collaboration, e-learning, or other platforms to efficiently transfer knowledge. These platforms facilitate access to those who choose to study from any location, provided they possess suitable devices and internet connectivity. The COVID-19 pandemic expedited the digital transformation of the education sector and emphasised individual adaptation.

Self-Directed Learning

Nowadays, with the evolution of online platforms, the Learning Management Systems (LMS) used, such as Moodle, allow us to record a wide range of learner actions and interactions, from low-level events such as mouse movements and clicks to higher-level events such as learning paths based on self-directed learning (SDL) principles and variations in event frequencies.

Self-directed learning refers to the result of enabling learners to take charge of their own learning experience and make choices regarding the specific knowledge they choose to acquire and master (Boyer et al., 2014). SDL includes students strategically organising their approach to course tasks and activities, establishing objectives for completion, closely monitoring their progress and comprehension of the material, and critically evaluating their performance upon completing each task. (Hung et al., 2010). Moreover, self-directed learning is a significant dimension of online learning readiness (Sarro-Olah & Fodor, 2023), which means the students can apply SDL better the better they are at online learning, considering that all other things are constant. Li and colleagues have broken down SDL into four main components: self-planning, self-learning, self-evaluation, and self-reflection (Li et al., 2023). All events can be identified as part of an SDL dimension so that the student's digital presence can be used to assess the role of each category and determine where more effort should be made to develop online learning readiness.

Educational Process Mining

Educational Process Mining (EPM) enables the mapping of students' behaviour by tracking their navigation patterns and interactions with course content within a Learning Management System (Romero & Ventura, 2013). Therefore, educators can utilise the EPM to comprehend better students' learning patterns, the variables that impact their academic achievement, and the skills they acquire (Alqaheri & Panda, 2022). This enables them to construct and evaluate educational process models that accurately depict observed behaviour.

The models identified by EPM can be utilised to gain a deeper comprehension of the fundamental educational processes, to identify learning disabilities at an early stage, to generate personalised recommendations for students, to aid students with specific learning disabilities, and to provide feedback to students, teachers, or researchers, among other applications (Cerezo et al., 2020). Furthermore, the EPM enables the analysis of students' behaviours and the categorisation of these actions in relation to specific activities. Conformity analysis processes can be conducted to see whether a previously modelled behaviour aligns with the observed behaviour (Adams & Van Der Aalst, 2021). The EPM, as a methodology, has the potential to introduce novel approaches for studying students' learning behaviour and problem-solving skills (Cerezo et al., 2020; Romero et al., 2016).

The objective of this paper is to present the results of data and process mining procedures as possible tools for course development and individual support. The course observed was conducted in the Moodle platform, and the data was obtained from its event log. The paper is organised as follows: section II describes the methods used to conduct the experiments; section III presents the obtained results; section IV provides the discussions; and section V sets out the final considerations.

Method

The nature of the research is exploratory, so it was particularly important to define the main research directions, which were determined by the research objective. The main considerations were educational data mining and educational process mining, with regard to SDL and the practical usability of the results. In terms of methods, it was crucial to identify the appropriate data source, find the necessary tools and consider the methodology.

Participants

The study focuses on the learning log data of selected students at Corvinus University of Budapest, Hungary. These students were all relevant to the analysis since they participated in the Business Informatics programme Science, Technology, Engineering and Mathematics (STEM) courses and have experience using Moodle as an

LMS. Furthermore, these students were second-year undergraduates while the observation occurred in the fall semester of the 2022/2023 academic year; thus, due to the pandemic, they were used to face-to-face and online learning. The Fundamentals of Artificial Intelligence as the basis for the data collection course was chosen because of its practical nature. Students had to solve practical problems during the lessons, which they accessed via Moodle. As a result, 110 students' data were available. However, due to the individual curriculum and unusual circumstances, 98 students' data were reviewed in detail.

Data Collection and Pre-processing

The analysis of educational data is not a new field, but nowadays much more data can be collected, and activity tracking can provide an objective way of understanding students' learning and the use of digital tools provided by the university. Our primary source of data is Moodle, an LMS used in Corvinus University of Budapest; however, Neptun also offered information about belonging to the classes and some essential course or student information. Raw data includes details about the date and time of the activities, the identifier of the executors, the context and classifications of the events and the location characteristics of activities (see Figure 1)

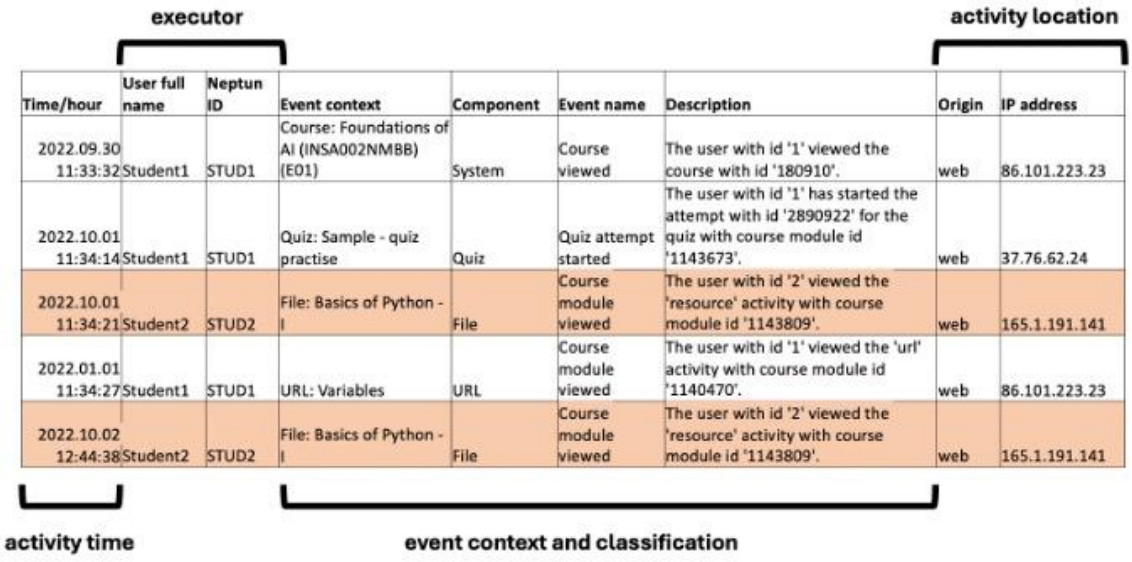

Figure 1. Sample of original Moodle log file (Source: prepared by the authors)

The logging settings of Moodle are suitable for understanding an event by its existence and characteristics but not by its length since events include only the initial times of activities. The exact moments of completion, however, are not logged, hence, defining the precise duration of the activities is beyond the scope of this study. The first step was to prepare the log files for analysis, such as only events of the selected students were required. Other participants' activities or system logs were eliminated. Furthermore, only the activities during the course were of interest, so just the events between 29-08-2022 and 05-02-2023 were included. Research into possible

duplication and system anomalies was also carried out at this stage. As a result, 54853 valid events were collected for the ninety-eight students surveyed. Python was used in the preparation process, given the extensive input data and multiple data sources. Another approach that made the use of this tool important was that big data raises key issues not only for processing but also for data privacy. In interpreting and using the data, the elements that would allow the identification of individual students were depersonalised, thus protecting the research participants. This process can be reliably tracked using Python.

Data and Process Analysis

The nature of the research justifies the use of a variety of tools and methods. Python was used for data analysis due to the reliability and transparency of the modules and procedures. Thus, after assisting with data cleaning, it has also proved useful for basic mathematical and statistical tasks, visualisation and hierarchical clustering. In addition, the RapidProm extension was applied for the process analysis procedure in RapidMiner. This tool offered an opportunity to examine events not only as a unit of activities but also as a link in a chain. Due to the specificity of log files, the Heuristic Miner algorithm was chosen. This algorithm can reveal the main elements of the process from the control-flow perspective and is a good choice because of its ability to deal with the noise in the data set and the possibility of identifying the main learning activity sequences (Weijters et al., 2006).

Results

Having clarified the source of the data and the tools needed, output data were examined according to two main criteria. These are gender differences and course activities. However, in the latter case, the time management aspect, SDL aspect, digital learning aspect and the learning process aspect are also discussed in more detail. The results show both the activity of the individuals studied and the useful information that can be obtained from the LMS, either during or at the end of the semester.

Gender Differences

Once the data has been pre-processed, detailed insight into student activity is possible. Data from ninety-eight students are examined, with gender differences being explored first. Activities were generated by seventy-five male and twenty-three female students, based on Moodle logs. Different amounts of activity were generated according to the different sizes of the gender groups, so an independent t-test can indicate similarities or differences between the two groups. Independent t-test emphasises that there is a statistically significant

difference between male and female students in the average number of activities if the chosen significance level is 5% and both samples follow normal distribution (see Table 1).

Table 1. Results of the independent t-test by gender (Source: prepared by the authors)

	Male		**Female**	
	Mean	Stdev	Mean	Stdev
Number of activities	539.88	191.12	624.43	177.52

Interpreting the results, female students generated statistically more activity during the semester by the data observed.

Course Activities

This course supported obtaining practical knowledge about AI and parallel Python programming. Each week, the lecturer uploaded theoretical and supporting content and Python training codes, which students could use to try out the methods they had learned. The solutions to the practice codes were also uploaded a few days after the lessons. These contents provided the material for the practical exam at the end of the semester, so the way the students use it can be a guide for the instructor.

Time Management Aspect

An overview of the activities throughout the semester gives a comprehensive picture of the digital content used in learning. This provides insight into behaviour related to the timing of digital learning and the frequency of content use. Figure 2 highlights the evidence of a cyclical learning schedule in the present research.

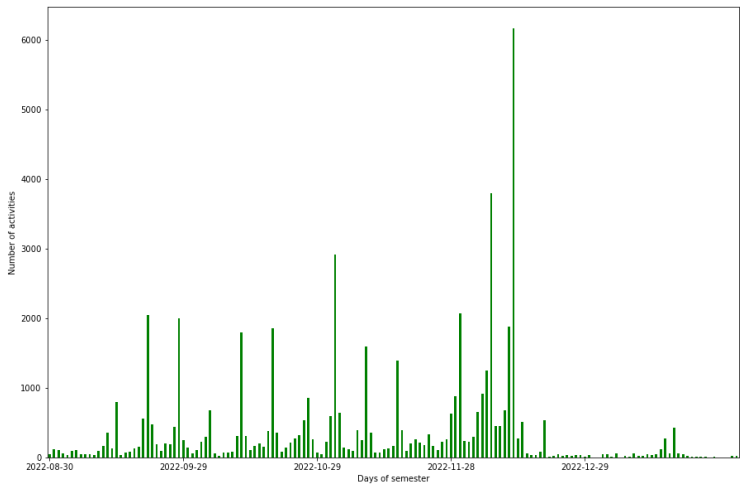

Figure 2. Number of student activities by the days of the semester (Source: prepared by the authors)

Students generated most of the events weekly on the day of the lessons. On the other hand, the exam was one of the most active, with most students taking the end-of-year test on 12-12-2022, for which they could and should have used Moodle.

In addition to the overall time usage, it is also possible to determine how many log files were generated by the students before assignments, how many before the exam and how many during other periods of the semester. The distance from these special days could categorise all events and could be counted per student. The event was considered part of an exam or assignments if it started 7 days before the exam. Finally, all ninety-eight students had standalone, close-to-exam and close_to_assignment events in individual composition. After data preparation, which included normality testing and standardisation, the data for each student became comparable. Based on the correlation values, it is possible to form clusters based on the three variables under study. Given the data and the lack of an ideal number of clusters, a hierarchical clustering procedure was chosen. Three clusters were the ideal choice based on the dendrogram (see Figure 3) and the agglomeration schedule.

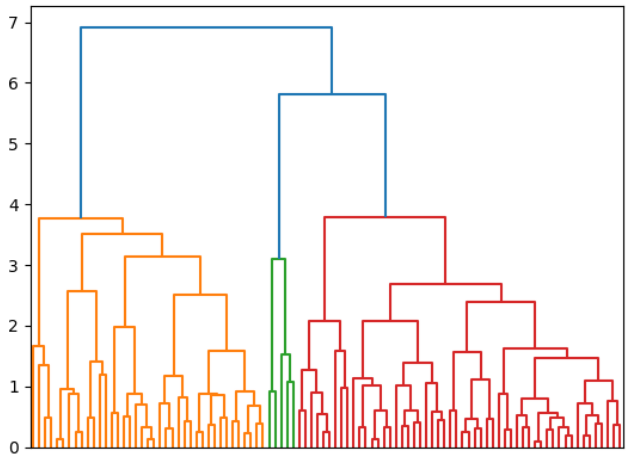

Figure 3. Dendrogram of hierarchical clustering (Source: prepared by the authors)

The first cluster, which includes fifty-four students, is called *Persistent digital learners*. According to the Moodle logs, these students showed higher than average activity levels during the semester, with no significant increase in activity levels before assignments and exams. The second group is the *Traditional learners*. Thirty-nine students belong to this group, and their main characteristic is that they were less active than average both during and at the end of the semester. The smallest group is *Deadline drive digital learners*, with five students. This cluster was active during the course but became particularly active around assignments, especially before the exam (see Figure 4). Therefore, the number and characteristics of the clusters suggest that a considerable proportion of students were active throughout the course, not just focused on the assignments and the exam.

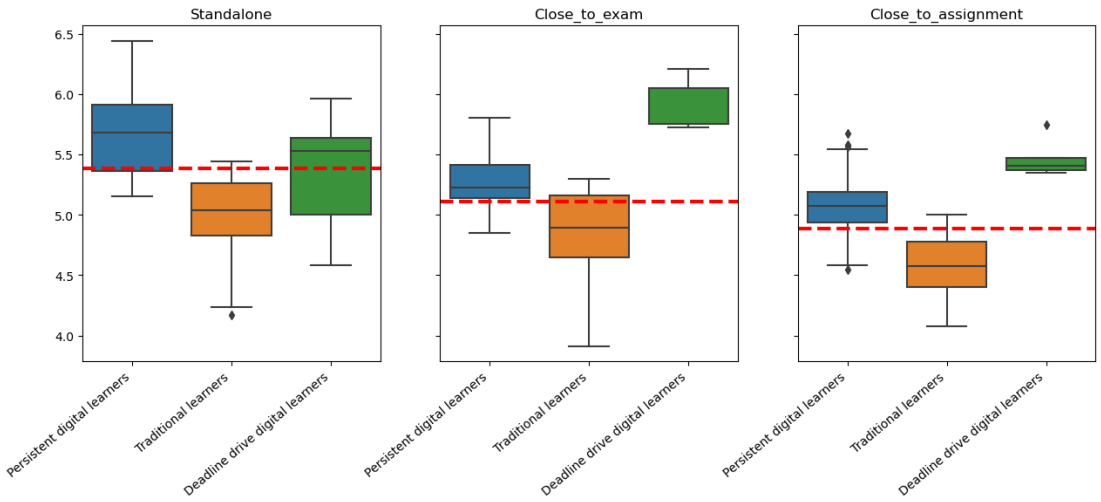

Figure 4. Boxplots about characteristics of clusters (Source: prepared by the authors)

Self-Directed Learning Aspect

Event logs from Moodle can be translated into SDL dimensions as well. Li and colleagues have presented their classification method in their work (Li et al., 2023), but the systematisation of events requires caution due to course specificities. In this study, therefore, the basic rules of classification are formulated according to the specificities of the own data. Events that focus on gathering information about courses and requirements are the parts of the Self-planning (SP) dimension. In contrast, the Self-learning (SL) dimension includes activities in which the reviewed person uses some tool in the learning process, such as presentations, practical supports, data sources and supplementary materials. In cases where the participant practises quizzes, prepares individually for the assignment or looks at the solutions for practical tasks or the lecturer's feedback, it can be classified as Self-evaluation (SE). The Self-reflection (SR) dimension includes events in which the students look at information related to the exam, or check the exam tasks, either repeatedly or retrospectively, and view the grades and related feedback.

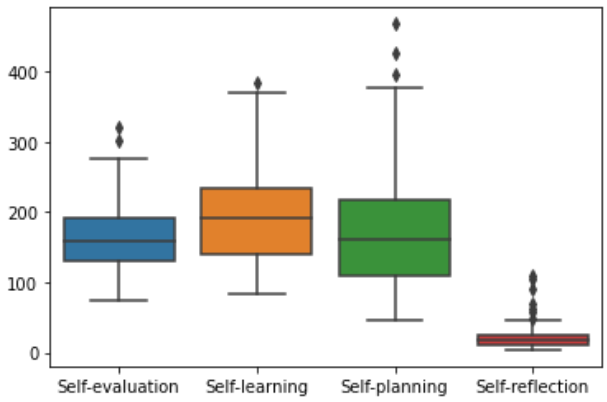

Figure 5. Boxplots about students' activities by SDL dimensions (Source: prepared by the authors)

Figure 5 highlights that the highest average number of activities among the SDL categories is found in the SL category and the lowest in the SR category. SP and SE are close to the average level of SL. The figure also shows that students found Moodle content useful mainly for self-study and were eager to gather information and evaluate their knowledge. This course, however, did not give enough space to the SR dimension or was not attractive enough for the students. From another aspect, students used the information available for the semester including by SP dimension. Furthermore, they also had access to learning support tools that are part of the SL dimension, which they used. Moreover, they had the opportunity to develop independently based on the solutions and individual feedback that came under the SE dimension. In terms of student behaviour, traces of SDL were recognisable, even though the use of Moodle was not compulsory, except for exam, quizzes and assignments.

Digital Learning Aspect

Categorising events can help to map activities from other aspects. Moodle has its classification for the events, namely components; however, this is not enough in some cases, and there are no built-in constraints to ensure collective understanding (Martínez-Carrascal et al., 2024). For a deeper insight, a classification is needed that points to the type of task in which the student's activity occurs (see **Hata! Başvuru kaynağı bulunamadı.**). In this case, the most important categories were some of the highlighted parts of the SL and SE dimensions, namely the presentation, the practice, the solution, and the supplementary types, as the instructor could also use them to assess the continuity of learning and possible individual obstacles even during the semester. The presentation-type activity was related to the number of times students viewed the uploaded theoretical background material. The Python code was available for exercise as a practical-type learning material, and the solutions could be viewed by clicking on the solution-type material. The supplementary-type resource provided various extra content on the topic, although, knowledge of it was not part of the requirement, but it provided an exciting insight for those interested.

Based on the Moodle log files, the reviewed students generated 3350 practice activities, 3204 presentation activities, 946 supplementary activities and 738 solution activities. There are different usage dynamics when looking at these events by relative month of the semester (see Figure 6Figure 6).

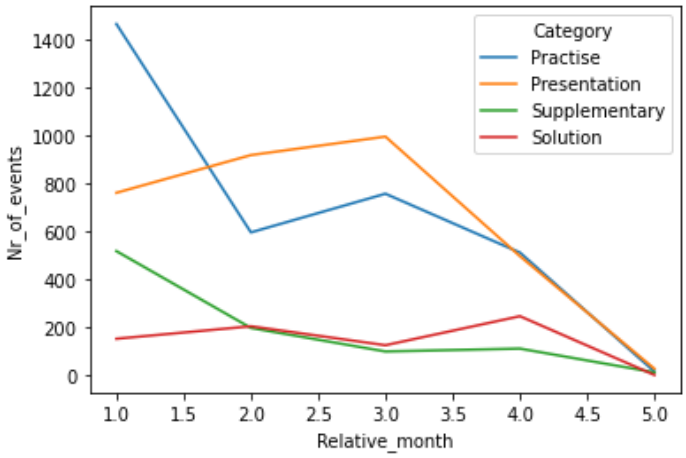

Figure 6. Number of events by the relative months of semester and the main categories (Source: prepared by the authors)

At the beginning of the semester, the most popular content was practice, with the number of recorded events decreasing as the course progressed. This is very similar to the supplementary type of event, which was, although, on a significantly smaller scale. Supplementary content was more popular at the beginning of the semester, but the amount of activity content decreased as the semester went on. The presentation-type events became more prevalent later in the semester since they reached their highest number of recordings in the third month. Solution content was also not popular in the first half of the semester, but as the exam approached, more activity was registered on this content.

