

Effectiveness of a Proposed Program Integrating MALL & Reciprocal Listening to Podcasts in Fostering EFL Faculty of Biotechnology Students' HOTS, Vocabulary Acquisition and Speaking Fluency

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Abstract

The aim of the current study was to develop Egyptian first year EFL Faculty of Biotechnology students' higher order thinking skills (HOTS), vocabulary acquisition and speaking fluency through a proposed program integrating mobile-assisted language learning (MALL) and reciprocal listening to podcasts. The study followed the pretest/ posttest one experimental group design. The study group consisted of forty students; they were taught by the researcher throughout the fall semester of the academic year 2021-2022 according to the proposed program. The study tools included a pre- /post- higher order thinking skills test, a pre-/post vocabulary acquisition test, a pre- post speaking fluency test, a rubric for measuring the study participants' HOTS and a speaking fluency rubric. Results indicated that there were statistically significant differences between the study group students' pre-tests and post-tests scores in favour of the post- tests scores. Therefore, it was concluded that the proposed program was effective in developing the study group students' HOTS, vocabulary and oral fluency.

Key Words: MALL; Podcasts; Reciprocal listening; HOTS; Vocabulary acquisition; Speaking fluency; Egyptian university students

فعالية برنامج مقترح قائم علي التكامل بين تعلم اللغة بمساعدة الهاتف النقال و
الاستماع التبادلي للملفات الصوتية في تنمية مهارات التفكير العليا و اكتساب
المفردات و طلاقة التحدث لدي طلاب كلية التكنولوجيا الحيوية

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الملخص

هدفت الدراسة الحالية إلى تنمية مهارات التفكير العليا و اكتساب المفردات و طلاقة التحدث بين طلاب الفرقة الأولى بكلية التكنولوجيا الحيوية المصريين الدارسين للغة الإنجليزية كلغة أجنبية من خلال برنامج مقترح قائم علي التكامل بين تعلم اللغة بمساعدة الهاتف النقال و الاستماع التبادلي للملفات الصوتية. و قد اتبعت الدراسة تصميم الاختبار القبلي/ البعدي للمجموعة التجريبية الواحدة. و تكونت مجموعة الدراسة من أربعين طالباً و قامت الباحثة بالتدريس لمجموعة الدراسة طوال فصل الخريف للعام الجامعي ٢٠٢١ / ٢٠٢٢م وفقاً للبرنامج المقترح. و تكونت أدوات الدراسة من اختبار قبلي/ بعدي لمهارات التفكير العليا و اختبار قبلي/ بعدي لاكتساب المفردات و اختبار قبلي/ بعدي لطلاقة التحدث و مقياسين متدرجين لقياس مهارات التفكير العليا و طلاقة التحدث. و أظهرت نتائج الدراسة وجود فروق إحصائية دالة بين درجات طلاب مجموعة الدراسة في الاختبارات القبليّة و البعديّة لصالح الاختبارات البعديّة. ولذلك خلصت الدراسة إلى أن البرنامج المقترح كان فعالاً في تنمية مهارات التفكير العليا و اكتساب المفردات و طلاقة التحدث لدى طلاب مجموعة الدراسة.

الكلمات المفتاحية

تعلم اللغة بمساعدة الهاتف النقال ، الملفات الصوتية ، الاستماع التبادلي، مهارات التفكير العليا ، اكتساب المفردات ، طلاقة التحدث ، طلاب الجامعة المصريين

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Introduction

Higher-order thinking skills (HOTS) refer to EFL learners' ability to think critically and creatively (Yeung, 2016). Additionally, in the light of Bloom's revised taxonomy, they refer to EFL learners' ability to analyze, evaluate and create, and they are usually opposed to the lower-order thinking skills (LOTS) that indicate EFL learners' ability to remember, understand and apply information (Anderson et al., 2014). Therefore, developing EFL university level learners' HOTS has become a major goal that most higher education institutions aspire to achieve. This might be due to the fact that the twenty first century citizens need-whether in their personal or professional lives- to make informed decisions on the basis of sound evidence; they, also, need to be able to think out of the box, thus finding innovative solutions to varied professional and real life problems.

Due to the importance of developing HOTS among students in varied educational stages, in the US, Polly and Ausband (2009) highlighted a year-long project in which novice technology teachers were trained in designing and using WebQuests to develop their fifth and sixth graders' HOTS. Likewise, in Malaysia, the i-think maps were adopted to help EFL Malaysian learners develop HOTS (Singh, Gopal, Tek, Masa-Singh, Mostafa & Ambar-Singh, 2020). Furthermore, promoting HOTS is considered a priority in the Indonesian educational system (Susanti, Retnaningdyah, Ayu & Trisusanap, 2020, p. 43).

At the research level, Gopal, Tek, Masa-Singh, Mostafa and Ambar-Singh (2020, p. 196) highlighted the need for conducting more studies to identify the effective strategies that can enhance HOTS among EFL students. Moreover, instructors should promote their students' HOTS in order to help them face varied challenges (Heong, Yunos, Othman, Hassan, Kiong & Mohamad, 2012). However, the majority of English teachers seldom use appropriate teaching strategies to

develop their students' HOTS (Susanti, Retnaningdyah, Ayu & Trisusanap, 2020).

In university settings, a number of studies were conducted to develop HOTS among English majors in Indonesia and Egypt such as the studies of Ahiri, Dunifa, Tanduklangi and Ghani (2015), Asari, Husniah, Ma'rifah and Anwar (2019), Mohamed (2019) and Irianti, Febriani and Friatin (2022). In these studies, varied instructional interventions were applied such as implementing contextual teaching and learning (CTL), collaborative learning and competitive learning, using interpretation cards, implementing a proposed reading program based on reciprocal teaching (RT) and employing a flipped classroom model. Nevertheless, to the researcher's best knowledge, no study was implemented to develop HOTS in EFL listening classes of Egyptian Biotechnology students.

Moving to vocabulary, it is the main building block of any language. Without vocabulary, EFL learners cannot convey their ideas and emotions. EFL learners' ability to speak, read, write, listen and translate is influenced by their knowledge of vocabulary (Pan & Xu, 2011; Mohamed & Adam, 2016; Afzal, 2019). Therefore, "limited vocabulary in a second language impedes successful communication" (Alqahtani, 2015, p.22).

Despite its important role in achieving communicative competence and speaking fluency, acquiring vocabulary has been quite challenging for many EFL learners (Derradji, 2016, p.32). This might be due to the fact that teaching vocabulary has been neglected for a long time due to the overemphasis of grammar at the expense of vocabulary (Kargozari & Zarinkamar, 2014, p.839). Thus, learning vocabulary is a challenging task, particularly, for non-native English learners who encounter considerable difficulties related to word meanings, use, spelling and pronunciation (Afzal, 2019).

To promote EFL vocabulary acquisition in higher educational institutions, varied studies were conducted in varied countries including Iran, Saudi Arabia, Thailand, Egypt and China by Kargozari and Zarinkamar (2014), Al-Darayseh (2014), Mohamed and Adam (2016), Mashhadi, Hayati and Jalilifar (2016), Phisutthangkoon and Panich (2016), Elsherbini and Ali (2017), Chavangklang, Chavangklang, Thiamhuanok and Sathitdetkunchorn (2019), Mohamed, Abdel Haq, Amin and Mohamed (2020), El-Shamy (2021), Nie, Fu, Rehman and Zaigham (2022) and Zakian, Xodabande, Valizadeh and Yousefvand

(2022). In these studies, a wide variety of approaches, methods and techniques were employed to foster EFL vocabulary acquisition, and they included listening to podcasts, doing song and corpus activities, applying the working memory strategy, implementing a program based on the Constructive Alignment Theory, making use of incidental vocabulary acquisition, implementing a multimodal extensive reading program, combining explicit and implicit vocabulary instruction, watching news video clips and using a mobile-assisted language learning (MALL) flashcard application. However, as far as the researcher knows, no study was conducted to enhance EFL vocabulary acquisition among Egyptian Faculty of Biotechnology students.

EFL vocabulary acquisition and speaking fluency are closely related; therefore, it is hard to find an EFL fluent speaker who has limited vocabulary repertoire. Fluency refers to EFL learners' ability to express themselves clearly without hesitations or unnecessary pauses (Hughes, 2011). It is achieved when the speech flows naturally at normal speed using proper intonation patterns and minimizing pauses to convey messages effectively in varied contexts and situations (Hoshino, 2012). Apart from the common use of rubrics, Ellis (2003, p.117) highlights varied scientific measures for assessing EFL learners' speaking fluency; these are "the number of syllables and words per minute, the number of pauses, repetitions, false starts and reformulations, the number of words per turn and the mean length of pauses".

Despite its importance, there are several factors that can hinder speaking fluency among Arab EFL university level learners. In their study, Zrekat and Sohmani, (2022) classified these factors into (a) limited practice of EFL speaking activities inside and outside the classroom, (b) students' overall low linguistic proficiency level including the insufficient vocabulary repertoire and the lack of adequate grammatical knowledge as well as (c) psychological barriers including negative attitudes, high anxiety levels, lack of motivation, self-consciousness and embarrassment. In their study, Alsiddig and Abdaldfi (2020) found that Sudanese fourth year English majors suffered from limited speaking fluency, and this had a negative impact on their overall speaking quality and performance. According to Rossiter, Derwing, Manimtim & Thomson (2010), speaking fluency is an overlooked and a neglected aspect in the EFL classroom in a way that negatively affects EFL learners' communicative competence. Furthermore, in the studies conducted by Helal (2019) as well as Elsadek, Abdel-Haq and Amin (2020), it was highlighted that Egyptian EFL

university level learners suffered from remarkable weakness in their speaking fluency; hence, they needed more innovative techniques to foster their ability to speak naturally and smoothly without unnecessary pauses, hesitations or repetitions.

In university settings, several studies were conducted to promote EFL speaking fluency. Among them were the studies conducted in Iran, Egypt and Japan by Ghonsooly and Hosienpour (2009), Elsadek, Abdel-Haq and Amin (2020), Hussein, Mohamed and Zaza (2020) and Thomson (2020). In these studies, concept mapping activities, electronic project-based learning (EPBL), Multimodal Approach activities and instruction of multiword expressions were employed to promote participants' EFL speaking fluency. It is worth noting that the studies of Ghonsooly and Hosienpour (2009), Elsadek, Abdel-Haq and Amin (2020) and Hussein, Mohamed and Zaza (2020) were conducted on English majors. Thus, as far as the researcher knows, no study was conducted to promote EFL speaking fluency among Egyptian Biotechnology majors.

To achieve the target of developing Egyptian EFL Biotechnology students' HOTS, vocabulary and speaking fluency, the researcher conducted deep investigation to find innovative teaching practices. After thorough examination, it was found that integrating MALL activities with reciprocal listening to podcasts would be a viable option that is worth investigating. Starting with MALL, it is based on the Connectivism Theory where technology and stable strong internet connections play a significant role in EFL classes. The term 'Mobile Assisted Language Learning' (MALL) was first introduced by Chinnery (2006) who believed that portable devices can be successfully employed in language learning contexts. Therefore, there is a growing interest in the use of mobile phones to learn EFL in varied contexts and among different age groups (Afzali, Shabani, Basir & Ramazani, 2017; Pérez-Paredes & Zhang, 2022). MALL refers to the availability of learning opportunities wherever and whenever a learner wishes to with the help of mobile devices (Geddes, 2004). On their part, Trifanove, Knapp, Ronchetti and Gamper (2004, p. 3) define a mobile device as any small portable device that learners can use anywhere.

Nowadays, MALL is gaining more popularity in EFL classes due to its practicality, availability and varied pedagogical advantages. For instance, MALL enables learners to use portable handheld devices inside as well as outside classrooms to foster their EFL linguistic proficiency levels; it, also, enables them to participate effectively in collaborative

learning activities where they work on real life tasks (Obreg & Daniels, 2012). Hence, it helps them make good use of their free time as well record speech to foster their speaking fluency (Obreg & Daniels, 2012). Besides, MALL implementation fosters EFL students' engagement, interactivity, motivation and autonomy (Kukulkska-Hulme, 2009; Burston, 2013; Hwang, Huang, Shadiev, Wu & Chen, 2014; Keezhatta & Omar, 2019; Zain & Bowles, 2021). It, also, creates an encouraging positive learning environment for EFL learners (Keezhatta & Omar, 2019; Zhou, 2021). In addition, MALL creates authentic learning materials and provides EFL learners with meaningful learning experiences that usually transcend the physical settings of traditional classrooms (Arvanitis & Krystalli, 2021; Zhou, 2021).

In university settings, MALL implementation fostered EFL learners' vocabulary acquisition in the studies of Suwantarathip and Orawiwatnakul (2015) and Helwa (2017). Moreover, MALL improved EFL university students' speaking skills in the studies conducted by Azeez and Albajalani (2018) and Sobh (2018). Furthermore, MALL enhanced EFL learners' listening comprehension skills in the studies conducted by Helwa (2017), Salih (2019) and Alzeini (2020). Additionally, it promoted Egyptian EFL university students' critical reading skills in Saleh's, Ahmed's and Fahim's (2020) study. Nonetheless, to the researcher's best knowledge, MALL activities were not implemented to develop Egyptian EFL Biotechnology students' HOTS although employing MALL activities can help EFL university level learners analyze information, evaluate ideas in the light of specific criteria and create new knowledge as they explore the infinite number of websites available on the internet using their portable smart devices.

Moving to podcasts, these are audio as well as video files that are downloadable and accessible using internet connections. They are effectively used nowadays in EFL classes in the light of the Connectivism Theory. Thus, a podcast is "a media file (mp3, wma, mp4) uploaded to the Internet by an individual, radio station, or any company or organization" (Shahramiri & Gorjian, 2013, p. 194). The word podcast is coined from both the words 'broadcast' and 'pod' because learners usually listen to audio files on portable devices such as i-pods (Shahramiri & Gorjian, 2013, p. 194). Podcasts are useful tools that enable EFL teachers to incorporate technology in the EFL teaching/ learning context while arousing learners' interest and fostering their motivation (Indahsari, 2020).

To elaborate, podcasts were found particularly helpful in fostering EFL learners' listening comprehension (Indahsari, 2020). Thus, in their study, Fadda and Qasim (2013) found that podcasts played a significant role in enhancing listening comprehension among Saudi female university students. In addition, in their study, Tabatabaee and Rezvani (2019) found that podcasts significantly improved Iranian EFL learners' vocabulary acquisition in general and idioms learning in particular. Besides, Huriyah and Contessa (2020) found that podcasts- when used with peer assistance- promoted Indonesian EFL learners' listening comprehension and motivation. In addition, podcasting can increase EFL learners' autonomy and independence, especially when they create and post their own podcasts on the internet (Yaman, 2016). On their part, Shahid & Ali (2017) found that watching video podcasts significantly fostered Saudi male English majors' listening comprehension skills.

As for reciprocal listening (RL), it is an instructional procedure that is based on the Constructivism Theory; it enables EFL learners to construct meaning as they actively engage in interactive dialogues using predicting, clarifying, questioning and summarizing strategies (Rokhaniyah, Utama & Marantika, 2020, p.39). Furthermore, it was developed on the basis of reciprocal teaching strategies effectiveness in developing EFL reading comprehension among varied learners.

It is worth noting the RL was found effective in developing Egyptian and Iraqi EFL learners' listening comprehension in the studies of Yusuf (2015) and Dehham, Hasan and Raheem (2018). Moreover, RL fostered EFL speaking fluency of Iranian intermediate level EFL learners in the study conducted by Drood and Asl (2016). It, also, fostered Iraqi EFL learners' speaking sub-skills of pronunciation, vocabulary and grammatical competence in the study conducted by Hussein and Dehham (2019). Additionally, RL activities were found effective in overcoming listening comprehension impediments among Indonesian EFL university level students; hence, RL fostered these learners' ability to identify key words, vocabulary items and grammatical patterns. It, also, enhanced their ability to differentiate between confusing English sounds.

Going back in time, in 1984, Palinscar and Brown developed reciprocal teaching to promote reading comprehension skills among EFL learners (Sahab, 2014; Navaie, 2018; Hussein & Dehham, 2019). Thus, reciprocal teaching is "an outstanding role-playing learning strategy that has been proven to improve reading and comprehension" (Satriani, Munawir, Khair & Putriani, 2022, p.170). It can be described as "a conversation between teachers and students in which each participant

takes turns acting as the teacher" (Satriani, Munawir, Khair & Putriani, 2022, p.170).

Reciprocal teaching proved its effectiveness in promoting reading comprehension among learners of varied age groups, nationalities, linguistic proficiency levels and backgrounds as in the studies of Choo, Eng and Ahmad (2011), Ostovar-Namaghi and Shahhosseini (2011), Abdul-Majeed (2013), Sahab (2014), Navaie (2018), Pangaribuan (2019) and Satriani, Munawir, Khair and Putriani (2022). Recently, reciprocal teaching proved its effectiveness in developing HOTS among Egyptian English majors in Mohamed's (2019) study. Therefore, implementing RL to develop EFL university students' HOTS is a researchable area that is worth investigating.

Based on the above, it was found that no studies- as far as the researcher knows- attempted to promote HOTS, vocabulary acquisition and speaking fluency among Egyptian EFL Biotechnology students using a suggested program that integrates MALL and RL to podcasts. Hence, the current study is an attempt to explore this research area and measure its effectiveness.

Context of the problem

The researcher observed some EFL first year classes of Biotechnology majors at October Modern Sciences and Arts (MSA) University, and it was noticed that most of them focused on getting the direct literal meanings of audio texts. They rarely practised any of the HOTS in their EFL classes. Classroom observations, also, revealed that most of EFL Faculty of Biotechnology students at MSA University had limited vocabulary in a way that negatively affected their speaking fluency. Furthermore, whenever these students participated in spoken activities, there were many pauses, repetitions and hesitations that hindered the natural flow of their speech.

