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STUDY THE IMPACT OF TEACHER EFFECTIVENESS AND ONLINE LEARNING FOR MATHEMATICS ACHIEVEMENT IN HIGHER SECONDARY LEVEL STUDENTS

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Abstract: Online learning platforms have grown in popularity as a result of the quick adoption of technology in education. Designing effective instructional strategies, therefore, requires an understanding of how online learning and instructor effectiveness affect students' maths achievement. The purpose of the study was to determine the influence of the learning environment on students' academic achievement in mathematics at the senior secondary school level. Consequently, the study investigated some components of the teaching environment and their possible influence on students' academic achievement in mathematics. At the same time, this study experimented with a social regulation-based online learning approach that enhances students' learning achievements and learning motivations in mathematics. Additionally, the impact of parental involvement in the form of parent conversations on high school students' arithmetic proficiency was investigated in this study. The study also identifies psychological elements that influence students' mathematical performance. A pre-test and post-test non- equivalent control group quasi-experimental research design was used in the study. Using a factorial matrix, the quasi-experimental design was utilized to compare the treatment's (at two levels) scores crossed with gender (at two levels). One intact class was chosen using simple random sampling, and the data were then evaluated using an independent sample t-test and descriptive statistics like mean and standard deviation. The results of this study make a minor contribution to the body of empirical research on the effects of content-specific feedback and metacognitive practice on high school academic attainment. The effect of online learning, including the utilization of virtual classrooms, online materials, and interactive learning platforms, was also investigated. The results show a strong positive correlation between maths achievement and teacher effectiveness. Students learning outcomes in mathematics were significantly impacted by teachers who displayed excellent instructional quality, exhibited good pedagogical content understanding, and managed their classes effectively. The study also showed that the use of online learning in mathematics instruction had a favorable impact on students' performance. The usage of online classrooms enabled engaging debates, group problem-solving, and individualized learning experiences, which contributed to improved mathematics performance.

Keywords: Teacher Effectiveness, Online Learning, Mathematics Learning, Higher Secondary Level Students, Psychological Factors, and Mathematics Achievement

1. INTRODUCTION

Mathematics has a very important role because mathematics is a basic science that is widely used in various fields of life. The enjoyment of mathematics directly affected mathematics achievement, and the feeling of difficulty indirectly affected mathematics achievement [1]. If researchers can identify specific areas of mathematics that consistently predict later mathematics proficiency, after controlling for other types of mathematical knowledge, general intellectual ability, and family background variables, they can then determine why those types of knowledge are uniquely predictive, and society can increase efforts to improve instruction and learn in those areas [2]. The educational payoff is likely to be strongest for areas that are strongly predictive of later achievement and in which many children's understanding is poor [3]. The sources of continuity in mathematical knowledge from fifth grade through high school [4]. They were particularly interested in testing the hypothesis that early knowledge of fractions is uniquely predictive of later knowledge of algebra and overall mathematics achievement [5]. Numerous studies have been conducted on the relationship between attitude toward mathematics and mathematics achievement, comparatively, research was deficient in examining the relationship between mathematics self-efficacy and mathematics achievement. Further, no research has been conducted using large-scale samples across the nation [6].

Teacher effectiveness has significant implications for decision-making regarding the preparation, recruitment, compensation, in-service professional development, and evaluation of teachers [7]. Classroom differences between effective and less effective teachers were examined in terms of both their teaching behaviors and their students' classroom behaviors. School and district leaders wanted to explore student readiness to learn from the perspective of the teachers and teacher effectiveness from the perspective of the students [8]. Teacher efficacy has been well explored from the perspective of the. Less examined in the literature are student perceptions of teacher effectiveness or teacher perceptions of student readiness to learn [9]. The online lecture or learning process can be carried out by universities online learning has its challenges, strengths, weaknesses, and barriers [10]. The face-to-face learning that has been done so far is to gather a lot of students in the class and the interaction process with one another so that the transmission process will be faster [11]. The online learning process is expected to be able to assist lecturers and students in carrying out lectures so that the educational process [12]. Online learning is online learning with the help of the internet so that it can meet lecturers and students virtually [13]. In recent years, online learning has become a demand in the world of education [14]. Online learning with the help of Internet networks makes the learning interaction process emerge, and has advantages in terms of connectivity, accessibility, and flexibility [15]. Therefore, this study approached the study of the impact of teacher effectiveness and online learning on mathematics achievement in higher secondary level students. The rest of the work is organized as follows, section 2 illustrates the literature survey of the study, section 3, portrays the problem definition and motivation of the work, and section 4 depicts the proposed research methodology. Section 5 reveals the result and discussion, and section 6 discloses the conclusion part of the research.

2. LITERATURE SURVEY

Glover et al [16] investigated the extent to which three coaching actions—modeling, practice, and feedback provided during data-driven coaching predicted (a) teachers' intervention implementation fidelity, (b) teachers' use of evidence-based classroom strategies, and (c) class-wide student achievement. In addition, teachers' intervention implementation fidelity mediated the relationship between teacher practice opportunities and teachers' use of evidence-based classroom strategies. Jiang et al [17] investigated the latent profiles of high school students' expectancy, value, and cost beliefs in math and English domains using a person-centered approach. the Findings of the present study suggest the importance of taking into consideration of students' expectancy, value, and cost beliefs together to better understand their motivational dynamics in school. Bishara et al [18] examined the association between humor, motivation, and achievements in mathematics in students with learning disabilities. The findings of this study show improved mathematics achievements and motivation in students with learning disabilities when humor is incorporated into mathematics classes.