Learning Process Aspect

The sequence identified by the student activities highlights the types of events that users prefer and how these actions are associated with each other. This approach reflects on the events generated during learning as a complex process. There are several possible tools, however, due to the specificity of the data, the Heuristic Miner algorithm was chosen. The heuristic process model provides a good solution for a detailed understanding of digital learning processes, as it is able to highlight important events and process relationships despite the noise in the input data (Weijters et al., 2006). The input data is taken from log files of Moodle and stored in a comma-separated value form. Only events belonging to the SL and SE dimensions were taken into account. The input data includes datetime attribute as a timestamp to the second, the masked Neptun IDs, which are the unique identifiers of the students, and the component classification categories, which are detailed in **Hata! Başvuru kaynağı bulunamadı.**. The RapidProm extension provides a tool to convert the input data into event log-type data. To do so, the event log factory was set to naive, the event classifier was defined as the event name, the trace identifier was specified as Neptun ID, and the event identifier was chosen as the category. Finally, after specifying the input data, the Heuristic Miner (Heuristic Net) was used to make the analysis

executable. The fitness of the model is 0.88, calculated when the model is run. This value means that the model covers event logs well (Chanifah et al., 2021).

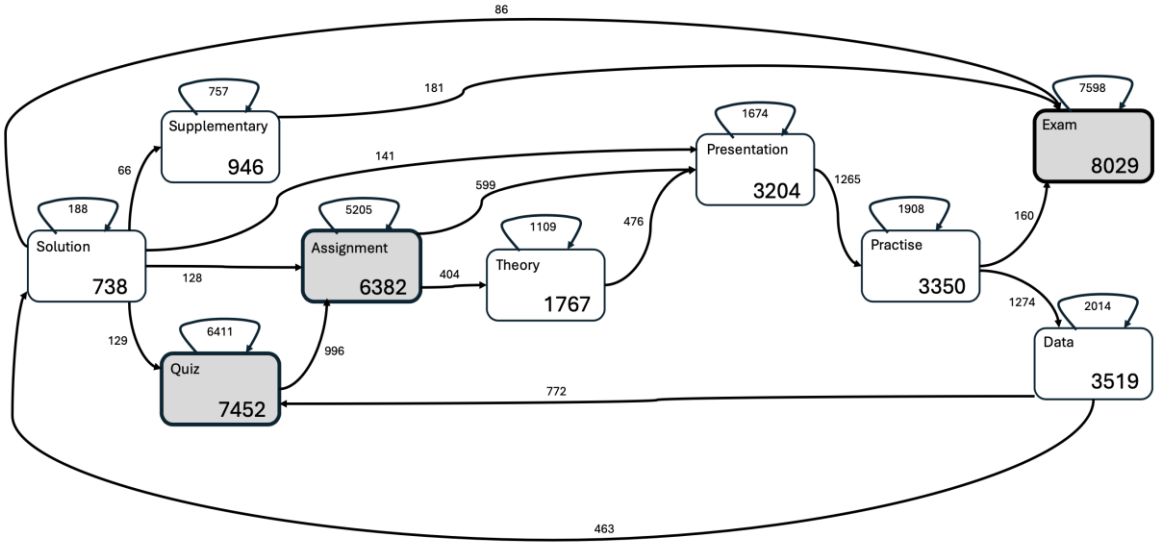

Figure 7. Heuristic process model of Moodle log events by cathegories (Source: prepared by the authors)

The results are presented in Figure 7. Categories, meaning event identifiers are marked with rectangles, showing the name and the frequency. Each category can return to itself in the process, indicated by a return arrow. The number on it shows the number of returns. This means that not only different events can follow each other, but also events of the same classification. In the case, however, where two different events are side-by-side, the direction of the edge between them indicates the direction of the relationship, and the frequency is also given next to the edges. The most frequent categories are those marked in grey. These were the compulsory ones to complete the course: the quiz, the assignment and the exam. It can be seen that 128 cases of solutions were followed by assignment events and 129 by quiz events, which suggests that students used solution content to prepare and achieve better results on the mid-term tests.

The presentation type content was followed by the practice type in 1,265 cases, so it can be said that the students had looked at the background knowledge needed to do the exercise before doing it. Practise type was followed 1274 times by data type activity, so the data used for the practical exercise was looked at by the students after the start of the exercise. And, whereas, data drives back to solution-type activity it highlights a sequence of practical learning. If the process is viewed from the exam side, the most common directions that precede it are practice, solution and supplementary. This can be explained by the fact that the final test was open book, so it can be seen that students used the previously uploaded content during the exam.

Discussion

The original log files were processed to extract information from the large amount of data that would support those involved in education. Considering all the activities of the course as a whole can be an approach to interpretation. In this case, the results can be used to target improvements to the course for the upcoming years. Nowadays, however, due to the wider educational representation of digital tools, meaningful data can also be extracted during the semester. Some of the methods could catalyse understanding by providing insights, such as identifying how participants schedule their learning, how they are ready to learn by themselves based on SDL dimensions or how they use the main content categories. In our study, practical content and presentations were the most common elements of digital learning, although the presence of these varied over the semester. In the process model, content related to the fulfilment of requirements, such as quizzes, assignments and exam, were the most frequently generated activities.

The results that Chanifah and colleagues presented in their work indicated similar results, as the most important activity types for the programming course they studied were quiz, course and URL (Chanifah et al., 2021). The course type mentioned in their case can be matched with the activity we identify as practice, and the URL can be data, practise, solution or supplementary type according to Table 2. In both cases, the quiz appears in the same way. The importance of computer-supported, real-time predictions has been mentioned before (Aldowah et al., 2019), however, in the context of an accelerated change of circumstances, its role has been enhanced. Our results may not be generalisable to all courses, but they provide supporting content that can be objectively extracted from Moodle log files.

An alternative approach is that students may also benefit from understanding the data, as the process model can be examined at the level of the individual. Our results have shown the learning process at the course level, but several studies have already stressed that it would be worthwhile to formulate personalised recommendations based on the EPM (Bogarín et al., 2018), and even individual learning pathways (Martínez-Carrascal et al., 2024).

In this study, we confirmed gender differences, which resulted in fewer female students participating in the course, but they were statistically significantly more active than their male peers, however, the present study did not find any reasons for this. The gender results are in line with the findings of Sáiz-Manzanares and colleagues on STEM courses, who have emphasized in their work that it is worth exploring ways of reducing the gender gap using learning data (Sáiz-Manzanares et al., 2021).

Classifying students by gender is not the only way to group them. In the present study, we distinguished three groups of students by their behaviour according to whether they used digital content near the exam, before assignments or during other periods of the semester. This is just one approach; other studies point out that grouping can also be done based on students' motivation and SDL level (van den Beemt et al., 2018). Furthermore, Li et al, focusing on online SDL, highlight that low and high-achieving groups in terms of performance show different learning patterns (Li et al., 2023). Additionally, students can be grouped not only by data but also by their individual learning processes (Ramos et al., 2021). This means that the data provide a wide range of opportunities to understand how students use digital tools in their learning, and the method chosen depends on the purpose. This research highlights only some approaches and does not look at offline learning. Moreover, we studied only a small group of students, and all participants were at Corvinus University in Budapest, Hungary. Furthermore, the behaviour of students taking a STEM course was observed. The characteristics of the course may also differ from other similar classes. Consequently, the log files of the students could be investigated more extensively in the future.

Conclusion

Concluding the results, the present research, based on the log files of Moodle as an LMS, sought to answer the question of how to use data and process analysis tools for understanding learning. First, the gender gap was analysed in the selected STEM course, showing that most of the participants, 75, were male and the minority, 23, were female. In contrast, it was proven through statistical independent t-test analysis that female students generated more activity on average than their male peers.

Looking at the whole semester, it can also be seen that students generated several log files weekly, which coincided with the contact hours. Between lessons, the activity rate is lower. Moreover, most of the activity is seen on the day of the exam when students were required to use Moodle to obtain grade. This evidence shows how students align their time management approach for requirements and, as seen in the case of the exam, it shows which events produce more activity. The students in the study adapted to the course and followed its pace in their individual learning.

In another approach, the use of time was also examined in terms of whether students studied mainly before exam, before assignments or during other parts of the semester. All students had all three of these activities, but in different combinations. According to these values, they were classified into three groups using a hierarchical clustering procedure. The first group is the Persistent digital learners with 54 students, who had higher than average activity throughout the semester, with no significant fallback. The second group is the Traditional learners. 39 students belong to this group and their main characteristic is that they were less active

than average throughout the term. The smallest group is Deadline drive digital learners, with 5 students. In their case, the most important period was before assignments and exam, with average activity for the rest of the semester. Given the practical nature of the course under study, the expected behaviour would be to get as much activity from the students as possible. However, it is also necessary to mention that the extent of offline learning is not apparent from the data examined.

In terms of the readiness of students for self-directed learning, Moodle logs can also form a basis. In doing so, it was found that, on average, most of the activities that students completed were related to self-learning, even though its components were not mandatory for students to use. The self-planning dimension of the SDL was also significantly present, meaning that students used information that was shared on the online surface. Similarly, the self-evaluation dimension is also visible in the data, but this also includes some of the activities of the quizzes and the assignments, so a higher number of logs was expected. Self-reflection, as a collector of the exam and related content, showed the fewest events on average compared to the other activities. However, it can be said that non-mandatory content was also used by students, giving evidence of the presence of SDL.

Having collected the SL and SE content that were most relevant for individual learning in this course, we further investigated thes practice, solution, presentation and supplementary types of events. The two most numerous were the practice and presentation types. The former generated more interest in the first half of the semester and the latter in the middle of the semester. The solution and supplementary content types showed significantly less activity than the previous two types. The solution type tended to be more important in the month of the exam according to the logs, which can be explained by the preparation and by the fact that students could use previous solutions during the exam. Supplementary, compared to the practice-type content, showed more activity in the first half of the semester. It can be concluded that the most popular content was that which the students could use with the lecturer during the contact hours.

So far, results available with data mining tools have been presented, but these have not been able to identify activity types as sequences or at least directions of connections. Process mining therefore focuses on precisely this by including the SL and SE dimensions. Each activity could be followed by an event of the same classification, so describing the general process with the categories used, especially to fit all possible processes, would give an infinite number of outcomes. For this reason, and because of the specificity of the data, the Heuristic Miner algorithm was used to construct the process model. Process mining showed that the most frequently visited activities were related to the exam or any type of test. This result could be related to the fact that the visit of the named content was mandatory to complete the course. It can also be seen that the solution, practise and supplementary contents were in many cases followed by an exam-type event, meaning that students used the course content for preparation and even for the exam. Furthermore, a noticeable number of

students followed the presentation category with the practise type, followed by data and finally the solution. This process shows that after reviewing the theoretical background, students used the Python codes to practice, then they opened the prepared data files and finally looked at the available solutions. Except for the exam and tests, this path is the most common direction, which was also the goal of the course.

Recommendations

In the present research, although we have studied a well-defined, small group, we make the following recommendations based on the results. First, it is worth considering at the course design stage how students' activities can and should be monitored. An important question is whether it is useful to interpret the data continuously throughout the semester, or if it is sufficient to do this only once at the end of the semester.

Based on the literature, it may be worthwhile to develop a recommended learning process, individual learning paths, or activity reports. In summary, the processing of log files can be useful for the instructor, who can intervene immediately if the data indicates that. For the students, it would provide direct feedback on their own activities and help them to follow their individual development paths. It is worth considering a structured form to which both students and teachers can have access. Processing log files can thus contribute to improvement.

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Appendix

Table 2. Categories of Moodle activities (Source: prepared by the authors)

Category	Definition	Component (Moodle)
Assignment	Assignments requiring independent work, where students had to upload their solutions to the Moodle platform by a set deadline.	Assignment File File submissions Online text submissions Submission comments Assignment
Data	Prepared data files for practice and exercises.	File System URL
Exam	The final test of the semester.	Assignment File submissions Online text submissions Quiz System
Information	Information on deadlines, expectations and specific occasions to complete the course.	Assignment File Forum Quiz System

		User report
Practise	Practical exercises to solve each topic in Python.	File Quiz System URL
Presentation	The theoretical material that precedes the exercises, focuses mainly on the theory needed for the practical solution.	File System
Quiz	Tests at the beginning of the class, which check the students' current level of preparedness in 5 short multiple-choice questions.	Quiz System
Solution	Solutions to practical Python codes were published the weekend after the class.	System URL
Supplementary	Content that is not part of the requirement but helps to understand it.	File System URL
Theory	A more detailed theoretical overview than the presentation.	Folder System User tours

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Paints of the Artist's Palette in STEAM Teaching

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Abstract

This qualitative study was an emergent phenomenological study based in the tradition of portraiture, which shares many of its features with ethnography, case study, and narrative inquiry. The purpose of this study was to identify the most engaging cooperative learning methodologies for students to actively participate in home-school learning with parents during scientific inquiry investigations and supportive strategies for teachers to employ for Science, Technology, Engineering, Art, and Mathematics (STEAM) education. The conditions identified motivated students and their parents to take ownership of the learning in which they became self-managed, self-responsible, and self-directed. Data indicated the increased success of students were the result of students participating in teacher-designed experiential, constructivist learning activities that utilized a facet of involvement strategies and provided students with authentic and socially constructive learning. Providing a guided inquiry-based learning environment also promoted student achievement and empowered students to assess their learning for developing self-responsibility, acquiring self-management skills, and raising student efficacy. As a result, students were empowered to develop scientific inquiry and literacy skills and were enabled to take control of the learning through cooperative learning that included interactive homework, collaborative inquiry-based activities, metacognitive questioning, self-assessments, and dialogue journaling.

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Introduction

Home-School engagement tends to weaken by the time students reach secondary school, leading to a decline in active parental involvement. The reduced engagement of parents during high school is influenced by the growing independence of adolescents and the encouragement of student self-sufficiency by parents (Catsambis & Garland, 1997; Epstein & Sheldon, 2022). The decline in home-school engagement during secondary school, driven by increased adolescent independence and parental encouragement of self-sufficiency, is particularly evident in reduced parental involvement in high school science. Parents often experience a decrease in confidence regarding their knowledge of science content, presenting a significant barrier to their participation in high school science. Consequently, cooperative parent engagement in high school science is particularly affected due to parental confidence issues related to science content and their own former experiences as science learners. Despite adolescents gaining independence, students still need ongoing guidance and support from parents as they take on greater responsibilities. Notably, areas witnessing a decline include discussions about school, homework, and parental assistance with homework (Epstein et al., 1999). Nevertheless, adolescents require the sustained guidance and support of parents as they mature and assume more responsibilities. Adolescents necessitate ongoing parental guidance and support and benefit in areas such as school-related discussions and assistance with homework.

The impact on students' interest in Science, Technology, Engineering, and Mathematics (STEM) and science courses is influenced by collaborative learning and integrated learning experiences, providing crucial support for science and STEM education (Barakos et al., 2012; Brown et al., 2011; Hebebci, 2021). Although parental involvement in student learning is more prevalent in elementary grades compared to high school, highly structured, subject-specific science and STEM learning occurs in high school as opposed to elementary school. Home engagement enhances the ability to support the development of scientific inquiry and literacy skills in STEM courses. Despite an increase in STEM-specific course enrollments during high school, parental involvement tends to decrease as students progress from elementary to high school (Epstein & Sanders, 1998; Funk & Hefferon, 2016; Hebebci, 2022).

Varying degrees of parental support and a student's home environment impact the quality of home-school relationships (Epstein & Sheldon, 2022; Shymansky et al., 2010). Creating a supportive atmosphere through social support is essential for not only facilitating learning but also empowering students in acquiring knowledge (Epstein, 1995; Mahoney et al., 2021). Supportive relationships contribute to emotional connections, the development of interpersonal skills, and the establishment of systems that aid students in achieving success (Darling-Hammond et al., 2020). To foster the development of constructivist scientific inquiry and literacy skills in students, promoting supportive and reciprocal home engagement assists in

nurturing the whole child, addressing both science learning and social skills development (Dignam, 2023). Well-structured support systems contribute to the social, emotional, and academic accomplishments of all learners (Osher et al., 2018). Involving parents in activities such as homework, learning tasks, or scientific investigations rooted in inquiry promotes active learning, questioning, and the application of knowledge (Darling-Hammond et al., 2020).

Providing students and parents with experiential, constructivist learning serves as a foundation for building social capital. Additionally, the process of developing social skills and engaging in cooperative learning provides students with opportunities to develop conceptual understanding (Dewey, 1933; Piaget, 1972; Vygotsky, 1978). Experiential, constructivist learning not only fosters conceptual understanding among students but also serves as a foundation for building social capital through the development of social skills and engagement in cooperative learning. As students actively participate in constructing knowledge and self-assess progress, they develop a deep understanding of curricular objectives and outcomes, thereby reinforcing constructivist principles (Dewey, 1933; Perkins, 1999). Parental participation in homework, activities, and investigations plays a crucial role in the academic and social development of students by providing ongoing feedback, guidance, and suggestions for improvement. Therefore, involving parents in a constructivist, experiential, and interactive manner creates avenues for nurturing student ownership of science learning (Kolb, 2014; Kolb et al., 1984; Piaget, 1972; Vygotsky, 1978). Engaging parents in homework, activities, and investigations provides ongoing feedback and guidance for students' academic and social development, while also cultivating student ownership of science learning through constructivist, experiential, and interactive activities.

Students develop scientific literacy by engaging in processes that afford opportunities to experiment, apply hypothetical-deductive reasoning, and assess findings (Bowyer, 1990). Scientific literacy also serves as a predictor of student inquiry behavior, facilitating the development of literacy skills (Wen et al., 2020). Scientific literacy is a predictor for student inquiry behavior and fosters the development of critical thinking and literacy skills development. Parental involvement enhances the development of students' scientific inquiry and scientific literacy skills for a lifetime of learning (Dignam, 2023). Contemporary scientific Science, Technology, Engineering, Art, and Mathematics (STEAM) advancements positively impact society, and providing students with a guided, inquiry-based learning environment promotes student achievement for attaining relevant scientific knowledge that can be employed for a lifetime of learning (Hebebci, 2023; Wen et al., 2020).

Establishing Systems of Support

Establishing social connections plays a crucial role in fostering collaboration, which supports students developing conceptual understanding for constructing knowledge (Schieffer, 2016; Vygotsky, 1978; Woolley et al., 2015). Building social connections is critical for nurturing collaboration and communications, which assists students in developing conceptual understanding and constructing knowledge. Communication among parents, students, and teachers is central in supporting collaboration during inquiry activities (Kaufmann & Ryve, 2019). Students who are socially supported and engage in inquiry are more likely to academically achieve (Epstein & Sheldon, 2022; Woolley et al., 2015). To actively involve parents, teachers require a supportive school environment to establish a home-school relationship and build capital (Darling-Hammond, et al., 2002; Darling-Hammond et al., 2016). Experiential learning through active parental involvement enables students to develop a deeper understanding (Epstein et al., 2021; Kolb et al., 1984).

