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From Textbooks to Touchscreens: Enhancing Andragogical ESP Learning in Saudi Vocational Classrooms Through Mobile-Supported Language Learning

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1. Introduction:

The spread of English in Saudi Arabia was fueled by varied customized programs launched by the Ministry of Education for social-economic development (Karim & Jamshed, 2023). Despite the prevalence of native languages, English has become the predominant means of communication in areas like business, education and scientific study (Moskovsky & Picard, 2018). In addition, changes within Saudi Arabian culture have created a seamless path to adopt English, given that it is a common language for natives and foreigners alike (Khawaji, 2022).

Being a foreign language, English holds a high position in the educational system of Saudi Arabia. English is one of the compulsory subjects at all levels of education, including public and private schools as well as universities and colleges. Also, English classes are a must in many colleges related to technology, medicine, and engineering (Barnawi & Al-Hawsawi, 2017). Further, English forms an integral part of the curricula in undergraduate preparatory year courses.

Though, English enjoys such a high social prestige, yet there are significant problems in the English language acquisition process. Specifically in the arena of ESP education and teaching in Saudi Arabia. This may be because of untrained teachers, teacher-centered approach, emphasis on memorization, outdated instructional materials, traditional assessment methods and lack of utilization of innovative techniques for learning (Khan et al., 2025). Additionally, numerous teachers of ESP require customized training in using new technology to employ it in their classroom environments. Aljuhaish et al. (2020) also shared that ESP teachers in Saudi Arabia should enhance their pedagogical skills for motivating local learners.

Despite the demonstrated benefits of different technological tools in facilitating language acquisition, there is no much research on the use of mobile technologies in the context of learning English for a specific purpose (ESP) language in Saudi Arabia. Although several studies done in Saudi Arabia have addressed e-learning and computer-assisted language learning (Al-Alami & Alhamami, 2024; Alnofaie, 2023; Khafaga & Alghawli, 2021), few studies have been conducted on the use of MSLL in Saudi ESP classes. Vividly, there is an existing gap between the potential benefits of mobile technologies and their pedagogic applications in the Saudi vocational ESP class settings. Besides, there is no study which conducted an experiment to establish the effectiveness

of implementing MSLL in Saudi vocational ESP classes. In other words, most studies conducted so far have been perceptional in nature.

To address the gap, the present study investigates the integration of MSLL into Saudi ESP vocational English classrooms. By incorporating mobile-based learning activities, the study aims to move beyond textbook-based, teacher-centered practices and promote greater learner engagement, motivation and autonomy. Grounded in the view that language learning extends beyond grammatical competence to include meaningful and contextualized use (Hymes, 1972 as cited in Jung, 2025), this study examines whether MSLL can better align ESP instructional practices with the current best practices and evolving demands of contemporary education and enhance ESP learners' performance. Moreover, the ESP challenges like teacher-centered instruction and limited technological integration are well documented, yet a mechanism through which MSLL may address these challenges remains underexplored. This study therefore not only inspects effectiveness but also attempts to link instructional design with theoretical constructs.

2. Literature Review:

2.1 Mobile Supported Language Learning

The concept of Mobile-Supported Language Learning (MSLL) involves the usage of mobile phones to aid language learning (Ali et al., 2024; Hameed et al., 2024). MSLL asserts that learners can greatly improve their skills in multiple aspects of the English language through the use of mobile applications. This type of technology fosters learner autonomy and self-directedness because learners get the liberty of choosing what they want to learn (Ogata et al., 2024).

Despite many difficulties associated with integrating MSLL into language learning processes, the contemporary research has proved its efficacy in education (Lazaro & Duart, 2023). Varied essential and impactful features of MSLL including portability, social connectivity, collaboration, learning irrespective of context, fast connectivity, learner autonomy, and learning alliance makes it effective (Lai et al., 2022; Ali et al., 2023). Though, some structural issues were there at the beginning, like the size of the screen and data storage problem yet presently this has been resolved with latest mobile devices which are equipped with fast processor, large storage and big screens.

Modern literature further elaborates the benefits of MSLL compared to other conventional and computer-assisted language learning methods. According to Ebadi and Raygan (2023), MSLL is much more innovative and engaging, providing options for both hybrid and distance learning. Okumuş Dağdeler (2023) further highlighted how MSLL enables a pedagogical approach not limited by either time or space and hence allows students to learn anywhere and anytime.

One more feature that makes MSLL a magnificent tool is its personalization abilities. As stated by Lei et al. (2022), with MSLL, learning becomes personalized and students can customize the pace of studying according to their preferences. Besides, MSLL provides an opportunity to engage in innovation by integrating exciting methods to learn. This makes the learning process more enjoyable and motivating (Yu et al., 2022). All in all, based on the mentioned properties, it may be stated that MSLL might prove itself useful in dealing with the identified problems of ESP learning effectively. The existing literature is quite positive about MSLL, conducting little critical analysis of the context-specific issues such as differences in the level of digital literacy or instructional quality. Recently conducted systematic review studies indicate that the effectiveness of MSLL depends on the context.

2.2 MSLL and Saudi Arabian classrooms

The MSLL model provides flexible and interactive learning experiences suitable for a variety of learners in Saudi Arabia (Naveed et al., 2023). While the MSLL model has immense potential, there is a lack of studies examining this approach in Saudi Arabia. Previous research focused mainly on the perceptions and attitudes of teachers and learners towards MSLL. However, many teachers stressed the importance of having specific skills in order to use MSLL effectively.

Mohamed and Halim (2023) evaluated the effectiveness of learning in EFL through smartphone assistance in a Saudi University. In the research, forty-five teachers and sixty-eight learners responded to two separate questionnaires for instructors and learners which aimed to explore how mobile phones can impact EFL learning. The findings revealed that MSLL is viewed positively by the participants as a learning tool for improving the quality of learning and teaching. However, the teachers pointed out the need for additional skills to ensure efficient execution of MSLL tasks and

listed various pedagogical challenges associated with it. Likewise, the perceptions of male and female Saudi English language learners were studied using an online survey conducted by Alaghbary (2021) while applying Chi-square and ANOVA tests. The results mirrored that both teachers and learners were positive about MSLL.

