# Multiplayer Virtual Reality-based English for Medical Purposes Learning: The Middle Eastern Students' Communicative Competence

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**ABSTRACT**

Speaking and writing skills, as the components of communicative competence, are the core of learning the language for specific purposes. The connection of students' academic and professional performance with their productive skills highlights the use of new methods of teaching and learning. To investigate the potential of virtual reality in learning English for Medical Purposes productive skills, this interventional study with control and experimental groups was conducted in flipped classrooms of a Middle East University using a mixed design with a sequential explanatory approach in 16 sessions. During the study, in addition to soliciting the participants' views, their progress and performance were assessed. In addition, the participants' perceptions were identified by conducting semi-structured interviews. Quantitative data analysis was performed descriptively and inferentially using the Wilcoxon signed-rank test and analysis of variance with repeated measures. Qualitative data analysis was done in a theme-based manner. The results showed that the participants considered the concerted practice as an effective way of learning English for Medical Purposes productive skills. Although virtual reality enhanced English for Medical purposes productive skills learning and communicative competence, the multiplayer framework of these games for concerted practice of skills significantly facilitated learning speaking and writing.

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## 1. Introduction

Using multiplayer platforms in designing serious games for English for Specific Purposes (ESP) is derived from the game-based learning theory, which provides students with the opportunity to take part in modifying the content of the games (Gaudart, 1999; Plass et al., 2015). This approach differs from conventional theories of using an application in academic language learning in which students are individually focused on pre-defined scenes. in a context separate from reality (York & deHaan, 2018). Interactive features of Virtual Reality (VR) provide the opportunity to experience realities while learning language skills (Teo et al., 2022). Practicing language skills by interacting with the world in games helps students' association in addressing their needs (Hung et al., 2018). All the features are effective in developing students' communicative competence to meet their needs (Tarrayo et al., 2021). As to learning ESP through serious games, activities with scenarios apart from life, retards learning productive skills, namely speaking and writing (Ishaq et al., 2022). To remedy these shortcomings, many VR developers have turned to designing these games based on the game-based learning theory (Ding & Shen, 2022). However, the social dimensions of this theory in teaching ESP in the Middle East need more research (Karasavvidis, 2022).

In particular, research on English for Medical Purposes (EMP) has confirmed the potential of students' collaboration for developing game-based language learning modules (Daungcharone et al., 2019). EMP speaking and writing are considered as influential skills in the academic and professional lives of students. A review of studies on teaching English comprehension skills in West and South-West Asia shows that few studies have paid attention to the context of team practice in writing serious game scenarios for teaching EMP speaking and writing and improving communication competence (e.g., EL Moudden, 2021; Gamlo, 2019). The popularity of concerted practice for learning English in Middle Eastern countries can lead to new research in EMP (Fathi & Barkhoda, 2021; Qian, 2022). In the same vein, in VR-based EMP learning, with the use of concerted platforms, special attention can be paid to the interaction among students. Along these lines, this interventional study investigates whether the multiplayer VRs can improve EMP productive skills among students, in the Middle East. Considering the multidimensional nature of game-based language learning activities, in this study, learning EMP productive skills was followed in the VR-based flipped classroom.

## 2. Literature Review

### 2.1 Game-based learning theory

Game-based theory in line with other related theories, has underlined the importance of students' presence in ESP learning. This way, attention to the academic and professional needs of students is based on an alliance. Interaction to address needs occurs at both individual and social levels. First, students' presence for practice occurs (Robles et al., 2021). Then, the flow of learning speaking and writing skills proceeds based on the change in the arrangement of

educational activities for interaction and problem solving.

Although in the Middle East, developing VR with familiar scenes for students has represented relevant dimensions of theories of ESP (Kitishat et al., 2020), most research has been conducted through single-player VR. The scene of these VRs is similar to the inert events in the books, which leaves little room for interaction (Lan, 2020). Because EMP has been launched for community care, providing conditions for incorporating the actual needs into educational technology-based practice seems indispensable. In learning EMP through educational technology, the prominent aspects of the world can be included by creating interaction among students to join efforts and generate a form of representation of entities of the world (Outemzabet & Sarnou, 2023). Negueruela-Azerola and García (2016) examined the concerted framework of game-based practice for learning ESP, emphasizing the effort to create interaction among students.

## 2.2 Productive skills of speaking and writing ESP

Students' communication with the world occurs through speaking and writing. Learning to speak and write ESP includes various skills and subskills; for example, students' knowledge and experience, ability to analyze content, environmental elements (e.g., natural scenes), and interaction (Gaffas, 2019). In particular, Widodo (2019) presents the central components of the cognitive development of learning to speak and write in the form of a guideline for the proper teaching of the skills. Meantime, the design of the game with scenes close to reality

makes the learning flow easily tied to the students' previous knowledge. Accordingly, the interaction during practice is directed to meet the needs. According to Lee et al. (2015), paying attention to these dimensions to develop EMP courses helps facilitate actual communicative competence. On the other hand, lack of attention to these components results in the untapped potential of communication and students' lack of communication competence in the world. Using the concrete environment related to the world to design game for EMP learning helps students fulfill their needs consciously.