To explore the problem at a deeper level, the researcher administered three diagnostic tests on a random sample of twenty first year Biotechnology majors at MSA University. The first test measured the students' HOTS as they listened to two podcasts downloaded from BBC learning English and entitled "*Is the Planet Warming up Faster?*" and "*Saving the White Rhinos*", and it showed the students' limited HOTS. In addition, the ability to create new ideas was the weakest skill among these students as displayed by the results of the diagnostic HOTS skills.

As for the second test, it was a vocabulary test focusing on EFL Biotechnology students' ability to comprehend and produce varied

vocabulary items; results of the vocabulary test revealed EFL Biotechnology students' limited vocabulary. Furthermore, it was found that these students' ability to produce varied vocabulary items was noticeably weaker than their ability to comprehend single words and lexical chunks.

Moving to the third test, it was a speaking fluency test that required them to do two tasks; the first task was to take notes and then describe a given picture in one minute without unnecessary pauses or repetitions. As for the second task, it asked them to take notes as they listened to a podcast from BBC learning English, 6- minute English entitled "*What is the Point of Blood Types?*". Then, they were asked to summarize the podcast content in two minutes using naturally flowing English. Results of the diagnostic speaking fluency test revealed the students' limited ability to speak in a native- like manner. Varied filled and silent pauses were evident in the students' spoken performance. Additionally, hesitations, repetitions, false starts and reformulations were quite obvious in these students' speech.

Results of the HOTS diagnostic test are consistent with the findings of Mohamed's (2019) study highlighting that Egyptian EFL university learners need effective instructional interventions to promote their HOTS. In addition, results of the vocabulary diagnostic test go in line with the findings of Elsherbini and Ali (2017), Helwa (2017), Mohamed, Abdel Haq, Amin and Mohamed (2020) and El-Shamy (2021) denoting Egyptian EFL university learners' limited vocabulary. Furthermore, results of the speaking fluency diagnostic test conform with the findings of Elsadek, Abdel-Haq and Amin (2020) and Hussein, Mohamed and Zaza (2020) revealing Egyptian EFL university students' poor mastery of speaking fluency.

As the researcher observed the teaching methods and activities employed by EFL instructors of first year Biotechnology majors at MSA University, it was discovered that:

- (a) MALL activities were rarely used to enhance these students' HOTS, vocabulary acquisition and speaking fluency.
- (b) Two of the RL strategies were sometimes employed while listening to podcasts. Thus, the students occasionally predicted the audio text content from its title and illustrations. Moreover, they sometimes summarized the assigned audio texts. The strategies of clarifying and questioning were not employed by these students.
- (c) Students did not practise recording their speeches and assessing their speaking fluency using a rubric.

- (d) Listening to podcasts was sometimes practised to develop listening comprehension skills only. Thus, podcasts were not used to develop these learners' HOTS, vocabulary acquisition and speaking fluency.

The study problem

The study problem was specified in first year EFL Biotechnology majors' poor HOTS, limited vocabulary and lack of speaking fluency. This, in turn, had a negative impact on their ability to analyze, evaluate and create ideas; it, also, made them unable to express themselves naturally like native speakers due to their limited vocabulary and lack of speaking fluency. This might be partially due to the fact that HOTS place heavy cognitive demands on EFL university students as they try to analyze and evaluate given data as well as create new knowledge. It might be attributed to EFL instructors' usual overemphasis of academic writing skills, grammatical accuracy and reading comprehension at the expense of promoting HOTS, vocabulary acquisition and speaking fluency among their students. It might be, also, attributed to the fact that most of these EFL instructors have little knowledge of and training in innovative techniques to foster HOTS, vocabulary acquisition and oral fluency among their students. So, the current study is an attempt to promote HOTS, vocabulary and speaking fluency among first year Biotechnology majors through implementing a suggested program that integrates MALL and RL to podcasts. Hence, this study tried to answer the following main question:

"What is the effectiveness of a suggested program combining MALL and RL to podcasts in promoting EFL Biotechnology students' HOTS, vocabulary acquisition and speaking fluency?"

The following sub-questions were derived from the study main question:

1. What are the theoretical foundations of a suggested program designed in the light of MALL and RL to podcasts for developing HOTS, vocabulary acquisition and speaking fluency among Egyptian EFL first year Biotechnology majors?
2. What are the steps that should be followed to design the suggested program in light of MALL and RL to podcasts?
3. What are the components of a suggested program integrating MALL and RL to podcasts in order to promote HOTS, vocabulary acquisition and speaking fluency among EFL first year Biotechnology majors?

4. How far is the suggested program effective in promoting first year Biotechnology majors' overall Higher-order thinking ability, EFL vocabulary acquisition and speaking fluency?
5. How far is the suggested program effective in promoting each higher-order thinking skill as well as EFL vocabulary comprehension and production among first year Biotechnology majors?

The study hypotheses

This study attempted to verify the following hypotheses:

1. There is a statistically significant difference between the mean scores of the study group on the HOTS pre-test and posttest in overall higher order thinking ability in favour of the posttest.
2. There are statistically significant differences between the mean scores of the study group on the HOTS pre-/posttest in each higher order thinking skill in favour of the posttest.
3. There is a statistically significant difference between the study group's pre-/ posttest means in overall vocabulary acquisition in favour of the posttest.
4. There are statistically significant differences between the study group's pre-/posttest means in vocabulary comprehension and production in favour of the post-test.
5. There is a statistically significant difference between the study group's pre-/posttest means in overall speaking fluency in favour of the posttest.

The study objectives

The current study main objectives were:

1. Specifying adequate techniques for designing a suggested program that combines MALL and RL to podcasts to develop HOTS, vocabulary as well as oral fluency among EFL first year Biotechnology majors;
2. Designing a suggested program integrating MALL and RL to podcasts to foster HOTS, vocabulary acquisition and speaking fluency among EFL first year Biotechnology majors; and
3. Measuring the suggested program effectiveness in enhancing HOTS, vocabulary acquisition and speaking fluency among first year Biotechnology majors.

The study delimitations

This study was delimited to:

1. an intact EFL first year Biotechnology class at MSA University;
2. a duration of three months to conduct the study experiment during the fall semester of the academic year 2021- 2022;
3. thirteen sessions for implementing the suggested program where the first session introduced the program aims and activities and the subsequent twelve sessions were devoted to implementing the study treatment;
4. promoting the study group's overall higher order thinking ability, each higher-order thinking skill, overall vocabulary acquisition and speaking fluency; and
5. fostering the study group's ability to comprehend and produce the new vocabulary items included in the program twelve audio podcasts.

Definition of terms

MALL denotes any learning mode where technological portable devices, EFL learners and the learning process are mobile (El-Hussein & Cronje, 2010). MALL is, also, defined as a broad area where technology plays a major role to foster EFL learners' language skills using handheld smart devices (Kukulska-Hulme, 2013; Gaber, 2015)

In the present study, it operationally refers to the study group's use of smart phones and a strong internet connection to (a) clarify the meanings of confusing vocabulary items or any difficult segment of the program podcasts, (b) find out example sentences where the new vocabulary items are contextualized, (c) get more elaborate answers to the analysis and evaluation questions, (d) create novel ideas and solutions to posed problems using varied websites and (e) record their summaries of the program podcasts and videos to foster their speaking fluency.

Reciprocal listening refers to an instructional procedure where EFL learners work actively in collaborative groups to predict, clarify, question and summarize spoken texts content and main ideas (Dehham, Hasan & Raheem, 2018; Hussein & Dehham, 2019; Rokhaniyah, Utama & Marantika, 2020).

In the current study, it operationally denotes the instructional procedure enabling the study group students to work in groups of four to predict, question, clarify and summarize the content of the twelve audio podcasts listened to throughout the current program implementation.

Podcasts are online audio or video files (O'Bryan & Hegelheimer, 2007, p. 165), and these files are downloadable and accessible at any time

and any place on portable devices including smartphones, PDAs, i-pads and i-pods (Shahramiri & Gorjian, 2013).

In the current study, they operationally denote the downloadable audio files that were accessed from BBC learning English, 6- minute English website throughout the study program implementation. The study group listened to these audio files to promote their HOTS, vocabulary acquisition and speaking fluency.

HOTS represent "a cognitive capacity that students should cultivate in order to improve their ability to think critically, logically, and creatively in order to solve problems" (Irianti, Febriani & Friatin, 2022, p.202). Furthermore, they can be assessed during EFL university students' attempts to analyze, evaluate and create ideas (Mohamed, 2019).

Operationally speaking, in the present study, they refer to the study group's capability of analyzing and evaluating information in the program audio podcasts; they also include these learners' ability to create new innovative ideas, plans and solutions while using varied sources with the help of their smart phones.

Vocabulary acquisition is defined as the process through which students learn the lexical items of a given language (Nordquist, 2019), and it entails EFL learners' ability to understand and use single words as well as lexical chunks in varied authentic meaningful communicative events (Alqahtani, 2015; Arumugam et al., 2020).

At the operational level, in the current study, it refers to the study group's abilities of comprehending and producing the new unfamiliar vocabulary items included in the program twelve podcasts.

Speaking fluency refers to EFL learners' ability to speak effortlessly and smoothly without hesitations (Alsiddig & Abdaldfi, 2020).

Operationally speaking, in this study it denotes the study group students' capacity to speak naturally with minimum pauses, repetitions, false starts and hesitations as they predicted, clarified, questioned and summarized the content of the program podcasts. It, also, refers to their ability to speak spontaneously and naturally while describing the given pictures and while providing oral summaries of the program videos.

The study variables

Independent variable: This refers to the study intervention (the suggested program combining MALL and RL to podcasts and applied on the study group).

Dependent variable: This denotes the study group's performance level in overall higher-order thinking ability, each higher order thinking skill, overall vocabulary acquisition, vocabulary comprehension and production as well as speaking fluency.

Theoretical background

Definitions of HOTS

HOTS are usually defined as the thinking skills that place more cognitive demands on EFL learners; these cognitive requirements go far beyond mere recall, comprehension or application of information, which are considered lower order thinking skills (LOTS) (Johansson, 2020). Therefore, HOTS refer to EFL learners' ability to engage in deep thinking and information processing attempts to analyze, evaluate and create (Johansson, 2020; Trejo– Onarvaez & Galindo-Galrey, 2022). In that sense, analyzing can be defined as EFL learners' ability to break down relevant ideas and information into smaller parts and see the connections among them whereas evaluating refers to their ability to make sound logical judgment based on specific criteria and norms. As for creating, it is the ability to "generate new ideas or concepts" (Mursyid & Kurniawati, 2019, p.120).

In their turn, varied researchers viewed that HOTS comprise the skills of forming assumptions, making comparisons, providing varied interpretations, analyzing data, arguing for or against different ideas and creating new knowledge (Lee & Choi, 2017). Other scholars believed that HOTS include learners' ability to think critically, solve real-life problems and evaluate given ideas (Schraw & Robinson 2011; Gorin & Svetina, 2011; Aldaka, 2020; Purwaningsih, Floriani & Rokhmah, 2021).

In the same vein, some scholars use the terms 'HOTS' and 'critical thinking' interchangeably on the ground that both demand sophisticated cognitive processing capabilities as well as profound analysis and evaluation of given concepts, ideas and information (Johansson, 2020). However, it should be noted that the current study adopted Anderson et al.'s (2014) revised Bloom taxonomy highlighting EFL learners' ability to analyze, evaluate and create as higher order thinking skills.

Importance of HOTS

Developing HOTS among EFL learners enables them to achieve their full potential, attain the intended learning outcomes and acquire self-regulation skills (Lateef, Arshad-Dahar & Latif, 2016; Mursyid & Kurniawati, 2019). As EFL learners practise HOTS, they are better able to think critically and creatively, thus fostering their abilities to solve

problems (Nourdad, Masoudi, & Rahimali, 2018; **Trejo–Onarvaez & Galindo-Galrey, 2022**). Therefore, HOTS are essential to prepare well-equipped citizens for the third millennium who are able to think independently, innovate and function effectively in adult life as well as in their future careers (**Yeung 2016**; Ping, Ahmad, Adnan & Hua, 2017; **Jerome, Lee & Ting 2017**; **Mursyid & Kurniawati, 2019**).

HOTS enable EFL learners to analyze information on the internet and create new ideas to be presented whether in a written or spoken format (**Mursyid & Kurniawati, 2019**). Moreover, developing HOTS among EFL learners can enhance the learning process effectiveness and speed; it, also, fosters EFL learners' curiosity as well as their imaginative abilities when they create new ideas (Nourdad, Masoudi, & Rahimali, 2018; Apriyanti, 2021).

In their study, Nourdad, Masoudi and Rahimali (2018) found that acquiring HOTS had a positive impact on EFL adult learners' ability to comprehend written texts. Likewise, Purnama and Nurdianingsih (2019) found out that training highly motivated Indonesian English majors in HOTS fostered their speaking ability.

Techniques developing HOTS in EFL classrooms

Researchers suggested varied techniques to develop HOTS among EFL learners. For instance, Bastos and Ramos (2017) found that asking Portuguese EFL secondary stage learners to produce and post YouTube videos on controversial issues was an effective cognitive tool that developed their HOTS. In their study, Setyarini and Ling (2019) promoted EFL young adolescents' HOTS through storytelling in a speaking class. Furthermore, Aldaka (2020) believes that the flipped classroom model can enhance HOTS in EFL classes as students study relevant online materials before class and do more challenging tasks in class, thus enabling them to analyze, evaluate and create while the EFL instructor functions as a mentor or an advisor. Therefore, in their study, Riza and Setyarini (2020) recommended adopting a flipped classroom model in speaking classes to promote EFL learners' HOTS.

As for Ghanizadeh, Al-Hoorie and Jahedizadeh (2020), they propose the use of graphic organizers, critical discourse analysis, reflective journals and argumentation to develop HOTS in EFL classrooms. Moreover, Gopalan and Hashim (2021) recommend using

literature classes to foster EFL learners' HOTS as literature enables these learners to analyze characters, themes and events; moreover, literature enables EFL learners to make judgments and create new ideas. Additionally, based on their studies findings, Akatsuka (2019) and Pasutri (2021) recommend that EFL teachers should use deep level questions that require students to utilize their cognitive abilities in order to promote their HOTS.

Definitions and importance of vocabulary

Vocabulary refers to single words as well as language chunks such as compound word, idiomatic expressions and phrases; therefore, vocabulary knowledge includes knowing its spelling, meaning, form, pronunciation and uses (Richards, Platt & Platt, 2007; Pan & Xu, 2011). Vocabulary is, also, defined as the lexical storage used by EFL teachers and learners in varied communicative contexts (Derradji, 2016).

Vocabulary development is essential for EFL learners as limited vocabulary can impede communication (Mohamed, Abdel-Haq & Al-Hadi, 2018). Additionally, acquiring vocabulary enhances EFL learners' communicative competence and fosters their ability to make meaning of spoken as well as written texts (Yuksel & Tanriverdi, 2009; Kargozari & Zarinkamar, 2014; Derradji, 2016; Sheridan & Markslag, 2017; Afzal, 2019). Based on studies findings, Chavangklang, Chavangklang, Thiamhuanok and Sathitdetkunchorn (2019) concluded that the size of an EFL learner's vocabulary is a principal element in promoting his/ her ability to comprehend varied texts. Hence, acquiring a wide range of vocabulary contributes to fostering EFL learners' linguistic proficiency levels (Nie, Fu, Rehman & Zaigham, 2022).

Techniques used to foster vocabulary acquisition among EFL learners

There are varied approaches, methods and techniques that can be employed to foster EFL learners' vocabulary acquisition. Among them, Pan and Xu (2011) recommend (a) teaching vocabulary items in meaningful contexts, (b) using sense relations including synonymy, antonymy, hyponymy and polysemy, (c) teaching word formation processes, (d) highlighting cultural differences related to vocabulary items connotations and (e) looking up new words in monolingual dictionaries to increase their comprehensibility and retention among EFL learners.

Rather than mere listing of new vocabulary items, Alqahtani (2015) proposes using real objects, pictures, drawings, miming, facial expressions, gestures, contextual clues and mnemonic tools to foster EFL vocabulary acquisition. Sheridan and Markslag (2017) suggest engaging EFL learners in cooperative card activities to foster their vocabulary acquisition and recycling. Using questionnaires administered on both first and second year English majors and their instructors in Algeria, Derradji (2016) as well as Baiou and Dehmeche (2020).found out that both students and instructors were motivated to use YouTube videos to foster EFL vocabulary development. In their study, Arumugam et al. (2020) found that Malaysian EFL university level students benefited from social media in fostering their vocabulary acquisition; therefore, they recommended using social media to promote EFL undergraduates' vocabulary.

In their study, Mohamed, Abdel-Haq and Al-Hadi (2018), advocate the use of authentic materials to foster vocabulary acquisition among Egyptian EFL learners. On their part, Khan, Radzuan, Shahbaz, Ibrahim and Mustafa (2018) propose employing MALL activities to foster Saudi EFL university students' vocabulary acquisition as well as their speaking proficiency. In their study, Yu and Sukying (2021) found out that Chinese EFL university level learners- who were studying in Thailand- had positive attitudes towards using smartphones to acquire vocabulary, and this was attributed to smartphones accessibility that transcends classroom settings and overcomes their limitations. Furthermore, in their study, Kana'an and Ahlullahsiddiqui (2021) found that incidental learning in reading texts fostered Saudi EFL undergraduates' vocabulary acquisition.