The use of iPad as an MSLL strategy in Saudi Arabia EFL classrooms was investigated by Elyas and Al-Bogami (2019). In their study, a mixed-methodology approach was adopted to divide the sample of forty English-as-a-foreign-language learners who were native speakers of Arabic into an experimental group and a control group. While the former group was taught using iPads, the latter group got instruction from white boards and printed resources for five weeks. Pre- and post-test evaluations based on reading and vocabulary were conducted along with engagement observations. The results indicated superiority of the experimental group and its greater engagement despite facing some difficulties using iPads.

In general, these findings imply that MSLL can contribute to improving English language learning in Saudi classes by engaging learners and facilitating flexible and computerized instructions. Nevertheless, the application of MSLL in adult ESP education should consider both pedagogical and technical aspects to be successful. Overcoming this problem is one of the main objectives of the current research.

Notably, previous research in Saudi Arabia has been mostly based on the perceptions of the participants, without conducting any experiments or longitudinal studies. As a result, there is a need for further empirical research in order to understand what results can be obtained through the use of MSLL in adult vocational ESP training programs.

2.3. Theoretical Framework: Connectivism – A New Paradigm for Digital Learning

George Siemens (2005) introduced Connectivism as the theory for the age of technology with an objective to provide an understanding of skills and activities required for learning in the current digital environment. This theory highlights the importance of socio-cultural context in relation to the learning process, stating that the process of acquiring knowledge does not take place in a single entity but across different contexts. Knowledge is perceived as a network, whereas learning is considered as the process of pattern identification (AlDahdouh et al., 2020). This theory shares a

strong relationship with Vygotsky's ZPD and Activity Theory as it focuses on socio-contextual aspects of learning (Fry, 2002, as cited in Sitti et al., 2013).

The major assumptions of Connectivism are those of independence, openness, connectivity, and diversity (Dziubaniuk et al., 2023). The theory encourages independent learning and argues that the process is not limited to the teacher's input but extends to the use of instruments, ways, collaboration and many other elements (Corbett & Spinello, 2020). One important tenet of connectivism is the idea that knowing the concepts is not enough; what really matters is how and why these concepts are learned through different techniques (Downes, 2022; Kibuku, 2020; Cronje, 2020).

Furthermore, the Connectivism paradigm stresses on the diversity of experience and learner autonomy to allow collaborative learning whereby ideas are shared and discussed (Korkmaz & Toraman, 2020). It involves aspects of network theory, chaos theory, self-regulation theory, and complexity theory while acknowledging that the act of learning is now much more than a solitary process in one's mind. The advent of new learning tools impacts how learning happens as well as its outcome. Thus, making the direct link between Connectivism and MSLL (Siemens, 2005; Picciano, 2021).

- To continue with, the Connectivism paradigm is implemented via appropriate MSLL practices in the current study such as:

- WhatsApp-based learning is networked learning with distributed knowledge
- Learners use Quizlet for node-based knowledge construction
- Grammarly feedback is technology-based cognition

Connectivist Principle	**Operationalization in MSLL**
Connectivity	Learners interacted through WhatsApp discussion groups
Distributed Knowledge	Learning resources were accessed through multiple digital platforms
Learner Autonomy	Learners completed independent mobile-based learning activities

Connectivist Principle	Operationalization in MSLL
Technology-Mediated Learning	Grammarly provided immediate automated feedback

Therefore, MSLL is not only a technological tool used in the current research but a systematic application of connectivist principles in today's scenario involving communication with networks and tools and peers in a digital realm. From a lens of connectivism, it is predicted that participants exposed to MSLL will outperform because of rapid connectivity, varied features and effective and instant feedback processes.

2.3.1. Recent Research on Connectivism

In recent research, Connectivism was used to study the impact of mobile-assisted learning on language development. In one such study, for instance, Shadiev et al. (2022) explored the impact of mobile-assisted second language learning environment (MSLLE) on the writing skills of students enrolled in an ESP program in universities. Simple random sampling was used to collect the data which involved the use of mobile devices and essays. Pre- and post-test results indicated improvement in the learners' writing skills due to the learners' involvement in digital collaborative learning in MSLL ambiance.

In another study conducted by Al Maawali (2022), the application of Connectivism to improve writing performance was investigated. For this purpose, forty Omani learners used their mobile phones to collaborate for writing activities. Pre- and post-test results revealed that using Connectivism strategies to engage the learners led to an improvement in their writing performance. Lastly, Mohammedeen et al. (2023) used Connectivism to explore the effect on communicative writing among thirty students from an Egyptian university. In the experimental study involving pre- and post-performance tests in descriptive and narrative writing, the outcomes were analysed to conclude that learners' performance improved significantly.

The above literature review is vividly evident that the existing literature has neglected researching the effect of MSLL on the learning process of English as a specific purpose in Gulf countries. Very

few research studies have tried to explore how to use MSLL with vocational learners learning English in their curriculum. In order to fill this void in the literature, the current study is conducted to determine how MSLL influences the learning performance of first semester vocational learners in Saudi Arabia.

Research questions:

1. What is the effect of the independent variable (MSLL) on the dependent variable (students' learning performance)?

2. Is there any statistically significant difference between the control and experimental group learners?

3. Methodology:

This research adopted a quasi-experimental research design where the quantitative research methodology was used for the purpose of collecting and analysing information based on the study objectives. In the view of Mohajan (2020) and Creswell (2024), a major strength of this type of research is the utilization of statistical methods. This results in greater efficiency and saves both time and money.

3.1. Participants

The subjects for the experiment were chosen as ESP learners who were in the first semester of the vocational learning program at some chosen vocational training centres in Saudi Arabia. The participants for the experiment had six years of English language learning experience since the English language learning in Saudi Arabia starts from Grade 6. Multi-use sampling was adopted in this particular study.

Five vocational institutes were chosen based on convenience sampling because of access restrictions. Following that, 100 learners were randomly divided into two groups; one was the control group and the other was the experimental group. It is important to note that the learners were all male and their ages ranged from 18 years to 19 years. All of them were Higher Secondary School graduates and belonged to various skill trades (welders, plumbers, automotive mechanics, electricians, etc.). This approach helped to ensure homogeneity within the experiment. Furthermore, five ESP teachers/instructors belonging to the same institutes were also selected based on the convenience sampling method. They were all males and permanent employees with ten years of experience and master's degrees in English.