Research shows that the ability to speak and write ESP is an indicator of the success of students during actual communication (McGrath & Liardét, 2023; Wang & Hu, 2023). These skills in EMP learning affect students' performance at a level beyond academic settings. As to the issue of improving the level of EMP speaking and writing, little research has addressed the simultaneous use of games concerning language teaching-learning theories. Eltahir et al. (2021) investigated the capacity of serious games in learning EMP among 107 male and female students by developing familiar learning environments. However, less attention was paid to students' presence to get in practicing the skills.

In Asian countries, game-based learning theory is the basis of much research on EMP learning through serious games. However, scenes of these games are developed in a single-player format apart from the realities of life. Bychkova et al. (2022) used game-based learning theory to teach EMP productive skills to 90 Russian students. To

improve the communicative competence of students, first, the realities of the world were represented through scenes of the game. Although the content of these games was adapted from the surrounding environment, each was a scene of reality that discretely addressed the topic of language learning. The synthetic form of these games gave rise to situations wherein the students could not reach an acceptable level of communicative competence for the professional field. With the emergence of multiplayer games and their introduction into university language learning, researchers sought to find the participation of students to optimize these games for ESP learning. This approach directed more attention to some needs and traits of the students in developing the games, and the rest of the characteristics remained on the sidelines. Teamworking is regarded as a desirable point of language practice for students in Asian countries; this way, concerted practice is considered one of the commonalities of these countries (Li & Campbell, 2008). In game-based EMP learning, however, less research has used combined scenario to design the games.

### 2.3 Virtual Reality

The combination of the dimensions of VRs with the real content of ESP has caused these games to be considered a serious activity in practicing English skills (Pack et al., 2020). Natural scenes from the world and the possibility of intervention in the body of serious games allow students to engage in concerted practice in an environment similar to the world. Making more additions to craft more realistic games has become the primary mission in higher education. Ramli et al.

(2020) consider multiplayer VRs a suitable platform for practicing communication skills in ESP education. Each student can have a role in the practice while exchanging their opinions to improve their communicative competence. Khazaie et al. (2021), by conducting a study in multiplayer VR-based EMP learning, underlined the presence of students with different proficiency levels to communicate for learning language skills. According to the results of their research, the circulation of knowledge in concerted practice occurs when the groups have a mixed framework so that students with higher proficiency can spread their knowledge of how to learn language skills quickly. Lantolf et al. (2018) once again say that in proposing a sociocultural theory for teaching ESP skills. However, the low level of interaction in the concerted practice of content has undermined the application of this theory in university language learning. With predefined single-player scenarios in VR design, it is not possible to provide a context for interaction between students for better understanding. Based on the game-based learning theory in language learning, correct ESP speaking and writing depends on giving students an active role. The research questions can be formulated as follows:

1. **What view do participants have about the concerted practice of EMP?**

2. **Is there any significant difference between participants' learning in practicing EMP skills through multiplayer (vs. single-user) VRs?**

3. **What are the participants' perceptions of VR-based EMP learning?**

### 3. Method

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### 3.1 Participants

Two different phases of quantitative and qualitative for teaching EMP productive skills led to the use of the mixed-methods sequential explanatory design to conduct this interventional study. The participants were selected through convenience sampling method from among 517 female (N = 279) and male (N = 238), Iranian (N = 352) and non-Iranian (N = 165; Arab, N = 44 and Urdu, N = 121) students studying medicine, dentistry and paramedicine in *Isfahan University of Medical Sciences*. They had taken EMP as a compulsory course in the first semester of 2022-2023 academic years. After obtaining the participants' consent to take part in the study, 508 participants took part in the English speaking and writing proficiency test with 30 four-choice speaking questions and two English writing activities. This test was selected from the standard Occupational English Test (OET). After determining the language skills of the participants in three levels: beginner 50-69% (n = 172), intermediate 70-89% (n = 190), and upper intermediate 90-100% (n = 146), they were assigned to the control or experimental groups using stratified random sampling. Characteristics of the participants are displayed in Table 1.

Table 1.

*Characteristics of the Participants*

| Students | Gender | | Nationality | | | Discipline | | Proficiency | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | male | female | Iranian | Non-Iranian | | M | PM | pre | I | Upper |
| | | | | Arab | Urdu | | | | | |
| | 238 | 279 | 362 | 44 | 121 | 301 | 216 | 172 | 190 | 146 |

*Note.* M = medicine; pm = paramedicine. Pre = pre-intermediate; I = intermediate; Upper = upper-intermediate.

Using the block randomization method, these participants were assigned to individual or three-member teams. A snapshot of the groups and their arrangement is shown in Figure 1.
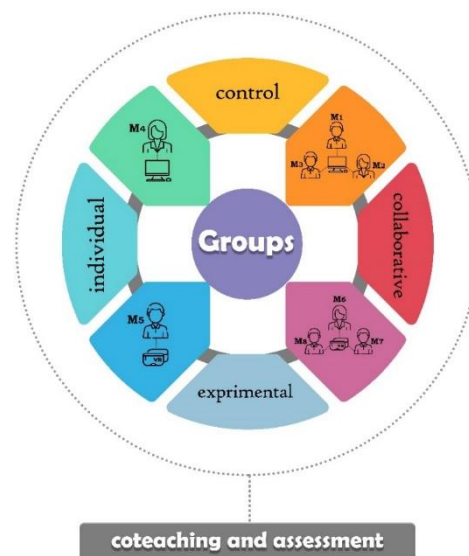


*Figure 1.* A snapshot of the groups

### 3.2 Instrumentation

**Questionnaire:** To answer the first question of the study and to solicit the view of students about the type of practice in

university language courses, the researchers developed a questionnaire to conduct a survey. This questionnaire was in the students' first language (Persian, Arabic, & Urdu). The questionnaire items were multiple-choice types with comment boxes where the participants could record their opinions in addition to choosing the options. The last item of the questionnaire was an open-ended question. The face validity and content validity of the questionnaire were confirmed by six applied linguists and content teachers in the pilot phase of the study (Taherdoost, 2016). The responses of the participants to the multiple-choice survey questions were evaluated by six professors of English language education and medical education, and the Intra-Class Correlation Coefficient was reported 0.74. A sample of the questionnaire items is shown in Figure 2.