Syamsuri et al [19] determined the relationship between high school students' attitudes and their mathematics learning achievement. The results showed that there was a weak but significant positive relationship between students' attitudes towards mathematics and mathematics learning achievement Mweni et al [20] hares findings from the study objective to establish the relationship between student anxiety and achievement in mathematics. The study found that there was a statistically significant positive correlation coefficient between student anxiety and achievement in mathematics. Marks et al [21] analyzed two ability and three achievement measures, with composite and multiple SES measures and a commonly used indicator of the home environment (HOME) in children aged from 3 to 15. The contributions of the shared environment ranged from 14% for reading recognition to 41% for the PPVT. Therefore, genetics is important, and the non-trivial contributions of the common environment are more likely to reflect school and neighborhood factors rather than parental SES and the home environment.

Perez, et al [22] determined the use of pre-recorded video lessons and its impact on student achievement in mathematics among Grade 8 students of Victorino Mapa High School during the school year 2021-2022. The results of the questionnaire also obtained positive results that students found helpful to their learning process. Mitchell et al [23] designed to compare scores on the Algebra 1 mathematics standardized test for music class participants and non- music class participants. Results from this study can be utilized to aid stakeholders and administrators in making a financial or educational environmental decision that can aid in the retaining of music classes or the creation or incorporation of music classes into the curriculum. Bhatia et al [24] aimed at finding a relationship between Achievement in Mathematics and the socioeconomic status of secondary school students of Indore City. SPSS, Pearson’s Product Moment Coefficient of Correlation (r) was run to calculate the Correlation between Achievement in Mathematics and Socio-Economic Status. The correlation between Achievement in Mathematics and the overall SES of students was not significant. Ezebube et al [25] explored academic achievement among secondary school students in the Anambra State Nigeria and was correlated with emotional

intelligence, self-esteem, and gender. The research was conducted in Nigeria and specified by the region in the Anambra State educational zones of Onitsha and Awka.

3. RESEARCH PROBLEM DEFINITION AND MOTIVATION

The maths skills that students in secondary school have a significant impact on their success in college and throughout their future jobs. A strong grounding in mathematics gives pupils more job alternatives and aids in the development of nuanced viewpoints. Genuine inventiveness, increased production, and an improvement in citizens' social well-being are all sparked by mathematical abilities. Any country's population must demonstrate a high level of scientific and mathematical literacy as a solid foundation for technical capability for it to be internationally competitive. Numerous nations continue to be poor as a result of weak mathematical and scientific literacy. Even though these nations use mathematics as a qualification for professions in science, technology, engineering, and mathematics at the university level, student proficiency in mathematics is low when compared to high-achieving nations. As a result, the study determined which factors would determine whether a study was included or excluded when conceptualizing and quantifying instructional efficacy and the effects of online learning on student accomplishment.

Mathematics competency is frequently a requirement for most university degrees, as it is a fundamental skill in many industries like science, engineering, and technology. The commonality of maths makes it a need for further education. Although having strong arithmetic abilities is essential for success in many academic fields, many students are unwilling to enroll in classes that focus on math. The cause is thought to be anxiety and pressure brought on by prior failures in maths study. The online learning environment gives students the chance to discuss their ideas with others and supports their independent learning. The use of other students' learning tactics during the study process, according to academics, can improve students' learning performances. Social regulation is the act of referencing the study techniques of other students and keeping an eye on one another while studying. From a constructivist viewpoint, this discrepancy can be explained by taking a closer look at the relationships between teaching and achievement as well as the learning processes that students engage in to absorb the material being taught. This establishes that maths proficiency affects secondary- level students' online learning and teaching experiences.

4. PROPOSED RESEARCH METHODOLOGY

Online learning has become a more popular learning method in recent years because of advancements in technology. By leveraging the Internet and various online learning platforms, learners can access the online learning environment from any location and study at their own pace. The learning environment can be more flexible with this form of learning. For a very long time, officials and academics have been deeply concerned about the mathematical abilities of secondary school students. Many academics think that the best indicator of a nation's long- term economic potential is the mathematical proficiency of its secondary school students. By categorizing how researchers have conceptualized, operationalized, and assessed teaching effectiveness and online

learning processes for students' academic achievement in mathematics at the higher secondary level, this research seeks to better understand these mechanisms.