3.2. Instruments

In order to investigate the effect of MSLL on the ESP learners, pre- and post-tests were mainly employed as tools for data collection. These tests included five language functions from the prescribed textbook along with some short answer questions prepared to accommodate heterogeneous learners. Pre-test results divided all the 100 learners randomly into two equal groups; control group and experimental group. Content validity was demonstrated through a Content Validity Index (S-CVI) of 0.94 provided by the review of five ESP teachers.

Test items were evaluated based on their clarity, relevance, and representative nature of the five language functions in the textbook. Internal reliability of the instrument was acceptable with a Cronbach's α coefficient of 0.81 (see Appendix 1). In fact, all the selected teachers had ten years of experience in instrument construction in vocational education context in Saudi Arabia. This helped to prove their proficiency in evaluating test instruments. Furthermore, construct validity was demonstrated by alignment of test items and the English functions in the syllabus and the expert judgement. Finally, inter-rater reliability was also achieved (Cohen's $\kappa = 0.82$) which suggests a high level of agreement among raters.

3.3. Procedure

The experiment lasted for a month and was implemented after the completion of the first-semester syllabus of the English Language and Communication Book 1 which comprised ten chapters with ten short-answer questions in each chapter. Thus, a total of 100 questions were covered and pertained to five different language functions: initiating and concluding the dialogue, seeking and providing advice and recommendation, conveying the sense of urgency, discussing experiences and skills and perception (refer to Appendix 2). Both the control and experimental groups were subjected to identical syllabuses but the main distinction was made in terms of teaching approaches. The teaching of the control group took place through teacher-centered classroom approach whereby face-to-face lessons were delivered via the prescribed book, printed from the e-book. Instructors used lectures, board work, and examples from textbooks to explain the targeted language functions. Learners performed the tasks independently without interacting with their colleagues, while feedback was limited to classroom sessions that entailed mostly oral correction or writing brief comments on learners' work. None of the mobile apps were used to conduct the lessons outside the classroom.

For the experimental group, instruction was based on an integrated MSLL model where classroom and mobile learning practices were combined. The use of a classroom was for imparting target language functions, which were supplemented by mobile technologies like Quizlet and Grammarly as well as teacher-technology feedback. Learning took place in the form of supervised and unsupervised practice on mobile devices, which also gave learners both automated and teacher-provided feedback. Learners were encouraged to engage in academic discussions via instructor-moderated WhatsApp platforms. Feedback was constant both within and out of class in order to facilitate revision. In order to prevent any bias arising from instructors, a standard instruction protocol was implemented in training the instructors before the intervention.

3.3.1. Instructional Design for the Five Language Functions

The instructional design was based on the language functions that were described in the syllabus book, which are:

1. Opening and closing a conversation

2. Making requests and suggestions

3. Urging someone to do something

4. Describing experience or expertise

5. Expressing perception

As for the learners in the control group, their learning process depended on the use of textbooks, was teacher-based and conventional, and the classroom discourse took place within the boundaries of classroom settings. Besides, the discussions related to the textbook context. Each target function was presented in a detailed manner by the teacher. Learners were given samples from the book, and some sentences were read out loud that were sometimes interpreted and paraphrased. During the practice phase, learners engaged in short activities that required answering questions. The questions were selected from the textbook and corresponded to the final test task which consisted of controlled answers and writing about situational prompts. Interaction between the participants of classroom communication took place using the initiation – response – feedback technique. Cooperation among learners was negligible, while oral practice mostly occurred in short and prepared exercises. Feedback was given only within classroom sessions either orally or in written form.

In comparison, mobile-supported instruction aimed at blended learning approach which was used by learners in the experimental group. Mobile-supported instruction focused on learner autonomy, collaboration, and participation. In the phase of explanation, major portions of the lessons were conducted in class, whereas additional instructions and examples including prompts, sample answers, and situational hints were given through Quizlet. Also, language, grammar and spelling checks were done using Grammarly. Mobile-supported micro-learning activities on functional language were undertaken in the phase of practice. Short dialogues that involved language use were jotted down and shared by learners. Situational responses were initially written, then checked and modified using Grammarly and with assistance from the teacher. Short reflections on language use in connection to trade skills were written. Prompts were opinion-based to help learners engage

in language use for interpretation and evaluation. In & out-of-class teacher and group interactions were encouraged within a teacher-controlled setup in order to facilitate collaborative learning. Feedbacks were offered using a blend of teacher and technology. Feedbacks covered grammar, spelling, clarity and contents related to the domains in the rubric. Feedback facilitated the understanding of functional language use, clarity, development and correctness in grammar and spelling.

It is important to note that all activities in both groups were aligned with the assessment rubric dimensions, including functional match, clarity, completeness, development, and grammatical accuracy.

Pre- and post-tests consisted of thirty short-answer questions, with a time allocation of 50 minutes. Written short-answer questions were selected based on prior research suggesting their effectiveness in assessing learners' preparation and knowledge while minimizing reliability concerns (Sam et al., 2016).

3.4. Rubric

To guarantee the reliability of our evaluations, we used an assessment rubric that is modified from the IELTS writing rubric via an automated evaluation system (see Appendix 3). Importantly, the ILETS rubric was taken as an initial framework. The descriptors were adapted for evaluating the short question answers rather than extended tasks.

From the IELTS rubric, the following four criteria were kept because of their relevancy to our context:

- Functional Match (congruence between the answers and the target functions)
- Clarity (coherence of the answers)
- Completeness (adequacy to cover the whole question)
- Development (proper logical organization within the answer structure)

IELTS descriptors were modified from 9-banded rating to 5-banded rating (1 = Poor, 5 = Excellent) to be appropriate to short-answer responses and easy for different teachers to mark and compatible with the system used (see Appendix 3).

The rubric evaluates the responses for different criteria such as functional match, clarity, completeness, and development. Each criterion is scored between 1 and 5. Teachers would evaluate responses for these criteria and rate them based on their scores; the system would then provide an automatic total score of responses. In this way, it is possible to avoid any kind of bias and evaluate students systematically. Our system does not use AI technology but only acts as a scoring aggregation system.

3.5. Variables of the Research

The reliability and validity of the study were maintained through controlling the dependent variables of the research. The potential variables that could be considered confounders in this experiment include the learners' socioeconomic status, teaching experience and professionalism of the instructors, and previous experience of the students in the subject and their performance in the assessments. These variables were controlled using the MAXMICON approach. The maximization of systematic and error variance was only conceptually considered in the application of the MAXMICON approach; in actual practice, it involved mainly sampling homogeneity and instructional control.

