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Impact of Specktron as a Digital Smartboard in Saudi English Classrooms

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ABSTRACT

There is a significant shift in teaching and learning methodologies due to the evolving demands of modern education. One innovative method that gained prominence is the utilization of smartboards to enhance English language acquisition. The present study investigates the application of Specktron (Smartboard) within English as a Foreign Language (EFL) classroom in Saudi Arabia. This research has a descriptive nature and a quantitative design was employed. The research targeted the entire population of Saudi EFL learners. A simple random sampling technique was applied to pick out 120, 12th grade students from 12 schools from the western province of Saudi Arabia. The province was chosen by purposive sampling. Initially, through a placement test the participants were categorized into two groups of 60 participants on the criterion of the test scores. One group was taught by textbook-based instruction and teacher-controlled method, while the experiment group was facilitated by Specktron. The span of intervention was 30-hour. Successive analysis of post-intervention test revealed a statistically significant difference in the group which learnt through Specktron. Thus, affirming the positive impact of Specktron (Smartboard) powered learning on EFL language performance. These findings also underpin the efficacy of Specktron as a valuable pedagogical tool in EFL contexts.

Keywords: Spekctron, Digital Smartboard, EFL learning, Grade 12, Saudi Arabia.

INTRODUCTION

The integration of educational technology has become increasingly central to instructional practices across a growing number of schools in Saudi Arabia. Contemporary institutions are generally well-equipped with digital resources, including computers, internet connectivity, and a range of emerging technological tools. These advancements offer significant potential for the development of innovative pedagogical strategies (Ali, Alaa, & Shahnaz, 2024). In recent years, the integration of educational technologies across academic domains has redefined pedagogical conventions. Consequently, it has yielded substantial innovations in teaching and learning. The

incorporation of these technologies into educational systems has created rapid adoption and practical interest due to its promising potential to enhance learning outcomes. Among some tools, Specktron as has shown considerable promise in supporting the development of language proficiency (Alsofyani & Barzanji, 2024). Spektron is a smartboard designed to facilitatite learning in classrooms.

The convergence of tech-learning, has laid the foundation for new, adaptive strategies in language education (Li et al., 2025). These tools can be effective in English as a Second Language (ESL) contexts, where flexible, personalized, and effective instructional resources are imperative.

Spekctron, is a smartboard having state-of-the-art language generation model, exemplifies this potential by facilitating near-human linguistic interactions and promoting learner engagement in English language acquisition (Ali, 2024).

Defining Smartboards

Smartboards are electronic boards made to facilitate bidirectional interaction between educators and learners. They foster greater classroom engagement and active participation (Singh & Mohamed, 2012). As user-friendly, innovative and versatile instructional tools, Smartboards accommodate the simultaneous involvement of a large number of students (Hache, 2009). In contrast, traditional blackboards primarily support passive learning, wherein students transcribe content from the board into their notebooks, which then serve as their primary study resource. Moreover, the ambiance becomes teacher-centred. Smartboards significantly reduce the cognitive and logistical burden on students, as they eliminate the repetitive task of note-taking. For instructors, the digital interface allows for the archival and on-demand retrieval of instructional materials, thus obviating the need for repeated manual preparation (Bleeker, 2010). Unlike blackboards, Smartboards retain content electronically, ensuring continuity and easy access.

Moreover, Smartboards eliminate the necessity of relocating students to specialized computer labs, instead transforming the classroom itself into a dynamic, tech-enabled learning environment that enhances interaction among peers, teachers, and digital content (Morgan, 2008). Functionally built on Windows platforms, these boards support diverse instructional tasks such as multimedia presentations, real-time annotations, and collaborative learning activities. Operable via touch or stylus, Smartboards closely mimic standard computing devices, making them both intuitive and efficient for instructional use. Unlike traditional boards that rely on physical media like chalk or markers, Smartboards enable writing, drawing, and design through touch-based interaction, offering a more interactive and resource-efficient alternative.

Saudi English Context

Within the Kingdom of Saudi Arabia (KSA), English language holds complex socio-cultural and ideological significance, extending beyond mere communication. It intersects with political, religious, and economic dynamics, gaining momentum amid national modernization and globalization efforts (Altalhi, 2024). Despite growing institutional support, the expansion of English continues to face cultural resistance, with some societal factions and also the lack of using technology in classrooms. Though, Saudi Arabia has prioritized technology-based classrooms predominantly for English language competence, yet rigorous efforts are required to implement tech-powered classrooms across the board (Ahmed, 2023). There is an urgent call to reevaluate and innovate curriculum design, pedagogical frameworks, and instructional strategies. The emergence of tech-powered tools like Specktron marks a paradigm shift in academic practice, prompting a reassessment of traditional methods and offering transformative opportunities to augment English language instruction (Alshammari, 2024). One of the most pressing areas for inquiry within this evolving landscape is the strategic application of grammar instruction in EFL environments. As English grammar is taught from grade 6 so the learners are required to learn English tenses which integrate lexical competencies with an awareness of current communicative demands and assist the speaker in verbal and non-verbal expression and communication (Ali et al., 2024) Studies have shown that Saudi students lack compression and knowledge about English tenses and their verbal and non-verbal communication exemplifies the problem of employing correct tense to develop right sense.