Definitions and aspects of speaking fluency

Scholars have offered similar definitions of speaking fluency. Hence, it is defined as the ability to engage in a naturally flowing conversational interaction using appropriate language without undue pauses or fillers (Housen & Kuiken, 2009; Bøhn, 2015). On their part, Alsiddig & Abdaldfi (2020, p. 4866) define speaking fluency as "the ability to know how to put words, sentences and ideas together in an appropriate way". In other words, fluency is the ability to speak smoothly without unnecessary hesitations, pauses or fillers (Lopez, Becerra & Avila, 2021, p.40).

On his part, Segalowitz (2010) highlights three complementary aspects of speaking fluency; these are utterance, cognitive and observed fluency. Cognitive fluency highlights the mental practices that enable EFL speakers to effectively and spontaneously communicate their ideas and feelings. Utterance fluency denotes the speakers' behavior in a speech event, and it includes the speech rate, breakdown (highlighted by filled and silent pauses) and repair (indicated by the number of repetitions and alterations). As for observed fluency, it refers to the listeners' perception of and reaction towards the speakers' use of linguistic as well as paralinguistic features of communication.

Importance of speaking fluency

Speaking fluency enables EFL learners to communicate naturally and smoothly, thus conveying their messages in a more native-like fashion (Rossiter, Derwing, Manimtim & Thomson, 2010; Yang, 2014; Ahmed, 2020). Hence, speaking fluency fosters EFL learners' communicative ability and can be perceived as a chief indicator of an individual's linguistic competence. Therefore, speaking fluency is a necessary requirement for EFL university students (Ghonsooly & Hosienpour, 2009; Yang, 2014; Elsadek, Abdel-Haq & Amin, 2020; Thomson, 2020). Furthermore, enhancing EFL learners' speaking fluency can increase their grammatical accuracy (Yang, 2014). Additionally, oral fluency is a main component that contributes to speaking proficiency, and it cannot be seen in isolation from accurate pronunciation and coherent organization of utterances (De Jong, 2018).

Techniques employed to enhance speaking fluency among EFL learners

Varied techniques were employed by researchers in different settings to enhance EFL speaking fluency. For instance, Yahay and Kheirzadeh (2015) found that oral presentations improved Iranian EFL learners' speaking fluency. Elsayed and Hassan (2019) found that engaging Sudanese EFL university level learners in Task-Based instructional activities promoted their speaking fluency. Moreover, Helal (2019) found that engaging Egyptian EFL undergraduates in internet-based collaborative tasks of giving oral presentations, digital stories retelling and group debates significantly fostered their speaking fluency. Using a questionnaire administered on Saudi EFL third and fourth year university students, Ahmed (2020) found that they viewed role plays and group debates as effective techniques to develop their speaking fluency.

In their study, Kana'an and Ahlullahsiddiqui (2021) promoted Saudi English majors' speaking fluency through the incidental learning of vocabulary as the students read varied written texts. On their part, Lopez, Becerra and Avila (2021) found that encouraging Ecuadorian senior high school students to record and post their own created videos on YouTube fostered their speaking fluency; they, also, found that most of their study participants had positive attitudes towards such an instructional procedure. Specifically, creating and posting these YouTube videos increased their normal speech rate as well as reduced their pauses, repetitions and corrections.

Ghasemi and Mozaheb (2021) found that concept mapping and the speech repetition 4/3/2 technique significantly fostered Iranian EFL learners' speaking fluency. To clarify, in the speech repetition 4/3/2 technique, EFL learners are encouraged to work in pairs or groups where they talk about familiar topics or summarize a given text for four minutes first. After that, they are required to repeat the same speech to listeners in three minutes and then in two minutes to foster their fluency (Hoshino, 2012; Wang, 2014; Ghasemi & Mozaheb, 2021). In their turn, Ahmed et al. (2022) found that using WhatsApp as well as Duolingo smartphone applications enhanced Iranian EFL adult learners' speaking fluency.

Definitions of MALL

MALL refers to educational practices where handheld portable devices play a dominant role (Traxler, 2005). It employs mobile devices in learning a foreign language, and these devices can be used for voice calling, video chatting, sending short messages, looking up unfamiliar words or expressions on electronic dictionaries and listening to audio texts (Kukulska-Hulme & Shield, 2008). Thus, MALL is a broad field which includes using varied devices such as smartphones, PDAs, pads, pods, GPS tools and MP3 or MP4 players to enhance EFL acquisition (Kukulska-Hulme & Shield, 2008; Kukulska-Hulme, 2013; Gaber, 2015).

Applications of MALL in EFL classes

In their study, Azar and Nasiri (2014) found that using mobile phones to listen to audiobooks enhanced Iranian EFL learners' listening comprehension skills; moreover, it was highlighted by the study participants that implementing MALL in their listening classes was quite engaging and interesting. Additionally, participants in Azar's and Nasiri's (2014) study shed light on the fact that MALL made audiobooks

accessible and available at any place and any time in a way that enhanced their ability to better make meaning of the listening texts. Likewise, in his study, Gaber (2015) found that a proposed MALL program fostered Egyptian EFL female secondary school students' listening comprehension and autonomous learning. Keezhatta and Omar (2019) found that MALL enhanced Saudi EFL secondary school students' reading comprehension. Additionally, in a review of researches, Zhou (2021) found that MALL fostered EFL Chinese learners' speaking ability. In Iran, Parsa (2021) found that MALL fostered EFL adult learners' grammar achievement.

Definitions and benefits of podcasts in EFL classes

Earlier, a podcast was defined as "an audio file in mp3 format that can easily be downloaded from the Internet" (Kargozari & Zarinkamar, 2014, p.840). Nowadays, podcasts can be either audio or audiovisual files, and they can be easily downloaded and accessed on portable media playing devices (Huriyah & Contessa, 2020, p.366).

In the EFL teaching/ learning field, podcasts are affordable and accessible at any time and at any place. Thus, EFL learners can play them several times until they fully comprehend and assimilate the information presented in each podcast. In addition, podcasts are considered an innovative tool to present relevant ideas on a wide range of topics (Kargozari & Zarinkamar, 2014, p.840; Mashhadi, Hayati & Jalilifar, 2016). Therefore, several researchers have used podcasts to develop varied language skills including (a) pronunciation as in the studies of Lord (2008) and Knight (2010), (b) listening and speaking as in the studies of Hawke (2010), Chan, Chi, Chin & Lin (2011) and Hoven & Palalas (2011) and (c) vocabulary acquisition as in the studies of Putman and Kingsley (2009), Borgia (2010) as well as Mashhadi, Hayati and Jalilifar (2016).

Definitions of reciprocal listening

Originally, reciprocal listening is "an instructional procedure that is designed to improve listening comprehension. This is achieved by encouraging a group of students to interact with the instructor to construct meaning and build understanding from a range of passages" (Dehham, Hasan & Raheem, 2018, p.1342). During RL, EFL students are involved in collaborative interaction as they listen attentively to audio texts and try to make meanings of these texts; this interaction takes place among groups of students as well as with the EFL teachers, and it involves the active use of predicting, clarifying, questioning and summarizing strategies. Moreover, it entails that EFL teachers work as facilitators and

guides to foster their students' active learning and meaning construction processes (Dehham, Hasan & Raheem, 2018; Hussein & Dehham, 2019; Rokhaniyah, Utama & Marantika, 2020).

Advantages of reciprocal listening

Reciprocal listening enhances EFL learners' collaborative learning, team work competencies, autonomy and active engagement in the meaning construction processes. Furthermore, it enhances EFL learners' motivation and positive attitudes. It, also, involves EFL learners in meaningful interactions as they predict and summarize the content of audio texts, clarify difficult vocabulary items, expressions or syntactic structures and ask relevant questions to attain deeper comprehension of the spoken texts at hand (Rokhaniyah, Utama & Marantika, 2020; Aquino-Rojas, Heredia-Arboleda and Lara-Velarde, 2021).

As EFL learners collaborate during the reciprocal listening procedure, more knowledgeable students help less knowledgeable students make meaning of the audio texts, thus benefiting from enjoyable social interactions to develop their linguistic competence. Reciprocal listening, also, enhances EFL learners' listening comprehension and enables them to monitor their spoken performance as they interact in the EFL classroom while implementing RL four strategies (Hussein & Dehham, 2019).

Reciprocal listening strategies

The four reciprocal listening strategies are purposefully employed to enable EFL learners to construct the meanings of spoken texts. Starting with predicting, it refers to EFL learners' attempts to anticipate the content of audio texts using their prior knowledge, text title, illustrations and pictures. Moving to clarifying, it denotes EFL learners' constant attempts to understand difficult vocabulary or grammatical structures as well as clear out any misunderstanding to attain deeper levels of text comprehension. Therefore, clarifying is an effective strategy that can develop EFL learners' vocabulary (Cárdenas & Pinzón, 2019). As for questioning, it takes place as EFL learners pose relevant questions to actively construct the meanings of audio texts. During reciprocal teaching, EFL learners should ask deep level questions to provoke and promote their HOTS (Mohamed, 2019). Finally, summarizing refers to EFL listeners' attempts to focus on the main ideas as well as the most important details of the spoken texts, thus leaving out less important details and getting a condensed form of the audio texts (Dehham, Hasan

& Raheem, 2018; Hussein & Dehham, 2019; Rokhaniyah, Utama & Marantika, 2020; Macias, Aquino-Rojas, Heredia-Arboleda & Lara-Velarde, 2021).

Macias, Aquino-Rojas, Heredia-Arboleda and Lara-Velarde (2021) propose a model for applying reciprocal teaching to foster EFL learners' listening comprehension ability. This model starts with EFL teachers' modeling reciprocal listening strategies in front of the students; this is followed by training the students in applying these strategies themselves as they practise listening to varied spoken texts. After that, it proceeds to instructors' active monitoring of the students' progress until these students are able to work independently and self-assess their listening comprehension ability.

During reciprocal listening, EFL learners are usually divided into collaborative groups of four where either an EFL learner becomes a leader who employs the four strategies (Rokhaniyah, Utama & Marantika, 2020) or each EFL learners assumes either the role of a predictor, a clarifier, a questioner or a summarizer following Pangaribuan's (2019) successful implementation of these strategies while teaching reading comprehension to EFL university students.

In the light of Pangaribuan's (2019) implemented procedure, the listening text is played in short segments (Hussein & Dehham, 2019; Rokhaniyah, Utama & Marantika, 2020; Macias, Aquino-Rojas, Heredia-Arboleda & Lara-Velarde, 2021); thus, the predictor anticipates the text content from the title and accompanying illustration; he/ she, also, predicts the upcoming segments content and sees whether his/ her predictions are confirmed or refuted. Also, as the spoken text is played in short portions, the roles within each group can switch one student to the right; thus, a questioner can become a predictor, a clarifier or a summarizer when the audio text playing is resumed. Such a swap of roles enables the EFL learners to practice all the strategies, assimilate the spoken text content and become more responsible for their learning.

Related studies

This section includes the following six sub-sections:

I. Studies conducted to promote HOTS in EFL classes

Ahiri, Dunifa, Tanduklangi and Ghani (2015) investigated the effect of three learning strategies (i.e., contextual teaching and learning

(CTL), collaborative learning and competitive learning) on 270 Indonesian EFL Faculty of Education students' HOTS. They, also, compared the HOTS of visual, auditory and kinesthetic learners. Furthermore, they examined the interaction between the study participants' learning strategies and styles. Instruments were a questionnaire (to identify the students' preferred learning styles) and a HOTS test. After administering the questionnaire, participants were randomly assigned according to a factorial 3 X 3 design. Thus, nine experimental groups of thirty students each were involved in this study based on the three learning strategies and the three learning styles. The intervention lasted for five months. Results revealed that CTL was the most effective strategy to foster students' HOTS as compared to collaborative learning and competitive learning. It was, also, found that visual learners displayed more HOTS than auditory and kinesthetic learners. Findings showed that CTL was more effective with kinesthetic learners; competitive learning was more influential when applied with visual learners, and collaborative learning had the greatest impact on auditory learners. Therefore, it was recommended to pay more attention to the students' preferred learning styles while employing learning strategies to promote their HOTS.

Faravani and Atai (2015) explored the impact of integrating students' multiple intelligences (MI), portfolio assessment and teacher's dialogic feedback on Iranian EFL adult learners' HOTS. Participants were forty female students aged from twenty to thirty years old, and they were equally and randomly divided into a control group and an experimental group; hence, each group consisted of twenty students. Each session, the control group students were assigned argumentative paragraph writing topics that did not take into consideration their dominant intelligence types and received portfolio assessment on their written performance. Using an MI checklist, the experimental group students were divided into smaller groups on the basis of their dominant intelligence types and received argumentative paragraph writing tasks accordingly; then, they received teacher's dialogic feedback on the quality of their writing and portfolio assessment of their written performance. The intervention lasted for eight sessions. The study instruments, also, included a HOTS rubric and writing tests. Results highlighted the experimental group students' significant HOTS improvement. Therefore, it was suggested that EFL instructors should take into consideration the students' dominant intelligence types while assigning them writing tasks. It was, also,

advocated that EFL instructors should employ dialogic feedback to enhance their students' HOTS.

Asari, Husniah, Ma'rifah and Anwar (2019) examined the effect of using interpretation cards on developing Indonesian English majors' HOTS. Data were collected using three classroom observations during the learning process of thirty-two English majors. They were, also, collected through administering a questionnaire and interviewing some of the treatment group. The intervention lasted for the whole semester where participants enrolled in a cross culture and communication course were given varied situations and case studies to examine westerners' attitudes and behavior, thus employing their ability to analyze, evaluate and create varied ideas. The researchers measured the participants' HOTS before and after the treatment. Results proved that interpretation cards were effective in developing the participants' HOTS as they enabled the students to display critical and creative thinking capacities.

Indriyana and Kuswandono (2019) explored the strategies used by Indonesian EFL junior high school teachers to develop their students' HOTS. Participants were twenty-two EFL instructors, and the study instruments were a questionnaire, interviews and classroom observations. Results indicated that participants employed varied strategies to enhance their students' HOTS. These included (a) asking divergent deep-level questions, (b) involving the students in group discussions, (c) informing the students of the lesson objectives, (d) offering the students informative feedback to help them refine and evaluate their ideas and (e) motivating them to think critically. It was suggested that future studies should explore the challenges that EFL teachers encounter while employing these strategies to foster their students' HOTS.

Mohamed (2019) examined the effectiveness of a proposed reading program based on the implementation of reciprocal teaching (RT) strategies in promoting Egyptian prospective EFL teachers' HOTS and reading motivation. Participants were seventy second year students. They were randomly and equally divided into a control group and an experimental group, and each group consisted of thirty-five students. The control group students were taught reading following the regular method, and the experimental group students were trained in employing the four RT strategies to enhance their HOTS and reading motivation. The study instruments were a linguistic proficiency test, a pre-/post HOTS test and a pre-/post reading motivation scale. Post- administration of the HOTS test

and motivation scale revealed the experimental group's significant improvement in their HOTS and reading motivation. Therefore, it was concluded that reciprocal teaching application developed the experimental group students' HOTS. Moreover, further studies were recommended to explore the effect of RT strategies on enhancing HOTS among EFL students in other educational settings and grades.

Susanti, Retnaningdyah, Ayu and Trisusana (2020) investigated the impact of employing collaborative strategic reading (CSR) on fostering Indonesian EFL vocational secondary school learners' HOTS. Participants were sixty-six students who were randomly divided into a control group of thirty-two students and an experimental group of thirty-four students. The experimental group received CSR instruction for eight sessions to foster their HOTS, and each session lasted for ninety minutes. As for the control group students, they were taught according to the regular method. The study tool was a pre-/post HOTS test. Posttest results revealed the experimental group students' substantial HOTS improvement. Therefore, it was concluded that CSR could enhance EFL learners' HOTS. Furthermore, EFL instructors were recommended to utilize varied strategies, techniques and approaches to enhance their students' HOTS.

Ariska, Gustine and Setyarini (2020) conducted a case study to identify how teacher's feedback could foster Indonesian EFL seventh graders' HOTS. The study adopted the qualitative research method where classroom observations were carried out to examine the types of teacher's feedback offered to thirty-one EFL junior high school students. In addition, a semi-structured interview with the classroom teacher was conducted to get a deeper analysis of his feedback. Results revealed that the English teacher in this study used feedback in four different ways to develop his EFL students' HOTS. These were (a) using 'why' questions to foster the students' reasoning ability, (b) employing feedback as a scaffolding technique to support the learners' deep thinking, (c) utilizing praise followed by 'what' questions to help the students elaborate their points of view and (d) using feedback to offer suggestions, thus enabling the learners to deal with more challenging ideas. Based on the results, EFL instructors were recommended to train their students in employing HOTS.

Susanti and Lailiyah (2021) explored the impact of training Indonesian EFL senior high school students in reading strategies on promoting their HOTS. The study participants were sixty eleventh graders who were randomly and equally divided into a control group and an experimental group. Thus, each group had thirty students. While the

control group received conventional reading instruction, the experimental group students applied the reading strategies of mind mapping and visualization to foster their HOTS. The study instruments were a writing pre-/posttest, an essay pre-/posttest and two rubrics to measure the study participants' HOTS prior to and after the treatment. The intervention lasted for two months over eight ninety-minute sessions. Results of the posttests administration revealed the significant growth in the experimental group students' HOTS. Therefore, it was concluded that visualization and mind mapping helped the experimental group students think at a deeper level, thus fostering their analysis and evaluation abilities as well as their creativity. It was, also, recommended that further research should examine the role of other reading strategies in fostering EFL learners' HOTS.