The participants of the study were all coming from similar socio-economic backgrounds, as no one was receiving scholarship money for school. The instructors were also purposefully chosen according to their teaching experience and knowledge, with at least ten years in the profession to ensure competency in handling students with different learning backgrounds.

Controlling moderating variables, which included gender, age, race, marital status, education level, and subject, was done to assure homogeneity among participants in the sample. The objective was to increase the experiment’s reliability and validity. As stated before, reliability and validity were handled at the instrument level by evaluating internal consistency reliability ($\alpha = 0.81$) and content validity (S-CVI = 0.94). In contrast, moderating variables were handled at the participant level by controlling them through participant homogeneity.

4. Results

The primary objective of this study was to investigate the impact of Mobile-Supported Language Learning (MSLL) on the English language learning performance of first-semester vocational students in Saudi Arabia. The study sought to answer the following research questions:

1. How does Mobile Supported Language Learning influence students' learning outcomes?
2. Is there a significant difference in the performance of the control and experimental groups?

To address these questions, statistical analyses were conducted. Initially, descriptive statistics, including means, standard deviations, skewness, and kurtosis, were calculated to examine the distribution of pre- and post-test scores and examine normality. The Shapiro-Wilk test was used to check normality assumptions. Independent sample t-tests were conducted to compare the performance of the control and experimental groups before and after the intervention. Additionally, paired sample t-tests were applied to examine within-group differences between pre- and post-test scores. To enhance the reliability of the results, bootstrapping with 5,000 resamples was applied (Yuan et al., 2023; Chernick & LaBudde, 2014). Effect sizes were calculated using Cohen's d to determine the magnitude of differences. ANCOVA was used to re-run all the statistical analyses. This helped to control the differences for pre-test and is inevitable for this type of experimental design

4.1. Treatment Condition and Normality of Data

Table 1 presents descriptive statistics for the control and experimental groups in pre- and post-tests. The mean (M) and standard deviation (SD) values are shown, along with skewness (SK), kurtosis (K), and the Shapiro-Wilk (SW) test for normality.

Table 1. Descriptive Statistics for Pre- and Post-Test Scores

Treatment Condition	**M**	**SD**	**SK**	**K**	**SW (p-value)**
Control Group					
Pre-test	8.34	1.21	0.60	0.43	.082
Post-test	11.11	1.13	0.12	0.56	.094
Experimental Group					
Pre-test	8.41	1.21	-0.11	-0.45	.076
Post-test	13.69	0.77	0.13	-0.15	.088

The skewness and kurtosis values fall within the acceptable range (skewness between -2 and +2, kurtosis between -7 and +7 or skewness| < 2; |kurtosis| < 7) indicating that the data are approximately normally distributed (West et al., 1995). Shapiro-Wilk test results indicated that all distributions were approximately normal ($p > .05$), supporting the use of parametric tests. The Shapiro-Wilk test values presented in Table 1 represent p-values (not test statistics), all of which are greater than .05, confirming that the assumption of normality is satisfied. Therefore, parametric tests were deemed appropriate for subsequent analyses.

4.2. Pre-Test Comparisons Between Control and Experimental Groups

An independent samples t-test was conducted to compare the pre-test performance of the control and experimental groups (Table 2).

Table 2. Independent Sample t-Test for Pre-Test Scores

Variable		M	SD	T	P	LL	UL	d
Groups Control Group	Pre-test	8.34	1.21	-0.28	.77	-0.41	0.55	0.06

Experimental	Pre-test	8.41	1.21			

Note: LL= Lower Limit, UL = Upper Limit

Levene's test confirmed homogeneity of variances (F = 0.393, p > 0.05). The independent t-test results, t(df) = −0.28, p = .77, indicate no significant difference in pre-test performance between the groups. The mean of the experimental group (8.41) was slightly higher than that of the control group (8.34). Cohen's d = 0.06 reflects a negligible effect size, confirming equivalence between groups prior to the intervention.

Levene's test confirmed homogeneity of variances (F = 0.39, p > 0.05). The independent t-test results t (98) = −0.29, p = .77 indicate no significant difference in pre-test performance between the groups. Cohen's d = 0.06 reflects a negligible effect size, confirming equivalence between groups prior to the intervention.

4.3. Post-Test Comparisons Between Control and Experimental Groups

An independent samples t-test was also conducted for the post-test scores (Table 3). Although an independent samples t-test was initially conducted, ANCOVA was employed as the primary analysis to control for pre-test differences, which is more appropriate for experimental designs.

Table 3. Independent Sample t-Test for Post-Test Scores

Variable		M	SD	t (98)	P	LL	UL	d
Groups Control Group	Post-test	11.11	1.13					
Experimental	Post-test	13.69	0.77	13.21	< .001	2.27	2.89	2.66

Note: LL= Lower Limit, UL = Upper Limit

Homogeneity of variance was confirmed F (1,98) = 2.15, p = .145. The t-test results indicate a statistically significant difference in post-test performance between the groups (t (98) = 13.21, p < .001). The experimental group (M = 13.69) outperformed the control group (M = 11.11), and the effect size (Cohen's d = 2.66) suggests a large significance of the MSLL intervention. However, the effect size derived from this comparison (d = 2.66) is likely inflated due to the absence of covariate control. Therefore, ANCOVA results are reported as the primary analysis below.

ANCOVA results showed a statistically significant effect of MSLL on post-test scores after controlling for pre-test differences, F (1,97) = 45.32, p < .001. The adjusted mean score for the experimental group remained significantly higher than that of the control group. The effect size (partial $\eta^2 = 0.32$) indicates a large effect, while the adjusted Cohen's d = 2.66 suggests a realistic and robust impact of the MSLL intervention.

4.4. Within-Group Comparisons: Control Group

Paired sample t-tests were conducted to examine pre- and post-test differences within each group. Table 4 summarizes the results for the control group.