*Figure 2*. Sample items of the survey questionnaire

**Assessment of speaking and writing progress:** The assessment was done using *NAVID's* learning management system (exam menu). Talking about pictures was used to assess participants' speaking skills. The examiner showed a set of four familiar pictures to the participant and read a number to them randomly. Each participant described the picture. If the descriptions led the examiner to choose the correct picture, five marks were given to the student.

To assess the participants' writing, the methods of assessing the transformation and completing the paragraph were used. To this end, a short paragraph was provided to each participant in each session to simplify the sentences. Besides, incomplete paragraphs were provided to each student to complete and expand their sentences. In each session, the participants' success in the writing assessment resulted in 10 marks. Six applied linguists and content teachers selected these activities; therefore, the face and content validity of the activities were confirmed (Weir, 2005). The reliability of these activities was calculated through Cronbach's alpha r = .8. A sample item of progress assessment is shown in Figure 3.



*Figure 3*. A sample item of progress assessment

**Objective Structured Video Exam (OSVE):** To complete the answer to the second question of the research, an OSVE was used to assess the communication competence of each participant in the field. This test provided the possibility to assess the participants in different stations of the virtual

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hospital. In the virtual hospital, the participants provided verbal or written solutions to the needs of standard patients. In Figure 4, an image of a virtual hospital is displayed. The categories of this instruction included clarity of answers, skill in conveying the message, correctness in the application of skills, and clinical feedback. The communication performance of each participant was recorded through the system and assessed automatically according to the instructions.
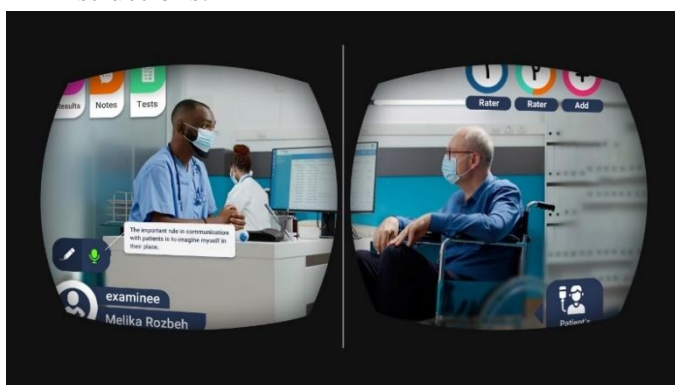


*Figure 4.* An image of the virtual hospital through VR glasses

**Interview:** To answer the third research question, the researchers designed a semi-structured interview with six questions. The questions of this interview were open-ended and students could raise new questions while answering. The questions were in the participants' first language. Sample items of the interview are shown in Figure 5.



*Figure 5.* Sample items of the questionnaire

### 3.3 Materials

Oral and written materials were selected *English for the students of medicine* (Deedari & Zia Hossaini, 2020), *English for students of dentistry* (Tahririan et al., 2021), *English for the students of nursing* (Kayhani et al., 2020), *English for students of operating room* (Akbari, 2018), *English for the students of anesthesia* (Mirza Suzani & Parvaresh, 2020) and *English* for *the students of laboratory* (Amalsaleh & Rafatbakhsh 2018). As to each session, the researchers, with the cooperation of five content professors using Adobe Connect, presented the materials for 30 minutes and recorded it as a lecture. The class link was put on the personal page of the participants in *NAVID*.

### 3.4 Procedure

This study was conducted in three stages (19 weeks) as follows:

**The first stage: Introduction of goals (first week):** At the beginning of the course, a trial session of training was held for the participants in a virtual format and the goals of the study were declared. Participants took part in training and assessment while practicing. At this stage, by sending a reminder SMS, the survey was activated for the first time so the participants could express their views.

**The second stage: Instruction, practice, and assessment (weeks 2-17):** This stage was held in 16 sessions. Each session was held in three parts:

*Part A: Instruction:* Each session began by learning pre-recorded lectures.