Establishing supportive relationships plays a vital role in fostering emotional connections, cultivating interpersonal skills, and establishing systems that assist students in achieving and succeeding (Darling-Hammond et al., 2020). Supportive connections between home and school promote scientific inquiry and literacy skills through constructivist, interactive learning activities and contributes to student academic achievement and enhancement of student social skills development. Fostering the development of scientific inquiry and literacy skills in students through constructivism promotes a supportive and reciprocal home-school relationship that contributes to nurturing the whole child, addressing both science learning and social skills development. Well-structured support systems contribute to the social, emotional, and academic accomplishments of all learners (Osher et al., 2018). Involving parents in interactive homework, scientific investigations, and inquiry promotes active learning, questioning, and the application of knowledge (Darling-Hammond et al., 2020).

Developing Conceptual Understanding

Providing students and parents with opportunities to engage in experiential, constructivist learning provides a foundation for fostering social capital. The process of developing social skills and engaging in cooperative learning offers students opportunities to develop conceptual understanding (Dewey, 1933; Piaget, 1972; Vygotsky, 1978). As students actively construct knowledge and assess their progress for conceptual understanding, they develop a comprehension of curricular objectives and outcomes, thereby reinforcing constructivist principles (Dewey, 1933; Perkins, 1999). Active parental involvement in homework, activities, and investigations contributes to the academic and social growth of students by providing ongoing feedback,

guidance, and suggestions for improvement. Involving parents in a constructivist, experiential, and interactive manner creates avenues for students to develop ownership of science learning (Kolb, 2014; Kolb et al., 1984; Piaget, 1972; Vygotsky, 1978).

Constructivism provides teachers with processes that provide students with increased control over their learning and a platform to showcase the acquisition of knowledge. Constructivism provides students with opportunities to develop knowledge through experiential learning (Kolb, 2014; Piaget, 1972). Affording students and parents with opportunities to participate in experiential, constructivist learning creates a platform for parental involvement in high school science and home-school support. Furthermore, the process of constructing knowledge enables learners to design investigations, apply inquiry skills through collaboration, make decisions, and generate answers for understanding (Bruner, 1996). As students actively construct knowledge and self-assess their progress, they develop a deeper understanding of curricular objectives and outcomes, thereby enhancing the principles of constructivism (Dewey, 1933; Perkins, 1999).

Cooperative Engagement for Supporting Learning

Interactive Homework

As students advance from primary to secondary school, parents experience less confidence in terms of assisting with science homework; however, parental involvement continues to impact students' motivation to learn. Interactive homework is context-specific and socially constructed, directly involving parents or family members in homework activities (Epstein et al., 2021). Consistently providing students with interactive, socially supported homework fosters the development of individual interest in science learning (Renninger & Su, 2012). When parents actively participate in homework and activities, their engagement stimulates student interest, influencing self-directed and self-managed completion of homework assignments (Battle-Bailey, 2003).

Interactive homework acts as a catalyst for interactions between the home and school, as well as for parental involvement with students (Walker et al., 2004). Enabling students to actively engage parents through interactive homework, constructivist learning opportunities, self-reflections, self-assessments, and the creation of rubrics requires the establishment of a trusting relationship between the home and school that allows student, parents, and teachers to network with one another (Darling-Hammond et al., 2020; Darling-Hammond et al., 2016). Parental involvement at the high school level forms the foundation for a social network that supports student achievement and success. Social networks and support systems play a crucial role for adolescent students as they navigate through the middle and high school grade levels.

Collaborative Inquiry and Metacognitive Questioning

It is imperative for parents to be central in their child's education. For this reason, this study utilized the involvement strategy of requiring parents to engage in collaborative inquiry activities with their child and to document growth and performances by maintaining weekly entries in dialogue journals. Students and parents were provided guidance by classroom teachers for performing collaborative inquiry science learning. Teachers provided background and application of metacognitive questioning strategies with parents and students. The utilization of metacognitive questioning involves supportive conversations and opportunities for parents and students to afford explanations, elaborate on ideas, and provide reasons that foster continued learning (Gillies, 2011; Mitsea & Drigas, 2019). Parents and students employed questioning strategies with one another for home-school science learning. Parents and students engage in dialogue about science phenomena and take turns as both tutors and tutees, with the tutor beginning by asking questions that encourage the tutee to think more deeply and reflect on the topic being discussed (Gillies, 2011). Implementing metacognitive strategies boosts students' academic performance, self-confidence, and self-awareness (Mitsea & Drigas, 2019). The application of collaborative approaches through metacognitive questioning contributes to the cultivation of critical thinking and problem-solving skills in learners (Gillies, 2011; Mitsea & Drigas, 2019).

Reflective Learning

Student self-assessments have a positive impact on both student achievement and self-regulated learning. Meaningful learning activities serve as the context for self-assessments, prompting students to engage in reflections focused on improvement (Yan, 2020). While summative assessments represent final grades for specific assignments, exams, or units of study, formative assessments are continuous, providing students with opportunities for mastery through feedback and the repetition of performances. Formative assessments also play a role in influencing self-regulated learning. Science teachers should develop and utilize both formative and summative assessments, allowing students to experience various assessment modes (Artler & Spandel, 1992). Integrating student-initiated self-assessments during learning activities further enhances the effectiveness of formative assessments (Lee et al., 2020).

Dialogic Learning

Facilitating opportunities for parents and students to engage through interactive homework allows students to engage in dialogue in terms of school learning. Student-initiated conversations foster positive social interactions with parents and provide parents with insight regarding high school student learning (Epstein et al., 2021; Howard et al., 2020). Interactive homework for parents and students also creates opportunities for

inquiry, self-reflection, and self-assessment. Whether in pen-and-paper or electronic form, dialogue journaling affords opportunities to document perceptions, questions, and knowledge for deeper learning. The process of recording thoughts creates communications for fostering a continuous exchange of ideas between students, parents, and teachers (Chan & Aubrey, 2021; Stillman et al., 2014). Dialogic learning contributes to the formation of a trusting relationship between students, parents and students for better supporting the social, emotional, and cognitive needs of all learners.

Research Objective

This study was conducted to identify the most engaging cooperative learning methodologies in high school science for students to actively participate in home-school learning with parents during scientific inquiry investigations. The potential significance of this research was a model of conditions and authentic strategies required to facilitate student science learning through cooperative engagement.

Research Questions

This study was conducted to determine the following research questions:

1. What are the most engaging cooperative learning strategies for use in high science for students to actively participate in home-school learning with parents during scientific inquiry investigations?
2. Which types of cooperative learning strategies were most effective in engaging both parents and students during collective, experiential inquiry?
3. How did engaging in cooperative learning affect student motivation to learn and engage in science inquiry?

Method

This research adopted a qualitative, emergent phenomenological design rooted in portraiture methodology. The study employed portraiture, incorporating elements of ethnography, case study, and narrative approaches (Lawrence-Lightfoot & Davis, 1997). By employing a qualitative, emergent phenomenological design, the research aimed to capture both objective and subjective perspectives concerning the impact of shared experiences on participants and the cognitive aspects of their social experiences (Creswell & Poth, 2018).

During interactive inquiry learning, parents, students, and teachers documented experiences in dialogue journals. The researcher analyzed attitudinal data in journal entries to ascertain parental and student perceptions regarding student growth, participation, and ownership of the learning. Attitudinal data from journal entries

were cross-referenced with surveys, questionnaires, and interviews to ensure comprehensive and reliable insights. Students engaged in self-assessments, which served as the primary instruments for gathering data regarding cooperative interactions and their impact on student learning and perceptions by parents and students.

In addition, students completed interactive homework and science inquiry activities with parents. Students and parents created criteria after inquiry activities that related what students and parents believed were the most important attributes of the scientific inquiry learning that occurred. Teachers engaged students in the classroom to create rubrics students constructed. Parents and students were also involved in creating exam questions to measure student learning. Students completed reflective, self-assessments of the learning to memorialize what was learned, aspects of learning that impacted student confidence, and what students would change regarding performances.

Results

Data were analyzed for themes and descriptive statistics were used to identify patterns and relationships amongst themes. Student descriptive statistics (Tables 1 and 2) and parent descriptive statistics (Tables 3 and 4) also served sources for the construction of univariate and multivariate tabular and graphic interpretations of inter-rater codification to visually identify themes for identifying relationships and triangulating findings. These data indicate that parents provided a great deal of support during home-school activities. Parents and students were actively involved during this research project in corresponding with one another through their dialogue journals and maintained open lines of communication. One parent stated in a dialogue journal entry after he and his child determined the scientific names of the leaf species they collected and stated, “I feel like I’m in biology again but this time I’m actually getting something out of it.” Attitudinal data indicated that the dialogue journals provided a forum for communicative opportunities to take place and fostered the ownership of learning in students and parents.

Table 1. Student interview results regarding parents, journals, and motivation

Question That Elicited a Descriptive Statistic Response	Percentage Agreeing
Students were looking forward to working with parents	20%
Students were not looking forward to working with parents	60%
Students did not have an opinion on working with parents	20%
Students responded experiences did not impact/change motivation	25%
Students felt an increase in motivation after engaging in inquiry	75%
Dialogue journal entries positively influenced learning	85%
Dialogue journals were helpful in communicating with parents	70%
Dialogue journals were helpful in taking responsibility for learning	80%
Self-reflections positively affected motivation to achieve	75%
Self-reflections improved ability to make adjustments and perform	80%
Motivation to learn increased after engaging in inquiry activity	90%

Table 2. Student interview results regarding self-assessments and confidence

Question That Elicited a Descriptive Statistic Response	Percentage Agreeing
The student-constructed exams related to inquiry…	
Motivated students to learn science	30%
Was helpful because it made students feel important	35%
Improved learning	25%
Other	10%
Students felt that constructing a rubric….	
Motivated students to succeed	75%
Provided students with direction	85%
Helped students better self-assess	70%
Was fun to do/other	80%
The most helpful strategies that impacted student success were…	
Self-assessing	30%
Using the student-constructed rubric	30%
Maintaining the dialogue journals	25%
Constructing and choosing the questions for exams	10%
Felt more confident to engage in scientific inquiry activities	85%

An objective of this study was to determine if students would develop self-responsibility and take ownership of the learning. As a result of maintaining self-reflections and formative assessments in dialogue journals, 85.0 % of students who volunteered to be interviewed responded that they were able to take control and responsibility of the learning. During an interview with a parent regarding her experiences in corresponding with her child through the dialogue journals, the parent responded that she "had never done anything like this before" and this strategy "made it easier to talk about all types of stuff" with her child. Another parent said that she felt like she knew her daughter "better" and as a result of the dialogue journals, the parent "watched [her child] learn and I learned with her." The dialogue journals helped parents and students better communicate. These parents indicated that they felt they were able to gauge their children's learning and observe them flourish. The reflective entries in journals enabled parents to *watch students learn* and to reflect on student abilities, motivation, and ownership of the learning. Tables 3 and 4 on the following pages illustrate parents' feelings and perceptions on the effectiveness of the dialogue journals and the most effective strategies utilized during this study.

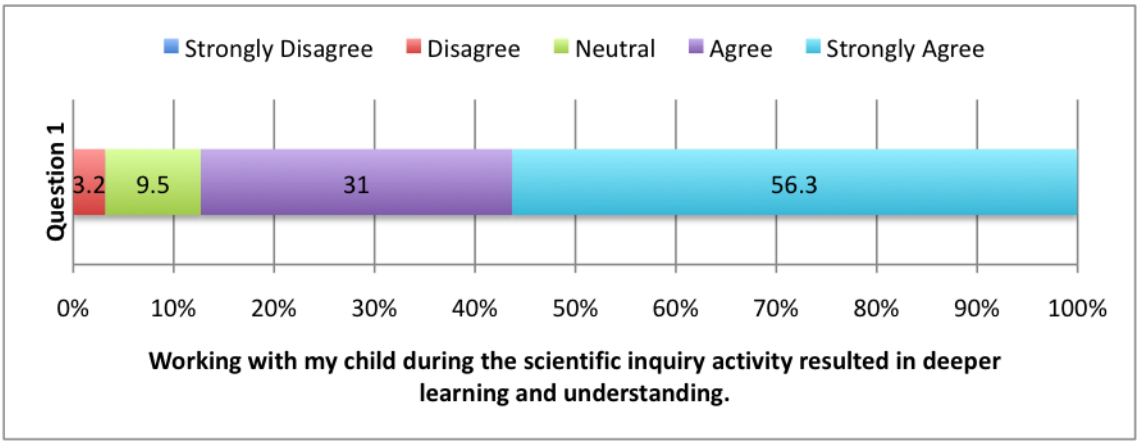
Table 3. Parent interview results regarding journals and student confidence

Question That Elicited a Descriptive Statistic Response	Percentage Agreeing
Dialogue journals were helpful in communicating with students	85%
Journals, self-reflections, and self-evaluations motivated students	80%
Experiences in corresponding in dialogue journals….	
It was a positive experience	85%
It was helpful for improving communications	85%
Facilitated student commitments and responsibilities	75%
Students learning habits improved	85%
Students' confidence increased	90%
Students' confidence remained the same	10%

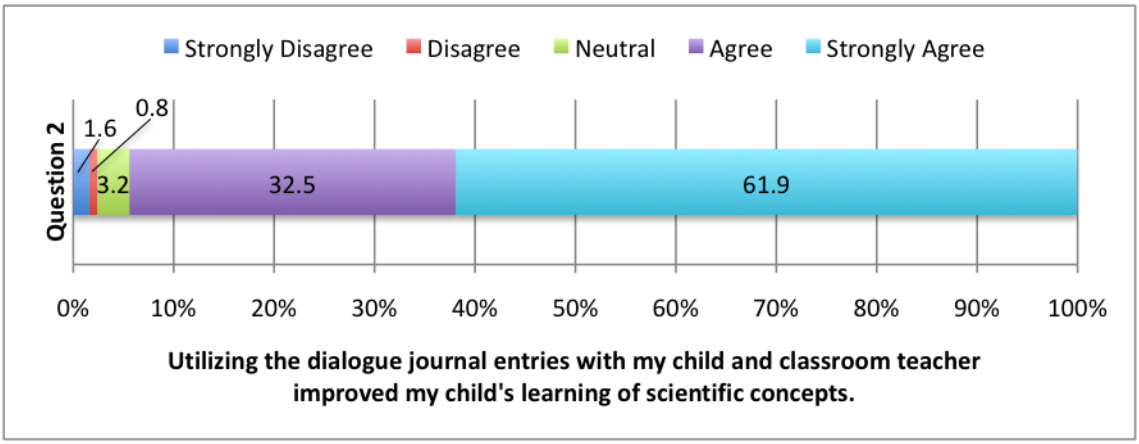
Table 4. Parent interview results regarding journals and student confidence

Question That Elicited a Descriptive Statistic Response	Percentage Agreeing
Parents were looking forward to working with their child	80%
Parents were apprehensive about working with their child	20%
A greater amount of collaborative involvement should be used	90%
Most helpful strategy to take control of the learning was….	
Self-assessing with parents	40%
Communicating in the dialogue journals	35%
The student-constructed rubric that parents and students used	15%
Designing the exam questions	10%

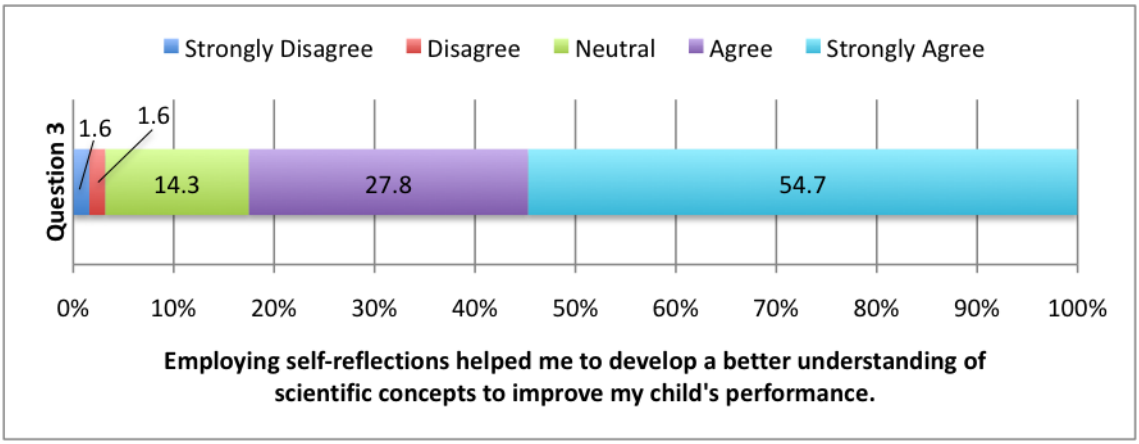
Parents noted in interviews strategies that helped students take ownership of the learning were the construction of the class rubric and examination by the students, (Figure 1). Students constructed a class rubric to gauge and assess their learning and an examination to measure their understanding of the key concepts. The construction of the class rubric and examination by the students provided students with a framework to make self-assessments based on their understanding, proficiency, and fluency of the key concepts. Students gauged their learning and made self-evaluations of their progress and adjustments to deliver a high-quality performance based on the criteria they developed. A student stated in her journal that constructing the rubric helped her performance in this activity because she knew "what characteristics separated a great project from an OK project."



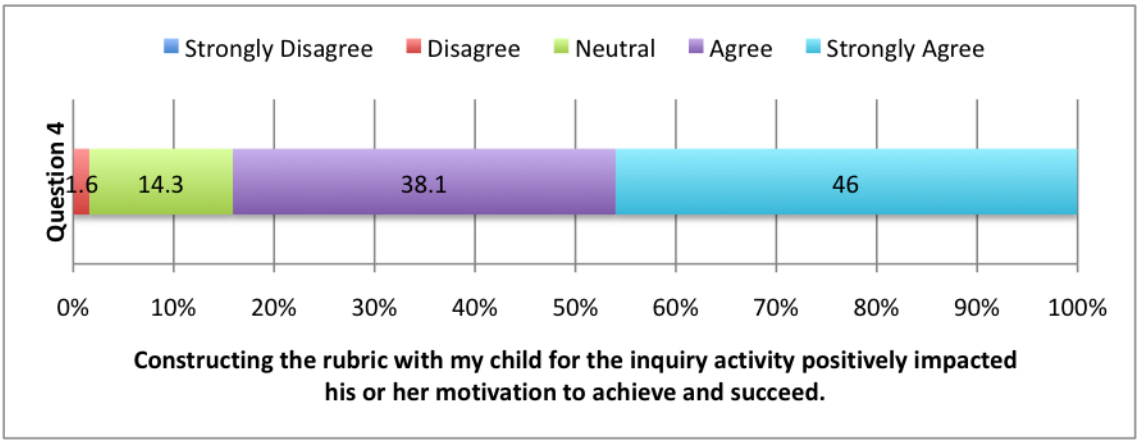
Working with my child during the scientific inquiry activity resulted in deeper learning and understanding.