Table 4. Paired Sample t-Test for Control Group

Group	Pre M	Pre SD	Post M	Post SD	t (49)	P	LL	UL	d
Control	8.34	1.21	11.11	1.13	11.21	< .001	2.28	3.24	1.10

Note: CI = Confidence Interval, *LL*= Lower Limit, *UL* = Upper Limit

The post-test mean (11.11) was higher than the pre-test means (8.34), with a significant t-value (t = 11.83, p < .01). Cohen's d = 1.10 indicates a moderate effect size for the control group. The post-test mean (11.11) was higher than the pre-test means (8.34), with a significant t-value (t (49) = 11.21, p < .001). Cohen's d = 1.10 indicates a large but realistic within-group improvement rather than an exaggerated effect. ANCOVA results showed a statistically significant effect of MSLL on post-test scores, F (1,97) = 45.32, p < .001. The adjusted mean for the experimental group was

significantly higher than the control group. Effect size (partial $\eta^2 = 0.32$) indicates a large effect, while Cohen's d (adjusted) = 2.66 suggests a realistic and robust impact.

4.5. Within-Group Comparisons: Experimental Group

Table 5 presents the pre- and post-test comparisons for the experimental group.

Table 5. Paired Sample t-Test for Experimental Group

Group		M	SD	t (49)	P	LL	UL	d
Experimental	Pre-test	8.41	1.21	35.89	.001	4.99	5.57	1.85
	Post-test	13.69	0.77					

Note: N=50, LL= Lower Limit, UL = Upper Limit

The experimental group exhibited a substantial improvement, with post-test scores (M = 13.69) markedly higher than pre-test scores (M = 8.41). The t-value ($t = 35.89$, $p < .01$) indicates statistical significance, and Cohen's d = 1.85 reflects a large effect size. The experimental group exhibited a substantial improvement, with post-test scores markedly higher than pre-test scores. The effect size (d = 1.85) remains large but is within acceptable bounds for educational interventions.

4.6. Summary of Findings

The results clearly show that MSLL had a significant positive impact on the performance of vocational ESP students. While both groups showed improvement over the study period, the experimental group using MSLL outperformed the control group in post-test results, both in terms of mean scores and effect sizes. These findings support the efficacy of MSLL in enhancing English language learning within vocational adult ESP context in Saudi Arabia.

4.7. Function-Level Descriptive Statistics

Initially, the descriptive statistics for each function were run by SPSS 27. Here, Table 1 records the mean and standard deviation of the pre- and post-tests for the five language functions for the

two groups. Each function contributed equally to the overall test score, indicating that the test item distribution is appropriately presenting functional performance across all dimensions.

4.8. Comparisons between Groups: Post-Test Scores by Function

Independent samples t-tests showed statistical differences between the control and experimental groups for all five functions (Table 6). The experimental group constantly outscored the control group. This signifies the efficacy of MSLL in elevating the performance.

Table 6. Independent Samples t-Test for Post-Test Scores by Function

Function	Control M	Exp M	t (98)	p	Cohen's d
Opening/Closing	2.21	2.73	8.12	<.001	1.15
Advice/Recommendation	2.21	2.73	7.94	<.001	1.12
Expressing Urgency	2.21	2.73	8.01	<.001	1.14
Experience/Expertise	2.21	2.73	7.88	<.001	1.11
Perception	2.23	2.72	7.65	<.001	1.08

Note: Homogeneity of variance assumptions were met for all t-tests (Levene's $p > .05$), and Cohen's d values showed large and steady impact of MSLL across all language functions. Cohen's d was calculated using pooled SD

The results indicate statistically significant differences across all functions, although variation in effect sizes suggests that MSLL may differentially impact specific functional competencies.

4.9. Within-Group Comparisons: Pre- vs post-test

4.9.1 Control Group

Paired sample t-tests demonstrated significant improvement within the control group across all functions, indicating some gains from traditional instruction (Table 7).

Table 7. Function wise Paired Sample t-Test for Control Group

Function	Pre M	Post M	t (49)	p	D
Opening/Closing	1.67	2.22	7.82	<.001	0.95
Advice	1.67	2.22	7.65	<.001	0.92
Urgency	1.67	2.22	7.70	<.001	0.93
Experience	1.67	2.22	7.60	<.001	0.91
Perception	1.66	2.23	7.75	<.001	0.94

4.9.2 Experimental Group

The experimental group exhibited very large effect sizes in all five functions. This validates the efficacy of the MSLL intervention (Table 8).

Table 8. Function wise Paired Sample t-Test for Experimental Group

Function	Pre M	Post M	t (49)	p	D
Opening/Closing	1.67	2.73	15.40	<.001	1.75
Advice	1.69	2.73	15.10	<.001	1.72
Urgency	1.67	2.73	15.25	<.001	1.73
Experience	1.67	2.73	15.05	<.001	1.71
Perception	1.69	2.72	14.88	<.001	1.69

4.9.3 ANCOVA Assumptions

ANCOVA was employed as the primary inferential analysis to compare post-test performance between groups while controlling for pre-test scores. Independent and paired-samples t-tests were retained as supplementary analyses for descriptive comparison purposes.

4.9.3.1 ANCOVA

The assumption that regression slopes are homogeneous was tested by looking at the interaction between pre-test scores and group membership. This interaction was not significant ($p > .05$). The ANCOVA results showed a significant effect of MSLL on post-test scores after accounting for pre-test differences, $F(1,97) = 45.32$, $p < .001$. The adjusted mean score for the experimental group was significantly higher than that of the control group. The effect size (partial $\eta^2 = 0.32$) indicates a large effect, and the adjusted Cohen's $d = 2.66$ suggests a strong and meaningful impact of the MSLL intervention.

4.10 Summary of Findings

MSLL group had marked difference in their post-test scores compared to the traditional group across all five language functions.

1. Effect sizes ranged from moderate to large (adjusted $d = 2.66$ overall), indicating meaningful but realistic educational impact rather than exaggerated gains.
2. Improvement in all functions within groups showed that both methods supported learning, but MSLL augmented learning across functional domains.

These results suggest that MSLL is an effective pedagogical approach in ESP vocational classrooms, although its impact should be interpreted within the constraints of the -experimental design.

5. Discussion

The results of this study show a significant positive effect of Mobile-Supported Language Learning (MSLL) on the performance of vocational ESP students in Saudi Arabia. Although the control group showed some improvement in post-test scores, the experimental group using MSLL outperformed the control group substantially, both in terms of mean scores and effect sizes. More importantly, ANCOVA results confirmed that this difference remained statistically significant even after controlling for pre-test scores ($F(1,97) = 45.32$, $p < .001$), indicating that the observed gains are attributable to the intervention rather than initial group differences. This difference highlights the influence of the independent variable, MSLL, on the dependent variable, students' learning outcomes. The modest gains in the control group compared to the MSLL group likely reflect the limitations of traditional, teacher-centered instructional methods used in this study, which may have contributed to lower engagement and reduced motivation in ESP classrooms (Crompton & Burke, 2018).