Irianti, Febriani and Friatin (2022) examined the role of adopting a flipped classroom model in enhancing Indonesian English majors' HOTS and listening comprehension ability. Participants were fifty-five students who were randomly divided into a control group and an experimental group. The control group had twenty-eight students, and the experimental group consisted of twenty-seven students. Data were collected via a pre-/post HOTS performance assessment and a pre-/post TOEFL listening comprehension test. Data were, also, collected using a questionnaire to identify the experimental group students' opinions about the inverted classroom model and its impact on developing their HOTS as well as their listening comprehension capacity. While the control group received prescribed instruction via online Zoom meetings, the experimental group students followed the flipped classroom model that combined both synchronous and asynchronous learning opportunities. The intervention lasted for three months, and the posttests were administered after fourteen online sessions. Results of the posttests administration revealed the significant growth in the experimental group students' HOTS and listening comprehension ability. It was, also, found that most the experimental group students believed that the flipped classroom paradigm enhanced both their listening comprehension ability and HOTS. Therefore, it was recommended to provide sufficient computers and a strong internet connection in order for the flipped classrooms to achieve their target.

Anandayu (2022) investigated how two Indonesian EFL high school instructors promoted their students' HOTS during online learning. The study tools included semi-structured interviews and classroom observations. The study focused on EFL learners' HOTS according to Bloom's revised taxonomy. Results revealed that both EFL teachers used

inquiry-based learning to promote their students' HOTS in online settings. They, also, utilized higher level questions and relevant pictures to enhance students' HOTS. Findings revealed that both EFL teachers faced difficulties in their attempts to promote their students' HOTS during grammar lessons. Furthermore, it was evident that both instructors encountered technical issues as they attempted to develop their students' HOTS in online learning contexts.

II. Studies developing EFL vocabulary among university level learners

Kargozari and Zarinkamar (2014) explored the role of podcasts in developing Iranian EFL learners' vocabulary. Participants were thirty-two TEFL majors, and they were randomly divided into a control group and an experimental group. The control group received conventional vocabulary instruction, and the experimental group students were taught the same vocabulary items through podcasts that were accessed anytime and anywhere throughout the intervention. Data were obtained through a pre-/post vocabulary test and through unstructured interviews with some of the experimental group students. Posttest results proved the experimental group's tangible EFL vocabulary improvement. Moreover, the experimental group had positive views of using podcasts to foster their vocabulary acquisition. Therefore, recommendations were made to use podcasts in order to develop EFL undergraduates' vocabulary as well as other language skills.

Al-Darayseh (2014) examined the effectiveness of integrating explicit and implicit teaching in developing Saudi EFL university students' vocabulary and reading comprehension. Participants were fifty-five second year students majoring in economics; they were randomly divided into a control group of twenty-eight students and an experimental group of twenty-seven students. While the control group received traditional instruction of vocabulary, the experimental group received a combination of incidental contextual teaching of vocabulary in given reading texts and direct teaching focusing on vocabulary meanings, synonyms, collocations and antonyms. The intervention lasted for a whole semester. The study instrument was a pre-/post vocabulary and reading comprehension test. Results of the posttest administration revealed the tangible improvement of the experimental group students' vocabulary and reading comprehension ability. Hence, it was concluded that combining explicit and implicit instruction of vocabulary enhances EFL university students' vocabulary development, and this, in turn, fosters their reading comprehension capabilities.

Mohamed and Adam (2016) investigated the effect of watching TV Breaking News video clips on developing Saudi EFL learners' vocabulary. Participants were fifty English majors who were randomly assigned into a control group and an experimental group. While the control group was taught vocabulary according to the conventional method, the experimental group was taught the same vocabulary as they watched the news clips. Data were obtained through a pre-/post vocabulary test comprising multiple choice and matching questions as well as gap filling items. Posttest results showed the significant growth in the experimental group students' vocabulary as a result of the intervention. It was, also, found that using these TV news clips enhanced the experimental group's motivation to learn English vocabulary. Therefore, watching TV Breaking News was recommended to enhance EFL university students' vocabulary development.

Mashhadi, Hayati and Jalilifar (2016) compared the effectiveness of listening to podcasts, self-study and conventional teaching in enhancing Iranian EFL medical sciences students' vocabulary learning. Participants were one hundred and thirty-two students who were randomly assigned into three groups: the self- study group, the conventional teaching group and the podcast blended learning group. The intervention lasted for thirty-two sessions, and the three groups studied the same vocabulary items; however, the podcast blended learning group did in-class activities as well as accessed and downloaded podcasts from the learning management system outside the classroom whenever it was convenient for them. The study tools were a vocabulary test, an attitude questionnaire, weekly vocabulary formative tests as well as interview prompts combining face-to face and WhatsApp messages for participants in the three groups. Results proved that podcast blended learning was the most effective mode of instruction to foster EFL vocabulary acquisition among the study participants. It was, also, found- through interviews and questionnaires- that the podcasts accessed via a blended learning model fostered the learners' engagement in the vocabulary learning process.

Phisutthangkoon and Panich (2016) investigated the impact of song activities on fostering Thai EFL students' vocabulary learning and retrieval. Participants were forty first year Faculty of Liberal Arts students. The study instruments were a pre-/post vocabulary test, a delayed posttest (administered two weeks after the treatment) and a questionnaire exploring the participants' opinions about song activities. Throughout the intervention, students practised song activities to foster their vocabulary acquisition. Results indicated the positive influence of

song activities on the participants' vocabulary learning. Moreover, there were no significant differences between posttest 1 and posttest 2 scores, thus proving the effectiveness of song activities in fostering the participants' vocabulary retention. Results of the questionnaire administration revealed the participants' positive opinions about employing song activities to promote their vocabulary learning and recall. Therefore, song activities were recommended to develop EFL university students' vocabulary; this was due to the fact that these activities lower the learners' affective filter and create an enjoyable relaxed classroom atmosphere that is conducive to learning.

Elsherbini and Ali (2017) explored the effectiveness of corpus activities in promoting Egyptian EFL first year university students' vocabulary and grammar. Participants were one hundred and four business English students enrolled in Sadat Academy, and they were randomly assigned into a control group of fifty students and an experimental group of fifty-four students. While the control group received vocabulary and grammar instruction according to the regular method, the experimental group practised varied corpus activities to foster their grammar and vocabulary; the intervention lasted for eleven two-hour sessions. Data were gathered through vocabulary and grammar pre-posttests, administering a questionnaire and conducting structured interviews with the experimental group students. Results illustrated the experimental group's tangible grammar and vocabulary development. Additionally, the experimental group had positive views of using corpus activities to foster their vocabulary and grammar skills. Nevertheless, it was recommended to examine the long-term impact of corpus activities on promoting EFL undergraduates' vocabulary and grammar.

Chavangklang, Chavangklang, Thiamhuanok and Sathitdetkunchorn (2019) examined the influence of a multimodal extensive reading program on Thai EFL freshmen's vocabulary acquisition and reading comprehension ability. Participants were sixty-seven students who were randomly divided into a control group and an experimental group. The study instruments were a pre-/post vocabulary size test and a pre-/post reading comprehension test. The control group was taught through regular instruction, and the experimental group students were involved in online multimedia reading activities where they were asked to read three online news articles on a weekly basis. Over a period of eight weeks, the experimental group read twenty-four online

multimodal texts; moreover, they practised identifying words synonyms and definitions using online dictionaries throughout the treatment. Results confirmed the experimental group's significant gains in their reading comprehension and vocabulary size. Thus, multimodal extensive reading activities were recommended to foster EFL university students' vocabulary development and reading comprehension proficiency.

Mohamed, Abdel Haq, Amin and Mohamed (2020) investigated the role of a suggested program based on the 'Constructive Alignment Theory' in promoting academic vocabulary among Egyptian EFL first year engineering students. Participants were sixty-three students, and they were randomly divided into a control group of thirty students and an experimental group of thirty-three students. While the control group studied academic vocabulary according to the prescribed method, the experimental group studied the same vocabulary items according to the proposed program. The treatment lasted for ten sessions. The study instruments were a vocabulary pre-test and a vocabulary posttest. Results of the posttest administration revealed a significant difference between the control group and the experimental group in favour of the experimental group. Hence, the implemented program proved its effectiveness in fostering the experimental group's vocabulary knowledge. Furthermore, it was recommended to examine the effect of constructive alignment activities on promoting EFL learners' reading, listening, speaking and writing.

El-Shamy (2021) examined the impact of employing the working memory strategy on fostering Egyptian fourth year prospective English teachers' vocabulary acquisition. Participants were forty students who were trained over eighteen two-hour sessions in applying the steps of the working memory strategy to enhance their knowledge of vocabulary meaning, form and use. Instruments were a vocabulary skills checklist, a pre-test, a posttest and a rubric. Results of the posttest administration revealed the remarkable development in the experimental group's vocabulary as a result of the intervention. Therefore, it was recommended to use this strategy to develop EFL vocabulary among primary and secondary stage students. It was, also, suggested to conduct further studies investigating the impact of the working memory strategy on EFL learners' speaking ability.

Nie, Fu, Rehman and Zaigham (2022) explored the effect of listening to songs on Chinese EFL first year university students'

incidental acquisition of vocabulary. Participants were 140 students, and they were divided into a control group and three experimental groups. The study focused on twenty-six target words. While the control group received regular vocabulary instruction, the first experimental group practised listening once to the target words in given songs. The second experimental group listened to the same words as songs were played three times. As for the third experimental group, they listened to the target vocabulary as the songs were played five times. The study instruments were vocabulary knowledge pre-/posttests that focused on words recognition, meaning and form. Posttest results proved that listening to songs enhanced vocabulary acquisition, especially at the word identification level. It was, also, found that listening to songs enhanced the experimental groups' vocabulary retention. Moreover, listening to songs three times proved to be the most effective repeated listening procedure to foster unintentional vocabulary learning and retrieval.

Zakian, Xodabande, Valizadeh and Yousefvand (2022) investigated the impact of using a MALL flashcard application on enhancing Iranian EFL university students' vocabulary acquisition and retrieval. Participants were freshmen and sophomores who were randomly assigned into a control group of twenty-five students and an experimental group of fifty-eight students. While the control group students learned vocabulary through word lists, the experimental group practised the same vocabulary items using a MALL flashcard application for four months. The study instruments were a vocabulary pre-test, a posttest and a delayed post-test. The posttest was taken immediately after the treatment, and the delayed posttest was taken after two months. Results proved the significant improvement in the experimental group's vocabulary whether on the posttest or the delayed posttest as compared to the control group students' performance on both tests. Therefore, it was proved that MALL applications could substantially improve EFL university students' vocabulary. Furthermore, it was recommended to conduct more studies to gain deeper insights into the impact of MALL applications on vocabulary acquisition.

III. Studies conducted to develop EFL speaking fluency

Ghonsooly and Hosienpour (2009) investigated the effect of involving Iranian second semester English majors in concept mapping activities on developing their speaking fluency. Participants were sixty EFL intermediate level students who were equally and randomly divided into two groups; hence, each group had thirty students. While the experimental group practised concept mapping before getting themselves involved in conversations and role plays, the control group were taught English conversations according to the usual method. Instruments included a placement test and an ILETS pre-/post-speaking test. Students' performance on the pre-/posttest was measured according to a set of criteria including the length as well as the number of filled and silent pauses in addition to the number of uttered syllables within the allotted speaking time. Results revealed that concept mapping substantially promoted the experimental group's speaking fluency as compared to the control group and as compared to their performance before the experiment implementation.

Alibakhshi and Sarani (2014) explored self-assessment effect on Iranian EFL students' speaking fluency and accuracy. In addition, they examined the role of participants' linguistic proficiency levels in fostering their accurate and fluent articulation of ideas. Participants were thirty intermediate and thirty upper intermediate learners. Moreover, they were further divided into two experimental groups -where students practised self-assessment of their speaking fluency and accuracy- and two control groups who received regular instruction. The intervention lasted for fifteen weeks. Instruments included a placement test, a pre-/post speaking test and a differential scale for measuring participants' speaking fluency and accuracy. Results proved the two experimental groups' substantial fluency and accuracy growth due to practising self-assessment of their spoken performance. It was, also, found that self-assessment enhanced the experimental groups' speaking fluency more than it fostered their speaking accuracy. Furthermore, results revealed that upper intermediate level EFL participants benefited more from self-assessment than intermediate EFL participants did.

Mohammadi and Enayati (2018) examined the impact of lexical chunks instruction on Iranian EFL intermediate level learners' speaking fluency. Participants were sixty students, and their age range was between thirteen and seventeen years old. They were randomly divided into a control group and an experimental group, and each group consisted of thirty students. The experimental group students studied varied English idioms, collocations and fixed expressions; they, also, practised using

these lexical chunks in paragraph writing tasks and conversations in eighteen sessions of ninety minutes each. As for the control group, they followed the prescribed instructional method. The study tools included a placement test, a pre-/post multiple choice test of lexical chunks and a pre-/ post- speaking test. The speaking test required the students to use lexical chunks to express themselves effectively. Posttest results showed that explicit teaching of lexical chunks had led to substantial progress in the experimental group's fluency as compared to the control group; therefore, it was recommended to explicitly teach EFL lexical chunks to promote learners' oral fluency.

Nasri, Namaziandost and Akbari (2019) conducted a study where they explored the role of pictures in developing Iranian EFL pre-intermediate level learners' speaking fluency and accuracy. Participants were fifty-four students aged between twelve and thirteen years old, and they were randomly and equally divided into an experimental group and a control group; thus, each group consisted of twenty-seven students. While the experimental group was offered pictorial cues before practising speaking activities, the control group was taught speaking through repetition and drills. Treatment took place over fifteen sessions of fifty minutes each. The study instruments included a pre-speaking test, a post-speaking test and a speaking checklist. Results proved the positive impact of pictorial input on fostering the experimental group's speaking fluency and accuracy. Therefore, discussing relevant interesting pictures before speaking tasks proved its efficacy for promoting EFL pre-intermediate level learners' oral fluency and accuracy.

Pardo-Soto and Cisterna-Zenteno (2019) examined the impact of video recordings using smartphone applications on fostering Chilean EFL seventh graders' speaking fluency. Participants were thirty-one students, and they were taught how to use smartphone video recordings to foster their speaking fluency. Instruments included pre-post speaking tasks, a speaking fluency analytical rubric and an interview of a focus group. Treatment lasted for four sessions of ninety minutes each. Results indicated the positive impact of smartphone speech video recordings on the participants' speaking fluency. Furthermore, analysis of the focus group interview revealed the participants' favourable views of using smartphone applications to enhance their ability to speak fluently.

Elsadek, Abdel-Haq and Amin (2020) examined the impact of electronic project-based learning (EPBL) on fostering Egyptian first year English majors' speaking fluency. Participants were twenty-seven students, and throughout the treatment they were involved in EPBL

activities to foster their speaking fluency. Instruments were a checklist of speaking fluency skills, a fluency pre-test, a fluency post-test and a fluency rubric. Posttest results proved the positive effect of EPBL on promoting the participants' speaking fluency skills.

Hussein, Mohamed and Zaza (2020) investigated the role of implementing multimodal activities in promoting EFL speaking fluency among Egyptian second year English majors. Participants were fifteen students, and they practised multimodal activities for three sessions each week. Treatment lasted for six weeks, and instruments were a speaking fluency pre-/posttest and a rubric. Findings proved the tangible effect of multimodal activities on developing the participants' speaking fluency. Therefore, it was recommended to implement multimodal activities to develop EFL varied language skills among students of different educational stages.

Ibrahim, Abdel-Hack and Zaza (2020) investigated the effect of e-portfolios on developing Egyptian EFL first year secondary stage students' speaking fluency. Participants were thirty students enrolled in a governmental school in Qalubeya governorate. Instruments were a checklist of oral fluency skills, a fluency pre-test, a fluency post-test, a rubric and a teacher's guide explaining the steps of using e-portfolios to develop the participants' speaking fluency skills. The intervention lasted for nine sessions of ninety minutes each. The posttest results revealed the significant growth in the participants' oral fluency as a result of using e-portfolios. Hence, it was concluded that using e-portfolios could substantially foster EFL secondary stage learners' speaking fluency.

Namaziandost, Homayouni and Rahmani (2020) explored the impact of implementing two co-operative learning techniques (i.e., 'Numbered Heads' & 'Think-Pair- Share') on fostering Iranian intermediate level EFL learners' oral fluency. Participants were seventy-two learners, and they were enrolled in a private language institute; in addition, they were equally divided into three groups of twenty-four students each. While the first experimental group students followed the numbered heads technique to foster their oral fluency, the second experimental group used the think-pair-share technique for the same purpose. The control group followed the traditional teacher-centered method. The intervention lasted for eight weeks. Instruments included an oral fluency pre-test, an oral fluency post-test and a rubric. Results indicated that both co-operative learning techniques were equally effective in promoting the experimental groups' oral fluency. Moreover, it was found that both experimental groups performed much better than the control group on the oral fluency posttest. Hence, it was concluded the

implementing co-operative learning techniques can effectively enhance EFL learners' oral fluency.

Thomson (2020) conducted a three-part action research to examine the role of learning multiword expressions in promoting Japanese EFL university students' speaking fluency. Throughout the study three phases, the experimental group students were exposed to lexical chunks to foster their speaking fluency whereas the control group students followed a program targeting their speaking fluency without teaching them how to use lexical chunks to enhance their fluency. Instruments included a vocabulary test and a speaking fluency test. Results revealed the experimental group students' significant vocabulary gains; in addition, they were much better at using the newly learned expressions in conversations. However, there were no statistically significant differences between the control and experimental groups in terms of their speaking fluency. Based on the study results, it was suggested that EFL university students need to practise using lexical chunks more than nine hours per week to achieve tangible progress in speaking fluency.