**Part B: Practice:** After learning, in each session, participants practiced speaking and writing EMP individually or collaboratively. In the control group, participants practiced skills individually or in groups, using online activities. In Figure 6, an online writing exercise is shown, with the first sentence placed by default at the beginning of the activity.
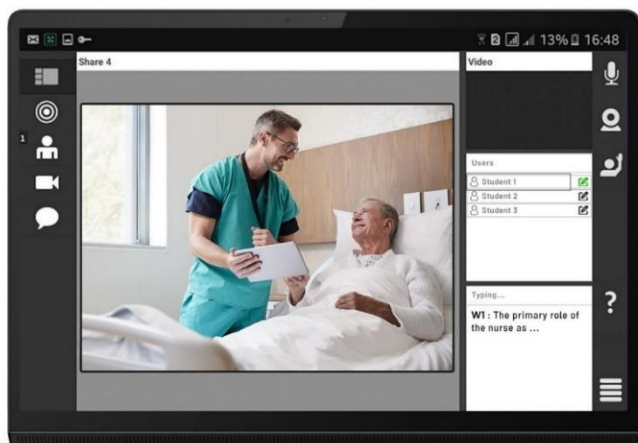


*Figure 6.* A sample of online activities

In the experimental group, participants, individually or in teams, practiced the skills through single or multiplayer VRs. This part took 20 minutes. Three-D VR models were designed using *3Ds Max* and uploaded into the Unity game engine. Participants practiced VR wearing its glasses. Figure 7 shows an example of multiplayer VR for the students of dentistry.
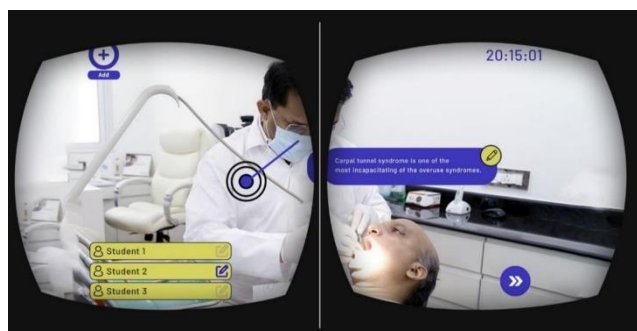


*Figure 7.* An example of VR-based writing activities

**Part C: Assessment in the classroom and the field:** After the instruction, the participants' skills were assessed for 15 minutes using the assessment activities, and a 0-20 mark was given to each student. The assessment was done by five English teachers.

Every four sessions, participants' EMP speaking and writing were assessed when each participant attempted to communicate with standard patients in the field. In each assessment, which lasted about 15 minutes, a 0-20 mark was recorded for each participant. Once again, in the eighth session, the survey link was activated.

**The third stage: Semi-structured interview (week 19):** To identify the participants' perception of the EMP course, two weeks after the end of the final session of instruction, practice, and assessment, 101 participants with the lowest and highest scores were selected from the groups. Fifty-nine participants declared their readiness to take part in the interview, of which 14 participants were purposefully selected to take part in the interview. Each selected participant was assigned a code. The main researcher, along with three teachers who knew the first language of the participants well, conducted the interviews for 25 minutes in the participants' first language. By obtaining the consent of the selected participants and assuring them to maintain confidentiality, the answers of each participant in the interviews were recorded and transcribed. The interviews were conducted until the saturation of the data, so that 4 participants from the control group and 4 participants from the case group were

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interviewed. Two general questions were asked about the way of practicing skills. To improve the quality of the interview, several steps were taken: the researchers carefully examined the interview questions; the researchers recorded their opinion during the evaluation; the conditions of the interview were explained; the interview questions were adapted to the questions raised by Harvey et al. (2015). These steps were conducted with the aim of creating credibility, transferability, dependability, and confirmability in the design and implementation of the interview. The procedure of this study is presented in Figure 8.
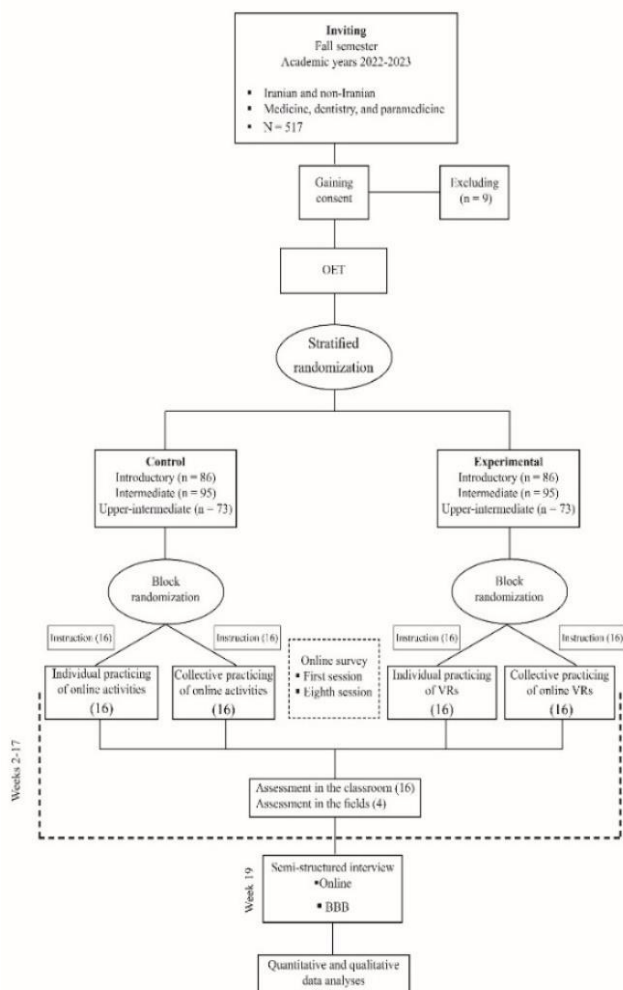
*Figure 8.* The trial profile of the study

**3.5 Quantitative data analysis**

Descriptive and inferential statistics were used in this study. The Wilcoxon signed-rank test was used to determine the significance of the difference in the view of the participants at the beginning and during the study. The repeated measures ANOVA was used to examine the progress of EMP speaking and writing during the course. The sphericity assumption was checked for the analyses. The Greenhouse–Geisser correction was used in the case for lack of sphericity ($p<.05$). The repeated measures ANOVA was used to check the participants' communicative competence in the field.