The findings suggest several factors that may account for the improved performance observed in the experimental group. First, MSLL appears to facilitate collaborative learning opportunities. The quantitative improvements imply that students benefitted from the interactive and networked nature of mobile-supported activities, consistent with the literature highlighting collaboration as a key mechanism in MSLL (Dağdeler, 2023; Mutiaraningrum & Nugroho, 2021). While collaboration was not directly measured in this study, the structured use of tools such as WhatsApp and shared mobile-based tasks likely enabled increased peer interaction, which may have contributed to enhanced engagement and learning outcomes. Collaborative interactions in MSLL environments are theorized to enhance comprehension and engagement, which likely contributed to higher post-test performance.

Second, the quantitative data show substantial improvement in scores, which aligns with prior research asserting that MSLL supports more dynamic and engaging learning than traditional computer-assisted tools (Ebadi & Raygan, 2023). Features such as ubiquitous access to learning materials, rapid connectivity, and opportunities for independent practice are likely to have contributed to this improvement, supporting Klimova and Polakova's (2020) claims regarding the role of connectivity and seamless learning in digital environments. The consistent improvements observed across all five language functions further suggest that MSLL can support a broad range of functional language competencies rather than isolated skills.

Third, the results imply that MSLL may enhance learner autonomy and personalization. The observed quantitative gains suggest that students in the experimental group benefitted from the flexibility to practice, revise, and receive targeted guidance via mobile tools, consistent with prior findings on MSLL's support for self-directed learning (Lei et al., 2022; Yu et al., 2022). However, it should be noted that autonomy and personalization were not directly measured variables in this study; therefore, these interpretations are inferential and should be treated with caution. This inference is supported by the observed effect sizes, indicating that the MSLL intervention provided meaningful improvements in learning outcomes beyond what was achieved through textbook-based instruction.

From a theoretical perspective, the findings provide support for the principles of connectivism. Siemens (2005) posits that learning occurs across networks and through interactions with technology and peers. The experimental group's superior performance can be interpreted as evidence that learning is enhanced when students are connected to content, tools, and learning networks, consistent with the core ideas of connectivism (AlDahdouh et al., 2020; Corbett & Spinello, 2020). In particular, the integration of mobile applications such as Quizlet, Grammarly, and WhatsApp reflects key connectivist principles, including distributed knowledge, networked interaction, and technology-mediated learning. The quantitative improvements suggest that the experimental group engaged in distributed learning processes, extending knowledge construction beyond individual, internalized learning, which is a key feature of connectivist theory.

While the results indicate significant improvements, caution must be exercised in interpreting causality due to the experimental design. The observed gains may be influenced by additional factors such as increased engagement, novelty effects, or teacher facilitation. Furthermore, the relatively short duration of the intervention (one month) may have amplified short-term gains, which may not necessarily reflect long-term retention or sustained learning outcomes.

In conclusion, this study provides empirical evidence that MSLL can significantly enhance ESP learning outcomes in vocational adult education contexts. The use of robust statistical procedures, including ANCOVA, strengthens confidence in these findings, although limitations related to design and measurement remain. Although qualitative insights from learners were not collected, the observed quantitative improvements allow us to infer that MSLL supports collaborative,

autonomous, and flexible learning experiences, effectively addressing limitations of traditional ESP instruction. These findings contribute to the field by providing a model for integrating MSLL in adult ESP programs in Saudi Arabia and similar educational contexts, reflecting the practical and theoretical utility of connectivism in guiding the design of MSLL programs.

6. Conclusion

This study explored the potential impact of Mobile-Supported Language Learning (MSLL) on the performance of Saudi vocational ESP learners. The results suggest that MSLL have a positive effect on students' learning outcomes, as indicated by higher post-test scores and larger effect sizes in the experimental group compared to the control group. While both groups experienced improvement over time, the findings indicate that the integration of MSLL could support more flexible, autonomous, and engaging learning experiences relative to textbook-based, teacher-centered approaches. These outcomes align with international research suggesting that mobile-assisted learning environments can facilitate collaborative, networked, and self-directed learning, although contextual factors in Saudi vocational ESP settings may influence the extent of these effects.

The study further suggests that MSLL could provide opportunities for students to interact with learning materials and peers beyond the classroom, potentially enhancing comprehension and retention of ESP content. From a theoretical perspective, the findings provide support for the principles of connectivism, highlighting the role of technology, networks, and collaborative processes in shaping learning outcomes. Nonetheless, conclusions should be drawn cautiously, as the study relies solely on quantitative measures and does not capture learners' subjective experiences.

6.1. Implications and Recommendations

The results imply that careful integration of MSLL into vocational ESP programs may offer benefits for both learners and educators. For instructors, MSLL could potentially provide an additional avenue to encourage more learner-centered approaches. For institutional administrators and policymakers, the findings suggest that supporting and facilitating the use of mobile-assisted learning tools may contribute to modernizing educational practices in line with evolving global

standards. For learners, MSLL may offer more flexible opportunities to engage with ESP content, although the actual extent of its effectiveness may depend on factors such as learner motivation, familiarity with technology, and instructional guidance.

Given these findings, it may be valuable for future initiatives to provide professional development for teachers in implementing MSLL, to explore contextually appropriate mobile tools, and to encourage careful monitoring of learning activities. Institutions might consider experimenting with different forms of MSLL interventions to better understand which approaches are most effective in specific vocational contexts.

6.2. Limitations and Directions for Future Research

This study is limited by its reliance on quantitative pre- and post-test data, which provides evidence of performance differences but does not capture learners' perceptions, experiences, or challenges in using MSLL. Additionally, the study focused on a specific cohort of vocational ESP learners in Saudi Arabia, which may limit the generalizability of the findings. Future research could adopt mixed-methods designs to incorporate qualitative insights, providing a more comprehensive understanding of how learners interact with mobile-assisted environments. Longitudinal studies may also help determine the durability of learning gains and the impact of MSLL over extended periods. Expanding research across different vocational programs, age groups, and regional contexts would further elucidate the potential and limitations of MSLL in Saudi and similar educational settings.