Ghasemi and Mozaheb (2021) explored the role of concept mapping and the speech repetition 4/3/2 technique in fostering Iranian EFL learners' speaking fluency. Participants were eighty students, and they were enrolled in a speaking course to prepare them for the ILETS exam. Additionally, they were divided into two experimental groups of forty students each. While the first experimental group practised concept mapping to enhance their speaking fluency, the second experimental group employed the 4/3/2 speech repetition technique for the same purpose. To clarify, participants in the second experimental group were requested to talk about familiar topics for four minutes first. After that, they were required to repeat the same speech to other listeners in three minutes and then in two minutes to foster their fluency. The intervention lasted for ten sessions. Data were collected using a fluency pre-test, a fluency post-test and an oral fluency measure. Data were, also, obtained through conducting interviews with four participants from each group. Results indicated that both the concept mapping and 4/3/2 techniques were equally effective in promoting the participants' speaking fluency. Interviews revealed that the participants liked concept mapping as it helped them see the connection between ideas whereas some participants maintained that implementing the 4/3/2 technique for a long time might be boring or uninteresting.

Ahmed et al. (2022) investigated the effect of two MALL applications (i.e., Duolingo & WhatsApp) on Iranian EFL adult learners'

speaking fluency and accuracy. Participants were ninety male students; they were enrolled in a language learning institution, and they were randomly assigned into three groups of thirty students each. While the first experimental group practised ten speaking online activities using Duolingo application on their smartphones, the second experimental group used WhatsApp application to do the same online activities. On the other hand, the control group did the assigned speaking activities offline according to the prescribed method. Tools included speaking pre-tests and posttests. Results proved the tangible speaking fluency and accuracy improvement of both experimental groups as compared to the control group. It was, also, found that using both Duolingo and WhatsApp applications was equally effective in fostering the students' fluent and accurate speaking ability. Hence, using these applications was advocated to promote EFL teaching and learning.

IV. Studies implementing MALL to foster EFL skills among university students

Suwantarathip and Orawiwatnakul (2015) investigated the effect of MALL implementation on fostering Thai EFL university students' vocabulary acquisition and attitudes. Participants were eighty students enrolled in a fundamental English course, and they were randomly and equally divided into a control group and an experimental group; thus, each group consisted of forty students. Both groups studied the same vocabulary; while the control group did paper-based vocabulary activities, the experimental group students did MALL vocabulary activities using the short message service (SMS) on their mobile phones. Tools were a pre-/post- vocabulary test and a questionnaire. The intervention lasted for fourteen sessions over a period of seven weeks. Results proved the experimental group's remarkable progress on the vocabulary posttest, thus providing evidence for the effectiveness of MALL in promoting vocabulary acquisition. Moreover, the questionnaire results revealed the experimental group's positive attitudes towards MALL SMS activities. Therefore, MALL activities were advocated to enhance EFL learners' vocabulary development while increasing their motivation.

Helwa (2017) examined the effect of a suggested program employing MALL activities on fostering EFL English majors' listening comprehension and vocabulary acquisition. Participants were thirty third year prospective English teachers. Data were collected through a listening comprehension pre-/posttest and a vocabulary pre-/posttest. They were, also, obtained through students' interviews and reports. Treatment took

place over fourteen two-hour instructional sessions to enhance the participants' listening comprehension and vocabulary. Posttests results revealed the participants' significant growth in vocabulary and listening comprehension as a result of the MALL intervention. Most of the interviewed students believed that MALL could promote their EFL listening comprehension and vocabulary acquisition. Hence, it was recommended to employ MALL activities in English curricula.

Azeez and Albajalani (2018) conducted a study to explore the impact of MALL on fostering Kurdish EFL university students' speaking sub-skills. Participants were second year prospective English teachers who were randomly divided into a control and an experimental group. The experimental group consisted of thirty-one students whereas the control group had twenty-six students. While the experimental group studied speaking materials using their smartphones for fifteen weeks, the control group studied the same materials according to the prescribed method. Instruments were a pre-/post speaking test and a speaking rubric. Results of the posttest administration proved the significant gains in the experimental group's accuracy, fluency, pronunciation, communication strategies, coherence, grammar and vocabulary. Hence, MALL activities were recommended to develop EFL university students' varied speaking sub-skills.

Sobh (2018) examined the effect of a suggested MALL teaching strategy on enhancing Palestinian English majors' speaking skills. Participants were twenty female first year students enrolled in a listening and speaking course at Al-Aqsa University in Gaza. Instruments were a TOIEC pre-/post speaking test and an ILETS speaking rubric. The researcher implemented MALL activities, and the intervention took place in eighteen sessions over two months. Results proved that MALL activities enhanced the participants' speaking sub-skills of fluency, pronunciation, grammatical correctness and adequate use of vocabulary in varied contexts. Hence, MALL use in university settings was advocated to foster EFL learners' reading, writing and listening skills. It was, also, recommended to conduct more researches to explore MALL role in minimizing EFL learners' speaking anxiety.

Salih (2019) examined MALL effect on developing Iraqi EFL university female students' listening sub-skills. Participants were sixty students, and they were randomly and equally divided into a control group and an experimental group; hence, each group consisted of thirty students. Participants were second year English majors. The study tool was a pre-/post listening test. While the control group practised EFL

listening according to the usual method, the experimental group was taught the same materials using MALL activities. The intervention lasted for fifteen weeks. Posttest results revealed the experimental group's tangible listening progress, thus affirming MALL role in fostering EFL university students' listening skills.

Alzeini (2020) investigated the impact of applying MALL on enhancing Emirati EFL intermediate level university students' listening skills. He, also, examined EFL instructors' perceptions concerning MALL effectiveness in promoting their students' listening ability. Participants were sixty-six foundation year students at Dubai Men's College. After randomly and equally assigning participants into a control group and an experimental group of thirty- three students each, the experimental group students were directed to use their smartphones to download varied listening applications. On the other hand, the control group followed the conventional method. Data were obtained through administering an ILETS listening pre-/posttest on both groups. They were, also, gathered through interviews with five EFL instructors who explained their views of MALL self-directed use to develop the students' listening competence. Posttest results proved the experimental group's tangible listening progress, and interviews showed that most instructors welcomed the use of MALL self-directed activities to enhance their students' listening skills.

Saleh, Ahmed and Fahim (2020) explored the effectiveness of a MALL program in fostering EFL critical reading skills among Egyptian third year English majors at Suez University. Participants were forty students, and the research instrument was a pre-/post MCQ critical reading comprehension test. Throughout the treatment that lasted for three months, students practised six critical reading skills using mobile applications including Google classroom app, WhatsApp and Google Drive app. Results of the posttest administration showed the significant growth in the participants' critical reading comprehension skills as a result of the study intervention. Therefore, implementing MALL activities was advocated to enhance EFL university students' linguistic proficiency levels.

Okumuş Dağdeler, Konca and Demiröz (2020) investigated the effect of MALL on enhancing Turkish EFL university students' knowledge of forty English collocations. Participants were seventy-three students, and they were divided into a control group of thirty-seven students and an experimental group of thirty-six students. While the control group studied the specified collocations through worksheets, the experimental group studied the same collocations using CollocatApp on their smartphones. Treatment lasted for fourteen weeks, and the study

tools were a collocation achievement test (CAT) and a vocabulary knowledge scale (VKS). Results revealed the positive effect of MALL on the experimental group's receptive collocational knowledge. However, the post VKS administration revealed that both groups were nearly at the same level, with no clear differences between them in productive collocational knowledge. Also, there were no substantial differences between both groups on the delayed posttests administered three weeks after the intervention. Therefore, MALL was effective in enhancing the participants' receptive vocabulary knowledge for a short term only.

In Indonesia, Harmanto (2021) examined MALL efficacy in enhancing EFL university learners' literacy skills. Specifically, the study focused on the literacy skills of reading comprehension, spelling, punctuation and grammar. Participants were twelve students enrolled in an international accounting program. The study tools were literacy pre-posttests. Participants used two main mobile applications throughout the intervention that lasted for one month only. These applications were lessonwriter.com and kahoot.com. Participants practised reading, punctuation, grammar and spelling using the lessonwriter.com app; they, also, practised spelling, punctuation and grammar using the Kahoot online gaming platform. Posttest results revealed that both groups displayed nearly the same overall literacy performance level. However, the experimental group performed significantly better than the control group in spelling and in the grammatical aspect of singular/ plural differentiation. Furthermore, it was highlighted that the limited duration of the experiment implementation was one of this study limitations that might had a negative impact on the study results.

V. Studies investigating the impact of podcasts on developing university students' EFL skills

Behjat and Yamini (2011) examined the role of podcasts, wikis and weblogs in developing Iranian EFL second year English majors' essay writing skills. Participants were thirty males and one hundred and twenty-six females with a total of a hundred and fifty-six students. They were divided into three groups; the first group listened to podcasts and then did the assigned tasks to foster their writing performance. The second group was asked to read certain texts in a wiki form and then edit or extend them to make them more appealing and informative for other readers. As for the third group students, they used a weblog to write as well as post argumentative essays on topics of their choice. The intervention lasted for two months and a half. The study instruments were a pre-/post essay writing test and a rating scale. Results revealed that podcasts, wikis and

weblogs were equally effective in developing the participants' essay writing ability. Therefore, using these three e-tools was advocated to foster EFL university students' writing skills.

Al Qasim and Al Fadda (2013) investigated the effect of Saudi EFL university students' generated podcasts on promoting their listening comprehension ability. Participants were forty-six female English majors, and they were divided into a control group of twenty-one students and an experimental group of twenty-five students. The experimental group practised using mobile phones to generate, record and play English podcasts, and the control group was taught in the light of the usual method. The experiment lasted for six weeks, and the experimental group uploaded their podcasts on iTunes and a blog. The study instruments were a pre-/post proficiency test and a questionnaire. Results proved that creating podcasts significantly promoted the experimental group students' listening comprehension; it was, also, found that producing, uploading and playing podcasts on the experimental group students' mobile phones fostered their motivation to practise listening comprehension skills.

Bamanger and Alhassan (2015) examined the effect of listening to podcast lectures on Saudi EFL university students' writing performance. Participants were fifty-five foundation year male students, and they were divided into an experimental group of twenty-six students and a control group of twenty-nine students. While the experimental group listened to traditional as well as podcast lectures to foster their writing ability, the control group listened to traditional lectures only. The study instruments were a pre-/post-writing test, a rubric and a questionnaire. Posttest results showed the experimental group's remarkable writing progress. The experimental group's significant punctuation, spelling and capitalization gains were, also, quite evident. In addition, most of the experimental group participants welcomed the use of podcasts lectures to improve their writing skills.

Aditya (2018) investigated podcasts effect on Indonesian English majors' listening comprehension. Participants were enrolled in the third semester of the English department. A pre-/post listening comprehension test was used to gather the study data. The intervention lasted for three weeks where participants listened to English podcasts to promote their listening comprehension. Posttest results proved the participants' significant listening comprehension improvement. Therefore, podcasts

were recommended to be used to foster EFL learners' active participation and interest in practising listening comprehension skills.

Chaikovska, Zbaravska and Bilyk (2019) examined the effectiveness of listening to profession-related podcasts in fostering Ukrainian EFL first year electrical engineering majors' listening and speaking skills. Participants were fifty students who were divided into a control group of twenty-four students and an experimental group of twenty-six students. The control group followed regular EFL instruction, and the experimental group practised listening to ten podcasts related to their field of specialization and then did listening comprehension and speaking tasks based on these podcasts. The study instruments were a pre-/post listening comprehension test and a speaking test. Results showed the experimental group's substantial listening comprehension and speaking progress. Hence, field-related podcasts were recommended to enhance EFL university students' meaning-making of spoken texts and to enable them to express varied ideas in communicative situations.

Huriyah and Contessa (2020) investigated the role of peer assistance while listening to podcasts in enhancing Indonesian EFL university students' listening comprehension and motivation. Participants were twenty-seven students, and the study instruments comprised a pre-/post- listening comprehension test and two questionnaires. While the first questionnaire measured the participants' perceptions of peer guidance while listening to podcasts, the second questionnaire examined the participants' motivation level after the intervention. Results proved the effectiveness of peers' assistance while listening to podcasts in promoting the participants' listening comprehension ability and increasing their motivation levels.

Mirzaeian (2020) explored the impact of Iranian EFL freshmen's collaboration in creating podcasts on their vocabulary acquisition and retrieval. Due to the study experimental design, participants were divided into an experimental group of fifty-one students and a control group of twenty students. While the experimental group students used vocabulary as they collaborated to create podcasts in the university labs using the Audacity program, the control group learned the same vocabulary as they followed the prescribed method. The study tool was a vocabulary test that was administered three times: prior to the intervention, immediately post the intervention and four weeks after the intervention. Results proved that

the experimental group's substantial gains whether in vocabulary acquisition or retrieval, thus indicating the efficacy of students' collaborative podcasts generation in enhancing EFL university students' vocabulary development and retrieval.

Zapata and Larenas (2020) examined the effect of Chilean EFL students' generated podcasts on their oral communication skills. Participants were nine females enrolled in a private university in Chile. The intervention lasted for one month where the participants attended four sessions to record podcasts on given topics. Then, the recorded podcasts were assessed by peers and the teacher according to a rubric measuring the speakers' vocabulary, grammar, fluency, pronunciation and communication effectiveness. The study tools were a podcast assignment, a rubric for measuring the students' oral skills and a focus group. Results revealed that involving the students in podcast generation tasks improved their oral communicative ability. It was, also, noticed that the participants' pronunciation and fluency substantially developed due to the intervention.

Cadena-Aguilar and Álvarez-Ayure (2021) conducted a study in Colombia. The study purpose was examining the impact of EFL university students' use of self- and peer- assessments of the podcasts they created on their speech comprehensibility. Participants were eighteen students, and the intervention lasted for five months. Throughout the experiment, a blended learning approach was adopted where the intervention took place in face-to-face classroom interaction for twenty hours and online for twenty hours as well. Participants were encouraged to peer and self-assess the speaker's comprehensibility level in each generated podcast. To obtain the study results, the researchers analyzed the learners' logs, the students' generated podcasts as well as their responses to a questionnaire. Results indicated that participants had significant gains in their speech comprehensibility after the intervention as compared to their speech comprehensibility prior to the experiment implementation. Therefore, it was concluded that self- and peer-assessment of the podcasts created by the participants fostered their self-regulation and enabled them to become more comprehensible during oral communication.

Basri (2021) explored the impact of listening to English podcasts on fostering Indonesian EFL university students' vocabulary acquisition. Participants were fifteen students enrolled in the third semester of the English department, and they practised listening to stories podcasts to

enrich their vocabulary. Furthermore, they were guided to listen to the podcasts three times at least per week to revisit the newly learned vocabulary. Prior to the intervention, participants took a vocabulary pre-test, and after the intervention, they took the same test to measure their vocabulary development. Results revealed that listening to podcasts significantly enhanced the participants' vocabulary.

Naeem (2022) examined the effect of listening to Google podcasts on fostering Egyptian trainee EFL teachers' listening comprehension. Participants were one hundred and seventy fourth year English majors. They listened to podcasts of Charles Dickens' novel '*Hard Times*' in extensive listening sessions for seven weeks. The study instrument was a pre-/post listening test. Results revealed that listening to podcasts fostered the participants' listening comprehension skills of literal comprehension, reasoning analysis and drawing conclusions. However, the adopted intervention was not effective in developing the participants' skills of finding evidence and making inferences. Therefore, future studies were suggested to investigate the reasons for that selective development.

VI. Studies examining reciprocal listening effectiveness in EFL classes

Yusuf (2015) explored the effect of a reciprocal listening program on promoting Egyptian EFL first year secondary school students' listening comprehension. Participants were forty-five females, and the study instrument was a pre-/post listening comprehension test. Participants practised listening comprehension throughout the implementation of the reciprocal listening program. Posttest results revealed the positive impact of the treatment on the participants' overall listening comprehension ability as well as their listening comprehension sub-skills. Therefore, it was concluded that practising reciprocal interactive listening strategies fostered the participants' ability to construct spoken texts meanings while engaging them in deeper level thinking and enhancing their active involvement.

Drood and Asl (2016) compared the effectiveness of reciprocal and non-reciprocal listening activities in enhancing Iranian EFL intermediate level learners' speaking fluency. Participants were forty students enrolled in a private language learning institute, and they were equally and randomly divided into an experimental group and a control group. Thus, each group had twenty students. Research instruments were a preliminary

English test (PET) and a pre-/post- speaking fluency test. While the control group listened to spoken texts and answered MCQs based on the assigned listening materials, the experimental group listened to the same texts but practised interactive reciprocal listening throughout the treatment. The intervention lasted for five sessions of thirty minutes each. Posttest results illustrated the experimental group's substantial speaking fluency gains, thus providing evidence for the positive effect of reciprocal interactive listening on promoting EFL learners' speaking fluency.

Dehham, Hasan and Raheem (2018) examined the influence of reciprocal listening strategies on Iraqi EFL learners' listening comprehension. Participants were sixty female fifth prep stage students. They were randomly and equally divided into a control and an experimental group; hence, each group consisted of thirty students. While the control group practised listening comprehension following the prescribed method, the experimental group students were engaged in reciprocal listening activities for nine weeks. The study instrument was a pre-/post- listening comprehension test. Posttest results proved the effectiveness of reciprocal listening strategies in promoting the experimental group's listening comprehension. Hence, it was concluded that reciprocal listening enabled the students to better make meaning of spoken texts while fostering their grammar, vocabulary and phonological skills.