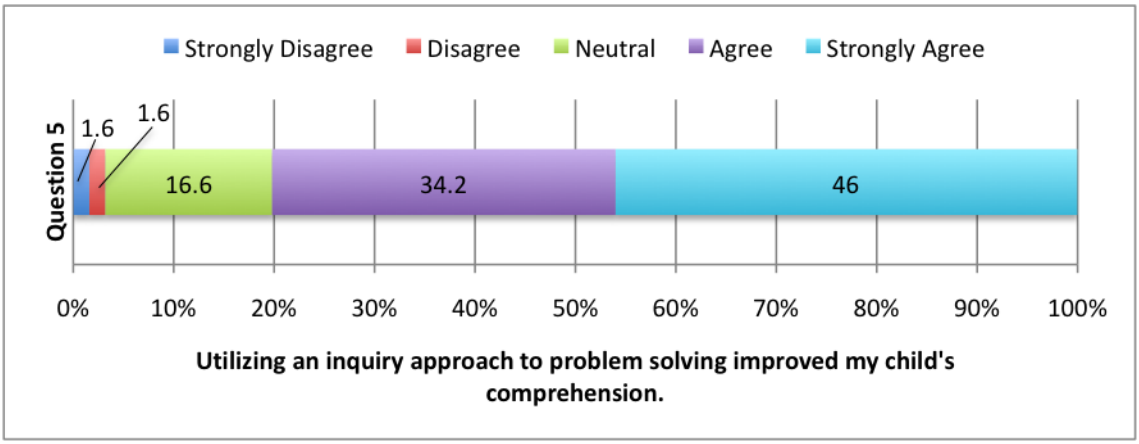
Utilizing the dialogue journal entries with my child and classroom teacher improved my child's learning of scientific concepts.



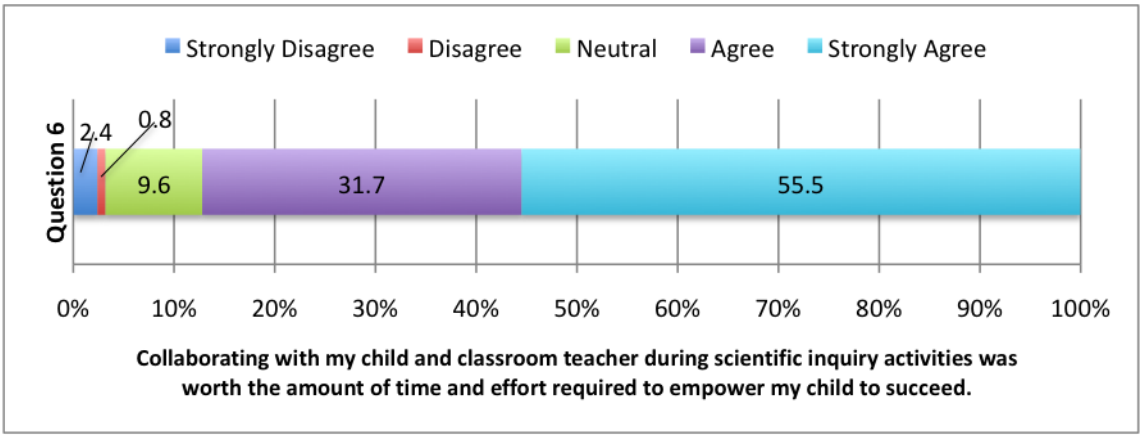
Employing self-reflections helped me to develop a better understanding of scientific concepts to improve my child's performance.



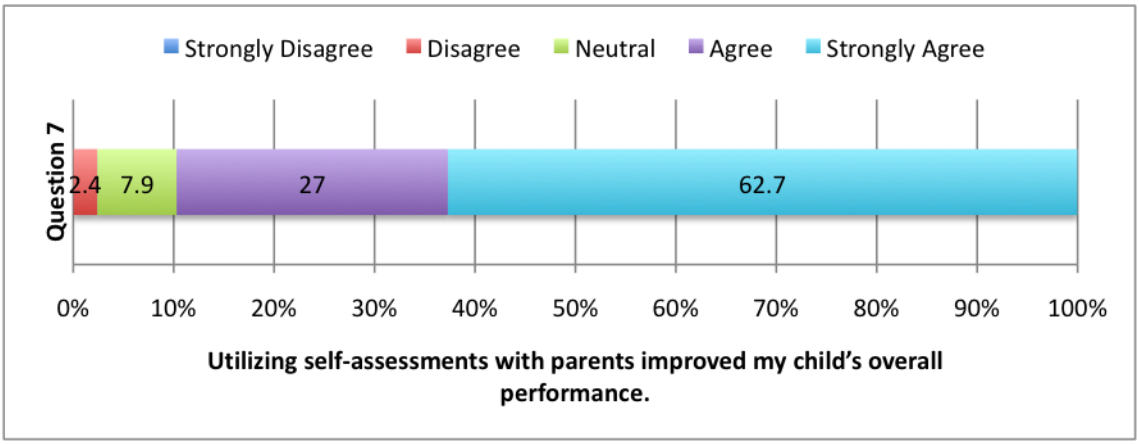
Constructing the rubric with my child for the inquiry activity positively impacted his or her motivation to achieve and succeed.



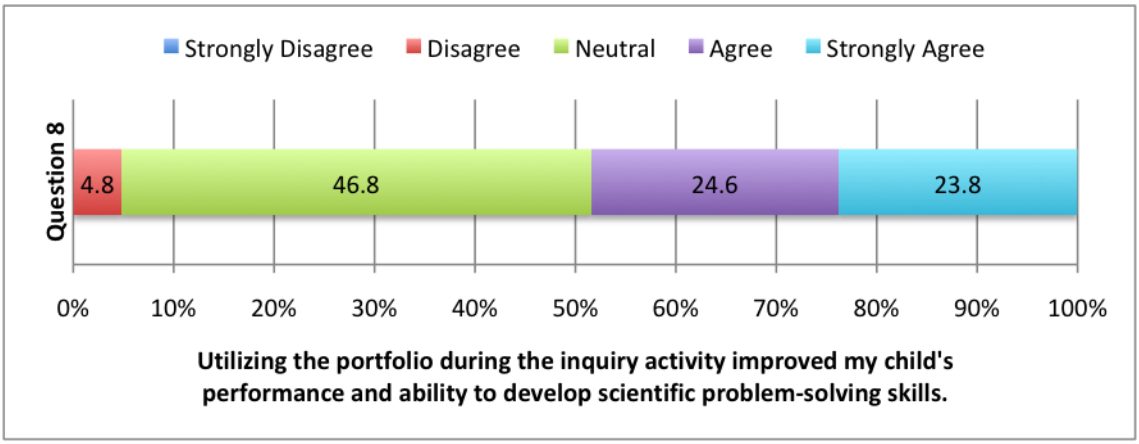
Utilizing an inquiry approach to problem solving improved my child's comprehension.



Collaborating with my child and classroom teacher during scientific inquiry activities was worth the amount of time and effort required to empower my child to succeed.



Utilizing self-assessments with parents improved my child's overall performance.



Utilizing the portfolio during the inquiry activity improved my child's performance and ability to develop scientific problem-solving skills.

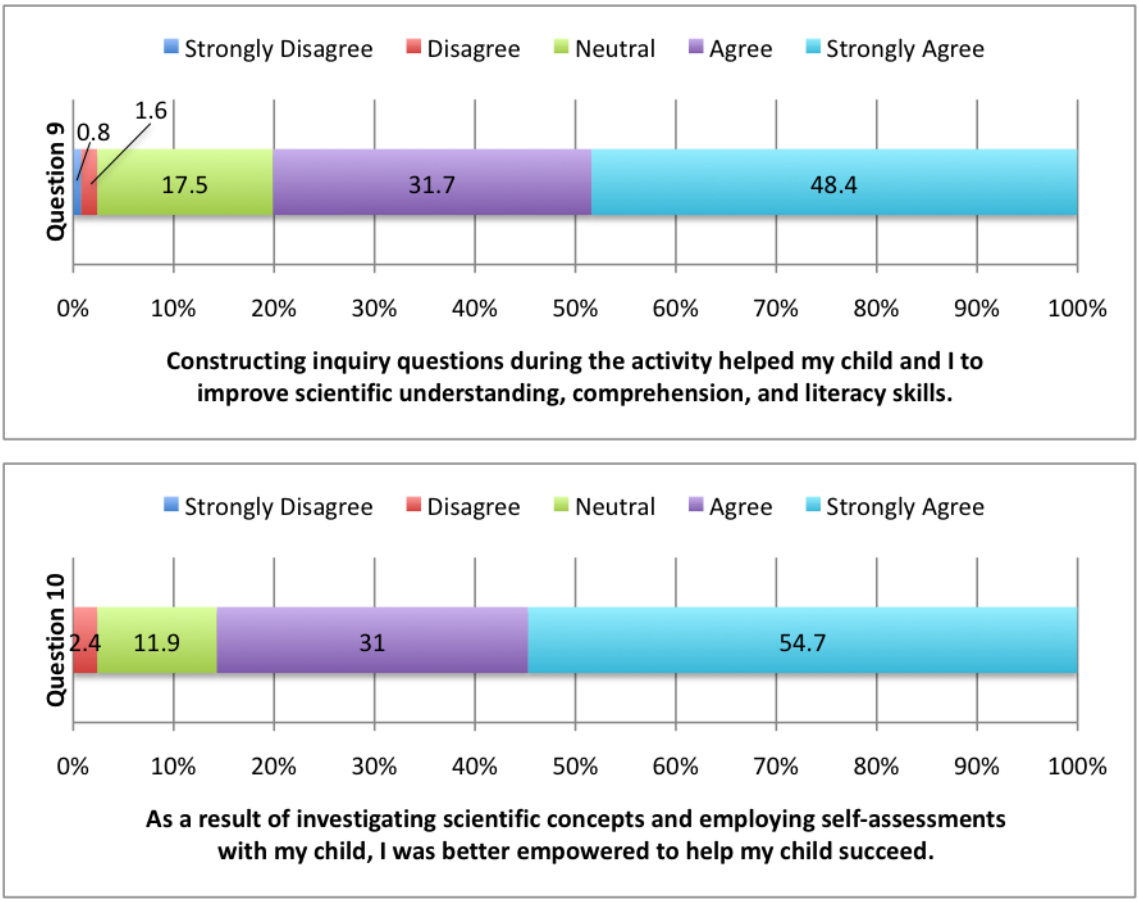
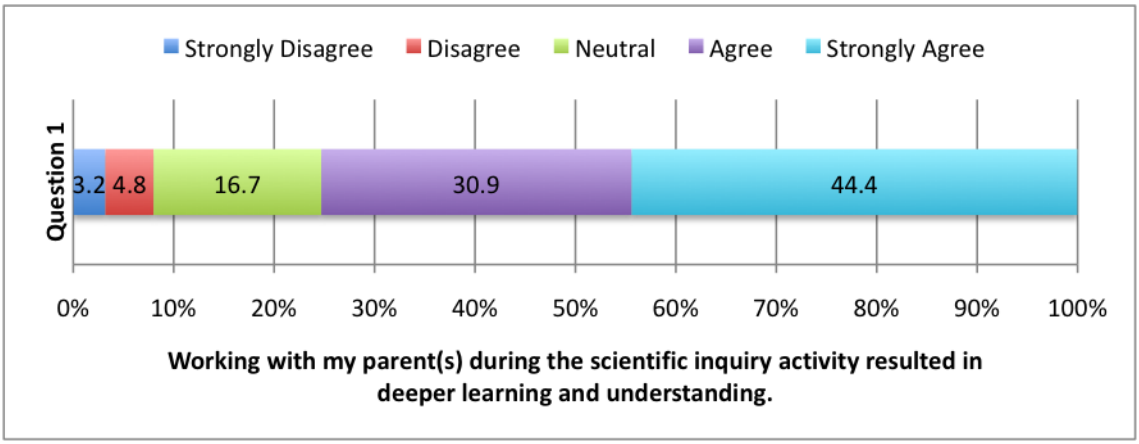
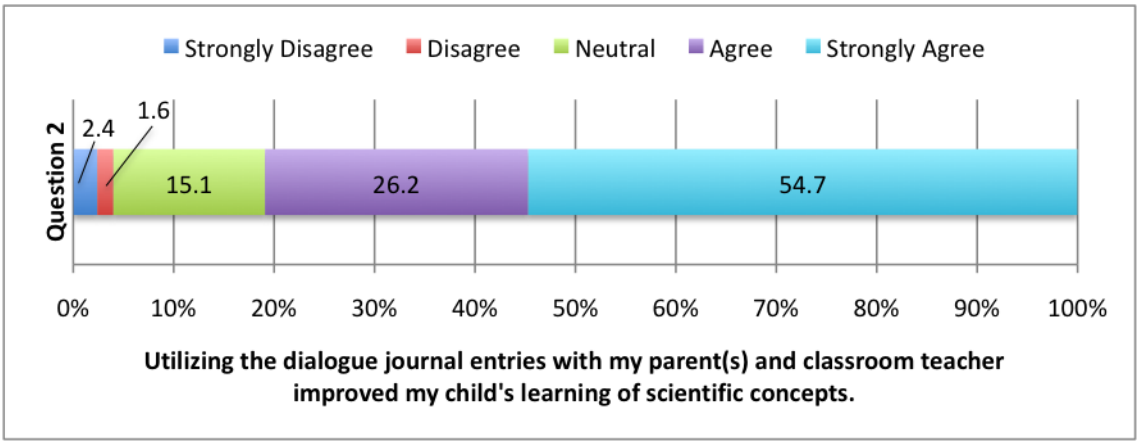


Figure 1. Parent interview responses

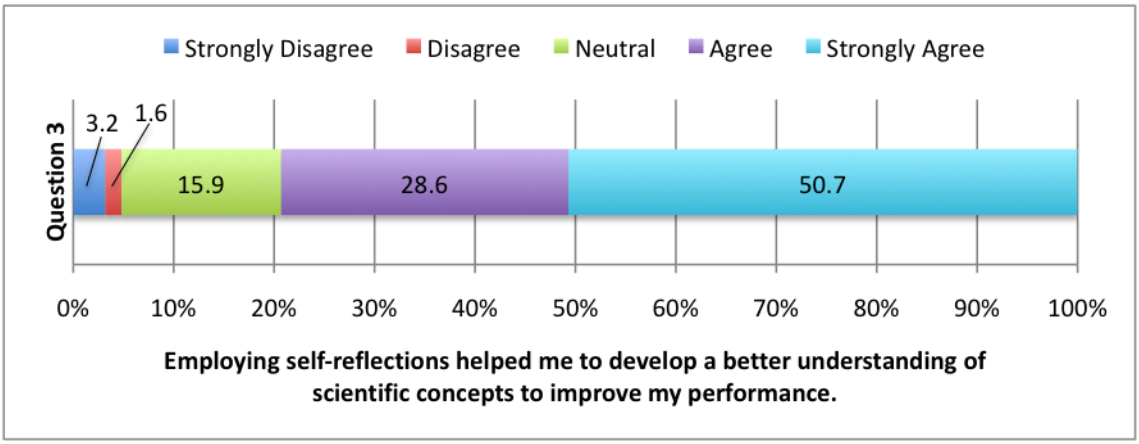
Students' interview responses noted how students perceived an ownership of the learning through construction of the class examination (Figure 2). Prior to the actual administration of exams during the unit of study, students determined what attributes exemplified a knowledge base of the key concepts and learning goals of inquiry. When students were asked during interviews which strategy they found most helpful, their responses were divided in half. When interviewed, 30.0 % of the students stated that constructing a rubric was the most helpful strategy students utilized. In addition, an equal percentage of students (30.0%) responded that the strategy of making self-evaluations and self-assessments was the most helpful because it aided students in making much needed adjustments to improve individual performances.



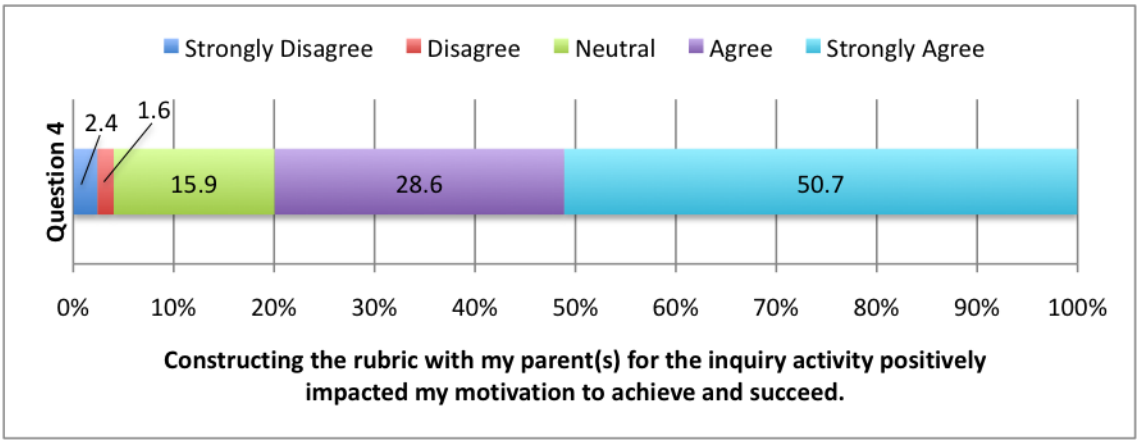
Working with my parent(s) during the scientific inquiry activity resulted in deeper learning and understanding.



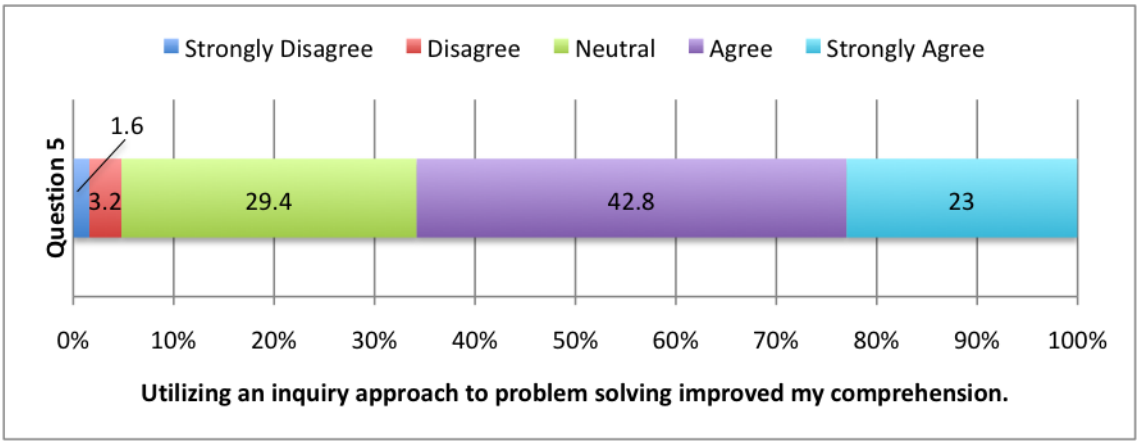
Utilizing the dialogue journal entries with my parent(s) and classroom teacher improved my child's learning of scientific concepts.



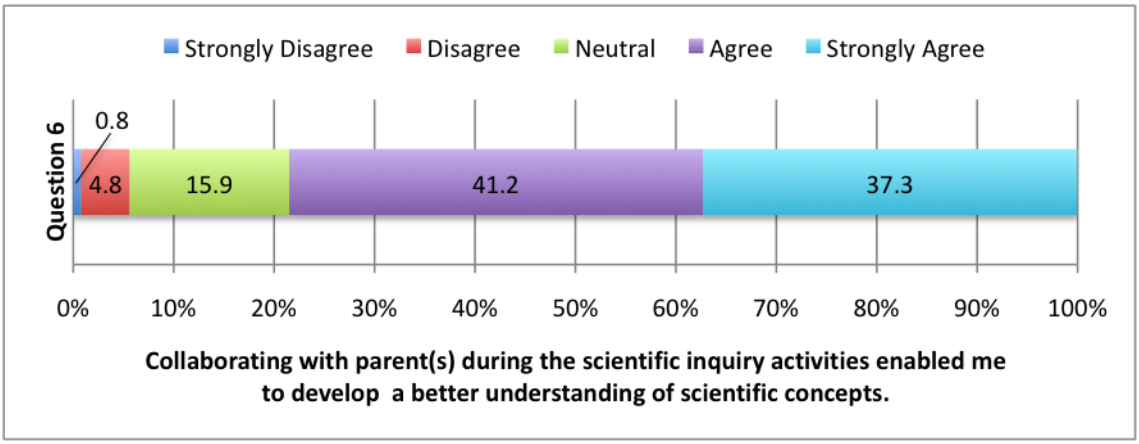
Employing self-reflections helped me to develop a better understanding of scientific concepts to improve my performance.