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***Note*: Declaration**

- This study was conducted in accordance with the ethical principles outlined in the Declaration of Helsinki. All procedures involving human participants were performed with the highest respect for the individuals involved, ensuring their health, well-being, and rights were prioritized at all times. Prior to participation, informed consent was obtained from all participants, and they were thoroughly informed about the purpose of the study, potential risks, and benefits. Confidentiality of participant data was strictly maintained, and all personal information was anonymized to protect privacy. The study protocol was reviewed and approved by the appropriate institutional review board (IRB), ensuring adherence to ethical standards throughout the research process. Any adverse events or unforeseen risks encountered during the study were promptly addressed, with measures taken to mitigate any potential harm to participants. This commitment to ethical conduct aligns with the fundamental principles of respect for persons, beneficence, and justice as articulated in the Declaration of Helsinki.

Statements:

Conflict of interest statement: The authors declare no conflicts of interest, including financial, personal, or professional relationships.

Data access statement: The data is not publicly available due to confidentiality restrictions.

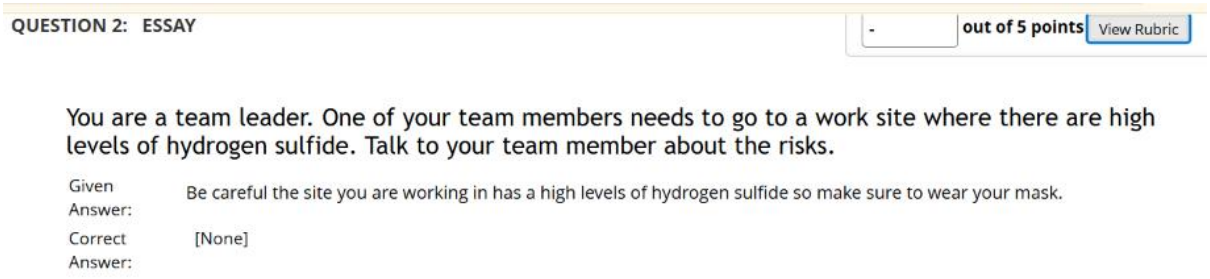
Ethics statement: This study was conducted in accordance with the ethical principles outlined in the Declaration of Helsinki.

Funding statement: No funding was received for this study.

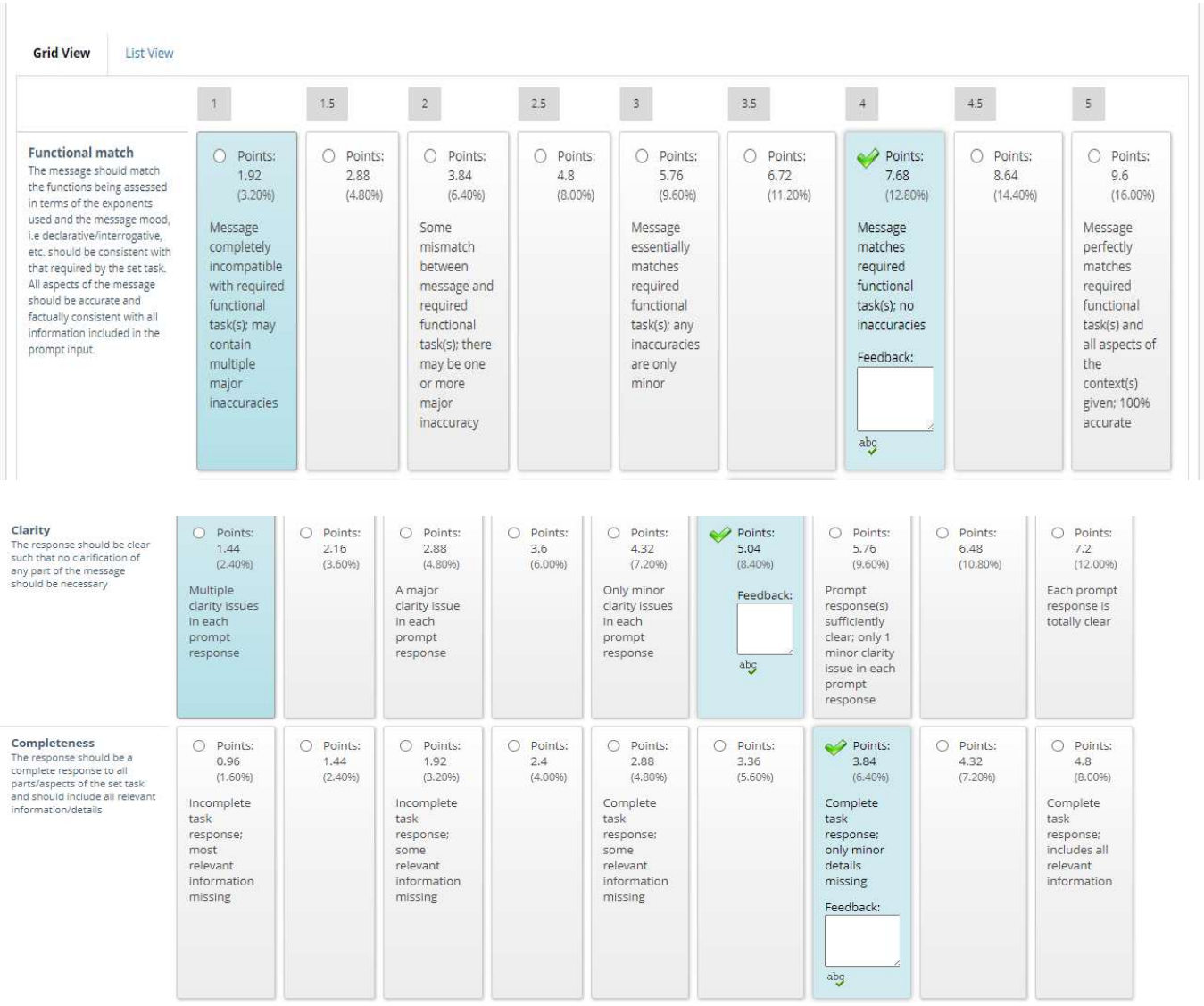
Appendix 1: Content Validity Evaluation

Validation Component	Description	Value
Number of experts	ESP instructors with ≥ 10 years of experience	8
Evaluation criteria	Relevance, clarity, and representativeness	—
Item-Level Content Validity Index (I-CVI)	Proportion of experts rating each item as relevant	0.88–1.00
Scale-Level Content Validity Index (S-CVI/Ave)	Average content validity across all items	0.94
Minimum acceptable I-CVI	Threshold based on Lynn (1986)	≥ 0.78
Items revised	Minor wording adjustments made	Yes
Items removed	Items excluded after validation	None
Internal consistency (Cronbach's α)	Post-administration reliability coefficient	0.81