**3.6 Qualitative data analysis**

Qualitative data was done using the theme-based analysis on the data collected from the participants' answers to the opened-ended questions of the survey and interview. The method of defining themes was done inductively. For this purpose,

1) Coders carefully read participants' answers;

2) In this step, the data were carefully categorized to extract salient codes, resulting in 17 common codes;

3) The codes were converted into themes and six main themes were agreed upon to draw the initial schema;

4) Reviewing the themes, two themes became one theme;

5) The sample answers of the participants were used for clarification, along with the themes. The themes are shown in Figure 9.

*Figure. 9.* The themes of students' responses

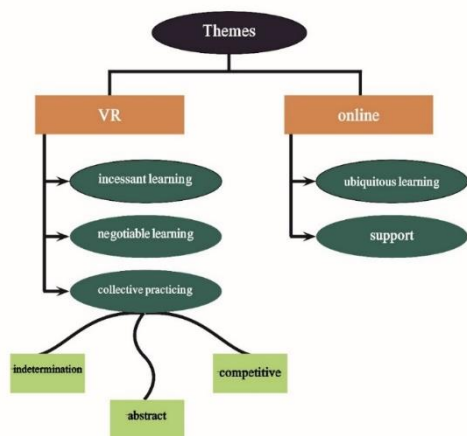The data obtained from the survey and interview participants' responses were analyzed using Qiqqa qualitative analysis software.

## 4. Results

### 4.1 Quantitative analysis

#### 4.1.1 Analysis of the participants' responses to the questionnaire

##### 4.1.1.1 Participants' view about concerted practicing

To answer the first question of the study, the findings showed that at the beginning of the study, 7 participants from the individual (5.9%) and 5 (4.2%) of the team arrangements in the control group chose the "*I am fully interested*" and "*I am interested*" options. During the study, 95 (80.5%) of participants who had practiced online activities individually and 85 (70.2%) who practiced activities collaboratively chose the "*I am fully interested*" and "*I am interested*" options. Wilcoxon's signed rank test showed that in the control group, the median ranks during the study in individual (Mdn = 4.18) and collective practicing (Mdn = 4.05) were significantly higher than the median ranks at the beginning of the study, in the individual

(Mdn = 3.04, z = -8.6, *p*<.001) and group practicing methods (Mdn = 3.05, z = -7.9, *p*<.001). At the beginning of the study, 11 participants (8.7%) and 7 (5.5%) participants in the individual arrangement of the case group and 7 (5.5%) chose the options 'I am interested' and 'I am interested'. During the study, in the individual arrangement of the group, 98 (77.8%) participants and in the collective practicing, 105 (82%) participants chose the options '*I am interested*' and '*I am interested*'. According to Wilcoxon's signed rank test, in the case group, the mean ranks during the research in individual training (Mdn = 4.02) and group (Mdn = 4.03) were significantly higher than the mean ranks at the beginning of the research, in the individual training method (Mdn = 3.09, z = -8.6, *p*<.001) and group (Mdn = 3, z = -8.7, *p* <.001).

##### 4.1.1.2 Reason(s) for being interested in collaborative practice

One of the multiple-choice items of the questionnaire asked the reason(s) for the participants' interest in collaborative practice at the beginning and during the research: "(at the beginning/during the course) if you were interested in practicing EMP speaking and writing in [...] flipped classes to collaboratively, what is your reason(s)?" Of the participants who participated in the survey, about 96% chose the options provided, and less than four percent stated their specific reason(s) for being interested (Figure 10).
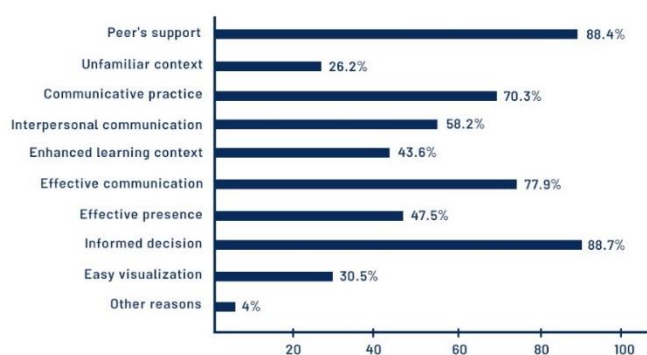
*Figure 10.* Participants' reasons for interest in concerted practicing

## 4.1.2 Analysis of the participants' progress

The effect of students' proficiency was adjusted to use repeated measures ANOVA to analyze the participants' EMP speaking ($F_{1,489} = 5252.25$, $p < .05$) and writing ($F_{1,489} = 6109.9$, $p < .05$) progress.