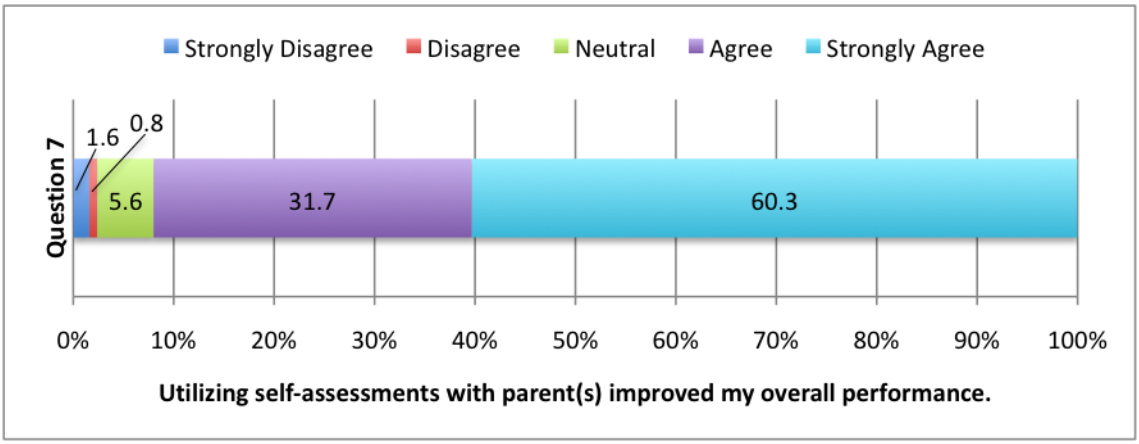
Constructing the rubric with my parent(s) for the inquiry activity positively impacted my motivation to achieve and succeed.



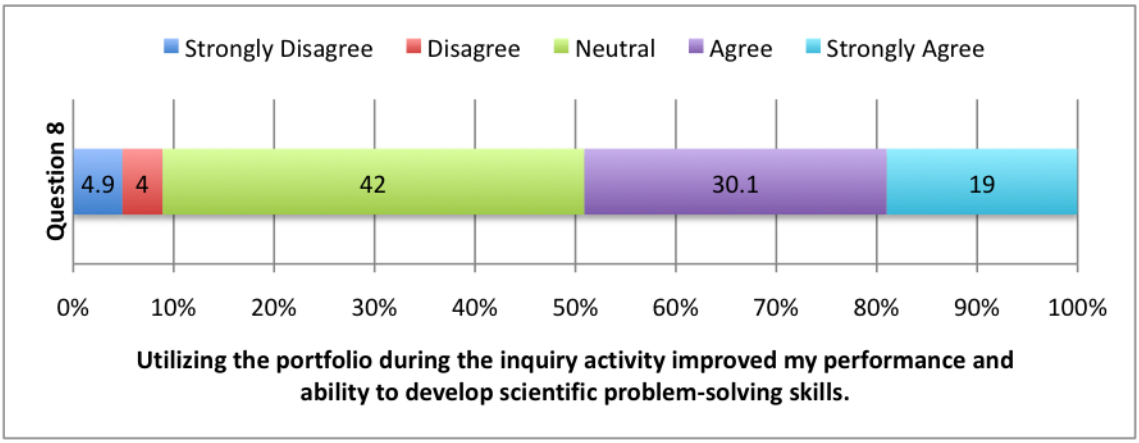
Utilizing an inquiry approach to problem solving improved my comprehension.



Collaborating with parent(s) during the scientific inquiry activities enabled me to develop a better understanding of scientific concepts.



Utilizing self-assessments with parent(s) improved my overall performance.



Utilizing the portfolio during the inquiry activity improved my performance and ability to develop scientific problem-solving skills.

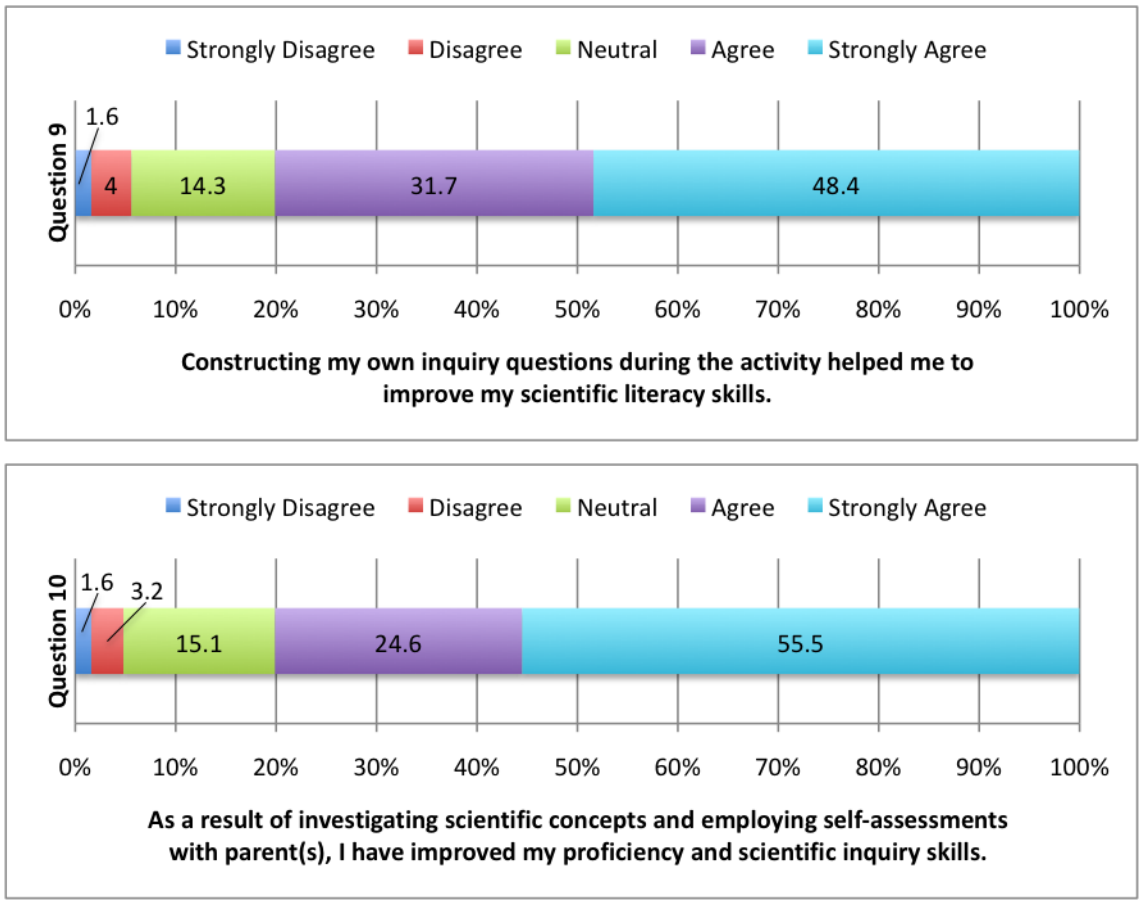


Figure 2. Student interview responses

Attitudinal data revealed dialogue journal entries created opportunities to establish positive, pro-social relationships between parents and students. Perceptions from parents and students indicated that dialogue journals were instrumental in promoting constructive communication among parents, students, and teachers. Journals facilitated meaningful dialogue, allowing students to engage in self-reflections and self-assessments for improvement and achievement. Through this process, students gained an understanding of the modifications needed to succeed, informing parents and teachers about their knowledge and comprehension. A teacher's journal entry highlighted, "When students are provided opportunities to reflect on their progress and performances, they determine the changes and adjustments they need to make in order to be more successful."

Discussion

Dialogue journal entries provided a wealth of self-reflective discourse in which students initiated communications, followed by parents, and finally teachers, who acknowledged student-parent discourse and occasionally provided encouragement. Teachers on the other hand maintained private journals to memorialize thoughts and perceptions at random for review by the researcher at the conclusion of the study. Attitudinal data

provided insight regarding teacher, parent, and student thoughts and their lived experiences highlighting social networking, social capital building, and influences on STEAM learning. The identified conditions prompted students and parents to take ownership of learning, fostering self-management, self-responsibility, and self-direction among learners. Experiential, constructivist learning activities promoted authentic and socially constructive learning experiences and empowered students to assess their own learning.

Conclusion

This study sought to determine (1) the most engaging cooperative learning strategies for use in high school STEAM learning with parents during scientific inquiry investigations, (2) the types of cooperative learning strategies that were most effective in engaging both parents and students, and (3) the effect of students engaging in cooperative learning effect during science inquiry. Data indicated the increased success of students were the result of students participating in constructivist learning activities that utilized a facet of involvement strategies and provided students with authentic and socially constructive learning. The ability of students to assess their learning assisted students in developing self-responsibility, acquiring self-management skills, and increasing student efficacy. As a result, students were empowered to engage in science learning and were enabled to take control of the learning through cooperative learning that included strategies such as interactive homework, collaborative inquiry-based activities, metacognitive questioning, self-assessments, and dialogue journaling.

The involvement of parents in discussions through dialogue journals, inquiry-based assignments, and interactive homework assignments resulted in improved student academic success. Cooperative learning opportunities facilitated student acquisition of scientific inquiry and literacy skills as a result of collaborating with parents and questioning and answering through the process of connecting through inquiry. Inquiry was a student-centered conceptual design that allowed parents to provide guidance and enabled students to control the learning during student-centered inquiry activities. Interactive parental involvement promoted an exchange of ideas and encouraged students to defend their ideas to support their positions through dialogue. As a result of these processes, parents were actively involved in the assessment and reassessment of student beliefs and understandings.

When parents guide students through activities, students are provided opportunities to reflect on what was learned and develop a deeper understanding of science concepts. Guiding students through the learning in a cooperative learning environment enabled students to develop an understanding of the concepts that they worked out themselves as a cooperative parent-student team. Constructivist learning during inquiry-based activities with parents provided a supportive, cooperative network that improved student science learning. Constructivism empowered students to develop their own questions about scientific concepts that created

dialogue in the forms of metacognitive questioning. Metacognitive questioning enabled both parents and students to become metacognitive guides for one another and empowered students to take control of the learning.

The involvement strategies parents and students employed motivated parents and students to take ownership of the learning. As a result, parental and student efficacy was increased and instructional practices were improved. Data indicated the increased success of students in this study were the result of students participating in an activity that utilized a facet of involvement strategies and provided students with authentic and socially constructive learning opportunities. Students believed their experiences were genuine and relevant. Many students believed they “felt like real scientists" and the learning was memorable and meaningful.

Recommendations

Data indicated cooperative learning via experiential learning, constructivism, interactive homework, collaborative inquiry-based activities, metacognitive questioning strategies, and dialogue journaling were highly effective in supporting student growth and achievement. Parent involvement in science learning activities at the secondary level through specific cooperative learning strategies resulted in students’ acquisition of scientific learning and parent and student efficacy. Data also indicated teachers increased their willingness to elicit parent involvement to support inquiry activities. Students believed their willingness to collaborate with parents increased during inquiry-based activity learning. Teachers also believed their professional efficacy and ability to form partnerships with parents increased as a result of employing proactive and interactive parent involvement strategies.

Students were an integral component of the learning and controlled the knowledge ascertained. Parents actively participated and communicated with students during the investigation and provided interminable support. It is recommended that students engage in experiential, cooperative learning either with other students in class or externally with parents to facilitate student science learning. Students gained knowledge as a result of utilizing metacognitive questioning strategies to derive solutions and construct meaning. Students made self-reflections and self-assessments to redirect their efforts and improve performances. The ability of students to assess their learning in concert with the other involvement strategies should be employed to support students developing self-responsibility, acquiring self-management skills, and for raising student efficacy.

Students believed they were empowered to develop scientific inquiry and literacy skills and were enabled to take control of the learning. Students were able to use these skills in developing criteria in constructing a rubric and to develop exam questions to test their understanding of the key concepts and learning goals. A primary

plan-of-action should be made to continue utilizing these strategies in STEAM classrooms to enable students to develop skills they can use throughout a lifetime of learning.

Teaching and learning theories should be considered in enlisting parent involvement and providing all students with multiple opportunities to learn the content and assess performances. For example, when parents are involved in inquiry activities with students, self-assessments and self-reflections should be encouraged to ensure students are provided multiple opportunities to demonstrate learning. Problem-based learning theory engages students in solving authentic science core subject or STEM case problems with parents through cooperation. Utilizing this theory may provide parents and students with both the social context and inquiry-based learning opportunity to reflect upon learning. The guidance, feedback, and authentic learning opportunities parents provide students during experiential, inquiry-based, constructivist problem solving facilitates a desire to learn and achieve.

Student assessments were devised to enable students to demonstrate knowledge that was learned. To combat the limited assessment experienced by most science students, teachers should create and employ assessments that are both formative and summative to evaluate student performance. Concept maps, portfolios, rubrics, and student self-assessments should be considered to better assess student growth. Students must be provided opportunities to construct knowledge through authentic, meaningful, educational experiences to achieve and succeed.

A recommended action should also include involving all students' parents in corresponding on a continuous basis in dialogue journals. Although dialogue journaling is time consuming, with the advent of a variety of electronic media platforms available for students, parents, and teachers, utilizing these tools may provide regular, positive communications for creating a positive, supportive relationship for all learners.

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Impacts of ICT as Tools in Teaching Biology in Senior Secondary Schools

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Abstract

Information and Communication Technology (ICT) has been pivotal in training across the world. Due to the abstractness of Biology in schools, it is essential to develop an effective strategy of ICT tools to improve student's learning process. Similarly, biology helps people understand how organisms adapt to their environment and the importance of biodiversity in sustaining our planet's delicate balance. Therefore, this study investigates the impacts of ICT as instructional material in teaching and learning biology and its gender dimension in senior secondary school at Ado-Odo Ota local government area of Ogun State, Nigeria. The sample size for this research was 240 which consisted of 180 Biology students and 60 Biology teachers. The research questions were investigated with descriptive statistics; Frequency and percentage with the Statistical Package for Social Science (SPSS). The results show a sizable correlation between information communication and technology and the performance of students offering biology in senior secondary school at Ado Odo Ota local government area of Ogun State. It also showed a notable difference in the performance of male students taught with information and communication technology-related facilities and female students taught with ICT-related facilities in Ado-Odo Ota local government area of Ogun State. It was concluded that ICT tools in Biology class can make students more interested in learning Biology. Therefore, Biology concepts should be incorporated into ICT tools to make learning Biology worthwhile, seamless, and entertaining.

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Introduction

Biology, a branch of natural science deals with the investigation for a deep understanding of natural phenomena and events. It is one of the central areas of scientific knowledge and is related to topics such as medicine, genetics, zoology, ecology, and public policy (Colleen et al., 2009). Biology is a broad fascinating subject that covers all aspects of life, from the basic cells to complex species. It provides a scientific understanding of everything living on earth, from plants and animals to humans. Additionally, biology helps people understand how organisms adapt to their environment and the importance of biodiversity in sustaining our planet's delicate balance. This is to highlight the importance of biology in the curriculum of secondary schools for adolescents. Kofi Anan, the former United Nations Secretary-General, in recognizing the importance of education of our young ones (adolescents) factors out that owing to achieve the aim of Universal Primary Education by way of 2015; we need to make sure that data and conversation applied sciences release the door of training systems (Mikre, 2011). This suggests the developing demand and progressively more essential region that Information and Communication Technology (ICT) has gotten hold of in education (Mikre, 2011).

Since ICT grants larger possibilities for college students and instructors to modify mastering and educating to personal requirements; society is forcing colleges to supply fantastic responses to this technical innovation. Hence, schools in the Western world invested significantly in ICT infrastructures within the past 20 years, and college students use computer systems more frequently and for a wide range of functions (Volman, 2005). In Nigeria, it seems that most college students and colleges lack amenities such as ICT facilities, these will have an effect on our media units such as projectors, and possibly may additionally enhance the teaching-learning system of the subjects in secondary schools including Biology.

Several research reveals that college students who make use of ICT amenities frequently exhibit greater knowledge of positive factors than those who do now not use ICT technological tools (Flower et al, 2003). This indicates how ICT has positively transformed all fields of humanity such as Education, Aviation, Agriculture, and Manufacturing, among others. Hence, ICTs have become increasingly important for teaching Biology. This is due to several factors, including the following:

1. ICTs allow students to access powerful tools used in biology teaching. These include spectrometers, genetic databases, microscopes, DNA sequencing tools, and more.
2. Students can use ICTs to carry out simulations or virtual experiments on topics such as evolution, cell structure, and metabolism that would often be too expensive or dangerous to perform in class without specialized equipment or hazardous substances present.

3. Teachers can bring content into their classrooms more engagingly with videos and images displayed on interactive whiteboards through online sources like YouTube which may not always otherwise be available to them at school premises.
4. The technology also allows teachers to easily share resources from remote places making cross-country activities possible even if there's limited physical conduction among participants.

Therefore, this study investigates the impacts of ICT as an instructional tool in learning and teaching biology, and its gender dimension in senior secondary school in Ado-Odo Ota local government area of Ogun State, Nigeria.

Literature Review

ICT and Educational Transformation in the 21st Century

The modern society is known as the knowledge age because of its increased demand for knowledge, however, demand is relatively slow, especially in Africa. The development of human capital requires a good education system. Thus, nations utilizing ICT could move beyond developmental milestones on economic improvement and participation, strengthening networks, and performing public services more effectively and efficiently (Nidup, 2020). ICT has been an important driver for education in many nations (Nidup, 2020). Notably, modern information technology can contribute to economic development; all countries are interested in its expansion and exploration.

Modern society demands that graduate students have a sound understanding of modern electronic devices, and accept computer-based technology, and other types of media that will provide a competitive advantage to them in the global labor market (Mwanda et al., 2017). So far, information technology has shown the potential to enhance education (Nidup, 2020). To harness this potential of information and communication technology, the education system must awaken the need of students to have the necessary skills (Nidup, 2020). Thus, the United Nations Educational, Scientific, and Cultural Organization (UNESCO) proposes to give quality education for young ones to improve both the teaching pedagogy and content of education and training materials, and support innovation and information-sharing through ICT (UNESCO, 2005).

ICT bridges a lacuna in the education system; by improving the quality of education, increasing the opportunities within education, creating information, and connecting populations in remote areas through better accessibility to resources and people (Nidup, 2020). ICT has been more affordable over the years because of the development of innovations and new devices. ICT builds up the role of making it more important to adapt educational consequences to the modern labor market, revolutionize the content and presentation of education, and promote information literacy (UNESCO, 2008). Kent and Facer (2004) established that the schooling

environment is a decisive setting in which students attend on a large scale of technology-centered activities, while home serves as a supplementary place for routine engagements in a smaller dimension of computer-related activities. Progressively, information technology is used successfully in instruction, learning, and evaluation of students (Fu, 2013).

ICT has been established as a powerful tool for improved education and reformation. Several research established that the precise use of ICT can enhance the quality of education and learning related to actual-life circumstances (Lowther et al., 2008; Weert and Tatnall 2005). Weert and Tatnall's studies indicated that learning, unlike traditionally known approaches, is a continuous lifelong activity in which participants vary their anticipations by seeking information. Over time, they would have to anticipate and be willing to search out new sources of information. The ability to use ICT will be an inevitable requirement for these learners as the advancement in society demands (Mintah, 2015).