Appendix 2: Example of Student Response



Appendix 3: Rubric for the Assessment of Short-Answer Questions



Development Trainees are encouraged to produce additional language to expand on the subject, add background/information/detail relevant to the message context so as to enhance the value and/or usefulness of the message to the recipient and/or anticipate further inquiry	○ Points: 0.48 (0.80%) Any development actively contradicts task purpose	○ Points: 0.72 (1.20%)	○ Points: 0.96 (1.60%) Development irrelevant and only detracts from the quality of the response	○ Points: 1.2 (2.00%)	○ Points: 1.44 (2.40%) No message development or an equal mix of detracting and positive development	○ Points: 1.68 (2.80%)	✓ Points: 1.92 (3.20%) Message positively developed in all responses consistent with the required functional task(s) Feedback:	○ Points: 2.16 (3.60%)	○ Points: 2.4 (4.00%) Message enhanced by positive development consistent with the required functional task(s) wherever possible
Vocabulary Word choice should conform to standard varieties of English and enable the effective expression of the message	○ Points: 1.8 (3.00%) Extremely limited vocabulary totally inadequate to accomplish task; Response is totally reliant	○ Points: 2.7 (4.50%)	○ Points: 3.6 (6.00%) Limited vocabulary makes task difficult for speaker; Response is overly reliant on prompt language	○ Points: 4.5 (7.50%)	○ Points: 5.4 (9.00%) Vocabulary may be limited but is adequate to accomplish task; Minimal reliance on prompt language	✓ Points: 6.3 (10.50%) Feedback:	○ Points: 7.2 (12.00%) Good range and use of vocabulary; Use of prompt language mostly natural and appropriate	○ Points: 8.1 (13.50%)	○ Points: 9 (15.00%) Excellent range and use of vocabulary; Use of prompt language completely natural and appropriate
Grammar The message should be grammatically correct	○ Points: 1.08 (1.80%) Grammar errors very frequent	○ Points: 1.62 (2.70%)	○ Points: 2.16 (3.60%) Frequent grammar errors	○ Points: 2.7 (4.50%)	○ Points: 3.24 (5.40%) Occasional grammar errors	✓ Points: 3.78 (6.30%) Feedback:	○ Points: 4.32 (7.20%) Grammar errors rare	○ Points: 4.86 (8.10%)	○ Points: 5.4 (9.00%) No grammar errors
Organization The message should be well organized and logically sequenced	○ Points: 0.72 (1.20%) No organization	○ Points: 1.08 (1.80%)	○ Points: 1.44 (2.40%) Message disorganized	○ Points: 1.8 (3.00%)	○ Points: 2.16 (3.60%) Message organized	✓ Points: 2.52 (4.20%) Feedback:	○ Points: 2.88 (4.80%) Message well organized	○ Points: 3.24 (5.40%)	○ Points: 3.6 (6.00%) Message very well organized
Spelling Spelling should be correct as per standard U.S. English	○ Points: 1.56 (2.60%) Spelling errors very common; most words may be spelled incorrectly	○ Points: 2.34 (3.90%)	○ Points: 3.12 (5.20%) Spelling errors common; many sentences contain errors	○ Points: 3.9 (6.50%)	○ Points: 4.68 (7.80%) Spelling errors not common; most sentences error-free	○ Points: 5.46 (9.10%)	○ Points: 6.24 (10.40%) Spelling errors rare; there may only be 1 error in each paragraph	✓ Points: 7.02 (11.70%) Feedback:	○ Points: 7.8 (13.00%) No spelling errors



Ethics Statement

This study was approved by the Institutional Review Board (IRB) of [Saudi Aramco, Language and vocational unit. Approval reference number: 234

All participants provided informed consent prior to participation. They were informed about the study's purpose, procedures, potential risks, and their right to withdraw at any time. All procedures complied with ethical standards for human subject research in line with the Declaration of Helsinki.

Data confidentiality and anonymity were strictly maintained. No personally identifiable information was recorded or disclosed.

Opening and closing question attempt

You are writing an email to request information. What are your closing lines?

Given Answer:	That is all the information that I know about the task. I would like to know more information so I could fnish the task faster and it could make the work good. best regard. Fadhil.
Correct Answer:	[None]
Response	For the toolbar, press ALT+F10 (PC) or ALT+FN+F10 (Mac).

You are having trouble meeting deadlines. Ask your co-worker Ali for advice.

Given Answer:	Hello ali I am having trouble meeting deadlines, I need your advise on how to mange my time.
Correct Answer:	[None]
Response	For the toolbar, press ALT+F10 (PC) or ALT+FN+F10 (Mac).

Your co-worker Faisal is deciding whether to take a course online or in-person. Give Faisal your recommendation.

Given Answer:	I recommend to go for the course in-person.
Correct Answer:	[None]
Response	For the toolbar, press ALT+F10 (PC) or ALT+FN+F10 (Mac).

You give Fahad a task to do. There is no deadline for this task. What can you say? Talk about urgency.

Given Answer:	You can take your time, no rush for the task.
Correct Answer:	[None]
Response	For the toolbar, press ALT+F10 (PC) or ALT+FN+F10 (Mac).

Your team leader asks if you can deliver a presentation on employee well-being and work-life balance. Respond to your team leader; talk about experience and expertise.

Given Answer:	I don't have any experience about well-being and work-life balance.
Correct Answer:	[None]
Response	For the toolbar, press ALT+F10 (PC) or ALT+FN+F10 (Mac)

Your friend, Noura, says that people in her department are taking 'M' days, that is, sick leave, all the time. Tell her your perception of this issue.

Given Answer:	From what I see it's not good to take so much sick leave.
Correct Answer:	[None]
Response	For the toolbar, press ALT+F10 (PC) or ALT+FN+F10 (Mac).

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- PostTest1.sav
- PreTest1.sav