### 4.1.2.1 Analysis of students' speaking progress

As shown in Table 2, while the mean and standard deviation of speaking progress scores were 12.4 and 2.1 for the individual practice in the control group, the mean and standard deviation were 12.51 and 2.02 for the participants who practiced together in this group. In the experimental group, the mean and standard deviation of students who practiced the EMP speaking individually were 14.94 and 2.03. The mean score and standard deviation for the participants who practiced speaking skills through VR together were 15.01 and 1.64. According to the results, a significant difference was found between the speaking progress for the two groups ($F_{1,489} = 1832.14$, $p < .001$); that is, the VR-based practice benefitted the students more than the online practices in terms of learning EMP speaking. During the course, speaking progress was significantly different ($F_{14,476} = 31.46$, $p < .001$). The high proportion of variation can be represented by multiplayer VRs as the vehicle of practicing the skills ($\eta^2 = .78$). The practicing manner led to significant differences in the participants' progress in the groups ($F_{1,489} = 177.9$, $p < .001$). It can be inferred that students' interaction for practicing speaking

enhanced their communicative competence. The time and group interaction ($F_{14,476} = 278.8$, $p < .001$) and the time and practicing manner interaction ($F_{14,476} = 22.07$, $p < .001$) resulted in significant differences in participants' EMP speaking progress.

### 4.1.2.2 Analysis of students' writing progress

According to Table 2, the mean score and standard deviation of participants' writing as a result of individual practicing of the skill in the control group were 11.1 and 2.2. In this group, the mean score and standard deviation of participants who practiced the skills together were 12.51 and 2.02. While the mean score and standard deviation of the participants who practiced writing individually in the experimental group were 14.82 and 2.04, the mean score and standard deviation of the participants who practiced the skill together were 15.18 and 1.5. According to the results, there was a significant difference between the writing progress of the participants in the two groups ($F_{1,476} = 69.19$, $p < .001$). It can be concluded that VR by representing the world allows the participants to adapt the learning of writing to their needs by visualizing themselves in a natural environment. The high proportion of variation can be explained by the group (effect size = .12). During the course, participants' rate of writing progress increased ($F_{14,476} = 33.99$, $p < .001$). The practice method made a significant difference in the writing progress of the participants ($F_{1,489} = 922.34$, $p < .001$). This way, interaction during writing practice helps to enhance the communicative competence of the participants. The interaction of time and

group ($F_{14,476} = 302.49$, $p < .001$) and the interaction of time and practicing method ($F_{14,476} = 35.9$, $p < .001$) led to significant differences in the writing progress of the participants.

Table 2.

*The Repeated Measures ANOVA Result of Progress in Learning Productive Skills*

|  | M | SD | M | SD | Effect | F ratio | df | $\eta^2$ |
|---|---|---|---|---|---|---|---|---|
|  | online |  | VR |  |  |  |  |  |
| **Total mean (speaking)** |  |  |  |  |  |  |  |  |
| individual | 12.4 | 2.1 | 14.94 | 2.03 | Time | 31.46** | 14 | .48 |
| concerted | 12.51 | 2.02 | 15.01 | 1.64 | Time* group | 278.8** | 14 | .89 |
|  |  |  |  |  | Time*PM | 22.07** | 14 | .39 |
|  |  |  |  |  | Time*proficiency | 5.2** | 14 | .13 |
|  |  |  |  |  | Group | 1832.14** | 1 | .78 |
|  |  |  |  |  | PM | 177.9** | 1 | .26 |
|  |  |  |  |  | Proficiency | 5252.25** | 1 | .91 |
| **Total mean (writing)** |  |  |  |  |  |  |  |  |
| individual | 11.1 | 2.2 | 14.82 | 2.04 | Time | 33.9** | 14 | .5 |
| concerted | 12.51 | 2.02 | 15.18 | 1.5 | Time* group | 302.4** | 14 | .89 |
|  |  |  |  |  | Time*PM | 35.9** | 14 | .51 |
|  |  |  |  |  | Time*proficiency | 6.65** | 14 | .16 |
|  |  |  |  |  | Group | 69.19** | 1 | .12 |
|  |  |  |  |  | PM | 922.34** | 1 | .65 |
|  |  |  |  |  | Proficiency | 6109.9** | 1 | .92 |

*Note.* PM = practicing manner. **$p<.001$.

### 4.1.3 Analysis of the students' productive skills performance

After adjusting the participants' proficiency scores, repeated measures ANOVA was applied to the analysis of the two group's productive skills of speaking ($F_{1,489} = 8442.89$, $p < .05$) and writing ($F_{1,489} = 7975.24$, $p < .05$) in the fields.

#### 4.1.3.1 Analysis of students' speaking performance

According to Table 3, the mean values and standard deviations of speaking scores in the fields were 10.19 and 2.13 for individual practicing of the skill in the control group, and 12.6 and 2.06 for joint practicing. As far as the assessment scores of the experimental group was concerned, the mean values and standard deviations were 14.59 and 2.12 for the individual practicing of the speaking skills and 16.22 and 1.62 for the joint practicing of the skills.