In Saudi Arabian EFL classrooms, teaching tenses often follows typical pedagogical ways. Instructional time is frequently dominated by mechanical repetition while the teacher assuming primary responsibility for student acquisition of tenses. This teacher-centered approach leaves learners with limited opportunities to independently assess or develop their competence. Moreover, there exists a common pedagogical assumption that conventional methods are effective and can develop foundational grammatical and tense knowledge effectively, So, instructors are inclined to use conventional tools and techniques (Alharbi, 2022). Such issues contribute to the persistent challenges and it results in creating problems for the students in mastering the structures of English tenses. There is a dire need to integrate novel methods and tools to elevate the efficiency of learning specially tenses which can ultimately improve the language of Saudi learners.

This study, therefore, investigates the pedagogical utility of Specktron as a Smartboard digital tool for supporting learners to acquire mastery of tenses in Saudi English language learning context.

Statement of the Problem

Conventional pedagogical approaches have proven inadequate in meeting the demands of effective second language (L2) acquisition. Learners frequently encounter a myriad of obstacles, including uninspiring instructional methods, rigid curricula, and the persistent reliance on rote memorization. Compounding these challenges are factors such as underqualified instructors, overcrowded classrooms, and a general lack of learner motivation. These systemic issues collectively hinder the development of essential language skills. Learning and utilising English tenses continue to present persistent challenges for learners of English language. A major contributing factor is the continued reliance on uninspiring instructional strategies that emphasize rote memorization of tenses rules without promoting genuine comprehension. Such practices often diminish student motivation and hinder their ability to internalize and apply correct tense rules and concepts effectively.

Research Objectives

This study is guided by the following research objectives:

1. To examine the impact of Specktron on the acquisition of English tenses of Saudi English language learners.

2. To evaluate the extent to which Specktron contributes to improved academic performance of local Saudi students.

Significance of the Study

This investigation is of considerable relevance within the Saudi Arabian educational landscape. The integration of smartboard, precisely Specktron introduces dynamic and engaging methods that resonate more deeply with the needs of modern learners. The seamless connectivity in current ambiance has transformed the learning needs of modern learners. Further, the growing recognition of latest tools for pedagogy have proved their vitality for modern education. This study is therefore essential in exploring the potential of Spekctron as an innovative pedagogical smartboard resource for enhancing the acquisition of English tenses among English language learners.

Research Question

1. What impact does Spekctron create on the tenses acquisition of Saudi English language learners?

LITERATURE REVIEW

According to prior research (De Vita, Verschaffel, & Elen, 2014; Ersoy & Bozkurt, 2015; Rajabi & Khodabakhshzadeh, 2015; Türel & Johnson, 2012), Smartboards vary in design and functionality, yet their common core objective is to enrich educational delivery through interactive multimedia. These devices typically comprise a touch-sensitive screen connected to a computer and projector, allowing instructors to present content in diverse formats. Some versions include pen-based interaction or finger-driven navigation, facilitating drag-and-drop features. Notable functionalities include displaying multimedia content, interactive visuals, zooming capabilities, stop watch facility and animation tools. All these aspects are built to enhance learners' engagement. Smartboards have been found be to quite effective in English language learning settings.

Teachers benefit from Smartboards by leveraging online resources, streamlining lesson planning, and preserving instructional content for future reference (Hockly, 2013; Hüseyin, 2014). Research suggests that these tools contribute to the development of students' social, cognitive, and creative abilities, while also increasing motivation and classroom participation (Millum & Warren, 2014; Türel & Johnson, 2012; Yang & Teng, 2014). Overall, the interactive nature of Smartboards provides a conducive learning environment that promotes collaboration and student-centered instruction (Torff & Tirotta, 2010; Turel, 2010).

However, despite these advantages, several limitations have been identified in Smartboard utilization within EFL contexts. Operational issues, such as equipment malfunctions and high costs, pose significant barriers (Alghamdi, 2015; Thomas & Schmid, 2010). Moreover, as emphasized by Schmid (2007), the efficacy of

Smartboards depends largely on the instructor's ability to integrate the tool effectively. This necessitates dedicated time for content preparation and resource curation, as outlined by Hall and Higgins (2005) and Smith et al. (2005).

One of the most critical challenges is the insufficient training provided to teachers on Smartboard use. Ersoy and Bozkurt (2015) argue that comprehensive professional development is essential for teachers to harness the full potential of Smartboards. Betcher and Lee (2009) further stress that successful integration requires educators to be flexible, collaborative, enthusiastic, and well-versed in instructional design.

Activity Theory

Activity Theory is a conceptual framework rooted in the socio-cultural tradition of Russian psychology, emphasizing the centrality of "activity" as a unit of analysis. Within this framework, activity is defined as a goal-directed, transformative, and dynamic interaction between the subject (the individual or group) and the object (the target or purpose of the activity).

Activity Theory (AT) offers a comprehensive theoretical framework for analysing human practices as developmental processes mediated by tools, social context, and cultural artifacts (Engeström, 1987). Rooted in the work of Vygotsky (1978), AT views learning not as an isolated cognitive event but as a socially situated activity system where tools, rules, community, and division of labour shape and transform human actions.