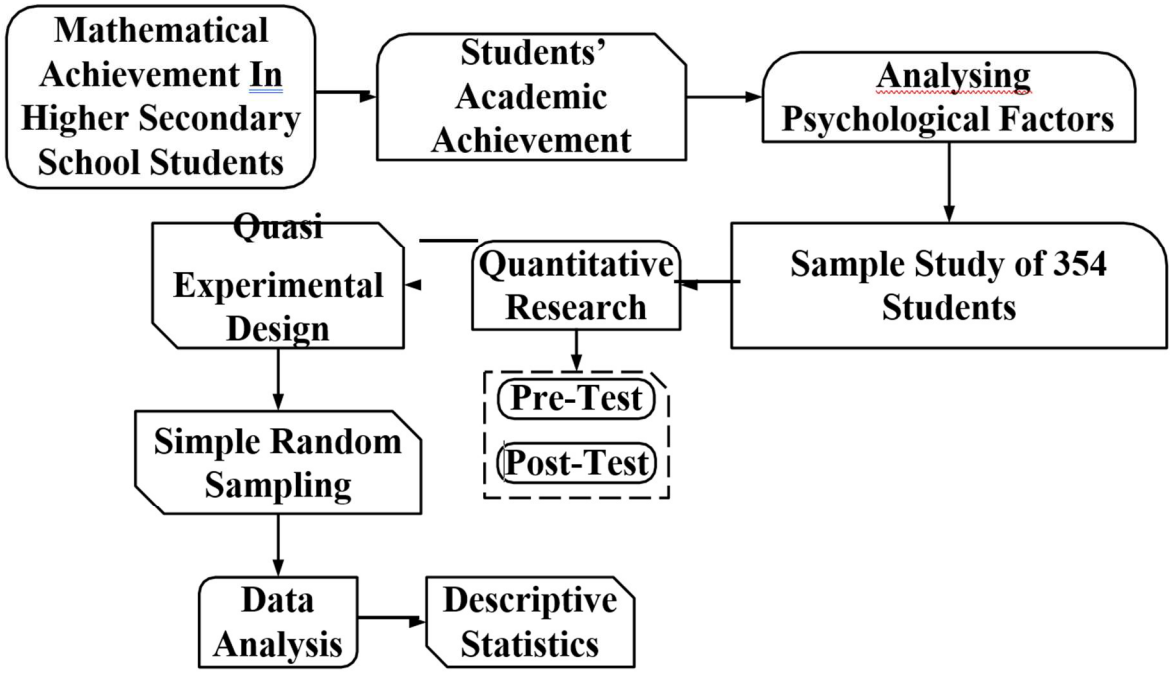

Figure 1: Block Diagram of the Proposed Work

Figure 1 depicts the block diagram of the proposed work. The major goal of the suggested activity is to raise students' maths proficiency in higher secondary school. Calculate the psychological elements that cause children to do poorly in mathematics for this purpose. Pre- test and post-test are the two types of tests used in quantitative research. Descriptive statistics are used to assess the data obtained from simple random sampling. To examine the learning environment affects students' academic progress in mathematics, this study used both an experimental and a descriptive survey approach. It sought to gather information from a sizable number of students about the elements of the learning environment to ascertain their opinions, attitudes, and perceptions of interest using a simple structured questionnaire. Using both the experimental group (excellent learning environment) and the control group (dull learning environment), experiments are used to demonstrate the impact of the learning environment on science students' performance in physics. A sample size of 354 students was selected, which corresponds to 30% of the total population. A sample is useless unless it accurately represents the complete population from which a generation is derived. To make analysis easier, the researcher samples all of the pupils, regardless of their gender or age. To obtain a fair representation of the population, the researcher utilized a random selection technique.

4.1 Data Collection

An achievement exam and a structured questionnaire served as the study's primary data collection tools. Four questions were asked about each element of the learning environment that was the

subject of the 16-item questionnaire. The students were asked to rate a series of assertions on a 5-point Likert scale that contains a list of them. On the other hand, the research was taught to the sampled students for two weeks while the control group was taught by the experiment. The researcher ensured that the experimental groups received high-quality instruction, while the control groups were taught in a neutral environment.

Table 1: Demographic Details of Respondents

Demographic	Characteristics	No. of Respondents	Percentage
Gender	Male	147	41.5%
	Female	207	58.5%
Age	17-18	127	35.8%
	16-17	93	26.2%
	15-16	71	20%
	14-15	63	18%
Standard	11	193	54.5%
	12	161	45.5%
Type of e-books	Non-interactive mathematics e-book	189	53.3%
	Interactive mathematics e-book	165	46.7%
Platform	Zoom Meeting	195	55%
	Google Classroom	159	45%

Schools were approached for the data collection either by calling the head teacher or dean of studies or by visiting them personally. Table 1 displays the information that was gathered from higher secondary school students using Google Classroom and Zoom meetings. These made the researcher and the department head of mathematics connect. The student survey and the Mathematics test were given out at the start of the academic year. With the assistance of one or more math teachers, the researcher and/or his assistants gave the tests and questionnaires to the students during math class. First, for this survey, two different geographical and education categories are chosen. In this study, they gathered 147 male and 207 female students from government and private schools, ranging in age from 19 to 20, 17 to 18, 15 to 16, and 13 to 14. With the aid of Zoom meetings and Google Classroom, they gathered information on
131 non-interactive and 189 interactive mathematics e-books for online learning. The confidentiality of the study's data collection and its exclusive usage for research purposes were guaranteed to the students.

4.2 Social Regulation-Based Online Learning

In the spring of 2022, this study was carried out in a virtual school. Despite being called a school, this non-profit, state-wide supplement program (approved by the state and managed by state organizations) allowed students to enroll in specific courses while also attending a traditional school or a virtual school located in the same state. This indicates that students continued to attend their local schools regularly while also enrolling in online classes at this online institution. Students in virtual schools conducted classes at their own pace, and all course-related contact occurred asynchronously, primarily through messages and online discussion boards. The virtual school's language classes used pre-packaged online learning resources that were licensed from outside suppliers, all of which had been reviewed by the institution to ensure that they met its requirements for quality. These online language courses used a combination of writing assignments assessed by the instructor and computer-graded questions for assessment.