It was revealed that the participants' speaking in the fields was significantly different during the course ($F_{3,487} = 22.46$, $p < .001$). Practicing the speaking skills through VR led to significant differences between the two groups' performance ($F_{1,489}$

= 7551.15, $p < .001$). It can be inferred that VR paves the way for the hands-on way of practicing the skills. The value of $\eta^2 = .93$ shows that the high proportion of variation can be represented by the vehicle of practicing. The way of practicing the speaking skills gave rise to significant differences between the two groups' speaking performance ($F_{1,489} = 3817.29$, $p < .001$); that is, teamwork as the derivation of communication can promote students' communicative competence. The interaction of time and group ($F_{3,487} = 90.35$, $p < .001$) as well as the interaction of time and practicing manner ($F_{3,487} = 80.12$, $p < .001$) resulted in significant differences in the levels of the groups' communicative competence.

### 4.1.3.2 Analysis of students' writing performance

Regarding the participants' writing in the fields, as shown in Table 3 in the control group, the mean values and standard deviations of the scores in individual practicing of the skill through online activities were 10.1 and 2.11 and in the concerted practicing were 12.68 and 1.98. In the experimental group, the mean score and standard deviation in individual practicing of EMP writing skill were 14.71 and 1.98. In concerted practicing of the skill through VR, the mean score and standard deviation were 16.23 and 1.62. According to the results ($F_{1,489} = 7849.19$, $p < .001$), there was a significant difference between the two groups. That is, the VR provided an arena for students to write on the scenes of the world and helped students significantly improve their communicative competence. The value of $\eta^2$ was .94, indicating a great magnitude effect size. The practicing manner also gave rise to significant differences in participants' communicative competence ($F_{1,489} = 3832.89$, $p < .001$). It can be inferred that concerted practice smooth learning of writing skills by looking at the contributions of students' gathering to individual development. The participants' writing significantly differed during the course ($F_{3,487} = 32.97$, $p < .001$). The difference between the participants' communicative competence in the fields was significant due to the interaction of time and group ($F_{3,487} = 86.64.19$, $p < .001$) as well as the interaction of time and practicing manner ($F_{3,487} = 64.59$, $p < .001$).

Table 3.

*The Repeated Measures ANOVA Result of Performance*

| | M | SD | M | SD | Effect | F ratio | df | $\eta^2$ |
|---|---|---|---|---|---|---|---|---|
| | online | | VR | | | | | |
| **Total mean (speaking)** | | | | | | | | |
| **individual** | 10.19 | 2.13 | 14.59 | 2.12 | Time | 22.46** | 3 | .12 |
| **concerted** | 12.6 | 2.06 | 16.22 | 1.62 | Time* group | 90.35** | 3 | .35 |
| | | | | | Time*PM | 80.12** | 3 | .33 |
| | | | | | Time*proficiency | 4.53** | 3 | .02 |
| | | | | | Group | 7551.15** | 1 | .93 |
| | | | | | PM | 3817.29** | 1 | .88 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Proficiency | 8442.89** | 1 | .94 |
| **Total mean (writing)** | | | | | | | | |
| **individual** | 10.1 | 2.11 | 14.71 | 1.98 | Time | 32.97** | 3 | .16 |
| **concerted** | 12.68 | 1.98 | 16.23 | 1.62 | Time* group | 86.64** | 3 | .34 |
| | | | | | Time*PM | 64.59** | 3 | .28 |
| | | | | | Time*proficiency | 8.07** | 3 | .04 |
| | | | | | Group | 7849.19** | 1 | .94 |
| | | | | | PM | 3832.89** | 1 | .88 |
| | | | | | Proficiency | 7975.24** | 1 | .94 |

*Note.* PM = practicing manner. **$p<.001$.

## 4.2 Qualitative analysis

Analyzing the participants' comments in the survey and the responses in the interview, it was found that the participants' criteria for evaluating the potential of flipped classes for learning EMP chiefly were the way of practicing skills. In view of this, in the control group, the emphasis was on *accessible learning* and *alliance*. B2 believed that:

"Interaction is one of the prominent dimensions of life."

B1 considered teachers' lectures before practicing EMP speaking and writing skills before attending the training session as preparation for better learning:

"... when the teachers presented lectures on speaking and writing, I had fewer questions in my mind."

The online practice of EMP production skills made it possible to enhance communicative competence. B1 said:

"With the possibility of being able to practice English skills for medical purposes, I felt that my communicative competence was improved..."

Participants from the experimental group emphasized communicative competence in the field and identified *uninterrupted learning*, *alliance in practice*, and *negotiable learning* as the rich potential of flipped classrooms.

## 5. Discussion

In this section, the findings are discussed in relation to the questions and the background.

I. 5.1 What view do participants have about the concerted practice of EMP?

Quantitative results from students' responses to the questionnaire revealed that various factors are effective in improving students' communicative competence to address needs in medical contexts: group practice (Robles et al., 2021); communicating with others to reach solutions (Negueruela-Azarola & García, 2016); participating in problem-solving (Lan, 2020); and attempting to help each other in advancing the practice (Outemzabet & Sarnou, 2023). The qualitative results confirmed these findings because the participants considered the concerted practice of EMP speaking and writing using multiplayer VR as effective in strengthening their communicative competence.

Students' presence to interact with peers and practice EMP production skills using VR as an influential factor in strengthening communicative competence is in line with the core of game-based learning theory (Gaudart, 1999). Plass et al. (2015) believe that when students in game-based practice can change the game for the benefit of themselves and other peers, students' ESP proficiency is at the acceptable level. Enhancing communicative competence using real-world representation occurs in flipped classrooms learning ESP (Teo et al., 2022). Individual practice with the help of digitized scenes of online activities is the leading cause of the ineffectiveness of technology-assisted university language learning courses. Although these factors have been discussed in previous research in academic language learning, less empirical research has been seriously focused on practicing setting close to reality.