AT has gained traction across diverse fields including education, organizational studies, and human-computer interaction (Kaptelinin & Nardi, 2006; Mwanza & Engeström, 2005). In educational contexts, it has been particularly useful for exploring how digital tools mediate learning processes and reshape classroom practices (Barab, Evans, & Baek, 2004). Researchers have applied AT to study collaborative learning environments, teacher professional development, and technology integration, underscoring its relevance in contemporary pedagogical research (Murphy & Rodriguez-Manzanares, 2008).

Main Points of Activity Theory

1. Activity as the Basic Unit of Analysis
    - Activity is viewed as a purposeful, goal-oriented interaction between a subject (individual or group) and an object (goal or motive).
    - It goes beyond individual actions to consider broader social, cultural, and historical contexts.
2. Mediation through Tools and Signs
    - Human interaction with the world is always mediated by cultural tools (e.g., language, symbols, technologies).
    - These mediating artifacts shape and transform both the activity and the subject.
3. Hierarchical Structure of Activity
    - Activity (motivated by a need or motive)
    - Actions (goal-directed processes that fulfill the activity)
    - Operations (routine or automatic behaviors shaped by conditions)
4. Object-Orientedness
    - Every activity is directed toward an object (not necessarily a physical item), which gives the activity meaning and purpose.
5. Social and Collective Nature of Activity
    - Activities are not performed in isolation; they are embedded in social systems and shaped by communities, rules, and the division of labor.
6. Development and Transformation
    - Activities evolve over time through contradictions or tensions within the system.
    - These contradictions drive change, innovation, and learning.

7. Engeström's Expansive Activity System Model
    - Extends Leontiev's framework by incorporating:
        - Subject (the actor or group)
        - Object (goal or problem space)
        - Tools/Artifacts (instruments of mediation)
        - Community (social group involved)
        - Rules (norms governing the activity)
        - Division of Labor (distribution of tasks and roles)

Despite the growing body of literature documenting the potential of Smartboards, most studies focus on perceptions, instructional practices, and pedagogical adaptation (Balta & Duran, 2015; Ersoy & Bozkurt, 2015; Jelyani et al., 2014; Rajabi & Khodabakhshzadeh, 2015). Few have rigorously examined the technology's direct impact on motivational outcomes in language learning. This is especially significant in the Saudi context, where learners often exhibit low motivation for acquiring English proficiency (Mahboob & Elyas, 2014; Al-Khairy, 2013; Aldosari, 2014; Bakar et al., 2010).

A gap persists in the literature regarding empirical evidence on the influence of Smartboards on learner motivation in Saudi universities. Recognizing this shortfall, the present study seeks to explore the impact of Smartboard integration on the motivation of Saudi EFL learners. By capturing learners' authentic experiences, this research offers practical insights for university-level EFL instructors aiming to adopt technology-driven methodologies tailored to their students' needs

METHODS OF RESEARCH

The study was conducted in two phases using a mixed-method approach. To assess the impact of digital reading via CSLL, a quantitative method was applied, where baseline and final tests were administered in an experimental setup. Scores from these tests were collected and analyzed with SPSS version 25. Additionally, qualitative insights were gathered to capture the views of learners involved in the experiment. For the reason, interviews were conducted, and the interview data was examined using Claude.ai, a reputable AI tool for thematic analysis.

Population and Sampling

The study population was drawn from Saudi Arabia, specifically including learners of English as a foreign language. The sample consisted of 100 tenth-grade students from public schools across the kingdom, selected through purposive sampling. The study had certain limitations: only male students were included, and data collection was limited to public sector schools only.

Research Tool

The CSLL method was implemented to assess its effectiveness on reading skills. This study specifically focused on digital reading via the CSLL approach, examining its impacts through experimentation. The credibility of any experiment relies on its reliability and validity.

CSLL method has previously demonstrated reliability, while the content's validity was ensured by selecting reading comprehension passages from the Ministry of Education's prescribed syllabus in Saudi Arabia. Both the experimental and control groups used the same ten passages; however, one group learned with a printed textbook, while the other used a digital format under the CSLL method. The passages were chosen to suit mixed-ability learners, providing each student an equal opportunity to engage with the material.

Variables

This study involved two independent variables; CSLL and content, while learning served as the dependent variable. Additionally, several confounding variables such as teacher behavior, learners' intellectual level, information regarding demography were considered. To address these, only experienced teachers with over ten

years in the field were selected for participation. All the learners were native Arabic speakers studying English as a foreign language and shared similar intellectual backgrounds, as they were science group students.

The study also accounted for various moderating variables, including gender, race, age, prior academic performance (Grade 9 scores), classroom atmosphere, teaching method, test structure, timing, and digital familiarity. All participants were of the same demographic profile—male, Arabic, and Asian—within the age range of 16 to 17, ensuring similar levels of cognitive development. Their English scores from prior exams (Class 9 final -term exams) were compared. Both groups received daily 45-minute lessons, and test durations were standardized at 50 minutes. Each reading test comprised four passages with five questions each.

The classroom environments were consistent, providing comfortable, well-equipped spaces, and instruction was conducted in English. The test format was familiar to the learners, aligning with their standard curriculum. Moreover, all participants demonstrated digital proficiency, having long-term experience with computers and mobile devices.