In the spring semester, a total of 354 students were approached by their professors, who extended invitations to participate in this research study. These potential participants were all enrolled in online courses appropriate for high schools. Although some middle students attended the virtual school as a consequence of petitions that had been granted by their schools, the vast majority of individuals contacted were of typical high school age. The student survey comprised 66 items, all of which were derived from other research that had found them to be reliable (further information is provided below). To make sure these materials were appropriate for the current project, three K–12 online learning experts and two senior members of the school staff also examined them. The Qualtrics website hosted the survey, which took 20 to 25 minutes to complete. The participants' demographic data, reasons for learning, learning methods, satisfaction with online learning, and perceived learning progress were all requested. 467 completed surveys were received. 20% was quite similar to another study done in virtual classrooms, which had a response rate of 20%.

4.2.1 Reliability Analysis

To investigate the reliability of the latent construct of online learning strategies, confirmatory factor analysis (CFA) was used. The structural links between online learning motivation and method utilization, and learning outcomes (such as student satisfaction, perceived progress, and final grades), were examined using SEM. Self-regulation may affect various online learning outcomes differently, according to prior research, which was the basis for conducting SEM independently for each outcome variable. Three structural equation models in particular were made. Model 1 examined how learning methods (i.e., metacognitive tactics) mediated the impact of self-determination (i.e., intrinsic motivation, identified motivation, inserted regulation, and external regulation) on satisfaction. The dependent variable in Model 2 was altered to perceived progress, while Model 3 assessed a different dependent variable: the students' final grades. Researchers can determine whether the hypothesized model is supported by the sample data based on the findings of CFA and SEM. The chi-square goodness-of-fit (2), the root mean square error of approximation, and the comparative fit index (CFI) are three statistical indices that measure how to fit the model. A low chi-square score suggests that the model fits the data well. To confirm

the model's fitness, RMSEA, and CFI should be utilized because the chi-square test is sensitive to sample size and a large sample size can quickly produce a significant chi-square result.

4.3 Pre-Test and Post-Test

The population of the study was made up of all eighth-graders attending elementary schools in public and private elementary, middle, and high schools. The study's sample was comprised of 354 students from Higher Secondary Schools in the eighth grade. Using a random selection technique, all students were split into two groups, Experimental and Control, based on results from a pre-test. A total of 354 students made up the experimental and control groups. Two equally qualified and experienced maths teachers taught both groups to protect the integrity of the subject. The only distinction was that the experimental group received problem-solving instruction while the controlling group received standard instruction.

With matched experimental and control groups, a pre-test and post-test design was adopted. The instrument was a self-created test. After researching the pertinent literature and speaking with subject matter experts, the researcher created a test. Eight questions in the test measured the student's academic achievement and performance skills, and they comprised multiple choice questions, matching questions, fill-in-the-blank questions, and practical solutions to mathematics problems. The set, information handling, and geometry sections of the eighth- grade mathematics textbook are all referenced in the test's items. The format of the test was designed to cover the knowledge, comprehension, and application levels. The same mathematical achievement exam was administered before and after the intervention, but the pre-test contained different questions in a different order or sequence. The doctorate committee and two specialists in mathematics education evaluated the items' validity. 15 students in a school not participating in the study but studying the same subject using the instrument of the pilot test.

4.3.1 Problem-Based Learning Task

Six groups of six students in four groups and two groups of seven kids were formed in the experimental group before the therapy; each group had a different learning style and academic performance. After that, teachers and students received training in problem-based learning. The therapy involved the kids working in small groups to solve illogical challenges. Everyone in the group was accountable for something. The discussion in the class was expected to have active participation from the students. While looking for a solution to the issue, they had to exchange knowledge, ideas, and experience with one another. They all have to be considerate of the wants and sentiments of the other group members. Each student had to do an independent study in addition to the group projects, and they had to be able to describe, explain, and assess their learning both individually and in groups. The instructor set up the groups for the problem- based learning sessions and established a focused, collaborative environment. The teacher made sure that the topic was in the students' hands. When direction was required, the teacher posed open-ended, very general questions and gave the class plenty of time to concentrate on the objective. Critical thinking was encouraged by the teacher. Students rated one another for participation, preparedness,

interpersonal skills, and contribution to group success after the problem-based learning implementation. In this way, it was anticipated that students would understand their position and what was expected of them on an individual and group level. It was anticipated that the four-week duration of the trial would be enough. The exact post-test was given following a four-week treatment period. The order of the test items was altered between the pre-test and post-test, which was the only alteration.

4.3.2 Research Instrument

Teachers responded to a self-administered survey. The criterion variable (teacher efficacy) and three predictors (course track, course grade, and match with the teacher's area of teaching specialization) made up the within-teacher variables. Gender, work experience, academic experience, leadership role in the school, and teacher's subject developed between-teacher variables. Created a special instrument for this investigation because teacher efficacy measures from earlier studies failed to satisfy the need for situational specificity outlined above (see pp. 9–10). Focused on courses rather than subjects in high schools because courses are the primary work assignments for secondary teachers, courses represent the intersection of content and learner characteristics, courses' content (unlike that of subjects) is established by government curriculum guidelines, and courses have previously been shown to be able to predict within- teacher variation in teacher efficacy. Four courses that teachers would be teaching in the fall were identified. The sixth item was eliminated due to the lower level of consensus surrounding it and its detrimental impact on the scale's dependability. For each of the four courses, the mean teacher efficacy score was computed using the final five prompts. The raw scores were translated into standard (z-) scores because they were typically bi-modal and negatively skewed.