Reid (2002), has buttressed that ICT provides students with more time to detect beyond the mechanics of course content, resulting in a better understanding of concepts in the field of study. Utilization of information technology also alters the teaching and learning relationships. Results from Reid's investigation reveal that teachers were notified that the correlation between teacher and student was sometimes more evident about information technology; this correlation increases students' courage when they can assist teachers with technical problems in the classroom (Manhibi, 2019). For this reason, ICT varies from the conventional teacher-centered approach and is essential for teachers to be more creative in personalizing and adapting their materials in the educational process (Manhibi, 2019).

ICT assists learners with their learning by enhancing their connections in communication between them and their instructors (Valasidou et al., 2005). Leuven et al. (2004) added that there are zero facts in the connection between the increase in the use of ICT in education and students' performance. He established consistency in a negative direction and a marginally important correlation between ICT use and some measures of student success. In confirmation of these, some students might use ICT to enhance their free time and spend less time studying; online games and improved communication channels do not necessarily mean raised success (Amankwah, 2015). In contrast, Abdulla et al. (2008) noted that ICT can change the pedagogical process; when, how, and when learning occurs, and the positions of students and teachers in the learning process. Karim and Hassan (2007) revealed significant improvement in digital information varies on how students comprehend, and how printed materials make studying easier. Relying on the rising usage of ICT in education, there has been a demand to solve the myth about using ICT as an intervention in the educational process and its gains on students' academic performance (Mbah, 2010).

Essence of ICT in Biology Education

ICT has transformed various aspects of education, including the learning and teaching processes. It has revolutionized the way biology students in senior secondary schools in Ogun State are taught and has had a significant impact on their learning outcomes (Aririguzoh et al., 2021). ICT has provided students with various resources, such as interactive digital textbooks, online databases, virtual laboratories, and educational websites. These resources enhance the students' understanding of biological concepts, improve their critical thinking and problem-solving abilities, and increase their engagement and motivation.

Furthermore, ICT has facilitated effective communication and collaboration among biology students and their teachers. The introduction of ICT in biology education has also made learning more interactive and hands-on. Through simulations, virtual dissections, and multimedia presentations, students can visualize complex biological processes and gain a deeper understanding of the subject matter. Additionally, ICT has enabled biology teachers to adopt innovative teaching methods and strategies. They can incorporate multimedia presentations, online quizzes and assessments, and real-time data analysis into their lessons. As a result, students can actively participate in their learning and develop critical thinking skills. Overall, the incorporation of ICT in biology education has proven to be beneficial for senior secondary school students in Ogun State. By incorporating ICT into biology education, students can access a vast amount of information and resources that go beyond the limitations of traditional textbooks (Stavreva et al., 2016).

ICT in Biology Education: Gender Dimension

Gender differences in the academic attainment of students are a topic of significant interest and debate among researchers. With the advent of ICT, innovative instructional delivery methods have emerged, potentially impacting how male and female students respond to Biology learning solutions. Several studies have explored the effectiveness of ICT use in education, suggesting that individuals exposed to this instructional delivery method tend to perform better in terms of academic scores compared to those relying on traditional classroom lectures (Allegra, 2013; Saxena et al., 2015). It is essential to note that differences may exist between male and female students in their utilization of ICT and subsequent academic performance in Biology. Some studies have indicated that male students outperform their female counterparts in biology (Daniel et al., 2016). This gender imbalance in technology use and its potential implications for the future roles of men and women is a concern highlighted by these researchers. It raises important questions for educational practitioners, policymakers, and parents.

To further understand the relationship between gender and learning outcomes in biology, additional research is necessary. Investigating whether gender influences the effectiveness of ICT use in educational settings will contribute valuable insights for designing inclusive and effective learning circumstances.

Methodology

Research Design and Analysis

A quantitative experimental design was utilized for the present study, through a well-structured questionnaire for collecting information from a sample of students and Biology Teachers as seen in Table 3.1. Data were identified coherently, individually, and in connection with the whole. The data was then labeled by assigning numbers and other symbols for responses to be placed into limited categories. This is significant since the data are mostly descriptive and require translation from qualitative to quantitative form (Ong'amo et al., 2015). After the labeled data had been classified, the large volume decreased and placed in homogeneous groups to obtain a significant correlation (Ong'amo et al., 2015). Then, data were analyzed by descriptive statistics; percentage, and frequency with SPSS using descriptive statistics as indicated in Table 3.1 and Table 3.2.

Instrument

The researcher visited the research locations to administer copies of the questionnaire to the respondents. This was done under close monitoring to ensure that the respondent filled out the questionnaire appropriately. The instruments were administered and collected back from the respondents immediately upon completion. The respondent's personal information was kept confidential, while research ethics and legal issues in research were observed strictly.

Table 1. Percentage Analysis on Teachers usage of ICT in Teaching

Gender	Teachers (n)	Percentage (%)	Students (n)	Percentage (%)
Male	15	6.25%	65	27.1%
Female	45	18.75%	115	47.9%
Total	60	25%	180	75%

Source: Field Survey 2023

Table 2. Percentage Analysis on Teachers usage of ICT in Teaching

Item	Daily	Weekly	All the time	Not Applied
For administration	15	33	05	07
To prepare Handouts	Nil	10	45	05
For online learning	14	30	04	12
For Power point Presentation	Nil	33	22	05
For teaching Students	07	12	35	06
Total	36 (12%)	118 (39.3%)	111 (37%)	35 (11.7%)

Source: Field Survey, 2023

Ethical Approval

To provide face and content validity of the tool, approval was obtained from the National Teachers Institute, Kaduna, Nigeria. Their suggestions and corrections were considered in modifying the instrument. Also, clearance was obtained from the school Principals across the selected schools, and before the commencement of data collection, verbal informed consent was obtained from each participant. Data privacy was ensured by not including the names of the participants. Anonymity and confidentiality were ensured; all records and relevant materials were stored in a locked cabinet and accessed only by authorized personnel, and the respondents were assured that they were free to opt out of the study at any point whenever they wanted. Moreover, the tool reliability was ascertained through the trial testing on 30 teachers apart from those used for the main study.

Results and Discussion

Through the assessment of the impacts of ICT on teaching biology in senior secondary schools in Ado-Odo Ota local government area of Ogun State, several key findings were identified. First, integrating ICT into biology teaching has had a significant positive effect on students' learning outcomes (Van Roy, 2012). These findings are consistent with other studies where Students' accessibility to ICT resources were reported to improve understanding of biological concepts, increased engagement, and enhanced critical thinking and problem-solving skills (Van Roy, 2012; Webb, 2005). Second, the use of ICT tools in biology education has made learning more interactive and hands-on (Webb, 2005; Reid, 2002), because this study revealed 39% of Teachers in the study area adopted ICT tools in their teaching process on a weekly basis. Students visualize complex biological processes through simulations, virtual dissections, and multimedia presentations. Similarly, online resources interactive quizzes allowed for self-paced learning and immediate feedback (Palaigeorgiou et. al., 2019).

Third, integrating ICT in biology teaching has provided students access to a large scale of current and relevant knowledge (Van Rooy, 2012). Students were able to access current research articles, watch educational videos, and access online databases and resources.

Furthermore, this study is in line with the study of Van Roy (2012), on the assessment of the impacts of ICT which revealed teachers also benefited from using ICT in biology teaching. ICT helps to increase efficiency in lesson planning and delivery, improved student engagement and participation. Teachers were able to access online educational resources and incorporate multimedia elements into their lessons, making the learning experience more dynamic and engaging for students.

Conclusion and Recommendations

Conclusively, ICT tools in Biology classes can make students more interested in learning Biology via the exposure it gives to concepts and explanations not commonly seen in classrooms. Biology concepts could be incorporated into ICT tools to make learning Biology worthwhile, seamless, and entertaining. From the results of the current study, the following suggestions are made:

1) Biology concepts should be incorporated into ICT tools to make learning biology worthwhile and seamless.
2) Female children should be encouraged or mentored closely to increase their interest in using ICT-related gadgets in learning biology to meet up with the global standard.
3) Integration of computerized Biology practical should not replace but rather be incorporated as a complement to traditional method of teaching practical Biology.
4) Government should organize solid training for Biology Teachers, to make them fit to impact their students.
5) Adequate computer Technological tools should be provided for learning in all schools.

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A Qualitative Study on Digital Citizenship Education in Primary Schools

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Abstract

In recent years, the number of studies related to digital citizenship has increased amidst the intense use of digital media. The literature, rich in theoretical and empirical examples related to this topic, provides a clear picture of contemporary society. There is little empirical research on digital citizenship education in the early school years. Thus, through this investigation, we aimed to collect qualitative data on the development of specific digital competencies and digital citizenship in primary school students. Therefore, the authors considered it appropriate to use the observation method in its participatory version. Over a year, a group of 29 pupils, aged between 6 and 7, formed the sample to identify how they would develop digital competencies and digital citizenship in the context of formal and non-formal learning experiences. To collect the necessary information, we used the observation protocol, conducted in the form of open-ended questions described by Gay, Mills & Airasian (2006). The results of the study showed that parental educational attainment, family structure, time spent online, and the type of device have an important impact on the development of digital competencies and digital citizenship in young learners.

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Introduction

The pace at which all fields of activity are transformed into the digital is accelerating, with the boundary between the virtual and the real gradually dissolving (Momanu, 2022). Younger people are attracted primarily by the novelty of digital content and by the increasingly appealing interface. They therefore spend a lot of time in front of screens, unaware of the dangers lurking in friendly forms. Considering this, there is a need to change the perspective on citizenship from territorial borders to the particular connections between each individual and the community materialized in the digital sphere (Božilović & Pavlović, 2021). Also, education in all its forms (formal, non-formal, and informal) must consider these changes in society (Momanu, 2022), and digital must be a recurrent element in most learning experiences offered to schoolchildren of all ages, including at primary level.

Digital citizenship is a broad concept, with its scope including related subtopics (Manzuoli et al., 2019), and research confirming through empirical data the extent of the phenomenon. Ribble (2014, p. 4) defines digital citizenship as “norms for responsible behavior about technology use". The theoretical model developed by Ribble (2015) shows the need to develop digital citizenship competencies by referring to the nine dimensions: digital access, digital commerce, digital communication, digital ethics, digital literacy, digital health, digital justice, digital security, digital rights, and responsibilities. Digital access means the fair distribution of digital tools to all internet users, digital commerce aims to purchase goods or services securely, without the shopper becoming a victim of cyber predators (Ribble, 2015).

Digital communication involves the exchange of information in a digital context; Ribble refers to digital ethics that indicates the promotion of good citizenship and empathy with the use of digital tools (Ribble, 2015). Ribble speaks about developing digital competencies in working with technology as digital literacy (Ribble, 2015). Digital health is about ensuring optimal health when interacting with technology, and addressing physical and psychological well-being as Ribble says (2015). Digital justice requires compliance with rules and laws in the online environment. Ribble mentions the safety use of the internet in his model, totaling the existing measures in virtual environments. Internet users enjoy rights and have obligations, aspects mentioned in the theoretical model of digital citizenship (Ribble, 2015). In this context, teachers should guide students to know and enjoy the rights they have, but also to fulfill each of their related responsibilities (Ribble, 2015).

The need for digital citizenship education is becoming a topic of major interest, focusing on the formation of responsible digital citizens from an early age (Couldry et al, 2014). With this in mind, through the present research approach, we aimed to identify how digital and digital citizenship competencies develop in primary education under the influence of different factors through a qualitative investigation. This study aims to

investigate the influence of parents' level of education, time spent on the internet by children, type of device used, and family structure on the level of development of digital competencies and digital citizenship in primary school students. In the context of this investigative approach, we considered it appropriate to formulate questions and we intended to find explicit answers about digital competencies and digital citizenship:

1. To what extent does parents' level of education influence the development of pupils' digital citizenship competencies?
2. What impact does the time spent on the internet in a day have on digital and digital citizenship competencies development?
3. Is there a significant link between the type of device used to navigate the internet and the development of digital competencies and digital citizenship?
4. How does the family structure of each participating student influence the development of digital competencies and digital citizenship?

Through this investigative approach, we want to illustrate the current situation at the primary school level about digital citizenship education at a practical-applicative level. Through participatory observation, we want to find explicit answers to the questions formulated at the beginning of this research approach.

Method

Participants

The research method used in this investigation was observation in its participatory version, i.e. the primary school teacher who will deliver the digital education and digital citizenship lessons. Throughout a year-long study, a group of 29 students aged 6 to 7 (12 girls and 17 boys) formed the sample to identify how they would develop digital and digital citizenship competencies in the context of formal and non-formal learning experiences (James, Weinstein, & Mendoza, 2021). We accessed easily the participants' personal information about students' family structure due to the classroom teacher's involvement in the position of participant observer. Of the total number of participating students, sixteen came from families with both parents having a college degree (bachelor's, master's, or doctorate), ten students where only one of the two parents had a college degree, and only three from families with both parents having a middle or high school education. Considering the time spent on the internet, twenty-two say they spend an average of one hour a day on the internet, five pupils say they spend more than two hours a day online, and two children say they access a few minutes per week. In terms of the type of digital device used, twenty participating pupils say they use their smartphone to navigate the internet, seven use a tablet and only two use a laptop. Two of the total number of students participating in the study owned smartwatches. Regarding the family structure of the participating pupils, four

pupils are single parents, twenty children have only one sibling, three children come from families with three children, and two are from families with four children. These data on children are relevant in identifying the influences on the development of digital citizenship competencies for primary school students.

Instruments

The participant observer obtained the data on time spent in a day on the internet or digital devices in the form of learning games. The participant observer recorded the data in descriptive but also reflective form, explicitly delineated and called, “field notes" (Gay, Mills, Airasian, 2006, p. 382). Considering that the participant observer taught the digital literacy and digital citizenship classes, she recorded the data shortly after each lesson was completed. In addition, the observer collected data on the educational level of parents, the structure of students' families, and the related information based on discussions with adults/legal guardians.

The observer used an observation protocol, in the form of open-ended questions described by Gay, Mills & Airasian (2006, p. 385; see Table 1), to collect the necessary information. The participant observer recorded after each lesson all descriptive information and reflected on what she identified. She observed 29 students as a group and she recorded all behavioral displays, competencies, knowledge, and reactions, which helped in the content analysis. She did the observation throughout all the lessons, being at the same time a primary school teacher. She integrated digital tools into the teaching activity every day and in the context of an optional subject called "Navigators in the Technology Universe” taught weekly. She launched discussions about the effective use of online media and organized group and individual counseling hours with parents and students from which she obtained relevant data about children's activity on the internet (James, Weinstein, & Mendoza, 2021). She recorded all of this information in a short time after these learning experiences to ensure the completeness and accuracy of the data.

Table 1. The Observation Protocol

Questions
What is the object of observation? How many students are involved?
What happens during the observation? What is the topic of discussion? What does each participant say, what does he do?
What is the context in which the events unfold? How are arranged the students in the classroom? How do they interact?
What is the involvement of each participant? Who is involved? Who is interested?
What is the organization of the group? What are the participants’ attitudes and behavior?
What interactions seem unusual or significant?
How does the activity end?
What did the observer do during the activity?

Procedure

At the outset of the study, the observer collected the parental consent for the inclusion of students in the research. The observer collected the data based on participatory observation from September 2022 to September 2023 by recording them in written form. The participant observer, a primary school teacher, recorded relevant data after each day of school in terms of the development of digital citizenship competencies, taking into account that students and teacher used digital tools in the classroom activity, as well as discussions about the use of online media. The observer did the participatory observation of the pupils included in the study within the specific primary school curriculum. Every school day, between 8:00 and 12:00, the primary school teacher and observer at the same time did with students' activities of digital citizenship education in an interdisciplinary way, alongside those of the compulsory curriculum (Communication in Romanian, Mathematics and Environmental Exploration, Personal Development, Visual Arts, and Practical Competencies). The observer took notes after each individual or group counseling of pupils/parents in which she collected relevant information about the level of digital citizenship competencies of the children. These were organized both at the request of the observer in the role of teacher for primary education and at the request of pupils or their parents. After these discussions, the observer recorded all relevant data to capture the level of development of digital citizenship competencies for the children included in the study.

Results

We structured the qualitative data analysis according to the questions at the beginning of the investigation generating four relevant sub-themes (see Table 2).

Table 2. Dimensions of Analysis

The research question	**Dimension of analysis**
To what extent does parents' level of education influence the development of pupils' digital citizenship competencies?	The influence of parents' education level on the development of digital citizenship competencies to primary school students.
What impact does the time spent on the internet in a day have on digital and digital citizenship competencies development?	The impact of the time spent on the internet in a day on the development of digital competencies and digital citizenship.
Is there a significant link between the type of device used to navigate the internet and the development of digital competencies and digital citizenship?	The connection between the types of devices used to navigate the internet and the development of digital competencies and digital citizenship.
How does the family structure of each participating student influence the development of digital competencies and digital citizenship?	The influence of the family structure of each participating student on the development of digital competencies and digital citizenship.

The influence of parents' education level on the development of digital citizenship competencies to primary school students

In the development of digital citizenship competencies for pupils, a key element is the level of parental education. The educational level of adults is a determining factor, influencing the digital citizenship competencies of their children. In addition, given that, parents are responsible for their children's education, their own academic beliefs and experiences influence the educational path of their children.

Based on participatory observations and data received from the families of the pupils included in the study, the observer found that those schoolchildren whose parents have a university degree (Bachelor's, Master's, and/or PhD) have a higher level of digital citizenship competencies. Parents with higher education make a rational and balanced schedule of spending time in front of gadgets, installing apps to remotely track their children's activity, shopping online with their children, spending time together watching educational materials, and selecting together with their children the online content they watch. These parents are enrolling their children in robotics and computer clubs where they develop their digital competencies, but also learn about internet safety. In addition, parents with higher education more often request individual counseling to discuss their children's academic performance and are more involved in schoolwork, supporting the partnership with teachers. On the other hand, parents with only vocational or high school education give their children uncontrolled freedom, spend considerable amounts of time in front of gadgets, displaying behavioral disorders and social difficulties. These pupils find it difficult to adapt to the demands of the school environment and perform poorly at school. They often imitate behaviors pursued on various social networks, reaching verbal and physical violence (Kumar et al, 2017).

Parents of these students find it difficult to find time to discuss with teachers about their student's academic performance and are inconsistent in strengthening the school-family partnership. Children with insufficient parental support have low digital competencies, knowing only how to play various games on their smartphones, without being able to perform tasks with a higher level of complexity (manipulating the mouse, opening files, consciously watching educational videos, and following algorithms).

Thus, children whose parents have a university or postgraduate degree develop strong digital and digital citizenship competencies, with the family being more involved in the development of specific behaviors and competencies for young learners.

The impact of the time spent on the internet in a day on the development of digital competencies and digital citizenship

A key determinant in the development of digital competence and digital citizenship is the time spent on the internet by schoolchildren (Greenhow, 2010). Thus, we found an inverse relationship between the time spent by young schoolchildren on the internet each day and the development of digital citizenship competencies. The more time young children spend on the internet, the more they expose themselves to online dangers, without knowing how to protect themselves in the digital environment. They are also tempted to make online purchases without parental consent. They use inappropriate language both in cyberspace and in everyday life and become victims of cyberbullying. Children who spend more than two hours a day are aggressive, find it difficult to distinguish between virtual and physical environments, and have difficulties relating to other children and teachers (Weinstein, & James, 2022).