RESULTS

Results excerpted from the data collection link-up for analyzing the data. The outcomes are established through findings received from the *t*-tests (paired & independent). Tables 1–7 exhibits the scores of two study groups; control and experimental for *t*-tests. The comparison between the two student groups was observed at two distinct points in time: the beginning and the conclusion of the study. i.e., the start and the end. In addition, for establishing the validity of data, kurtosis and skewness analyses were applied.

Comparing the Treatment Circumstances and Initial Assumptions

Before conducting illative analyses to compare treatment circumstances, early assumptions were calculated. This also was comprised of examining the skewness and kurtosis of the constructs. The standard deviation gauges the intensity or extent of variability within and among the samples. Thus, it is a prevalent tool across statistical analyses and holds significant weight across disciplines. It also contributes crucial insights into data variability and distribution.

Prior to the inferential analyses for the comparison of treatment conditions, preliminary assumptions were measured. This encompassed investigating the skewness and kurtosis of the understudy constructs for ensuring the normality of data. Standard deviation was also calculated to examine the degree of variability within and between samples, serving as a widely used tool in statistical analysis due to its relevance across disciplines. Standard deviation provides essential acumen into data variability and distribution patterns. Thus, supporting the overall reliability of the findings.

The following is the key to the terms mentioned in the tables of the analysis:

Mean Value	MNV
Standard Deviation	SDN
Skewness	SNS
Kurtosis	KUT
Shapiro-Wilk	SPWK
Control Group	CTLG
Experimental Group	EPLG
Confidence Interval	CDI
Lower Limit	LRLT
Upper Limit	URLT
Cohen's *D*	CND

Table 1: Statistics presentation of pre- and post-testing: CTLG and EPLG groups (no. of participants = 50), including SNS and KUT. 2.69

TC		*MNV*	*SD*	*SNS*	*KUT*	*SPWK*
		N				
CTLG	Pre-test	6.77	1.20	0.57	0.57	2.79
	Post-test	9.69	1.02	0.20	0.19	2.90
EXPLG	Pre-test	6.78	1.20	-0.05	-0.64	2.93
	Post-test	15.98	0.59	0.28	-0.19	2.03

In Table 1, the pre- and post-test data for the two groups involved (CTLG and EPLG) is show. It also includes some key metrics such as mean values (MNV), standard deviation (SDN), skewness (SNS), and kurtosis (KUT). Additionally, Shapiro-Wilk (SPWK) values for both groups are provided, where SPWK confirms data normality if values fall within the -2 to +2 range for skewness, as supported by Louarn et al. (2024). The SPWK test results were also non-significant, confirming a normal distribution across both groups. Furthermore, analyses were conducted using the 5000-sample bootstrap method, a widely recognized and reliable approach for estimating sample distribution (Long & Rooklyn, 2024).

Table 2: Independent-sample *t*-test pre-test results (CTLG and EPLG), *N* = 100.

Variable	EXPG (50)		CLG (50)				*95% CI*		
	MNV	*SDN*	*MNV*	*SDN*	*t (118)*	*P*	*LRLT* *URLT*		*CH*
Pre-test	6.78	1.20	6.77	1.20	-2.90	.005	-1.43	- 0.31	0.008

Glass's *delta* = (6.77 - 6.78) / 1.2 = 0.008333.
Hedges' *g* = (6.77 - 6.78) / 1.2 = 0.008333.

For sample data analysis for the treatment groups, an independent-sample t-test was performed by SPSS 25. The MNV of CTLG and EXLG were 6.77 and 6.78. This indicates a very slight difference in scores of the participants in the two groups. Standard deviation (SDN) which reflects the degree of variability around the mean, for CTLG and EXPLG were (SDN = 1.20) confirming minimal variance in data spread between the two groups.

The assumption of homogeneity of variance was upheld, as evidenced by an F-value of 0.016 and a P-value greater than 0.05, signifying that pre-test score variances remained stable across two groups. Investigating the pre-test data by applying independent-sample t-test revealed no significant differences, indicating comparable group performance before the intervention. However, the t-test statistic (t = -2.90) produced a P-value of 0.005, falling below the alpha threshold of 0.05, suggesting that the two sample groups may represent distinct populations.

The confidence interval for the t-test ranged from -1.43 to -0.31, suggesting that the true mean difference between groups likely lies within this interval. Notably, the exclusion of zero within this range highlights the statistical significance of the observed effect at the selected confidence level. The effect size, calculated using Cohen's D, was 0.008, indicating a moderate difference in the pre-test values between the experimental and control groups according to Cohen's (1988) benchmarks. This finding was corroborated by effect size measurements using Glass's delta (0.008) and Hedges' g (0.0083), both of which confirmed the effect magnitude and sample standard deviations.

Table 3: Independent-sample *t*-test post-test results (CTLG and EPLG), *N* = 100.

Variable	EPLG (50)		CTLG (50)				*95% CI*		
	MNV	*SDN*	*MNV*	*SDN*	*t (118)*	*P*	*LRLT* *URLT*		*CH*
Post-Test	15.98	0.59	9.69	1.02	-26.01	.005	-5.931	- 3.989	7.58

Glass's *delta* = (9.69 - 15.98) / 0.58 = 10.844828.
Hedges' *g* = (9.69 - 15.98) / 0.829699 = 7.581065.