4.3.3 Data Analysis

The statistical method or tools used to analyze the research data is known as data analysis. To perform a descriptive statistical analysis of the acquired data, the Mean (Average) and Standard Deviation (SD) of each item were computed. Since it employed a 5-point scale, the decision criteria required that any item with a mean below 3.00 be rejected. Additionally, the data were examined using inferential statistics of the t-test to assess the test.

5. RESULTS AND DISCUSSION

To assess the viability of employing the Collective Efficacy Short Form with higher secondary students, reliability and factor analyses were first conducted. After that, a level-1 model estimation was finished, which examined student perception ratings. Finally, a two-level hierarchical linear model estimation was performed using teacher and student assessments of faculty group competence (levels 1 and 2, respectively). The below results are the findings of these analyses. This analysis is performed using the SPSS software.

Table 2: Simulation System Configuration

SPSS Statistical Tool	Version 23.0
Operation System	Windows 10 Home
Memory Capacity	6GB DDR3
Processor	Intel Core i5 @ 3.5GHz

The simulation configuration table is shown in Table 2. The variables used in this analysis are Learning and Teaching Environment (LTE), Teacher Effectiveness (TE), Teacher Effectiveness (TE), Online Learning Social Regulation (OLSR), Online Learning Social Regulation (OLSR), Parental Involvement (PI), Parental Involvement (PI), Learning Habits (LH), Self-Confidence (SC), Academic Stress (AS), and Students' Academic Achievement (SAA). The data were evaluated using correlation, multiple regression, t-test, chi-square test, and reliability in the proposed work.

5.1 Correlations Analysis

The Pearson correlation coefficient (r), which measures a linear relationship, is the most widely used approach. A number between -1 and 1 is used to describe the strength and direction of the relationship between two variables.

Table 3: Correlation Coefficient Results

		LTE	TE	MPD	OLDER	SLA	PI	MA	LH	SC	AS	SAA
LTE	Pearson Correlation	1	.192**	-.027	.066	-.035	.000	-.016	-.002	-.056	.033	-.002
	Sig. (2-tailed)		.000	.614	.214	.508	1.000	.761	.978	.293	.532	.969
	N	354	354	354	354	354	354	354	354	354	354	354
TE	Pearson Correlation	.192**	1	.115*	.002	-.012	.006	.011	-.030	-.020	.070	.080
	Sig. (2-tailed)	.000		.030	.972	.829	.905	.831	.572	.714	.191	.133
	N	354	354	354	354	354	354	354	354	354	354	354
MPD	Pearson Correlation	-.027	.115*	1	.187**	.120*	-.023	-.034	-.076	-.011	-.016	-.047
	Sig. (2-tailed)	.614	.030		.000	.024	.664	.524	.155	.837	.760	.376
	N	354	354	354	354	354	354	354	354	354	354	354
OLSR	Pearson Correlation	.066	.002	.187**	1	.124*	.039	.029	-.085	-.028	-.058	-.010
	Sig. (2-tailed)	.214	.972	.000		.019	.467	.583	.110	.602	.279	.854
	N	354	354	354	354	354	354	354	354	354	354	354

SLA	Pearson Correlation	-.035	-.012	.120*	.124*	1	.129*	.014	-.027	.023	.034	.030
	Sig. (2-tailed)	.508	.829	.024	.019		.015	.787	.618	.671	.519	.571
	N	354	354	354	354	354	354	354	354	354	354	354
PI	Pearson Correlation	.000	.006	-.023	.039	.129*	1	.103	-.098	-.081	-.068	-.029
	Sig. (2-tailed)	1.000	.905	.664	.467	.015		.053	.066	.130	.199	.584
	N	354	354	354	354	354	354	354	354	354	354	354
MA	Pearson Correlation	-.016	.011	-.034	.029	.014	.103	1	.074	-.029	-.024	.047
	Sig. (2-tailed)	.761	.831	.524	.583	.787	.053		.166	.590	.649	.376
	N	354	354	354	354	354	354	354	354	354	354	354
LH	Pearson Correlation	-.002	-.030	-.076	-.085	-.027	-.098	.074	1	.097	.061	-.074
	Sig. (2-tailed)	.978	.572	.155	.110	.618	.066	.166		.067	.252	.163
	N	354	354	354	354	354	354	354	354	354	354	354
SC	Pearson Correlation	-.056	-.020	-.011	-.028	.023	-.081	-.029	.097	1	.253**	.100
	Sig. (2-tailed)	.293	.714	.837	.602	.671	.130	.590	.067		.000	.061
	N	354	354	354	354	354	354	354	354	354	354	354
AS	Pearson Correlation	.033	.070	-.016	-.058	.034	-.068	-.024	.061	.253**	1	.142**
	Sig. (2-tailed)	.532	.191	.760	.279	.519	.199	.649	.252	.000		.007
	N	354	354	354	354	354	354	354	354	354	354	354
SAA	Pearson Correlation	-.002	.080	-.047	-.010	.030	-.029	.047	-.074	.100	.142**	1
	Sig. (2-tailed)	.969	.133	.376	.854	.571	.584	.376	.163	.061	.007	
	N	354	354	354	354	354	354	354	354	354	354	354
**. Correlation is significant at the 0.01 level (2-tailed).												
*. Correlation is significant at the 0.05 level (2-tailed).												