Hussein and Dehham (2019) analyzed the effect of employing reciprocal listening strategies on Iraqi EFL students' speaking skills. Participants were sixty female fifth grade preparatory stage students, and they were equally and randomly divided into a control group and an experimental group. Therefore, each group comprised thirty students. A pre-/post- speaking test was used as the study instrument. While the control group practised regular speaking activities, the experimental group employed reciprocal listening activities where they predicted the content of audio texts, posed questions, clarified confusing vocabulary items and summarized the listening materials. The treatment duration was nine weeks. Posttest results highlight the experimental group's remarkable speaking progress. Therefore, it was concluded that reciprocal listening strategies enhanced the participants' speaking ability due to the interactive nature of these strategies. It was, also, concluded that reciprocal listening implementation fostered the study participants' pronunciation, vocabulary and grammatical competence.

Rokhaniyah, Utama and Marantika (2020) explored the influence of reciprocal listening activities on overcoming listening comprehension

impediments among Indonesian EFL university students. Participants were international relations majors, and the study was a two-cycle action research. Data were collected through a pre-/post- listening test that focused on measuring three listening comprehension abilities; these were (a) identifying key words, (b) identifying vocabulary items and grammatical patterns as well as (c) differentiating between English sounds. Additionally, data were gathered through a questionnaire, classroom observations and interviews. Posttest results illustrated that reciprocal listening enabled the study participants to overcome their listening comprehension barriers. Additionally, it was found that reciprocal listening activities fostered the participants' engagement. It was, also, found that reciprocal listening improved the study participants' vocabulary, grammar and ability to make meaning of spoken texts representing varied accents. Therefore, it was recommended that EFL instructors should train their students in implementing the four RL strategies to achieve better learning outcomes.

Hekmati (2022) investigated the impact of applying reciprocal listening strategies on fostering Iranian EFL medical students' understanding of films in virtual classes during the COVID-19 pandemic. Participants were fifty-four freshmen. They practised the RL four strategies as they watched the medical films in segments. These medical films included documentaries, movies and speeches related to the students' specialization. The intervention lasted for twenty-four sessions. The study was qualitative in nature, and the data were obtained through interviews and observation notes. Results indicated that reciprocal listening strategies enhanced the participants' understanding of the spoken visual texts; additionally, it was highlighted by the students that implementing these strategies promoted their linguistic proficiency level as well as their knowledge of medical terms. Therefore, future studies were recommended to be conducted on larger samples in other educational settings.

Commentary

Reviewing pertinent studies enabled the researcher to identify suitable instructional activities and techniques for designing and implementing the present study program. Additionally, the current study instruments were designed and employed in light of relevant previous studies. However, the current study is different from these studies as it aimed at developing first year EFL Biotechnology majors' HOTS, vocabulary acquisition and speaking fluency through a suggested program combining MALL and RL to audio podcasts.

Method

In the present study, the researcher followed both the Descriptive Method and the Quasi- experimental Method. The Descriptive Method was employed while reviewing relevant literature and specifying the activities and techniques to be used in the study program combining MALL and RL to podcasts to foster EFL Biotechnology students' HOTS, vocabulary acquisition and speaking fluency. It was also used while specifying the program and pre-/posttests design. The Quasi-experimental Method was employed during the experiment implementation, the tests administration, the data analysis and findings interpretation.

Participants

To conduct the current study, a study group of forty first year Biotechnology majors at MSA University was randomly chosen in the fall 2021 semester. Students' age range was between eighteen and nineteen years old, and they were taught by the researcher throughout the study three- month treatment.

Research design

The current study is mainly experimental. The pre-/posttest one study group design was adopted to achieve the study aim.

Study tools

This study employed the following five tools:

- ❖ a pre- /post-HOTS test to measure the study group's overall higher-order thinking ability as well as each higher-order thinking skill;
- ❖ a rubric for assessing the study group's overall higher-order thinking ability and each higher-order thinking skill on the pre-/post- HOTS test;
- ❖ a pre-/ post vocabulary test to measure the study group's overall vocabulary acquisition as well as their vocabulary comprehension and production;

- ❖ a pre-/post speaking fluency test; and
- ❖ a speaking fluency rubric.

The study tools can be further illustrated as follows:

A. The pre-/ post HOTS test

This test was designed by the researcher and used before the program application to assess the study group students' overall higher-order thinking ability as well as their performance in each higher-order thinking skill. As a post-test, it was used to investigate the effectiveness of the suggested program combining MALL and RL to podcasts in enhancing the study group's overall higher-order thinking ability and each of the three HOTS.

To measure the test validity, a panel of jury consisting of six TEFL and assessment specialists evaluated the test in terms of the number and difficulty level of its items as well as their appropriateness to the linguistic level of EFL first year Biotechnology majors.

The jury ensured the test validity. In addition, they added, modified and deleted some of the test items to enhance its validity. The final form of the test consisted of four sections. Each section took twenty minutes, and in each section, the students listened twice to a podcast that is closely related to their major. These podcasts were accessible on and downloaded from BBC Learning English- 6-minute English website. The HOTS pre-/posttest podcasts titles were “Dog Detectors”, “Being Slim: Is it in Our Genes?”, “Can Jelly Fish Help Us Solve Our Problems?” and “Corona Virus Versus Other Pandemics”.

While listening to the podcasts for the first time, students were allowed to take notes if they wanted to on a separate blank sheet of paper. Then, after listening to each podcast for the second time, students were asked to answer three open-ended questions measuring their HOTS. So the total number of the test questions was twelve; they were all open-ended to give the students the chance to freely display their higher-order thinking capabilities. In addition, each higher-order thinking skill was equally measured in four questions throughout the test. Students were asked to write their answers to the test questions in the spaces given on the question paper, and no separate answer sheets were provided.

Based on the test piloting results, the time allocated for the HOTS test was eighty minutes, including giving the students clear guidelines on how to take the test. The test was scored by the researcher and two other raters using a rubric out of thirty-six marks, and each of the three HOTS was marked out of twelve marks. Thus, according to the rubric, each of the test twelve open-ended questions carried three marks. A zero was given to wrong or left answers. While scoring the students' answers, their grammatical, punctuation and spelling errors were ignored as long as they could convey meaningful ideas, thus focusing on assessing the students' analysis, evaluation and creative thinking ability.

● **Test piloting**

Before administering the test on the study participants, it was piloted on a random sample of twenty first year Biotechnology undergraduates at MSA University. Results of the pilot study showed that a period of eighty minutes would provide the students with sufficient time to listen to the podcasts and answer the test twelve questions. The test duration was calculated by identifying the time taken by the fastest student to complete the test (60 minutes) and the time taken by the slowest student (100 minutes) to finish the test and dividing them by two. The pilot study, also, indicated that the students faced no difficulty comprehending the test items. The pilot study students did not receive the study treatment.

In order to measure the HOTS test reliability, it was taken by a random sample of twenty first year Biotechnology students. Two weeks later, the test was retaken by the same twenty students. The Pearson reliability coefficient between the test/ re-test scores was 0.84, which is quite high. Hence, the test proved to be reliable.

B. The HOTS rubric

Students' HOTS were scored using an analytical rubric designed by the researcher. This rubric was revised by six TEFL and assessment specialists to make sure that it was fair, clear and consistent. It was, also, reviewed to ensure its ability to adequately measure the students' HOTS. Based on the jury members' comments on the rubric initial form, the following final version of the rubric had three performance levels, and they ranged from outstanding to unsatisfactory.

Higher-Order Thinking Skill	Outstanding (3)	Average (2)	Unsatisfactory (1)
Analyzing	The student's response fully analyzes the idea under investigation.	The student's response partially analyzes the idea under investigation.	The student's response minimally analyzes the idea under investigation.
Evaluating	The student's response accurately evaluates the highlighted idea, concept or phenomenon and provides three or more convincing reasons to justify his/ her judgment.	The student's response partially evaluates the highlighted idea, concept or phenomenon and provides two convincing reasons to justify his/ her judgment.	The student's response minimally evaluates the highlighted idea, concept or phenomenon and provides one convincing reason to justify his/ her judgment.
Creating	The student's response suggests three or more innovative original alternatives/ ideas.	The student's response suggests two innovative original alternatives/ ideas.	The student's response suggests one innovative original alternative/ idea.

According to the above rubric, the students' higher-order thinking skills were assessed, thus receiving three marks if the performance was outstanding, two marks if it was average and one mark if it was unsatisfactory. A zero was given if the student did not attempt the question. As the test consisted of twelve questions, this rubric was employed to assess the students' answers to the test questions.

In the light of the rubric final version, answers of the experimental group students to the HOTS pre-/posttest were marked by the researcher and two more scorers who were trained in using this rubric prior to conducting the experiment. In addition, to ensure the inter-rater reliability, Cronbach's Alpha was calculated, and it was 0.82, which is significant at 0.01 level. Furthermore, the average of the three raters' scores was obtained for each student's overall higher-order thinking ability as well as the three HOTS.

C. The pre-/post vocabulary test

This test was designed by the researcher to assess the study group students' vocabulary prior to the program implementation. As a post-test, it was used to investigate the impact of the suggested program integrating MALL and RL to podcasts on fostering the study group's' overall vocabulary acquisition as well as vocabulary comprehension and production.

The test first version was given to a panel of jury consisting of six TEFL and assessment specialists to make sure that it was valid. They were asked to evaluate the test items and their adequacy to first year Biotechnology students' EFL linguistic level.

The panel of jury ensured the test validity. Additionally, they modified some distractors in the MCQs to make them challenging enough, and they, also, suggested giving the first letter of each vocabulary item as a clue to help the students produce them as they supplied the missing vocabulary in given sentences. The test final version had two parts: vocabulary comprehension and production, and each part had twenty-five items with a total of fifty items.

In part (A) of the vocabulary acquisition test, students' vocabulary comprehension was assessed through five MCQs, ten matching items and ten gap-filling items. To clarify, students were asked to select the right answer from either (a), (b) or (c); they matched the given ten words and expressions with their definitions, and they filled in the blanks in sentences with given ten words or expressions. In part (B) where students' vocabulary production was assessed, the students answered ten items where they substituted definitions with suitable words or expressions that gave nearly the same meanings. They, also, supplied seven missing words or expressions in each of the given sentences using the initials provided as clues to help them. After that, they used the verbs between brackets to rewrite given sentences as they replaced the underlined words or phrases with eight phrasal verbs that conveyed nearly the same meanings.

Based on the test piloting results, the test duration was one hour, and it included offering the students clear test taking instructions. Students answered the test on the same question paper; no separate answer sheet was provided. The test scoring was carried out by the researcher herself. Each test item carried one mark, so the test total marks were fifty, and each of the students' vocabulary comprehension and production was marked out of twenty-five. A zero was given for wrong, double or left answers. In part (B) where vocabulary production was assessed, students' errors in punctuation, spelling and grammar were disregarded as long as they were able to produce the right vocabulary item.

● **Test piloting**

The test was piloted on a random sample of twenty first year Biotechnology undergraduates before it was taken by the study group.

The test piloting process proved that the test items were adequate and doable within one hour. The test duration (one hour) was estimated by specifying the time taken by the fastest student to finish the test (45 minutes) and the time taken by the slowest student to do the test (75 minutes) and dividing both by two. Furthermore, the pilot study students were not exposed to the study intervention.

The vocabulary test/ re-test administration was followed to measure its reliability. Therefore, the same test was taken twice by twenty EFL Biotechnology students with a period of two weeks in between. The Pearson reliability coefficient was found to be 0.87, which is quite high. Thus, the test was considered reliable.

D. The pre-/post speaking fluency test

This test assessed the study group students' speaking fluency before and after the program implementation. As a pre- test, it identified the study group's speaking fluency level before the intervention. As a post-test, it measured the impact of the study suggested program on enhancing the study group's speaking fluency.

To ensure the test validity, it was examined by a jury of six TEFL and assessment specialists. The jury maintained that it was valid; furthermore, they deleted a task where the students were required to describe two pictures. They, also, stated that the test three tasks would achieve its aim without making it stressful for the test-takers. The test final version followed the ILETS test structure and consisted of three parts: introduction and general questions, long-turn questions and analytical discussions. Thus, part (A) included short response questions where the students were required to introduce themselves and talk about their daily routine, future plans, favourite sports, hobbies and meals as well as means of transportation in Egypt. Part (A) took four to five minutes. Part (B) took three to four minutes, and in this part students were asked to take longer turns to describe the healthy life style that people should adopt in terms of the eating, exercising and sleeping habits. Before talking in part (B), students were given one minute to think and make notes if they wished to; they were, also, offered some guiding points to facilitate their speaking task. In part (C), students were involved in longer discussions for four to five minutes where they discussed the causes and effects of adopting an unhealthy lifestyle; they, also, discussed the current

environmental issues of going green, recycling, pollution and global warming.

The test was taken in the form of individual interviews with the students. The students' responses to the test tasks were recorded after getting their approval. The test duration ranged from eleven to fourteen minutes per learner, including offering clear test taking directives. Using the speaking fluency test, the test was marked out of twelve.

● **Test piloting**

The test was piloted on a random sample of twenty EFL first year Biotechnology students at MSA University. Based on the pilot study, it was evident that the test took eleven to fourteen minutes per learner; additionally, the pilot study students found the test tasks manageable and appropriate to their linguistic level. Students involved in the pilot study did not receive the present study intervention.

To measure the test reliability, it was taken by a group of twenty EFL first year Biotechnology undergraduates. Then, it was retaken by the same students after two weeks. Using Pearson Correlation coefficient, the test-retest reliability was calculated, and it was 0.83. Therefore, the test was considered reliable.

E. The speaking fluency rubric

Students' speaking fluency was marked using a holistic rubric designed by the researcher. Following the remarks highlighted by six TEFL and assessment experts, the rubric final form was designed. These remarks aimed at guaranteeing the rubric fairness, objectivity and adequacy. The following is the rubric final version where four performance levels were specified, and they ranged from very good to poor.

	Very good (4)	Good (3)	Fair (2)	Poor (1)	Total
Fluency	Speech is native-like; it is consistently effortless, natural and smooth.	Speech is mostly smooth but with few hesitations, repetitions or short pauses.	Speech is slow and somewhat unnatural. Some unnecessary long pauses, repetitions and hesitations are evident.	Speech is very slow, stumbling, nervous and uncertain except for short memorized expressions. Frequent long pauses, repetitions and hesitations hinder the natural flow of ideas.	

As shown above in the rubric, the students' speaking fluency level was assessed, thus receiving four marks if the performance was very

good, three marks if it was good, two marks if it was fair and one mark if it was poor. A zero was given if the student did not attempt the question. As the test consisted of three questions, this rubric was employed to assess the students' performance in each of the three questions. Therefore, the speaking fluency test was marked out of twelve marks.

Using the rubric, the study group's speaking fluency on the pre-/posttest was assessed by the researcher and two other scorers. These scorers received enough training in using the rubric before evaluating the study group's oral fluency. To ensure inter-rater reliability, Cronbach's Alpha was calculated, and it was 0.85 (significant at 0.01 level), thus proving scoring consistency among the three raters. While assessing the study group's speaking fluency on the pre-/ posttest, the average scores were calculated after specifying the marks given by each rater for every student.

Treatment

After the study group students took their HOTS, vocabulary acquisition and speaking fluency pre-tests, they received the current study intervention through a suggested program combining MALL and RL to podcasts to develop their HOTS, vocabulary and speaking fluency. *The program components can be described as follows:*

Aim

The program aim was promoting HOTS, vocabulary acquisition and speaking fluency among Egyptian EFL first year Biotechnology students. This was achieved through engaging the study group in MALL activities and reciprocal listening to domain-specific audio podcasts throughout the intervention.

Learning objectives

By the end of this program, students were anticipated to promote their overall higher-order thinking ability, each of the three HOTS, overall vocabulary acquisition, vocabulary comprehension and production as well as speaking fluency. Specifically, they were expected to be able to (a) analyze and evaluate given ideas, (b) create novel, original ideas and solutions to solve posed problems, (c) make meaning of new unfamiliar vocabulary included in the program podcasts, (d) produce the newly acquired vocabulary in relevant contexts and (e) speak fluently without unnecessary hesitations, pauses or fillers.

Content

This program content comprised twelve audio domain-specific podcasts downloaded from and accessed on BBC Learning English, 6-minute English website and twelve relevant YouTube videos. These podcasts and videos were meticulously chosen by the researcher to be appropriate to Egyptian EFL first year Biotechnology students' linguistic level. As the researcher selected the program audio podcasts and videos, she made sure that they would be motivating and interesting for Biotechnology students. It was, also, important to check the cultural aspect of the podcasts and videos to ensure its suitability to the students' cultural background. The audio podcasts were quite intelligible as they were pronounced by native British English speakers. Additionally, the researcher made sure that the speakers' pronunciation in the selected videos was clear and intelligible enough to help the learners understand the videos content and to enable them to summarize these videos, thus recycling the newly learned vocabulary and fostering the students' speaking fluency. As the videos were watched and summarized during the formative assessment tasks, it was important to make sure that their content was closely related to the content of the audio podcasts played in each session. The content of the program can be further illustrated in the upcoming two tables:

Table (1): Titles of the program audio podcasts

Session No.	Title of the Audio Podcast
One	“COVID: One Year On”
Two	“Smart Tech and Climate Change”
Three	“Food Waste”
Four	“Curbing Our Plastic Addiction ”
Five	“The Woman whose Cells Never Die”
Six	“It Is All in the Genes”
Seven	“Saving China's Elephants”
Eight	“Diabetes”
Nine	“Is the Recycling System Broken?”
Ten	“Melting Ice Sheet: Is It Too Late?”
Eleven	“A Future without Doctors”
Twelve	“How Green Is Nuclear Energy?”