The performance of the CLG and EXPG groups was evaluated through comparative analysis presenting that the mean value (MNV) of the EPLG (15.98) was very high in comparison to CTLG (9.69). This considerable difference suggests a strong effect of the intervention tool. The standard deviation (SDN = 0.59) of EPLG group

points to a wider spread of data points from the mean, indicating the superior performance of the EPLG over the CTLG, which had a standard deviation of 1.02.

The assumption of homogeneity of variance was met, with an F-value of 1.3111 and a P-value greater than 0.05, confirming consistent variance in post-test scores across both groups. The t-test statistic (t = -26.01) supports the conclusion that the two groups represent significantly distinct populations, with the EPLG showing a much higher mean than the CTLG. The confidence interval for the t-test, between -5.931 and -3.989, indicates that the true population parameter likely falls within this range, and the absence of zero within this interval verifies the statistical significance of the observed effect at the selected confidence level.

The effect size, measured by Cohen's D (CD), was 7.58, which indicates a large difference between the groups, following Cohen's (1988) guidelines. This substantial effect size is further confirmed by Glass's delta (10.84) and Hedges' g (7.58), both of which support the large effect size and reflect the sample standard deviations.

Table 4: Comparison of pre-test and post-test scores in the control group using paired-sample *t*-test (*N* = 50).

VR	Pre-test		Post-test				*95% CI*		
	MNV	*SDN*	*MNV*	*SDN*	*t (149)*	*P*	*LRLT*	*URLT*	*CH*
CTLG	6.77	1.20	9.69	1.02	-26.89	.000	-3.01	-2.8	2.62

Glass's *delta* = (9.69 - 6.77) / 1.2 = 2.433333.
Hedges' *g* = (9.69 - 6.77) / 1.113643 = 2.622026.

CTLG group's analysis was done via a paired-sample t-test which examined their performance across initial and final assessments. The mean value (MNV) in the pre-test was 6.77 which raised to 9.69 in the post-test. Thus, indicating that traditional teaching methods had a limited effect on learning outcomes. In terms of data spread, the standard deviation (SDN) was 1.20 for the pre-test and decreased to 1.02 in the post-test, reflecting a narrow clustering of the data points around the mean in the post-test, which suggests a slight increase in consistency.

The comparison of pre- and post-test scores is further supported by the t-value (t = -26.89, P < .000), which specifies that though the post-test mean (9.69) was somewhat higher than the pre-test mean (6.77), the difference was not substantial. The t-test result (t = -26.89, with df = 47) and a P-value of 0.000 (below the α level of 0.05) show minimal significant variation between the pre-test and post-test scores for the CTLG group. This proposes that, although there was a slight improvement in students' average performance, the increase was not pronounced.

The 95% confidence interval limits (CL) indicate that the population mean difference (μd) likely falls within this interval, supporting the reliability of the observed changes. Despite some improvement in scores, this increase was relatively minor. Lastly, the effect size, represented by Cohen's D at 2.62, points to a small effect according to Cohen's (1988) standards, underscoring that while there was minor improvement, the intervention had a minimal impact on the CTLG group's outcomes. The value of Glass's *delta* = 2.433333 and

Hedges' *g* = 2.622026), equally supporting that the effect size was not large.

Table 5: Summary item statistic.

	MVN	Min (pre-test)	Max(post-test)	Range (x1 & x2)	Ratio = Max / Min	VC	NI
Item Means	mc = 8.23	m1 = 6.77	m2 = 9.69	DM = 2.92	RM= 1.413	vb = 2.639	2
Item Variances	vp = 1.251	v1 = 1.080	v2 = 1.559	vd = 0.579	vr = 1.371	vv = 0.157	2
Inter-Item Correlations	.785	.785	.785	1.000		.000	2

The values mentioned substantiate the divergence of the CTNG in their pre-test denoted by x1, post-test denoted by x2 (Table 5). The minimum value is x1, while the highest is x2. Additionally, x1 / m1 = 6.77 and x2 / m2 = 9.69. This explains the diverse array of MNV signified as DM = (m2 – m1) = 2.92, whereas MNV ratio RM = (m2 / m1) = 1.413 = (0 + 01.4%). The joint MNV (m1, m2) is calculated through a center point CM = 8.23, and the variance between them (m1, m2) is calculated by vp = 1.251 relating the unpredictability among the groups. Congruently, v1 (variance) is x1 = 1.080, and v2 (variance) is x2=1.599. Thus, justifying the change in the variance showed by vd (v2 – v1) = 0.479, and also the ratio of variance denoted by vr (v2 / v1) = 1.451. Going ahead, v1, v2 (pooled variance) is calculated by vb = 2.639, telling the variation inside the groups (x1, x2), and vv = 0.157 designates the change of variance of groups (x1, x2). The paired-sample confirmations pointedly have a positive correlation (i.e., r = 0.768) amongst pre- and post-test clusters.

Table 6: Comparison of pre-test and post-test scores in the experimental group via paired-sample *t*-test (*N* = 50)

VR	Pre-test		Post-test				*95% CI*		
	MV	STDV	*MV*	*STDV*	*t (149)*	*P*	*LWRL*	*UPRL*	*CH*
EPLG	6.78	1.20	15.98	0.59	-66.11	.000	-8.11	-7.18	9.72

Glass's *delta* = (15.98 - 6.78) / 1.2 = 7.666667.
Hedges' *g* = (15.98 - 6.78) / 0.945542 = 9.729867.