Children who spend an average of one hour a day online are more tolerant, can identify dangers on the internet and ask for adult help, make purchases only in the presence of and with the consent of their parents, browse online content only with parental approval and retrieve information from verified sources. They have good digital competencies, can solve tasks on the internet, and work through algorithms (coding games). They also know what can they do and not to do on the internet and identify those dangerous behaviors online. Children who spend only a few minutes a week on the internet have a higher level of motivation for learning and a greater interest in exploring different tasks involving the use of online tools and media. The observer notes that they have low digital competencies, need more time to understand online tasks, and have poor hand-eye coordination when solving applications with the mouse. They also find it difficult to identify appropriate behaviors in order not to become victims online. They tend to believe that online activity is all about entertainment, unaware of the dangers that may lurk.

On the other hand, we found out a direct connection between time spent online and the development of digital competencies, with pupils who spend more time online having higher digital competencies (Rideout & Robb, 2020). Thus, children who spend more than an hour a day using different devices know how to define different specific digital terms (laptop, tablet, mouse, internet, online apps, website, etc.), unlike those who use only a few minutes per week. Pupils who use the internet daily are dexterous in using digital devices, can access different files and applications, and are independent in integrating them into their daily work. They can complete tasks involving algorithm solving without adult support.

The connection between the types of devices used to navigate the internet and the development of digital competencies and digital citizenship

Another important factor in the development of digital competencies and digital citizenship is the type of device used to navigate the internet. Based on observations, we found that the gadgets used by students did not influence the development of digital citizenship competencies in young students. They make the same choices and exhibit similar behaviors whether using their phone, tablet, or smartwatch. The difference we noticed is when parents install different apps to control their children's internet activity. Thus, children whose parents track what their sons or daughters access are more tolerant of rules, accept the limits imposed, are more sociable, and are more aware of the dangers they may face online. They often ask for adult support when navigating the internet and openly accept parental advice.

Children whose activity is not tracked by parents through various apps are often engaged in dangerous situations, imitate aggressive online behaviors, and have difficulty accepting external boundaries imposed in the school environment (Robards & Lincoln, 2020). They socialize awkwardly encountering obstacles in interacting with children of the same age, and have difficulty accepting the rules of the school environment. They do not seek parental advice and access various online content without adult consent. However, we have noticed that schoolchildren who use smartphones are more dexterous in navigating the internet. The touch screen, its small size, and the lack of need to coordinate hand movements with the visualized material in comparison with the mouse make it quicker and more skillful for children to use the smartphone. Thus, the level of digital competencies is higher for pupils using this device as opposed to those using other gadgets. On the other hand, when children who predominantly use the phone try to use other types of digital devices (laptops, smart watches, etc.) they need constant adult support, without being able to transfer the acquired competencies effectively.

The influence of the family structure of each participating student on the development of digital competencies and digital citizenship

The family structure of each student participating in the study has a significant influence on the development of digital and digital citizenship competencies (Hinduja & Patchin, 2020). In terms of family structure, we observed that there is a significant influence on the development of digital citizenship competencies. Single child families benefit from increased parental support in the enabling use of digital devices. This is justified by the fact that parents devote all their time to a single child, as opposed to families with two or more children where their attention has to be in many directions. The parents in developing digital competencies and digital citizenship both through activities in collaboration with adults in the family and through participation in various

robotics and computer clubs support the pupils who do not have siblings. In this way, young children develop digital and digital citizenship competencies, which in turn boosts their self-esteem. Children with only one sibling tend to spend more time on the internet, and adults do not supervise them closely. If they have older siblings they access online content above their age level, influenced by family choices. If they have younger siblings, they tend to watch below-age content, maintaining a certain childishness in their general behavior. Students in families with three or four children do not have a routine for their use of digital media, their siblings or friends influencing their choices. They behave irresponsibly unaware of the dangers they are exposing themselves to. They also do not seek adult advice in the choices they make, often putting themselves at risk. All these manifestations in the online environment are also noticeable in schoolwork, as they are more restless and inconsistent, with no routine to support them in achieving their learning objectives.

Discussion

At the end of this study, which capitalized on participatory observation, the observer collected qualitative data that affirmed a gradual development of digital competencies and digital citizenship among primary school students. The school activities illustrated digital citizenship and subsumed dimensions at a practical level by reference to primary education. The level of education of the parents or legal guardians, the structure of the family, the time spent on the internet, and the type of device that the children use to navigate the online environments influences the digital and digital citizenship competencies of primary school students. Regarding the education level of the parents, following participatory observations, we found that there is a direct connection between the education level of adults and the development of digital citizenship competencies in primary school students. Parents with higher education tend to be more involved in the formation of responsible behaviors in the online environment by children in primary school. Parents keep a close watch on the activity of the little ones. They spend time together with the children watching educational materials on the internet, installing applications with the help of which they monitor what the little ones do when they navigate alone, and encouraging schoolchildren to participate in computer science or robotics clubs where they go through content related to cyber security.

On the other hand, parents with secondary or high school education give their children total freedom without setting clear boundaries, which makes children develop aggressive behavior both online and in social interaction in everyday day life. These children are involved frequently in conflict situations generated by the lack of awareness of their actions and a lack of guidance provided by adults (Smith, 2020). In their absence, the development of responsible behaviors, specific to a good digital citizen, is impossible, an aspect illustrated based on the results obtained from the collected data. Thus, digital citizenship has taken a much more practical form, as the development of specific competencies for safe internet browsing of young students. On the other

hand, at a practical level, the obtained results are significant for proposing concrete solutions to current education problems. We see the need to diversify learning experiences, both formal and non-formal, in the context of early schooling for students to develop specific competencies (James, Weinstein, & Mendoza, 2019). In addition, there is a need for learning activities that leverage the school-family partnership for the development of digital citizenship competencies.

Regarding the influence of the amount of time spent on the internet in a day, following observations we found that those children who spend more than two hours a day expose themselves more to dangers on the internet, are tempted to make purchases online without adult support and develop the most aggressive behaviors. On the other hand, they have better digital competencies than children who spend less than an hour a day or those who navigate the internet only a few minutes per week. We found the best results for children who spend about an hour on the internet every day, watching educational materials, having a well-established schedule, and a supervised activity through online applications. These children know how to avoid online dangers by asking adults for help, make online purchases only in their presence and with the consent of their parents, have good and very good digital competencies, and manage to solve tasks involving work algorithms given in exercises of coding. As for children who only have access to the internet for a few minutes each week, they have an optimal level of motivation for learning. They are interested in tasks involving the use of online tools, but they need constant support from an adult in solving simple tasks on the internet (opening the device, some pages on the internet, moving the cursor, etc.). In addition, they have difficulties defining simple digital terms and show a withdrawn attitude when the discussions during the didactic activities mainly focus on the digital component of education.

The type of device used to navigate the internet is another defining element in the development of digital competencies. Following the observations, we found that the students who use smartphones to navigate the internet show greater dexterity in accessing different online content, showing increased digital competencies. However, they have difficulties when they change the type of gadget, not being able to have the same performance as with the smartphone. Regarding the level of development of digital citizenship competencies depending on the type of device used, we did not find any change in the manifestation of behaviors specific to a good digital citizen. Regardless of the gadget time used, children show similar behaviors regarding the safe and effective use of online environments.

Family structure is an important aspect of the development of digital competencies and digital citizenship. As the number of children in a family increases, the care of parents decreases, because of their divided attention. Thus, the little ones take on the models of their brothers and sisters, exposing themselves to dangers and accessing content that is not appropriate for their age. They either watch videos below their age level if they

have younger siblings or those that require a higher degree of maturity, which causes them to develop inappropriate behaviors. As the number of children in a family decreases, the support offered by parents in developing responsible behaviors on the internet, specific to a good digital citizen, increases. Adults have more time to guide students to make positive choices in the digital environment, with children gaining a sense of confidence and increased self-esteem in using online tools. Single-child families are more involved in the student digital and digital citizenship competencies development, with the child participating in different IT or robotics clubs, spending more time with their parents in the digital environment, watching educational video materials together, and better respecting a daily routine for accessing applications.

Conclusion

At the end of this qualitative investigation, we can conclude that this approach shows the importance of different factors in the development of competencies necessary for the training of future generations. Digital citizenship is a primary aspect for all internet users, especially against the background of the intensification of the use of digital tools. In addition, with the lowering of the age level from which children start using digital tools, it becomes essential to train specific behaviors so that the little ones know how to protect themselves from the dangers that appear in the use of online environments. Education for digital citizenship must thus start from an early age so that the premises of a "healthy" society of the future can be formed (Verduyn et al., 2017). In this created context, the qualitative approach that we undertook showed the importance of factors such as the level of education of the parents, the structure of the family of origin, the time spent on the internet, or the type of device used are the aspects whose influence was analyzed. The results of the research are important against the background of the need to ensure a quality education by the requirements of today's society, but especially of the future. Limitations of the study are the large quantity of data to be collected, the relatively small sample, and the chronologic and energy-consuming aspects of the qualitative method used.

Recommendations

Regarding future research possibilities, we propose investigating the influence of factors such as the type of applications used by children, the field of work in which parents are active, or aspects regarding the structure of the family of origin (the gender of the other children in the family) on the development of digital competencies and digital citizenship in primary school students. We also propose to investigate the influence of these factors on a sample of middle school or high school students.

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Social Media and the Reshaping of Religious Identity in Youth

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Abstract

In recent years, much research has shed light on social structure and interpretation concerns that have highlighted problems with religious tolerance and intolerance. Social constructions have changed as a result of Internet-based connections and social media platforms like Facebook, Twitter Instagram, etc. which have reopened old discussions about paradigms of peace from a fresh viewpoint. To understand the correlations between social media usage and attitudes impacting religious tolerance and intolerance, this study evaluated previously published data regarding attitudes and stereotype modifications via research on the Muslim-Hindu interaction in Nepal. An online and offline survey is used to assess the research hypothesis about online platform usage frequency, relationship-bridging attitudes and actions, religion, life happiness, and social trust among youngsters. The findings revealed a statistically significant positive association between Facebook and YouTube usage frequency and views toward religious intolerance especially after being influenced by Indian Islamaphobic media as it is the neighboring country of Nepal, with an enhanced relationship bridging both online and off. Additionally, the paper aims to show the correlations between heavy social media users and individuals who cited social media as the cause of their eventual offline intolerance. The findings of this study are beneficial to individuals trying to comprehend and take part in peacemaking in a society that is continuously changing, always linked, and mediated by the Internet.

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Introduction

The development of technology arbitrates communication has brought about an unparalleled change in how people connect and engage with one another in societies. One important effect of this expansion is the emergence of a society that is technology arbitrates. However, without mentioning Social Media use within the global community, it is impossible to envision and understand this " technology arbitrates communication" or its result, the " technology arbitrates community." By way of explanation, individuals all over the globe use digital platforms, such as Twitter, Facebook, YouTube, WhatsApp, Instagram, etc., to promote their views, interests, values, and initiatives. On various social media platforms, many people are also using self-generated and self-oriented communications to communicate and transfer words, graphics, and audio. As a result, discussions on social media's effects and implications, difficulties, and dangers have become inescapable in academic debate, especially when it comes to the topic of religious tolerance in modern-day Nepal. Hatred toward others has been spread via social media.

We have known that many important international human rights agreements provide the freedom of religion or belief. It covers a wide variety of liberties, including the freedom to practice, observe, and teach one's religion or believe in private or in public, alone or in community with others, and the freedom to have or adopt a religion or belief of one's choosing. Additionally, the freedom of religion or belief covers all types of beliefs, including theistic, non-theistic, and atheistic beliefs as well as the ability to keep one's religion or belief a secret. It also includes the freedom of thinking and personal convictions in all areas of life.

Nepal has a population that follows a variety of faiths and beliefs. Nearly 81.3 % of Nepal's citizenry is Hindu, making up the vast majority of the nation's people. Buddhism is the country's second most widely practiced religion, with 9.04 %; Islam is the third most common religious doctrine, with 4.38 %; Kiratism is the fourth, with 3.04% of the population; and Christianity is the fifth, with 1.41 percent of the population. 2 Less than 1% of Nepal's population practices any of the other five faiths that the government has officially recorded (Nepal, 2018). Muslims, who make up roughly 4% of the inhabitants of Nepal, have coexisted peacefully with the country's Hindu majority for many years. They came to the country as immigrants but built strong communities., Nepal always took pride in its tradition of religious tolerance. But in the recent era through well-known Indian news outlets and media platforms, Hindu nationalist extremists and India's Islamophobic media are using different factors to spread hatred toward Nepal.

Since everyone is impacted by interpersonal conflict, unfavorable views, and prejudices, meaningful answers to some of the most fundamental concerns of human interaction remain elusive. Religion and conflict have a long history in human history. The pervasiveness of conflict serves as a reminder of the universality of the need

for appropriate solutions. When people engage in new ways, there is more potential for conflict and new strategies for resolving it. Innovative channels of communication and socializing may prove to be both areas for debate and new paradigms for peace with the introduction of Internet-based social media and its penetration into information-based societies (Ess et al., 2007; Possamai et al., 2020).

Statement of Problem

Many conflicts appear to have religious roots on the surface but really develop in religious circumstances, use religious terminology, and emerge along religious lines. Due to society's general failure to comprehend the real causes of most of this conflict, erroneous assumptions are frequently drawn, which have an adverse impact on behaviors and legislation and further complicate an already complicated problem. As a result, we are no closer to resolving problems that date back many years. Knowledge gains have also contributed to a greater understanding of how the human brain functions, just as technological advances in destructive capacities have made the hazards of unsolved concerns intolerable. Additionally, new organizational and socialization patterns have been introduced by technological pioneers in online social media. Opposing sides in long-running conflicts have mostly accepted these new patterns. There is reason to believe that a new and increasing realm of possibilities is possible since the subject of how people connect with one another lies at the heart of every conflict, including religious intolerance.

So, in this paper, social media is discussed because it has an impact on attitudes and is linked to tolerance/ intolerance. Hence the research aims to deeper analyze; the shape, character, and scope of social media's influence on promoting religious intolerance.

As a result, it is essential to examine the characteristics of social media and religious networks. Social media may be a strong instrument without a doubt, but it is unclear how this power might foster interreligious understanding. To find the finest methods for utilizing social media in the ongoing effort to bring about peace, this must be seriously evaluated. As a result, I see the utmost importance in doing an urgent investigation of the role of religion in social media and new interreligious communication paradigms.

Religion and Social Media

Technologies have always had a major role in politics, religion, and society. As a result, many studies have been conducted to determine how social and technical aspects affect people's habits and ideals (Bargh et al., 2002; Cheong, 2012; cobb, 1998; Hall et al., 2019; Turkle, 2011; Wagner, 2011). If we look at religion in social media; Media content and its purported cultural and moral qualities have received a lot of attention. The

criticism of social media, however, bemoans the allegedly predominately negative and anti-social (even anti-religious) sentiments. What opportunities exist for religion and religious values if most of the social media public dialogue is regularly characterized by opposing and adversarial viewpoints? Social media has been accused of being an addictive force that has a severe psychological impact on people's relationships and social lives. Social media has been said to govern everyday life, dictating when we eat, sleep, socialize, and even reproduce (Hall et al., 2019; Meyer et al., 2010). Traditional religions are interested in these duties and functions, at the very least, and it is important for the media to play a significant part in setting the conditions or atmosphere in which religion must exist.

According to Stout, a larger understanding of worship is necessary since denominations are unable to completely consider the growing variety of religious and mystical experiences. Popular culture's social media platforms are also significant because they help people build groups, orient their beliefs, provoke intense emotions, and include ritualized behaviors.

Users frequently utilize religious terminology to describe their experiences when this happens through social media such as the internet, movies, and other forms of media (Stout, 2012). People of many religions, including Christians, Jews, Muslims, Hindus, Buddhists, and others, utilize social media to varied degrees. Many individuals are searching for religious significance rooted in popular culture's social media at the same time.

Further, In his analysis of neo-Hindu philosophers on religious plurality, author P.S. Daniel writes, "philosophies and viewpoints. Reverting to Vedic dharma, according to certain philosophers, is the answer. Nevertheless, individuals like Vivekananda and Gandhi had a realistic understanding that all people could not be unified under a single, rigid faith. Numerous diverse religions will coexist with mankind for as long as it does." (Stout, 2012). Therefore, rather than asserting that all faiths are equal, unique, or aiming towards the same thing, it is vital to recognize the diversity of religions to create religious peace. Respect for one another should be maintained because each faith offers something distinctive. Because misperception of other religions is the cause of conflicts and rivalries, interfaith discussion is crucial for a peaceful coexistence.

Reasonable arguments for the viability of virtual reality in the form of digitized settings have been made by a number of academics in current history. Google glass, in the words of Jennifer Cobb, is "a location that appears separated from the material realm." A digital universe is entered. One exits a virtual environment. When someone assumes the role of their avatar in a particular virtual environment, their "appearance" changes. Additionally, there is no eating, resting, or growing in such digital environments. Sometimes people have even viewed the feeling of being in a digital reality as a form of digital paradise or, as Cobb puts it, "the Platonic realm incarnate." (Jennifer Cobb, 1998). Such a world simply beckons our desire to live there. We create the

monitor an obsession; we crave it. We not only seek to view the screen but also wish to be shown in it, according to Wagner, who claims that "the sensation of engaging with virtual reality is marked by tremendous crave." (Wagner, 2012).

According to Heidi Campbell, digital communication technologies foster interconnected community structures, stimulate exploration with religious identity construction and self-presentation, and promote concurrently drawing from various and diverse religious sources and experiences. According to him, blogs and other digital platforms are evolving into something like to a hybrid of religious journals, memoirs, and individualized emails, enabling users to share their daily thoughts and religious rituals publicly (Campbell, 2003).

In current history, social media platforms have increasingly taken over as the main online action hubs, especially for young people and teenagers. Ellison and Boyd have noted social media platforms as places where people in this age group establish their identities. Particularly, Facebook has been investigated as a site for online identity creation. Additionally, Facebook's religious groups have been noticed as a tool that is becoming more and more prominent. Furthermore, some authors claim that spirituality has been discovered to be a component in foretelling Facebook user participation (Ess et al., 2007; Possamai et al., 2020).

As we can extract, the connection between religion and social media is so strong that, depending on how it is perceived and applied, it may either bring harmony or serve as a barrier to our society. Since youngsters are more involved on social media they are easily brainwashed with different posts and captions they go through, or we may also say they wrongly interpret that information resulting in negative outcomes in their attitude towards some spiritual group.

The online world has an influence on interpersonal life in addition to faith. The innate personalities of society in some way bind them to the site's network. A social environment is a place where individuals may educate. They will probably imitate the behaviors of their parents, friends, or neighbors. They are persuaded in this way to upgrade their phone and engage in online gaming. It is now also a dependable supply during times of stress or difficulty. They utilize the internet more frequently the more psychologically conflicted they are. The explanation for this is provided by the scientific dominance hypothesis. This suggests that human development and evolution have coincided with technology advancement. However, there has been a mental conflict among young people about online use. The pursuit of one's personal desires and upholding one's moral and societal obligations are at odds. In terms of psychology, it is a struggle between the id and super-ego when utilizing modern technologies. Lastly, there exists a disparity between the various social and economic groups of individuals. The difference amongst various age groups can also be seen. This may also cause

miscommunication or even hostility between them. Ultimately, this hypothesis has implications for youngsters, electronics, neurology, spirituality, and social science. Such concepts will guide my analysis.

Talking about Nepal, the ratio of Internet usage has reached to 70.41 % according to data of 2019 (Nepal Telecom authority, 2019) where the majority are young individuals. Today's youth no longer like spending time with their parents. They are becoming farther apart every day. They might only have a few friends in real life, but they may have thousands of pals on digital networking. Despite spending a lot of time on digital networking, they dislike talking, traveling, and other forms of social interaction. To further explore the effect of usage of social media in recent days in shaping the behaviors of youngsters when the social media is more filled with religion-related crimes, genocides, and Islamophobic speeches that even increased during Pandemic Covid-19 of Indian Media which is excessively exposed in Nepal.