Table 3 displays the findings of the Pearson correlation coefficient. This coefficient of 0.590 was discovered using Pearson correlation statistics with a 0.080 alpha level of significance. This demonstrates a positive correlation between students' passion for learning mathematics and their exposure to multimedia. It has a 0.009 correlation coefficient. It demonstrates the close connection between EM and SE as well. Thus, there is a connection between student engagement and problem-

solving ability. Correlation coefficients of 0.142** are produced, and the significance level is set at 0.034. As a result, problem-solving ability has a good effect on both students' mathematical thinking ability and degree of retention.

5.2 Regression Analysis

Multiple linear regression analysis was done to determine the relationship between students' thinking capacity and their problem-solving competence after the components' validity and reliability were validated.

Table 4: Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	**.216[a]**	**.046**	**.019**	**5.893**
a. Predictors: (Constant), AS, MPD, MA, LTE, LH, SLA, PI, TE, OLSR, SC				
b. Dependent Variable: SAA				

The model summary of the study is shown in Table 4, which includes the data for the regression, regression square, standard error of the estimate, and Durbin Watson. For AS, MPD, MA, LTE, LH, SLA, PI, TE, OLSR, and SC, this was expected. The dependent variables, however, are SAA. Here, the standard error is 5.893 and the R square value is 0.046.

Table 5: Regression Analysis

ANOVA[a]						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	580.501	10	58.050	1.672	.086[b]
	Residual	11911.140	343	34.726		
	Total	12491.641	353			
a. Dependent Variable: SAA						
b. Predictors: (Constant), AS, MPD, MA, LTE, LH, SLA, PI, TE, OLSR, SC						

The most popular statistical technique currently in use for evaluating hypotheses is ANOVA. This approach is flexible enough to accommodate more experimental designs and spans a wide range of topics. Table 5 shows the results of the ANOVA regression analysis, which includes 580.501 Sum of Squares values and an F value of 1.672. The dependent variable is SAA, and the predictors are TM, GE, and ME.

Table 6: Coefficient Analysis

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		

1	(Constant)	16.536	3.000		5.513	.000
	LTE	-.018	.058	-.017	-.313	.754
	TE	.081	.055	.081	1.485	.138
	MPD	-.065	.055	-.064	-1.178	.240
	OLSR	-.001	.054	-.001	-.012	.990
	SLA	.033	.053	.034	.624	.533
	PI	-.039	.058	-.037	-.683	.495
	MA	.059	.052	.060	1.117	.265
	LH	-.096	.052	-.099	-1.838	.067
	SC	.077	.055	.077	1.394	.164
	AS	.116	.053	.120	2.190	.029
a. Dependent Variable: SAA						

Table 6 shows the regression test coefficient values, which can be used to predict variables and determine whether they affect the statistically significant model (by looking at the "Sig." column). Additionally, the values in the "B" column under "Unstandardized Coefficients" can be used because the constant value is 16.536, and the t value is 5.513. The relevance of the work is 0.000, respectively.

Table 7: Residuals Statistics Results

	Minimum	**Maximum**	**Mean**	**Std. Deviation**	**N**
Predicted Value	15.92	23.35	19.34	1.282	354
Residual	-14.241	15.294	.000	5.809	354
Std. Predicted Value	-2.669	3.125	.000	1.000	354
Std. Residual	-2.417	2.595	.000	.986	354
a. Dependent Variable: SAA					

Table 7 displays the regression model's residual statistics. The mean expected values are 19.34, and the standard deviation is 1.282. Standard deviations for standardized residuals, standard predicted value, and standard residual are 5.809, 1.0, and 0.986, respectively. However, the standard projected value, standard residual, and residual average values are all 0.000.

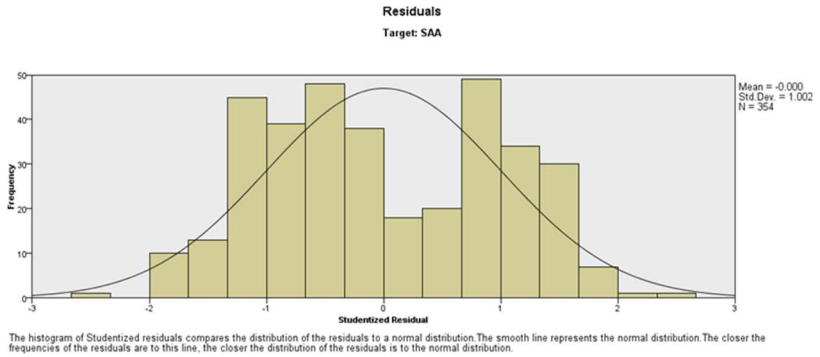

Figure 2: Standardize Residual Graph Analysis

A residual, usually referred to as a raw residual, which is frequently used in the context of regression analysis is shown in Figure 2. The vertical separation between a data point and the forecast line is known as a residual. It is a sign that the prediction was inaccurate. The residuals represent how distant each data point is from the prediction line, which is effectively the average of the data points. The mean and standard deviation of the target variable, SAA, respectively, are 0.000 and 1.002.