The performance of a single group (EXPG) in the initial and final tests is measured by paired-sample *t*-test (Table 6). The MV in the initial test (6.70) is vividly significant compared to the MV value in the final test (16.65). This elucidates that the intercession instrument has formed substantial effect on students' scores. Here and now, viewing the data disparity, the STDV is 1.24 in the pre- and 0.61 in the post-test group. This verifies that the post-test group reflect wider data points spread around the MV in contrast to the pre-test group, representing high variance in the scores in the post-test. The inequalities amid the pre-test and post-test of the EXPG are mentioned through the *t*-value (t = -63.75, with df = 47) having a *P*-value of 0.000* < (α = 0.05). This *t*-test statistic value designates that both sample groups are from varied populations, thus suggesting a better performance of the participants in the post-test group compared to the pre-test group. Further, the effect size of CD was 10.26, signifying a higher difference, as per Cohen's classification (1988). This increase validates the inclusion of the tool used for the experiment. Overall, the scores reflect that the null hypothesis (Ho: ϱ = 0) is to be rejected, suggesting that there is a significant and positive correlation between the two populations.

Table 7: Summary item statistic.

	Mean	Minimum	Maximum	Range	Maximum / Minimum	Variance	No. of items
Item Means	mc = 11.675	m1 = 6.70	m2 = 16.65	md = 9.95	mr = 1.291	vb = 29.867	2
Item Variance	vp = 3.284	v1 = 1.112	v2 = 3.284	vd = 2.312	vr = 2.953	vv = 2.981	
Inter-Item Correlations	.739	.739	.739	.000	1.000	.000	2

The figures declared authenticate the aberration of EXPG in their pre-test as x1 and post-test as x2 (Table 7). The least value is x1, and the highest is x2. Also, x1 or m1 = 6.70 and x2 or m2 = 16.65. This explicates the mean diverseness md = (m2 – m1) = 9.95, where MV ratio mr = (m2 / m1) = 2.481 = (2 + 48.1%). The common ME (m1, m2) is measured on a middle point mc = 11.685, and the variance between them (m1, m2) is premeditated by vp = 3.284 displaying the variance amid the groups. Correspondingly, consider v1 (variance = x1 = 1.112) and v2 (variance = x2 = 3.284). Therefore, authenticate the variance change signified as vd (v2 – v1 = 0.485). The ratio of variance is vr (v2 / v1 = 2.953). Moving forward, v1, v2 (pooled variance) is measured by v = 3.284 showing the change occurring within the groups (x1, x2); and vv = 2.981 labelling the variance difference of the groups (x1,

x2). This paired-sample affirmation has a positive correlation (i.e., r = 0.739) between pre- and post-test participant groups.

DISCUSSION

In this research, Specktron has shown to significantly enhance learners' reading comprehension skills. The improved performance of the learners is a direct result of the tool's ability to mimic human-like responses through a process involving pre-processing, encoding, decoding, and post-processing of instructions (Su & Yang, 2023). English reading comprehension, especially for second and foreign language learners, can be challenging. However, Specktron provided multiple avenues for practice texts tailored to the learners' proficiency levels, which gave the experimental group a distinct advantage. This agrees with Lin and Chen (2024) who confirmed that Specktron is a valuable tool for developing English reading skills.

One distinguished feature explored in this research of Specktron was its capability to provide practice passages to users. This permitted learners to repetitively practice reading by exploring different texts, thus accustoming them to answering comprehension questions. Additionally, the feedback generated by Specktron could be reviewed by teachers for further simplification and clarification which enhanced the learning experience. The tool also played a decisive part in vocabulary building, offering synonyms, contextual antonyms, and simplified sentence meanings. This aligns with the research by Mugableh (2024) who stated that contextual vocabulary is key to understanding texts. Moreover, Specktron exposed learners to cultural contexts, tone, and nuances in reading materials, contributing to a broader understanding. The personalized reading options provided by Specktron helped increase the learners' reading stamina by offering varied reading materials. This expanded their concentration and focus. Faisal (2024) also reflected the idea that reading stamina can be improved through exposure to different types of passages, essays, and articles, as noted in various studies. Additionally, Specktron's ability to summarize key points and passages facilitated learners to grasp the main ideas and context of the texts. a practice supported by research that highlights the importance of summarization in enhancing comprehension and analytical skills (Daza et al., 2024). This multi-dimensional support from vocabulary expansion to improved focus and comprehension significantly contributed to the improved reading abilities of the experimental group.

Observing it from the IDEE framework by Su and Yang (2023), this study aptly aligns with its core components, particularly concerning the integration of generative AI tools like Specktron. A central emphasis of the framework is to classify desired outcomes, which was also the prime goal of the educators and researchers in this study. Through the use of Specktron, they aimed at enhancing personalized learning and facilitating improved student outcomes. However, the process did not rely solely on AI; teachers actively monitored student inputs and provided guidance to ensure that the automation was accurate and appropriate. This aligns with the IDEE framework's emphasis on controlling the degree of automation when generating content and delivering feedback. Throughout the experiment, ethical guidelines were strictly adhered to, ensuring that AI-generated responses were unbiased, further reinforcing another element of the IDEE framework—ethical AI use. The teacher's role in continuous oversight ensured that Specktron was effectively meeting the learners' needs. To manage the limitations of the tool, diverse prompts were used to ensure more precise results, which is in line with the IDEE framework's recommendation for the ongoing evaluation of AI's impact to optimize its effectiveness.