As shown in table (1), the above twelve audio podcasts were listened to and discussed by the study group throughout the program implementation. They were carefully selected on the basis of their relevance to the students' major to enhance their involvement and participation in the active meaning- making processes. Through RL to these podcasts, students practised asking and answering HOTS questions, acquired new contextualized vocabulary and promoted their speaking

fluency as they summarized the content of each podcast using naturally flowing English without undue pauses, hesitations or repetitions.

Table (2): Titles and URLs of the program YouTube videos

Session No.	Title of the Video	Video URL
One	"The Story of Corona Virus"	https://youtu.be/w5HvxsOo00E
Two	"How Tech Could Help the World Fight Climate Change"	https://youtu.be/C14LJmj2w2A
Three	"Food Waste: The Hidden Cost of the Food We Throw Out"	https://youtu.be/ishA6kry8nc
Four	"Curing Our Plastic Problem"	https://youtu.be/NvnJrH1WW98
Five	"The Immortal Cells of Henrietta Lacks"	https://youtu.be/221GbAVWhro
Six	"What Is Gene Editing and How Does It Work?"	https://youtu.be/I5_2c52OPFw
Seven	"Endangered Animals"	https://youtu.be/7k8CcAU2Lt0
Eight	"Understanding Type 2 Diabetes"	https://youtu.be/JA;Zv41iUJU
Nine	"How Recycling Works: How to Help Our Earth"	https://youtu.be/VIRVPum9cp4
Ten	"A New Climate: Greenland's Melting Ice"	https://youtu.be/Xutf2eRDcgl
Eleven	"Artificial Intelligence Gives Cancer Research a Boost"	https://youtu.be/vhUu5vwYUak
Twelve	"The Pros and Cons of Nuclear Power"	https://youtu.be/lzj6UxOtVcE

As highlighted in table (2), the program short videos were meticulously selected to be watched by the students during the formative assessment of their vocabulary production and speaking fluency in each session. The videos were selected on the basis of their relevance to the sessions topics. In addition, it was taken into consideration that the videos were interesting and suitable to the students' linguistic proficiency levels and cultural background. They were, also, selected after ensuring that the speakers in the videos used clear pronunciation and spoke at a normal pace to enable the students to easily follow them. After watching the videos in groups of four on their mobile phones, students were asked to individually practise giving a recorded summary of the video main ideas in one minute only without pauses or hesitations. Then, a random selection of representatives from some groups came to the front of the class and gave their oral summary in one minute also. The rest of the class used the rubric designed by the researcher to assess their classmates' fluency level.

Activities

Throughout the suggested program, the study group students were asked to practise various activities combining MALL and RL to podcasts. These activities were mainly carried out in groups of four and then discussed with the class as a whole.

Throughout the program sessions, students discussed pictures, podcasts and videos that were closely related to the sessions topics. At first, the discussions focused on the main ideas conveyed by these educational materials. Then, special attention was paid to promoting the study group students' HOTS, contextualized vocabulary comprehension and production as well fluent natural speaking ability.

To develop the study group students' HOTS, students were guided and monitored by the teacher as they asked and answered HOTS questions during the implementation of RL to the program podcasts. The teacher's guidance started with modeling posing HOTS questions; it, also, moved to providing the students with stem questions to help them ask questions targeting HOTS. Afterwards, as the teacher rotated among the group during the active questioning process, she offered the needed feedback until they were able to work independently with minimal guidance to analyze, evaluate and create varied ideas. Additionally, with the help of the HOTS rubric, students practised assessing their classmates' responses to the HOTS questions posed by the questioner in each group.

To develop the students' vocabulary, first they listened to the new vocabulary items as they were contextualized in the program podcasts and videos. To foster vocabulary comprehension, students' listened attentively to the definitions of the new vocabulary items at the end of each podcast. They, also, wrote down the meanings of these new vocabulary items included in each podcast in a vocabulary notebook that they kept, thus making the newly acquired terms and expressions part of their active vocabulary. Also, to enhance vocabulary comprehension, the clarifier in each group used the internet connection on his/ her mobile phone to come up with synonyms, antonyms, hyponyms, definitions and examples to enable his/ her group to better make meaning of the unfamiliar vocabulary items at hand.

To foster vocabulary production, the clarifier in each group was asked by the questioner to put the new vocabulary items in meaningful sentences of his/ her own. Additionally, at the end of each session, each student was asked to put the newly acquired words and expressions in sentences of their own in the vocabulary notebook; this was weekly assignment, and it was reviewed by the instructor at the beginning of the next session. Also, summarizing the podcasts and videos content enabled

the students to actively and purposefully produce the new vocabulary in meaningful communicative contexts. It worth noting that the newly acquired vocabulary was meaningfully produced by the learners as the questioner in each group posed varied questions and the group members answered these questions.

To promote the experimental group students' speaking fluency, they practised speaking naturally like native speakers without unnecessary hesitations, pauses or repetitions as they predicted, clarified, questioned and summarized the content of the program podcasts. They, also, used their mobile-phones to video record summaries of the podcasts and then assess their performance with the help of the speaking fluency rubric. Moreover, each session, they practised describing given relevant pictures using naturally flowing English.

Treatment duration

After the current study program had been designed, it was presented to six TEFL experts who offered their modifications and suggestions to refine it. Afterwards, two sessions were randomly selected and applied on a random sample of twenty EFL first year Biotechnology majors. Results of the program piloting proved its adequacy for the students' linguistic abilities, age and culture.

The pilot study students stated that the materials taught and activities practised during both sessions were interesting and attention-grabbing. They particularly enjoyed asking and answering HOTS questions as they provoked their thinking and involved them in the analysis and evaluation of the ideas presented in the program audio podcasts. They, also, liked using their smartphones to find creative innovative ideas relevant to the topics at hand. They maintained that they found video recording themselves while summarizing the content of the podcasts a challenging task at first, and then they enjoyed it as it fostered their self- confidence and speaking fluency while minimizing their speaking anxiety. They, also, enjoyed the content of the podcasts as they discussed topics that were closely related to their field of specialization. Furthermore, they liked the fact that the new vocabulary was presented in the context of interesting podcasts. They believed that summarizing the podcasts and the videos fostered their vocabulary acquisition and speaking fluency at the same time.

In the light of the pilot study, it was found that each session needed to be implemented over the duration of three hours to adequately carry out the session activities. The program aims, content and activities were introduced in a two-hour session. Then, the program twelve sessions were

implemented over a period of three months during the first term of the 2021- 2022 academic year. The treatment started on October 10th., 2021 and came to an end on January, 9th. 2022.

The suggested teaching strategy

The researcher adopted a suggested teaching strategy throughout the program sessions. This strategy was based on combining the RL model proposed by Macias, Aquino-Rojas, Heredia-Arboleda and Lara-Velarde (2021) and Pangaribuan's (2019) implementation steps of reciprocal teaching strategies in groups of four students. Additionally, it integrated MALL activities and RL to audio podcasts throughout the program implementation. Based on this teaching strategy, sessions consisted of pre-, during and post-listening phases. *The following is an explanation of these phases:*

I. Pre-listening in phase

- a. Teacher randomly divided the students into groups of four. As the class consisted of forty students, the teacher randomly assigned them into ten groups of four students each.
- b. In each group, the students were randomly given four cards with four assigned roles: the predictor, the clarifier, the questioner and the summarizer. Students were told that each role was going to be shifted later to the student seated on the right.
- c. Then, the teacher displayed the podcast title and images on the data show, and she asked the predictor in each group to tell his/ her classmates what he/ she thought the podcast would be about. After sharing the predictions within the group, the predictor of each group was asked to share his/ her prediction with the whole class as he/ she came to the front of the class to write the prediction on the whiteboard in the following prediction/ confirmation chart:

Prediction	Confirmed	Refuted	Evidence from the Podcast

- d. As the predictors wrote their predictions on the board, the teacher told them that they would realize whether their predictions were confirmed or refuted after listening to the podcast and getting evidence from the text confirming their correct predictions.

- e. Students were told to listen attentively to the first half of the podcast, take notes and write down any point or vocabulary item that was confusing or unclear to them. They were told that it was the role of the clarifier in each group to clear out any misunderstanding and explain confusing points or vocabulary items.

II. During listening phase

- a. Students listened to the podcasts to find out whether the predictions made prior to listening were confirmed or refuted and to find evidence from the text for confirmed predictions.
- b. The audio podcast was played in two segments, and each segment lasted for three minutes.
- c. As the students in each group listened to each segment of the podcast, they took notes. Moreover, the questioner in each group was guided by the teacher to write down comprehension checking questions at first to make sure that the students fully grasped the content of the spoken text before he/she started asking HOTS questions.
- d. The questioner was asked to spot any difficult vocabulary items and any confusing parts for the clarifier to explain them to the rest of the group.
- e. To enhance vocabulary comprehension, the clarifier was guided to use the internet connection on his/ her mobile phone to get synonyms, antonyms, hyponyms, definitions and example sentences for the unfamiliar vocabulary items. For instance, in session one, the word '*wimpy*' was unclear to some students, so the clarifier used the internet connection on his mobile phone and stated that it meant 'weak' and its antonym is 'strong'. He, also, clarified its meaning as he searched on the internet for a sentence where the word wimpy is used and found, "*This virus is wimpy. If you eat well, and take your medicine, you can easily recover from your illness.*"
- f. To foster vocabulary production, the questioner asked the clarifier in each group to put the difficult vocabulary in a sentence of his/ her own to make it active vocabulary. Hence, in session nine, the expression '*the public at large*' was unfamiliar for some students, so the clarifier in one of the groups explained -with the help of her smartphone- that it meant "the majority of people all over the

world". Then, she used it in a sentence of her own as she stated, "*The public at large are against smoking.*"

- g. Then, the teacher modeled how to ask deep-level questions focusing on the analysis and evaluation of the ideas presented in the spoken text and gave them the following stem questions to guide them while posing such questions.

Analysis Stem Questions	<ul style="list-style-type: none"> • Analyze the pros and cons of _____. • How would you analyze the factors that contribute to _____? • Compare the merits and demerits of _____. • Identify the similarities and differences between _____. • Categorize countries according to spread/ rate of _____.
Evaluation Stem Questions	<ul style="list-style-type: none"> • Among all the uses of _____ in our modern life, what is the most important and valuable use? Provide reasons to justify your choice. • How would you assess/ evaluate/ appraise the role of _____ in _____? Give reasons to support your answer. • What criteria would you use to judge the effectiveness of _____ in _____? • How would you appraise the severity/ seriousness/ significance/ danger of _____? Justify your response.

- h. As the questioners asked analysis and evaluation questions in each group, the teacher rotated and listened attentively to the posed questions to make sure that they address the first two HOTS. Teacher encouraged the rest of the group to answer these HOTS questions based on their understanding of the text. She, also, directed the students to use the internet connection on their mobile phones to find more elaborate answers to these questions.
- i. Examples of the analysis questions posed by the students were "*How would you analyze the reasons for food waste?*", and "*Analyze the reasons why elephants are considered an endangered species in China.*" in sessions three and seven respectively. Examples of the evaluation questions posed by the students were "*How would you assess the use of artificial intelligence (AI), computer models and machine learning to help store renewable energy? Give reasons to support your answer.*" and "*How would you appraise the severity of the plastic addiction problem? Provide evidence to support your answer.*" in sessions two and four respectively.

- j. Thus, in session five, for example, the questioner in one of the groups posed the analysis question, *"Analyze the medical contributions of using Henrietta Lacks' immortal cells."* to which one of his group members replied, *"Due to their exceptional qualities of replacing themselves endlessly, Henrietta's cells were used to get the polio vaccine. They were, also, used for the treatment of cancer and AIDs. Moreover, they were used in IVF."*
- k. Also, in session eight, the questioner in one of the groups posed the evaluation question, *"Evaluate the severity of the diabetes illness in the 21st. century. Provide evidence to justify your response."* to which one of his group members replied, *"Diabetes is a very severe illness in the 21st. century. If it is not controlled well, it can lead to more dangerous diseases such as heart problems, stroke, renal failure and blindness. It can, also, lower countries' economic development rates due to its huge medication and health care expenses as well as its negative impact on individuals' health and productivity."*

III. Post- listening phase

- a. Students completed the prediction/ confirmation charts with evidence from the podcasts for their confirmed predictions. For example, in session seven on gene editing, the completed chart was as follows:

Prediction	Confirmed	Refuted	Evidence from the Podcast
1. Gene editing definition	√		"It is the ability to manipulate – or control – DNA."
2. Gene editing technique	√		"It scans the DNA searching for the error. Then it uses molecular scissors to snip through both strands, which switches off the faulty gene. Or it can repair the code by inserting a healthy copy of the gene."
3. Names of scientists specialized in gene editing		√	
4. Pros of gene editing	√		"It raises the prospect of treating – even curing – some genetic diseases. For patients with blood, immune, muscle or skin disorders, it offers the possibility that their faulty cells could be removed, or changed in the lab, and then put back."

- b. To foster the students' creativity, the teacher modeled at first asking and answering creative thinking questions. She, also, offered the students some stem questions to guide the questioner in each group while posing creative thinking questions. Examples of these stem questions were as follows:

Creative Thinking Stem Questions	<ul style="list-style-type: none"> • What alternatives would you suggest to_____? • Propose/ Create a plan to_____. • What changes would make to _____? • Suggest more effective techniques to_____.
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- c. In the light of the above creative thinking stem questions, the questioner in each group was encouraged to come up with a question where the rest of the group would be involved in active search on the mobile phones for ten to fifteen minutes to come up with novel innovative ideas in response to the posed question. For instance, in sessions ten, questioners asked their group members to create plans through which governments can slow down the rate of Greenland's melting ice sheets problem. Therefore, their group members used the internet connection on their mobile phones to find out the answers from varied sources, and they stated, *"The plan will be based on monitoring CO₂ emissions and greenhouse gases resulting from industrial activities, imposing huge fines on individuals and factories that exceed the allowed limit of CO₂ emissions and greenhouse gases, constructing enormous walls to prevent [ocean water from eroding the edges of the glaciers](#) and cooling hot bedrocks."*
- d. Also, in session eleven, questioners asked their group members to propose other alternatives- apart from detecting cancer- where artificial intelligence (AI) can be used in the healthcare field. After searching for answers to this question on their mobile phones, members of different groups stated, *"AI can be used in the medical field in different ways. It can be used to improve diagnosis using chatbots. In addition, through machine learning algorithms, AI can enable doctors to identify patients who are at risk for developing certain illnesses. It can be, also, used to personalize treatment plans based on each patient's genetic profile."*

- e. The teacher guided the students in each group to use the rubric to assess their creative thinking after she modeled using that rubric to assess her own thinking.
- f. To enhance the students' speaking fluency, they were encouraged in groups of four to use their mobile phones and video record their summaries of the whole audio-podcasts in two minutes. They were guided to use naturally flowing English without unnecessary pauses, fillers or hesitations. Then, each student displayed his/ her video recordings to the rest of the group. Using the speaking fluency rubric that was explained and handed in to the students in the introductory session, each student assessed his/ her classmate's oral fluency while the teacher rotated and gave feedback when needed.
- g. To further enhance the students' speaking fluency, the teacher displayed three pictures on the data show and guided the questioner in each group to ask the rest of the group members to describe these pictures using clear English without pauses or hesitation. Each picture was described in one minute only. For example, the pictures of session twelve displayed wind power, solar power and a destroyed nuclear power plant.
- h. As members of each group described each picture in one minute only, the rest of the group commented on the clarity level of the ideas used as well as the fluency of each speaker using the given speaking fluency rubric.

Instructional aids

This program made use of the following aids:

1. the images used in the pre-listening stage to introduce the topic and enable the students to predict the content of the program audio podcasts;
2. the audio podcasts listened to and discussed throughout the program to enhance the experimental group students' HOTS, vocabulary acquisition and speaking fluency;
3. the videos watched and summarized by the students to formatively assess their vocabulary production and speaking fluency;
4. the pictures displayed on the data show and described by the students to enhance their speaking fluency and vocabulary production;
5. the vocabulary formative assessment exercises displayed on the university e-learning website;

6. the HOTS open-ended formative assessment questions displayed on the university e-learning website;
7. the handouts including the HOTS and speaking fluency rubrics; and
8. the data show that displayed the pictures, videos and varied activities.

Assessment

Throughout the program application, formative assessment was carried out as follows:

- I. *To achieve the goal of formatively assessing of the students' HOTS*, they used their mobile phones, logged into the university e-learning website and answered HOTS open-ended questions in groups of four first. Then, they shared their responses with their classmates in the form of an open class discussion. They, also, used their mobile phones to find more elaborate answers to the analysis and evaluation questions and to generate innovative ideas for the creative thinking questions. Meanwhile, the teacher rotated giving feedback only when necessary and monitoring the students' performance. After that, during the open class discussions, students assessed their classmates' responses to the HOTS questions with the help of the given HOTS rubric.
- II. *To formatively evaluate the students' vocabulary comprehension*, they answered MCQs, filled in the gaps in sentences using given words and matched vocabulary items with their definitions. Moreover, they wrote down the meanings of the new vocabulary items at the end of each session in their vocabulary notebook.
- III. *To accomplish the target of formatively assessing the students' vocabulary production*, they were asked to substitute the given definitions with the words or expressions they referred to. They, also, supplied the missing words or expressions in given sentences using the initials provided as clues to guide them. Furthermore, at the end of each session, students were required to do a home assignment where they put the newly acquired vocabulary in sentences of their own and write down these sentences in a vocabulary notebook. The teacher reviewed these sentences at the beginning of the subsequent sessions.