Nepal's Social Platform and Religious Life

With an area of 381,200 square kilometers, Nepal is a tiny nation. It is centered between India in the east and south and Tibet in the north. This nation's land is split into three sections. High mountains are at the top, hills are in the middle, and flat Terai is at the bottom. The 2011 census indicates that there are about 26 million people living in Nepal. The number will undoubtedly rise in the census in 2021. Three distinct groups of Nepalese make up the majority of this community. They are Nepalese natives as well as Indo-Nepalese and Tibeto-Nepalese. Because of this, Nepalese people may appear to have brown or white complexion, and they may also resemble Indians and Chinese. Nepal is distinctive and lovely because of its diverse skin tone and facial features. Nepal contains more than 50 languages and over 36 different ethnic groups. The primary national language, however, is Nepali, which is spoken across the country. Due to the diversity of faiths and traditions among all the ethnic groups, Nepal is a nation with a rich cultural heritage.

The predominant religious doctrine in Nepal is Hinduism. This is the reason Nepal was referred to be a Hindu state prior to becoming a secular state in 2007. Conservative Hindu organizations and activist organizations continue to work toward the restoration of the Hindu state. So, Hindus make up the bulk of the people (86%) in Nepal whereas, Muslims make up (5%) of the country's population. There has been a harmonious atmosphere until recently when the flame of hate with misconceptions and political hypocritic plans started blazing in India flooding its politically captured media it sent a spark to its neighboring nations mainly through the posts on Facebook and YouTube, that built negative thoughts in the minds of young fellows following some Hindu extremists and naive individuals.

Religion is a form of meditation, while the online world is a technological one. Although each is a distinct creature, they are connected in some manner. People have created technology that enables them to keep their

religious life online and sense the presence of their deity. The benefit is misused by politically affiliated agencies in order to create a grapple among the public for personal benefit.

The goal of almost every religion in the world is to spread its teachings. They wish to be known and their beliefs to be known to other religions. A satisfying moment is when one's religious community gains new members and makes disciples. The internet is doing a terrific job in helping people attain their aim of showing a growing number of followers. Due to the physical distance before the internet, it was challenging to spread one's beliefs across the country. Everyone can discuss their beliefs digitally and even reach a wider audience. The net is the ideal medium for inspiring, influencing, attracting, and even converting people from one faith to the other.

No doubt that religious organizations also use the media for formal announcements or marketing advertisements. The easiest way to spread information about any religious holiday, lecture, or meeting is now through social media. This kind of religious organization occasionally organizes free medical clinics, blood drives, food or clothing distributions, and other charitable events. With the help of digital technology, all these humanitarian endeavors receive extensive advertising. They rely on the web to hire new employees for their company.

Nowadays, individuals criticize other religions in addition to sharing information about their own. The most popular tendency is to make films or post critical remarks on digital networking about other faiths. Social media has evolved into a venue for expressing one's religious convictions. It occasionally caused naïve religious believers' feelings to be harmed. But this can't prevent; in fact, it's getting worse in our culture. Most individuals frequently conceal their own spiritual infirmities while highlighting the infirmities of others.

For example, Hindu societies make it a huge deal when a Muslim does anything improper and utilizes the media to broadcast and propagate it throughout the world and same do the Muslim group (Mogul et al., 2024). The new Nationality Amendment Act was just enacted in India, where the Hindu nationalist BJP is currently in power under Prime Minister Narendra Modi. All minor religions were included in this new law, but Muslims were not among those who might get Indian citizenship after six years of presence in India. This law created a lot of chaos physically and also virtually and digitally. there was a case of 30 Muslim death on the other hand media was also flooded with people blaming each other(Amarasingam et al., 2022; Mogul et al., 2024) ,there was another war field throughout social media. Nepal is closely connected with India and also has open borders; every action in India directly or indirectly affects Nepal influencing Nepali citizens to be hypnotized by the Islamophobic spell of India.

Islam in Nepal

In Nepal, Islam is minority religion. Islam was not created in Nepal; rather, it was carried there by Muslims from other Islamic nations, including Tibet, India, and Pakistan. Those who arrived from Pakistan's Kashmir province were in fact merchants. They are recognized as being more dignified and intellectual than other varieties of Islam. The earliest branch of Islam in Nepal is found in Kashmir. Islam of Indian descent visited Nepal for both economic and legal reasons. They have certain characteristics with Nepal's other prevalent Islam culture. During the reign of King Ratna Malla, a businessman from Tibet named Muslim arrived in Nepal. Despite their best efforts to impart Tibetan culture, Kashmiri and Indian Muslims eventually transformed them. Nonetheless, the majority of Nepal's Tibetan Muslims are wealthy and own significant enterprises. They choose to dress and speak like Tibetans yet adhere to certain other Muslim communities' social and cultural norms (Siddique, 2001).

The British presented Nepal with the additional land, which was primarily in the Dryland areas, as a present in 1857, during the Indian freedom movement. Muslim people had previously settled there, and it also became a portion of Nepal. They were granted land in the southern region of Nepal, which borders India, to farm and establish their own businesses. Because of this, most of the southern region of Nepal is now a manufacturing sector. Muslims reside not just in the Southern region but also in hilly regions. In the sixteenth century, Gorkha chiefs generally asked residents of the hilly region to produce artillery, agricultural implements, jewelry, etc. However, because of the persecution in India, they made their home in Nepal's mountainous area. Muslims in the mountainous region do not now have the same chances as those in the flat zone. A few of them even lack fundamental knowledge of the Muslim faith (Siddique, 2001).

Muslim youngsters did not initially have access to education. However, until 1940, children were urged to attend school. Muslim girls showed a greater preference for housekeeping. Muslim females are reluctant to go to school with guys. They could have decided to remain in the home for this purpose. It is required for everyone, boys and girls, to receive an education. Muslim schools are thought to total absence a national quality of education, nevertheless. Minimal attempt is being made by the state to standardize their educational system (Haque, 2009).

Considering there aren't many highly qualified Muslims in Nepal, it's wonderful that they may study and integrate themselves into civilization by attending school. As much of their holy material is written in Urdu and Arabic, Muslim youngsters should also study it. They learn about the fundamental beliefs and practices of their religion in their Islamic school as well. They recite the Holy Quran and follow several religious customs, including fasting and praying (Siddique, 2001; Sijapati, 2011)

Despite having a separate religious belief, they do not stand out from other religions in Nepal in terms of look. They dress alike and communicate using the same language. Their social structure and surroundings are like that of another Nepalese. They are viewed as Nepalese with just a different faith. Due to its border with India, Nepalese of any religion in the south are influenced by that country. As a result, they frequently perform rituals in an Indian fashion. Muslims in highland areas, however, are more impacted by Nepal's Hindu culture. In their social and religious lives, they incorporated numerous Hindu traditions.

Islam has two distinct religions. One is Shia, whereas the other is Sunni. Shia honors Hazrat Ali Ibn Abi Taleb, the fourth descendant of the Caliph of Islam, while Sunnis generally adhere to the traditions of the Prophet Muhammad. There are more Sunni Muslims in Nepal. Shia Muslims are a relatively small minority in Nepal. It's noteworthy to note that Nepalese Muslims do not practice caste discrimination within their community, although coexisting with Hindus.

They encourage all varieties of Muslims to congregate at their mosque. No matter what kind of Islam and socioeconomic standing, they are not hesitant to swap marriages. The term "untouchable" does not exist in their faith (Siddique, 2001). One of the most important Islamic holidays is the celebration of sacrifice known as Eid ul-Adha. Eid ul-Fitr, which marks the conclusion of fasting, comes next. Utmost notable one is Ramadan, which is a month-long period of fasting from sunrise to sunset.

Methodology

Due to the human and social aspects of my study, I decided to adopt the empirical technique. Distracts focusing on numerical or statistical data, it also focuses on human nature, attitudes, and relationships. The study design, according to (Bryman, 2012) is a strategy that aids in data collection. It incorporates a few tools, including organized interviews, self-filling surveys, and observing people, the participants. Since the questionnaire method is the most suitable one for this study topic, I also employed it. The interview can aid in understanding how different people feel and see the subject of the study. Since there hasn't been much study done in this area in the country of Nepal, an in-depth interview can help me gather data on the subject. The interview was split into two sections as well. One is a face-to-face conversation, while the other is a survey. Twenty persons in all were questioned about the subject of my investigation.

life of youths. Since this topic is not getting the attention of Nepalese yet, there is not much research done about this topic in Nepal. As a result, gathering data for quantitative analysis is challenging. And although individuals in Nepal today are aware of how technology affects social lives, the impact of digital on religious life is still an unexplored area of study. Descriptive study is much more appropriate since it allows me to always

adapt quickly with my study because this issue is mostly focused on personal views, views, and forces of nature. It resembles Bryman's description of qualitative research in many ways. He states that "One of the major themes of descriptive study is the manner in which individuals being examined comprehend and describe their social world". (Bryman, 2003). The respondent's very nature is the focus of my investigation, not how much or how many there are. In other words, it is ecological rather than quantitative. I was interested in researching how young people think and behave.

I was able to conduct a detailed investigation with a small sample thanks to the descriptive design. It provides a much deeper look at the topic. Engaging with online consumers is key to identifying the positive and negative effects that today's kids are experiencing due to the technology and to provide them with potential solutions if those effects are unfavorable. I end by arguing that, generally, a descriptive study has been faithful to my subject.

Starting from scratch was essential because there aren't many sources or studies on this subject accessible in Nepal. In my study, subjects were the participants. Youth were the major focus demographics. The participants were 12 in number between the age group of 15 to 30 who have knowledge and experience about the internet and are more involved in it. Among them 5 were Muslims and the remaining were Hindus. This age group was selected as they are highly vulnerable to internet misuse today. They are the ones in their high transition period as they are active and curious, and they think that they must get involved in every matter.

Data Collection

The respondents were the main pillars for my study. Conclusions are mostly based on the interview information I used as my major source of data. I used every method I could to carry out the interview, including physical meetings, virtual meetings, and with questionnaire survey. Respondents completed questionnaire that asked them to describe their own behavior and reaction in the relevant scenario as well as their thoughts on the posed questions. Since it would restrict the participant's right to free speech, objective question types were avoided. Free responses were therefore anticipated from the respondent when they took part in the questionnaire surveys.

Findings

All the selected respondents had a mobile phone from a very young age and were aware of every function of the device. It was obvious as it is counted as a very basic need of every individual no matter what age group they belong to. Mobile phone is the most used device among Nepalese rather than tabs or laptops. It’s a kind of fashion and a matter of pride for youngsters below age 25.

So, When I shuffled through the pages of Respondents' answers I found out that each participant used 24/7 hours of internet. Some of them had a Wi-Fi connection in their residential area and some of them used mobile data. They seemed to keep connected to the internet every time. They also used the internet excessively to take the advantage of the spent money if there is a limited expiry date of the net. My interview result says that maximum youth are connected to the internet for more than 12 hours daily. According to them, they cannot stay away from using Facebook, YouTube, Instagram, or Tik-Tok. Additionally, no one missed a day without using the internet. However, each participant said that the cost of the internet is affordable whereas 6 out of 12 participants thought it is expensive.

Youngsters' attitude toward social media for religious purposes

Since the invention of the internet, individuals have had access to a wide range of religious websites, whether they are dedicated to their own religion or something else entirely. People can learn about any other faith's traditions in addition to being able to observe them. By clicking on a link with documentation about other people's faiths, youngsters do so as well but now they see they contrast and compare. Six of the respondents claimed that since they enjoy talking about their respective religious beliefs, they enjoy making internet acquaintances from all different religious backgrounds. They believe that discussing one's beliefs digitally is a viable channel. Some brought up the fact that some religious practices are false and send out incorrect ideas. Youths should use caution when participating in this kind of spiritual movement online.

Upon asking about the recent activities of Hindu nationalist fundamentalists and their Islamophobic media that blamed the Muslims for spreading Covid in the world, out of 7 Hindu participants 3 of them replied very aggressively claiming that the media was right, one of them says:

> "*I have Muslim friends in my institution I was good to him until I come to know that they are the reason behind spreading the corona. I don't talk to her anymore. They think everything is caused because of their Allah's will but actually, they are the cause of such a terrible situation."*

I was bewildered to hear this; Similar response was from the other two. They said:

> *"I got the information about the Muslims being the cause of the spread of infection by the Indian Media. Thank god! We know now so that we can take precautions from them, i.e., Muslims!"*

Muslims, who make up roughly 4% of the inhabitants of Nepal, have coexisted peacefully with the country's Hindu majority for many years. They came to the country as immigrants but built strong institutions. Even in

a place where religion has frequently resulted in bloodshed, Nepalis take pride in their tradition of religious tolerance.

Through well-known Indian news outlets and social media, Hindu nationalist extremists and India's Islamophobic media are using the coronavirus to spread hatred to Nepal. Influenced by neighboring nations Negative allegations have rapidly spread in Nepal when combined with the country's journals and newspapers (Budhathoki, 2020).

However, the remaining four respondents said that they were involved in commenting under the posts claiming that the news is wrong, and it spreads violence. These respondents however approached positively towards the rumors flooding social media.

The remaining Muslim respondents showed aggression towards such sold media saying that its politically affiliated and wants to create violation against each religion. Some even said that:

> "*Media is to be blamed to create such sensation and arise negative attitude, however as a Muslim I would say, it's our mistake too for not being able to be involved enough in to media to be stopping or fighting against such rumors*"

So here, Muslim respondents believe that being in the minority and nounable to play enough on media made the news spread faster without anyone stopping them.

On one hand some youngsters were influenced by the media that their attitude started changing and on the one hand, such manufactured tales have tarnished India's media's reputation in Nepal. In Nepal, the hashtag *#RIPIndianMedia* became popular. Yet even Nepali journalists, news websites, and the general people published and tweeted anti-Islamic content, leading to the trending hashtag *#IslamophobiaInNepal.*

Upon asking how far they believe in Social Media Majority of respondents claimed that they do believe on it most of the time but sometimes when videos or talks seem artificial to them, they don't. So basically, it depends upon their will to believe or not. Whereas Some Muslim respondents said:

> "*Media is no more a place to rely on especially when there is negative news about Muslims."*

The respondent seemed to be hurt by the false accusation on Muslims that somehow influenced the behavior of non-Muslims in the nation.

Digging further, asking about their inclusion ad having friends on social media; Despite the fact that social media is used for socializing, most teenagers are unlikely to go online and look for new acquaintances. Instead, they preferred to wait for friend requests from other people. The majority of the young participants did not like looking for new acquaintances. With the friends they already have, they are content. One participant said that she was too nervous to make friends on her own, so she preferred to wait for others to approach her. Two of the teenagers stated that they do not enjoy sharing their activities with the world, even though the majority use social media to interact with others. They instead kept their life secret as people may interpret them and they be caught in problems. Some people disliked displaying themselves online. They did not want to be disturbed, which is why. One participant even tried to cancel her Facebook account due to pointless posts made by others. Social media, in her opinion, is a time waster. Instead of wasting time on Facebook, she attempted to concentrate on doing something helpful. She was using it again, though, merely to get in touch with her pals, whom she had missed since moving to the new place. She says:

> "*Sometimes the videos and posts on Social media is very negative that make me feel depressed making her to over think the situation resulting to bad mood*" She further says, "*Sometimes I want to be nice to my Muslim fellow's but at the back of my mind those news of social media makes me not be behave good with them."*

Youths seem to be dangling in ways to believe or not to believe in social media, or how to behave or not behave and what reaction they should show and shouldn't. Some respondents also claimed that sometimes they go on debating on social media supporting their own faith until late at night. In case if they lose or if the other respondents start using bad language it leads them to aggression and feeling hate towards the whole community of that faith.

One of the respondents who belong to conservative Hindu family says:

> "*Social media is full of millions of ideas. Once You dip inside you are even more confused than before. My Parents are kind of extreme in their religion, but I am not. I have some Muslim friends and they are polite. Watching the news over media, especially the news that got spread against Muslims during Covid and some extremists Hindus wanted to take it as an advantage to highlight and blame Muslims weren't right and I don't support it."*

This was a good response from an undergraduate Student. At the same question, another respondent says:

> *"Muslims always want to be dominating. They think their religion is perfect and none else."*

Upon asking Why he think so, He replied:

"I saw much news on Indian channels and every time they show such news, our media doesn't talk about this stuff though its important."

Again, this was a shocking reply. No wonder, the media is swapping off the youths into a violent mindset. If the media had been a free space without any corruption and without being sold to any political parties, it would have been a better place to spread peace, but the case is the opposite.

Conclusion

As a Nepali Muslim citizen, I am really concerned, which is what provoked me to learn about the current trend affecting Nepalese youngsters. With the development of internet connections, Nepal, a developing nation, has recently experienced a boom in its digital media and gadgets. There have been about equal good and unfavorable consequences when examining the impact of the internet on social living. Yet, since it affects their thoughts, emotions, and entire attitude, the adverse impacts are more severe than the favorable benefits. Some participants—and yet not all—have previously gone through these transformations in their personal lives. It can result in internet addiction if they continue to use it needlessly and excessively. Additionally, it has been seen people using the internet to argue with their Muslim friends It is because Nepal is currently in an environment where the country's shift from underdevelopment to development in political, social, and economic sectors can be plainly recognized. This might be seen as a clash between contemporary and traditional beliefs.

The matter of acting is the outside media that is openly brainwashing the youths. The attitude towards Muslims in India has altered, especially following the ascent of Modi. In any event, India has a long history of portraying Muslims badly. To foster hostility with Indian Muslims, India tried to promote misinformation about Nepali Muslims. India has consistently assaulted Nepali Muslims, whether it is in the name of mosques and madrassas in the Terai border area or on other grounds. This misinformation if spread among youth will cause big hostile placing Muslim minorities in a Problematic situation. Youngsters need to be educated about the different faith equally. They need to know from a very young age that No religion provokes fighting and killing and it's their prime responsibility to respect each religion. Early teachings will shield them from getting swapped away by the corrupt media of the recent time.

The surge in Racism is concerning Nepal's Muslims, but they are hopeful that their friends and neighbors will prevent things from growing uglier. Many cite the fact that the violence that erupted in 1992 after the demolition of the Babri Masjid, a mosque constructed on land that was also cherished by Hindus in Ayodhya, India, failed to cross the border. On social media, however, there has been a steady increase in assaults against Nepali

Muslims. There haven't been any documented violent assaults against Muslims, and the majority of Nepalese still oppose attempts to sow division. Yet it needs proper precautions and new policies to stop the neighboring country from entering Nepal with their strategies. Nepal needs to increase the height of its borders to protect every sect of the land.

Limitation of the Study

The research is yet to highlight many factors and needs a more detailed study. My research has a limitation on respondents. I chose a certain age group and studied only the youngsters excluding political leaders, parents, and teachers, as they all can be an important subject to study on how they utilize social media and how they can help in shaping the mind of future individuals of the nation. There isn't much research done on this topic in Nepal, especially concerning the religious tolerance and social media. However, similar research of other countries guided me to come up with this, yet I couldn't find any research done on Muslim minority countries. Nevertheless, the research is about technology and technology is improving each day, bringing changes in youths' thoughts, lifestyle, and attitudes so the study might not be beneficial in the future, However, Since the world seem to be concerned about Muslims and there are a lot of misinformation and Islamophobic thoughts in the air, my research can be a reminder to the leaders of the nations to take preventing measures to avoid any kind of splits and violation in the nation.

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