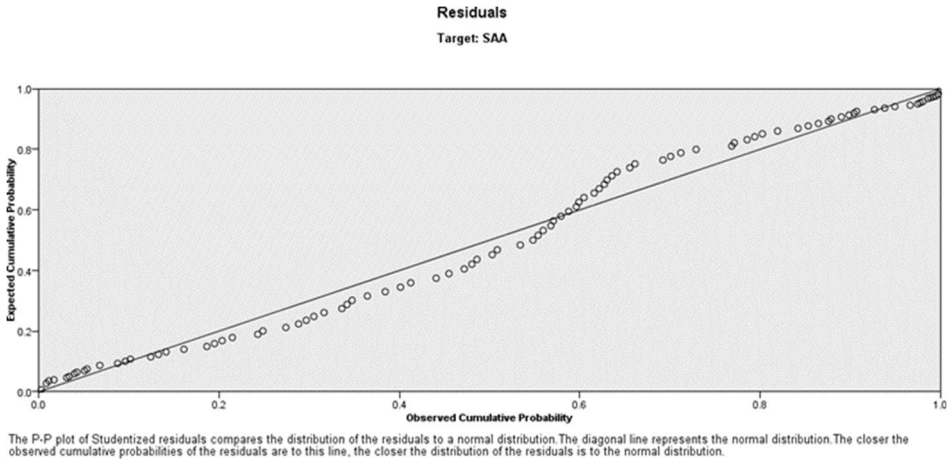

Figure 3: Normal P-P Plot of Regression Analysis

Figure 3 displays a typical P-P plot for the regression model. A normal probability plot is a method for evaluating the regression's normality and variance homogeneity assumptions. A P- P plot is used to compare the observed cumulative distribution function (CDF) of the standardized residual to the expected CDF of the normal distribution. Plotting residuals associated with a normal probability graph scale against the cumulative frequency of the distribution of standardized residuals produced by the model employing normal probability. The assumption of homoscedasticity is made when the plot is a straight line without any curves or outliers. If there are extreme points far from the normal probability graph scale line (outliers) or curves along the line, the assumption of heteroscedasticity has not been satisfied.

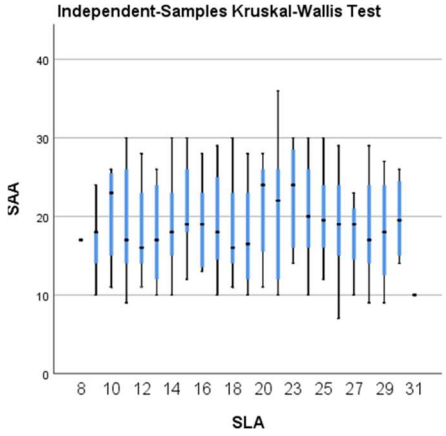

Figure 4: Kruskal-Wallis Test Analysis of Box Plot

The calculated p-value in the Kruskal-Wallis test is shown in Figure 4, which is either smaller or larger than the standard 0.05 level of significance. The null hypothesis is accepted if the p-value is greater; otherwise, it is rejected. The p-value in the aforementioned example is 0.779 and is therefore higher than 0.05.

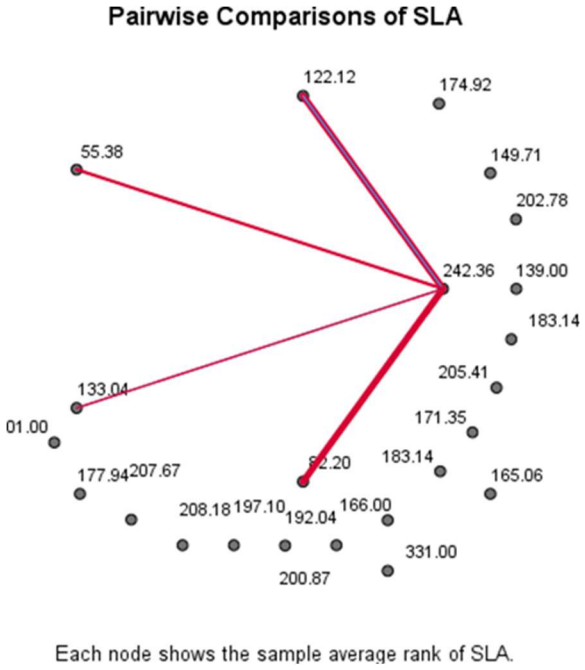

Figure 5: Pairwise Comparison Results of Dependent Variable

Figure 5 shows the outcomes of the proposed research's pairwise comparisons. Assess if there are statistically meaningful disparities among the group means of SA, identifying their probable ranges, and evaluating their practical significance through the use of individual confidence intervals. Students, the table for individual tests shows the confidence intervals for the variance between pairs of averages. All of the following pairs of means have confidence intervals that include 0, indicating that the differences are not statistically significant.

5.3 Chi-Square Test Analysis

A statistical technique called the chi-square test is used to compare actual outcomes to predictions. This test aims to determine whether a discrepancy between actual and predicted data is caused by chance or by a connection between the variables being examined.

Table 8: Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	480.824[a]	506	.783
Likelihood Ratio	418.256	506	.998
Linear-by-Linear Association	.034	1	.853

N of Valid Cases	354		
a. 552 cells (100.0%) have an expected count of less than 5. The minimum expected count is .01.			