Overall, this study ties itself with studies by Espartinez (2024), Lee et al. (2024), and Stöhr and Malmström (2024) who experienced the use of Specktron in the EFL classroom and found it to be a productive element.

Besides performing a descriptive analysis, a thematic analysis was performed using Claude.ai to look for significant themes present in the test. For this reason, fifty interviews were conducted which was a lengthy procedure. For the interviews, an open-ended questionnaire was structured. It took 20 days for conducting the interviews. These interviews are significantly pivotal as they provide a real opinion of individuals (students) who used AI apps for the experiment process. The questions of the interview can be found in Appendix 1.

Some core conditions of the interview were as follows:

- The participants were informed about the interview prior to recording.
- The recording was done with their consent.
- The interviews were done in a comfortable environment to avoid noise, weather, and other factors.

All the interviews were later transcribed and some themes were picked from Claude.ai such as the following:

- Passionate about usage
- Sufficient information
- Ease of use

- Reliability
- Variety in the learning process
- Beneficial for grammar improvement
- Is it a distraction?

Moving on, for the analysis of the given themes in the text, the following steps were taken:

- Initially, familiarity was developed with the text.
- Then, codes were generated where the key features were labeled as passion and engagement, effectiveness and satisfaction in learning, ease of use, reliability, variety in the process of learning, improvement of grammar, and non-distractive element; see Appendix 2 for the complete codes.
- The next step was to explore these themes in the text. Thus, these codes were then allocated with the broader yet pertinent lines to make a viable theme.
- Along with extracting a theme, each theme was given a name, and after that all the themes were reviewed to finalize the procedure of the data analysis.

Table 8 defines the themes extracted from the Claude.ai analysis.

Table 8: Claude.ai analysis of themes.

1. Positive engagement and passion	Includes passion and engagement with Specktron
2. Effectiveness and satisfaction in learning	Covers information sufficiency and accuracy
3. Ease of use	Relates to ease in using the software
4. Reliability	Talks about the accuracy of the tool
5. Variety in the process of learning	Talks about the variation of Specktron in explaining the query of the user
6. Improvement in grammar	Refers to the improvement in grammar for the learners
7. Non-distractive learning environment	Refers to the focus and relevance of the Specktron responses

In the next step, two examples were given for each theme from the text, as presented in Table 9, to understand the themes.

Table 9: Examples of themes.

1. Positive engagement and passion	Student 12: "Yes, I feel quite energetic and passionate about using Specktron." Student 25: "I felt it is attractive and interactive with fun-learning."
2. Effectiveness and satisfaction in learning	Student 43: "Specktron gives sufficient knowledge and information regarding my grammatical questions." Student 31: "The way it explains and exemplifies the question in simple language is easy for me to comprehend."
3. Ease of use	Student 04: "I don't find any problem in using Specktron. The software is very smooth in use and easy in operation." Student 49: "The user can easily operate with simple instructions. There is no difficulty I face in using it."
4. Reliability	Student 17: "I feel that the responses are accurate and updated." Student 02: "I found it very reliable as it gives me an accurate and correct reply to each of my prompts."
5. Variety in the process of learning	Student 26: "In my view, Specktron is a latest way of learning and understanding."

	Student 48: "I feel it is hard to ask again for a grammatical question as in class due to shyness and fear."
6. Improvement in grammar	Student 09: "Indeed, I think Specktron is a sensational software for giving variety in the procedure of learning magnificently." Student 27: "It gives multiple replies to satisfy the user. I feel several replies to the same queries are its prolific feature."
7. Non-distractive learning environment	Student 05: "In my viewpoint, it is an advantage and it does not distract its users. I found it a great learning partner and interactive tech-dependent tool." Student 43: "Only replies to the desired prompts and there is no irrelevant information for any distraction in there."

Figure 2 presents the thematic analysis of the user responses regarding their experience with Specktron. The graph shows the prominence of each theme based on the number of references in the text.