For many participants, the improvement in communicative competence in teamworking was more tangible. They acquired higher levels of communicative competence and provided more solutions; for example, the number of unsolved problems among teams was minimized at the end of the semester. This result is similar to vicarious learning, in which students learn by observing the performance of their peers who have a higher level of language proficiency in the course. Similarly, teamworking can be a suitable solution to address the unfamiliar dimensions of technology-based learning. Therefore, setting the stage for interaction among students to practice EMP skills in scenes similar to the surrounding world results in

better communication competence of students. The common points of this research with previous studies can be summarized in Figure 11.
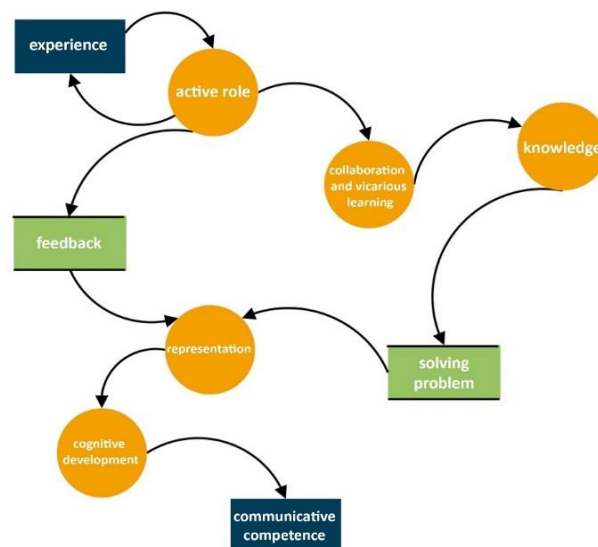
*Figure 11.* Common points of this research with previous studies

**5.2 Is there any significant difference between participants' learning and performance in practicing EMP skills through multiplayer (vs. single-user) VRs?**

A significant difference in the level of speaking and writing proficiency of the participants was obtained as a result of individual and collective practice in online and VR-based classrooms. Although by individual practicing, it is possible to achieve diverse learning, during which the needs of each student can be addressed separately, learning EMP speaking and writing together leads to strengthening the level of communication competence of students. Lantolf et al. (2018), in the project of socio-cultural theory in university language learning, reported better communication competence as the result of students' interaction, during which students with a higher proficiency level practice with their

peers who have a lower skill level to help find a solution on the needs.

Several researchers have tried to explain that interactive practice in serious game-based language learning leads to better learning (Daongcharon et al., 2019; Gamlo, 2019). If team practice in flipped EMP classrooms facilitates the communication competence of students in teams with members of different language proficiency levels the flow of knowledge from students with higher proficiency levels facilitates the communication skills of their counterparts with lower skill levels. The speaking and writing level of the participants who practiced individually in the field was much lower than their speaking and writing level in the classrooms. McGrath and Liardét (2023) justify this result by proposing the level of ESP proficiency in two potential and actual forms. Based on this, learning occurs in its actual state when ESP skills are practiced collaboratively.

## 5.3 What were the participants' perception of collective VR-based EMP learning?

From the point of view of the participants, a concerted practice of speaking and writing skills fostered rich opportunities to improve communication skills through diverse capacities: a double effort to learn, coherent planning during training, more skill to manage the training environment, and better learning. Recent research has emphasized the importance of multiplayer practice in designing serious games for university language learning (e.g., Khazaie et al., 2021). This study also showed that the multiplayer VR directed the participants to evaluate this type of practice as suitable for acquiring communicative competence.

### 5.4 Limitations of the study

The main limitations of this study were:

First, this study was formed with the population from Isfahan University of Medical Sciences. For this reason, many aspects of language learning may be hidden in VR-based flipped classrooms. Second, this study was conducted in a Middle Eastern university and was limited to Pakistani, Lebanese, and Iranian students. The percentage of Persian-speaking students was much higher than non-Iranian students. Third, this study was conducted in the field of EMP, and the application of (VR)-based flipped classrooms did not go beyond the University of Medical Sciences. Finally, the survey and interview questions were designed as tools and methods of practicing EMP skills in relation to two game-based and sociocultural learning theories.

### 5.5 Further studies

To enhance students' communicative competence, it seems necessary to conduct more extensive research with a diverse population of students (e.g., from different first languages). Meanwhile, it seems necessary to use educational technology to represent the world in teaching ESP in other academic disciplines. This study can be done with new serious games, such as metaverse.

### 6. Conclusions

In this study, the potential of VR and teamworking in flipped classrooms for learning EMP productive skills were investigated. The findings can effectively enrich the literature on the use of serious games in university language learning.

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According to the first research question, from the participants' views, various factors were influential in promoting the use of multiplayer VR in EMP learning: interactive training environment, problem-solving in concerted practicing, sharing experiences, and vicarious learning. In relation to the second research question, the results showed that the potential of concerted practice in university language learning with the help of VR underlining teamwork and establishes the standard dimensions of the practice, which encourages students to interact for better learning. As regards the third question, it was found that the participants articulated that the collective decision-making that was formed as a result of the interaction in the practice of productive skills appeared as a move towards a more accurate representation of the world in flipped classes.

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