Table 8 presents the results of the Chi-square test of independence, which examines if there is a statistically significant link between categorical variables. Using the Chi-Square Test of Independence, only categorical variables can be compared. It is not possible to compare continuous variables or continuous and categorical variables. Furthermore, the Chi-Square Test of Independence is limited to evaluating relationships between categorical variables and is unable to conclude causality.

5.4 Reliability Analysis

Assessing the validity and factor structure of the Collective Efficacy Short Form as particularly applied to the higher secondary students in this study was the first step in the data analysis process. Utilizing confirmatory factor analysis, data were examined. In a rotating varimax solution, there were two components. Each of the six measures showed a significant connection with group competence, and the six items for group competence were precisely loaded.

Table 9: Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.794	.192	11

The reliability study as shown in Table 9 indicated a strong Cronbach alpha degree of dependability for group competency at (.794). On the other hand, just three of the items in the second component showed significant connections. For task analysis, reliability analyses were unacceptably poor (.149). The task analysis factor of higher secondary school pupils is not supported by these results, but the group competence factor is. Thus, a single-factor instrument evaluating just the faculty group competency component of teacher effectiveness with six items was produced by the factor analysis for use with higher secondary school students.

Table 10: Item Statistics Analysis

	Mean	Std. Deviation	N
LTE	18.96	5.519	354
TE	19.25	5.923	354
MPD	19.59	5.889	354
OLSR	19.11	5.942	354
SLA	19.19	6.019	354
PI	18.56	5.568	354
MA	18.88	6.041	354

LH	19.51	6.130	354
SC	18.90	5.898	354
AS	19.61	6.178	354
SAA	19.34	5.949	354

Table 10 displays the summary item data from the reliability test. It shows that summary statistics, a subset of descriptive statistics, provides a general overview of the sample data. Statisticians typically try to describe and characterize the observations by determining their minimum, maximum, range, and variance. In this instance, the range is 18.56, and the values for the six items' standard deviations are 5.519 and 5.949. For SAA, the average values are 19.34.

Table 11: Intraclass Correlation Coefficient

	Intraclass Correlation[b]	95% Confidence Interval		F Test with True Value			
		Lower Bound	Upper Bound	Value	df1	df2	Sig
Single Measures	.021[a]	.006	.040	1.241	353	3530	.002
Average Measures	.194[c]	.064	.313	1.241	353	3530	.002
Two-way mixed effects model where people effects are random and measures effects are fixed.							
a. The estimator is the same, whether the interaction effect is present or not.							
b. Type C intraclass correlation coefficients using a consistency definition. The between-measure variance is excluded from the denominator variance.							
c. This estimate is computed assuming the interaction effect is absent, because it is not estimable otherwise.							

Table 11 shows the intra-class correlation coefficient (ICC). The ICC is used to assess the agreement when there are two or more independent raters and the outcome is measured on a continuous scale. The average measure's lowest and upper bounds are 0.064 and 0.313, respectively, while the ICC's value is 0.194 with a significance level of 0.002.

6. RESEARCH CONCLUSION

New teaching-learning paradigms and instructional tools have been made possible by technological advancements in the twenty-first century. Online learning is one of the ideas created by such advances. The purpose of this study is to determine the impact of online mathematics instruction on higher secondary students' mathematical achievement. This makes use of a quasi-experimental study methodology and presents a random sampling model for gathering data. Mean, standard deviation and the chi-square test were the data analysis techniques used for quantitative data, and they were all processed by SPSS. This study emphasizes the considerable influence of online learning and teacher effectiveness on higher secondary students' mathematics proficiency. The results show that the crucial of effective teaching methods and the use of online learning are

to raise students' maths performance. According to the study, there is a correlation between math achievement and teacher effectiveness. Students learning achievements in mathematics are greatly influenced by teachers who exhibit excellent instructional quality, have solid pedagogical content understanding, and successfully manage their classes. Performance improvements are a result of their knowledge, their capacity to hold students' attention, and their capacity to explain complex concepts in simple terms and provide encouraging feedback. Additionally, incorporating online learning into math instruction is advantageous. Interactive learning platforms, online resources, and virtual classrooms offer chances for group conversations, cooperative problem-solving, and individualized learning. These technological resources provide students with the opportunity to dynamically and engagingly explore mathematical ideas, which improves their performance and comprehension.

However, at a significance level of 0.05, the obtained data are evaluated using Pearson product-moment correlation and multiple regression. Results explore the relationship between online learning and high mathematics achievement among senior secondary school students as measured by instructor effectiveness. Based on these findings, it was suggested that senior secondary school mathematics teachers should foster their students' productive attitude towards mathematics and online learning social regulation, which are motivating their mathematical accomplishment. According to studies, there are statistically significant positive, statistically non-significant, or even statistically significant negative direct relationships between teaching quality aspects and student learning outcomes. Despite the benefits of online learning, obstacles like technological difficulties and the lack of widespread access to dependable internet connectivity must be resolved. For successful implementation, it is also important to promote digital literacy among teachers and students and to provide proper training in online teaching approaches. The conclusions of this study indicate that it is crucial to fund programs for the professional development of teachers to advance their instructional abilities, content knowledge, and classroom management techniques. Additionally, educational institutions ought to place a high priority on the creation of digital infrastructure, guarantee fair access to online materials, and aid teachers and students in successfully navigating online learning environments. Addressing these issues will enable educators, policymakers, and curriculum creators to support effective teaching methods and fully use the advantages of online learning to improve mathematical achievement among students in higher secondary-level students.

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