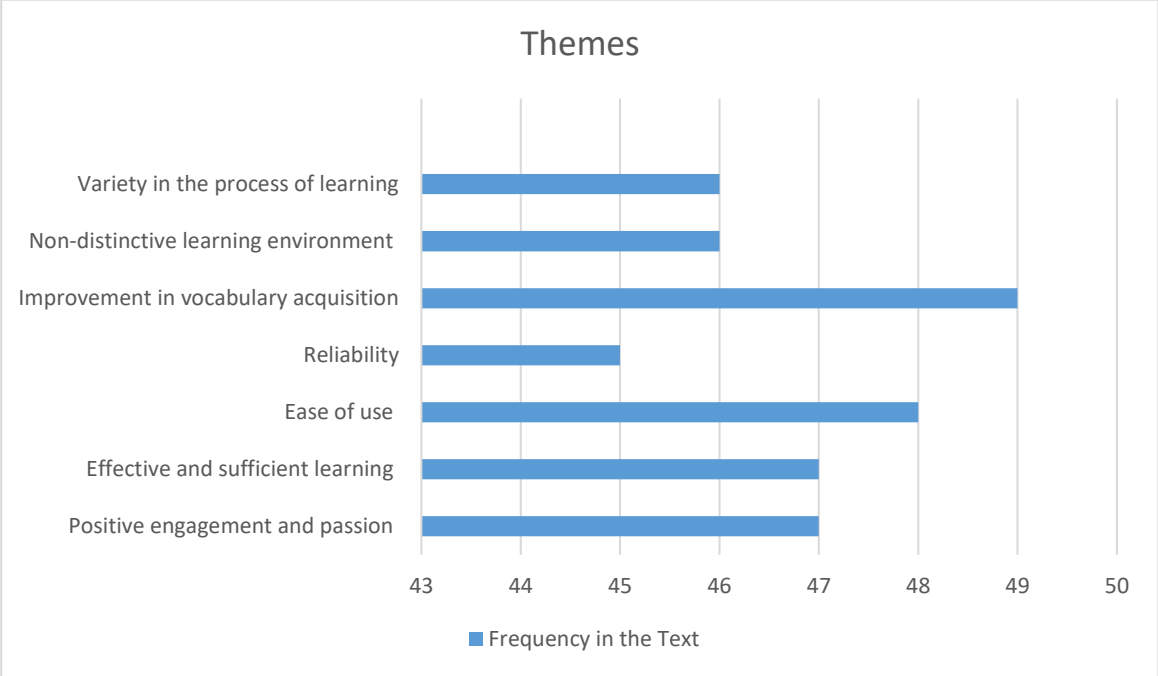

Figure 2: Most frequently mentioned themes in the text.

In the last step, we summarized the findings in a report format and presented the results using visual tools like graphs or tables. We found the following:

- Effective learning and grammar improvement were the most frequently mentioned themes, indicating the significant role Specktron plays in enhancing learning and grammar understanding.
- Positive engagement and passion and ease of use and reliability were also prominent, reflecting the user's enthusiasm and the ease of using the tool.
- Non-distractive learning environment was mentioned but with less frequency, emphasizing the focused learning environment that Specktron provides.

This visual representation helps to quickly grasp the key themes and their relative importance in the user's feedback.

Extracting the themes from any interview gives an inclusive reflection of the ideas shared by the participants of the interviews. The interviews conducted in this research were of high importance as they provide the opinions of those participants who used Specktron in the experimentation process.

In the context of reading skills, it is essential for any tool to be engaging and stimulating to sustain learners' interest, as reading requires stamina. Students indicated that Specktron was a highly engaging tool that fostered

their enthusiasm for learning. Additionally, repetitive learning methods can become tedious, but with Specktron, the varied responses to the same prompts introduced diversity, effectively satisfying the learners' curiosity. This aligns with the view that variation is a hallmark of Specktron (Ooi et al., 2023).

Moreover, many AI tools can be overwhelming due to lengthy instructions or complex operations, which can frustrate users. However, the participants shared that Specktron's simplicity and user-friendliness motivated them to engage with the tool easily. Its reliability in providing accurate responses also increased their trust in the tool, resonating with the opinion that a well-trained AI model can be dependable (Ray, 2023).

A crucial component of reading comprehension is understanding grammar. Often, learners struggle with sentence structure and contextual meaning. Participants felt that Specktron helped them grasp the context and pragmatic meanings without much difficulty. Finally, all participants agreed that Specktron did not hinder their reading comprehension practice. Instead, it offered valuable assistance by providing relevant information in a simplified manner, helping them stay focused and acquire knowledge effectively. This resonates with the conclusions of Li et al. (2024), Lin and Chen (2024), Faisal (2024), and Yang and Li (2024).

CONCLUSION

Specktron has demonstrated significant potential as a transformative tool for language acquisition. To evaluate its effectiveness in enhancing reading skills within Saudi Arabian English as a Foreign Language (EFL) classrooms, a controlled experimental design was employed. The study involved two groups: one receiving traditional instruction, and the other integrating Specktron interactions with conventional teaching methods. Both cohorts were exposed to identical materials and activities over a three-week period. Upon completion, a reading comprehension assessment was administered, and results were analyzed for comparative purposes. Additionally, a series of interviews was conducted to capture students' perspectives on the utility of Specktron in their learning experience.

The findings revealed a marked improvement in reading proficiency for the group utilizing Specktron in conjunction with traditional pedagogy. The interview data corroborated these outcomes, with students citing enhanced learning, improved grammatical accuracy, heightened engagement, ease of use, and reliability as key advantages. These results underscore Specktron's potential as a powerful AI-driven educational tool capable of significantly augmenting language instruction in EFL contexts. The incorporation of AI into educational practices offers a promising avenue for advancing language proficiency and improving the overall learning experience.

Nevertheless, the study was limited by its focus on a single gender, school grade, and nationality. Future research should explore the application of Specktron or other AI technologies across a more diverse population, including different educational levels, university students, and female learners, to facilitate comparative analyses. Moreover, replication of the study in various national and cultural contexts would provide insights into the universal applicability of AI tools in education. As AI continues to gain prominence in educational discourse, it presents a vast array of possibilities for research and instructional innovation.

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