IV. To formatively evaluate both the students' speaking fluency and vocabulary production, students used the mobile phones, logged onto given links and watched short relevant videos. After that, they were requested to individually practise giving a recorded oral summary of the video main ideas in one minute only. Then, a random selection of representatives from some groups came to the front of the class and gave their oral summary without pauses or hesitations in one minute only. The rest of the class used the rubric designed by the researcher to assess their classmates' oral fluency level.

At the end of the intervention, summative assessment was carried out when the HOTS, vocabulary acquisition and speaking fluency posttests were taken by the study group. This summative assessment aimed at measuring the impact of the suggested program on promoting overall higher-order thinking ability, each of the three HOTS, overall vocabulary acquisition, vocabulary comprehension and production and speaking fluency among students in the study group.

Statistical analysis

After administering the HOTS, vocabulary acquisition and speaking fluency pre-posttests on the study group, the researcher used paired- samples t-tests to find out whether the study hypotheses were confirmed or refuted. Furthermore, following Dunlap's (1994) formula, the program effect size values were calculated to measure its effectiveness in promoting the study group students' HOTS, vocabulary and speaking fluency.

Results

The following were the study findings in relation to its hypotheses:

Hypothesis One: "There is a statistically significant difference between the mean scores of the study group on the HOTS pre-test and posttest in overall higher order thinking ability in favour of the posttest."

To determine the impact of the suggested program application on the study group's HOTS on the pre-.posttest, a paired sample t-test was employed. See table (3).

Table (3)
T-test results comparing the study group pre-/posttest means in overall higher-order thinking ability

Test	N	M	S.D.	D.F.	t value	Significance Level	Effect Size
Pre-test	40	14.45	1.728	39	23.53	0.01 Level	7.54
Posttest	40	24.07	1.956				Large

Table (3) revealed a statistically significant difference at 0.01 level between the study group's pre-/posttest mean scores in overall higher-order thinking ability in favor of the posttest as the calculated t- value was (23.53). Therefore, the study first hypothesis was accepted. Furthermore, the effect size value (7.54) showed the large effect of the implemented program on the study group's overall higher-order thinking ability in comparison to their HOTS on the pre-test.

The following figure demonstrates the study group's substantial improvement in overall higher-order thinking ability after the application of the suggested program as compared to their overall higher-order thinking ability before the treatment:

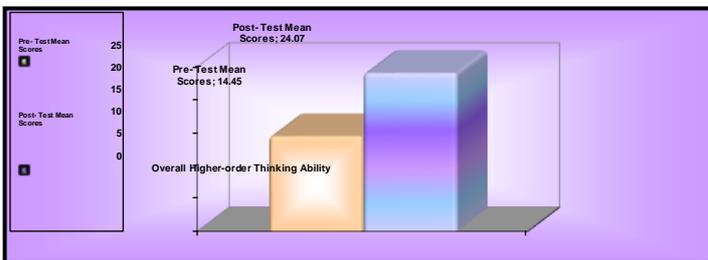


Figure (1)
Comparing the study group's pre-posttest means in overall higher-order thinking ability

Hypothesis Two: "There are statistically significant differences between the mean scores of the study group on the HOTS pre-/posttest in each higher order thinking skill in favour of the posttest."

In order to examine second hypothesis validity, paired samples t-tests were utilized. The t-test results proved the statistically significant

differences between the study group's pre-posttest means in each higher-order thinking skill in favour of the posttest. Hence, the second hypothesis was confirmed.

The upcoming table shows this statistical significance at 0.01 level. Moreover, the effect size values proved that the proposed program had a large effect on the study group students' performance in each of the three HOTS as compared to their performance in each skill on the pre-test. It is worth noting that the current program had large effect size values of (3.85), (4.22) and (6.17) on the study group students' analyzing, evaluating and creating skills respectively. This, in turn, proves that combining MALL activities and RL to podcasts significantly fostered EFL Biotechnology students' ability to analyze and evaluate varied concepts as well as enhanced their ability to create original innovative ideas.

Table (4)
T-tests comparing the study group's pre-/posttest means in each higher-order thinking skill

HOTS	Test	N	M	S.D.	D.F.	t value	Significance Level	Effect Size
Analyzing	Pre-test	40	4.95	1.34	39	12.01	0.01 Level	3.85
	Posttest	40	8.38	1.04				Large
Evaluating	Pre-test	40	4.90	1.34	39	13.16	0.01 Level	4.22
	Posttest	40	7.76	0.58				Large
Creating	Pre-test	40	4.57	0.91	39	19.24	0.01 Level	6.17
	Posttest	40	7.88	0.67				Large

Hypothesis Three: "There is a statistically significant difference between the study group's pre-/ posttest means in overall vocabulary acquisition in favour of the posttest."

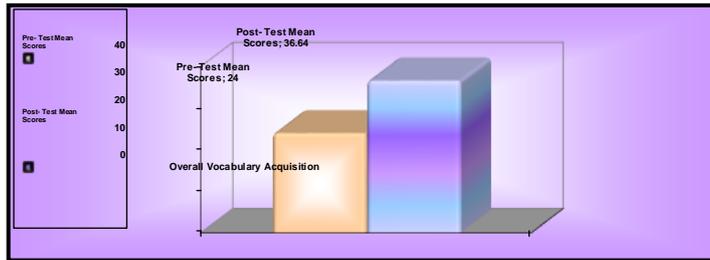
Table (5)
T-test results comparing the pre-/ posttest means of the study group in overall vocabulary acquisition

Test	N	M	S.D.	D.F.	t value	Significance Level	Effect Size
Pre-test	40	24	3.03	39	19.98	0.01 Level	6.40
Posttest	40	36.64	2.94				Large

In table (5), the t-test value (19.98) proved the significant differences between the pre-/posttest means of the study group in overall vocabulary acquisition in favour of the posttest. Therefore, the third hypothesis was affirmed. Additionally, the effect size value of (6.40)

proved that the applied program enhanced the study group students' overall vocabulary acquisition.

The next figure highlights the tangible improvement in the study group's overall vocabulary acquisition after the treatment as compared to their overall vocabulary acquisition before the intervention.



+ *noun*' business collocations.

Figure (2)
Comparing the study group's pre- posttest means in overall vocabulary acquisition

Hypothesis Four: "There are statistically significant differences between the study group's pre-/posttest means in vocabulary comprehension and production in favour of the post-test."

Table (6)
T- Test results comparing the study group's pre-/posttest means in vocabulary comprehension and production

Vocabulary Acquisition Aspect	Test	N	M	S.D.	D.F.	t value	Significance Level	Effect Size
Vocabulary Comprehension	Pre-test	40	12.74	2.13	39	16.73	0.01 Level	5.36
	Posttest	40	19.40	1.77				Large
Vocabulary Production	Pre-test	40	11.26	1.23	39	20.05	0.01 Level	6.43
	Posttest	40	17.24	1.34				0

s displayed in table (6), the t-test values of (16.73) and (20.05) proved the statistically significant differences between the study group's

pre-/post-test vocabulary comprehension and production means in favour of the posttest. Hence, the fourth hypothesis was confirmed. Furthermore, the effect size values of (5.36) and (6.43) indicated that the study program had a larger effect on fostering the study group's vocabulary production than on enhancing their vocabulary comprehension.

Hypothesis Five: "There is a statistically significant difference between the study group's pre-/posttest means in overall speaking fluency in favour of the posttest."

A paired sample t-test was conducted to compare the study group students' overall speaking fluency mean scores prior to and after the intervention. As indicated in table (7) below, the calculated t-value (24.97) and effect size value (8.00) proved the program positive influence on the study group's overall speaking fluency. Thus, the fifth hypothesis was confirmed.

Table (7)

T-test results comparing the pre-/ posttest means of the study group in overall speaking fluency

Test	N	M	S.D.	D.F.	t value	Significance Level	Effect Size
Pre-test	40	6.70	1.07	39	24.97	0.01 Level	8.00
Posttest	40	8.78	0.92				Large

The study group students' significant speaking fluency improvement on the post-test as compared to their performance on the pre- test is illustrated in the upcoming figure:

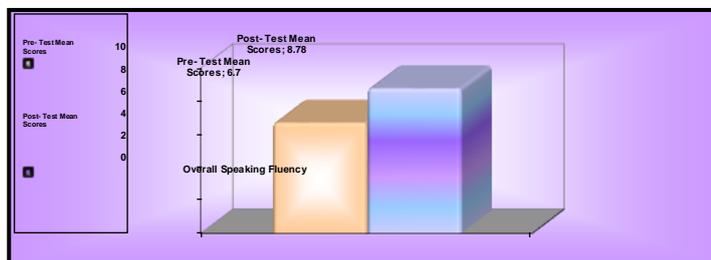


Figure (3)

Comparing the study group's pre-posttest means in overall speaking fluency

To sum up, the study five hypotheses were affirmed. The study group students substantially developed their overall higher-order thinking skill, each of the three HOTS, overall vocabulary acquisition, vocabulary comprehension and production and overall speaking fluency after the treatment as compared to their performance before the intervention, thus proving the effectiveness of the current program integrating MALL and RL to domain specific audio podcasts.

Discussion

The posttests results revealed that the applied program combining MALL and RL to podcasts was effective in promoting the study group students' overall higher-order thinking skill, each of the three HOTS, overall vocabulary acquisition, vocabulary comprehension and production as well as overall speaking fluency. Thus, the current study results are consistent with Mohamed's (2019) findings proving that implementing the four reciprocal teaching strategies can foster Egyptian undergraduates' HOTS. The present study results are, also, consistent with the findings of the studies carried out by Suwantarathip and Orawiwatnakul (2015) and Helwa (2017) indicating that MALL activities can foster EFL learners' vocabulary development. Additionally, the study results go in line with the findings of Kargozari's and Zarinkamar's (2014) study and Mashhadi's, Hayati's and Jalilifar's (2016) study illustrating that podcasts fostered EFL undergraduates' vocabulary. Furthermore, the current study results are consistent with the findings of Azeez and Albajalani (2018), Sobh (2018) and Ahmed et al. (2022) highlighting that MALL fostered EFL speaking fluency. Additionally, the present study results go in line with the findings of Pardo-Soto and Cisterna-Zenteno (2019) indicating the positive impact of video recording speeches using smartphone applications on fostering EFL learners' speaking fluency.

Throughout the treatment, several elements have resulted in the experimental group's significant growth in **overall higher-order thinking skills and each higher-order thinking skill**. Among them was the use of expressive images displayed during the pre-listening phase to arouse the students' interest, activate their prior knowledge and help them predict the content of the audio-podcasts. In fact, these images triggered the students' active involvement in the program sessions. Besides, students were guided and monitored by the teacher as they asked and answered HOTS questions during the implementation of RL to the program podcasts. The teacher's guidance started with modeling posing HOTS questions; it, also, moved to providing the students with stem questions to help them ask questions targeting HOTS. Afterwards, as the teacher rotated among the groups during the active questioning process,

she offered the needed feedback until the students were able to work independently with minimal guidance to analyze, evaluate and create varied ideas.

The purposeful use of modern technology throughout the program implementation engaged the students and motivated them to actively employ HOTS as they listened to the audio podcasts. To clarify, using the internet connection on the students' mobile phones enabled them to find more elaborate answers to the analysis and evaluation questions; it, also, helped them come up with innovative ideas for the creative thinking questions. Furthermore, the formative assessment open-ended HOTS questions- that were discussed and answered at the end of each session- helped the students' gradual HOTS development. Additionally, with the help of the HOTS rubric, students practised assessing their classmates' responses to the HOTS questions posed by the questioner in each group during and post-listening as well as during HOTS formative assessment. This rubric enabled the students to self- and peer-assess their HOTS. Furthermore, throughout RL implementation, students' collaborative learning and gradual independence helped them think for themselves, thus asking and answering deep-level questions to enhance their HOTS.

As far as **vocabulary acquisition** is concerned, throughout the treatment, vocabulary incidental learning and explicit teaching were integrated, and this, in turn, fostered the study group students' vocabulary acquisition. Such integration goes in line with the findings of the Al-Darayseh's (2014) study indicating that combining both modes of instruction fostered EFL university students' vocabulary. Thus, incidental vocabulary learning took place as the students first listened to the new vocabulary items as they were contextualized in the program podcasts and videos. Then, explicit vocabulary teaching took place as the study group students were guided by their instructor to do varied instructional activities to enhance their vocabulary comprehension and production.

To foster **vocabulary comprehension**, students were guided to listen attentively to the definitions of the new vocabulary at the end of each podcast. They, also, wrote down the meanings of these new vocabulary items included in each podcast in a vocabulary notebook that they kept, thus making the newly acquired terms and expressions part of their active vocabulary. Also, to enhance vocabulary comprehension, the clarifier in each group used the internet connection on his/ her mobile phone to come up with synonyms, antonyms, hyponyms, definitions and examples to enable his/ her group to better make meaning of the unfamiliar vocabulary items at hand. Such a practise conforms with the

findings of Chavangklang, Chavangklang, Thiamhuanok and Sathitdetkunchorn (2019) indicating that using online dictionaries to get synonyms and word meanings fostered EFL undergraduates' vocabulary comprehension. Additionally, the formative assessment exercises at the end of each session fostered the study group students' vocabulary comprehension as they answered MCQs and gap-filling items using given words and expressions and as they matched vocabulary items with their meanings.

As far as **vocabulary production** is concerned, the clarifier in each group was asked by the questioner to put the new vocabulary items in meaningful sentences of his/ her own. Also, summarizing the podcasts and videos content enabled the students to actively and purposefully produce the new vocabulary in meaningful communicative contexts. It is worth noting that the newly acquired vocabulary was meaningfully produced by the learners as the questioner in each group posed varied questions and the rest of the group members answered them. The formative assessment tasks- where the students were asked to (a) substitute the given definitions with the words or expressions they referred to and (b) supply the missing words or expressions in given sentences- fostered the study group's vocabulary production. Additionally, at the end of each session, each student was required to put the newly acquired words and expressions in sentences of their own in the vocabulary notebook; this was weekly assignment that was reviewed by the instructor at the beginning of the next session.

To enhance the study group students' **speaking fluency**, they practised speaking naturally like native speakers without unnecessary hesitations, pauses or repetitions as they predicted, clarified, questioned and summarized the content of the program podcasts. They, also, used their mobile-phones to video record summaries of the podcasts to promote their speaking fluency. During the formative assessment task, the students used their mobile phones, logged into given links, watched short videos and individually gave recorded oral summaries of the videos main ideas in one minute only, thus promoting their speaking fluency. The study group's speaking fluency was further promoted when a random selection of representatives from some groups came to the front of the class and gave their oral summaries of the videos without pauses or hesitations in one minute only. Additionally, using the speaking fluency rubric to self- and peer-assess recorded summaries of both the podcasts and the videos raised the students' consciousness of speaking fluency

aspects. This, in turn, enabled them to work hard to speak as naturally as possible, thus gradually developing their speaking fluency.

Conclusions

The following conclusions are reached in light of the study results:

1. The current study proved the effectiveness of the suggested program combining MALL and RL to podcasts in enhancing EFL first year Biotechnology majors' HOTS, vocabulary acquisition and speaking fluency.
2. There is, also, evidence that MALL activities could substantially foster EFL tertiary level students' ability to make meanings of and produce varied vocabulary items.
3. Recording summaries of podcasts and videos promotes EFL university students' ability to speak naturally without undue pauses, hesitations and repetitions.
4. Posing and answering deep level questions during RL to podcasts enhance EFL university level learners' HOTS.
5. Keeping a vocabulary notebook makes the vocabulary items active in the learners' minds and encourages them to revisit these lexical items whenever possible.
6. Podcasts and videos naturally present contextualized vocabulary to EFL learners, thus facilitating its acquisition.
7. Guiding EFL students while RL implementation and then encouraging them to gradually work on their own make them more autonomous learners who can think for themselves and monitor their progress.
8. Encouraging students to self- assess their HOTS and speaking fluency using rubrics raises their consciousness of their strengths, weaknesses and the areas they need to work on for future improvement.
9. Combining incidental learning and explicit teaching fosters EFL vocabulary acquisition among university level learners.

Recommendations

The following recommendations are made based on the study findings:

1. Innovative engaging instructional strategies should be adopted to foster EFL Biotechnology students' HOTS, vocabulary and speaking fluency.
2. EFL university level learners should be offered varied chances to speak their minds, exchange ideas, pose and answer deep level questions and use varied internet resources to foster their HOTS.

3. EFL vocabulary should be contextualized in interesting authentic written and spoken texts to facilitate its acquisition.
4. Enough time should be dedicated in classroom settings to enable EFL students to predict, clarify, question and summarize the content of varied texts.
5. EFL teachers should be trained in the implementation of varied MALL activities to enhance their students' HOTS and linguistic competence.
6. EFL university level lecturers should plan well-designed lessons integrating MALL and reciprocal teaching strategies to develop their students' critical and creative thinking skills, reading and listening comprehension as well as vocabulary acquisition.
7. Teachers' role as mentors and advisors- who are ready to offer help only when needed- should be emphasized in EFL Biotechnology classes, thus encouraging students to become more independent.
8. EFL students should practise HOTS and varied EFL skills in a relaxed engaging learning environment.
9. EFL university students' consciousness should be raised to highlight the significant role of expanding their vocabulary in achieving speaking fluency.

Suggested studies

The following research areas are worth investigating:

1. The impact of other reciprocal listening programs (involving listening to speeches, news, weather forecasts and daily conversations) in fostering EFL undergraduates' listening comprehension and pronunciation skills;
2. The effect of video podcasts reciprocal teaching on enhancing EFL university students' critical and creative thinking;
3. The effectiveness of other MALL programs in developing specialized vocabulary among engineering, pharmacy and medicine students; and
4. Comparing the effectiveness of mind maps, speech video recording and oral demonstrations in fostering EFL university and secondary stage students' speaking fluency.

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