

The Effectiveness of Using Mobile Interactive Voice Assistant Applications in Developing Academic Self-Efficacy of Saudi University Students during the COVID-19 Pandemic

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Abstract: The current research aimed to investigate the effectiveness of using mobile interactive voice assistant applications (i.e. Siri and Google Assistant) in developing Saudi university students' academic self-efficacy during the COVID-19 pandemic. The research followed the one group quasi-experimental design. It was delimited to a period of the second term during the academic year 2020-2021. Forty-eight participants completed the Arabic Academic Self-Efficacy Scale developed and validated by the author. Results indicated that the participants showed higher improvement in the mean scores of the posttest compared to the pre-test. Additionally, in the post-testing of academic self-efficacy according to grade point average variable, there were statistically significant differences between the mean scores of the participants, whereas there are no statistically significant differences between their mean scores in the post-testing of academic self-efficacy according to mobile digital skills variable. Based on the results, maximizing training courses for faculty members to optimize their digital competencies in using modern technology in teaching is highly recommended.

Keywords: Academic self-efficacy, COVID-19 Pandemic, Interactive voice assistant, Mobile Applications.

1 Introduction

Human societies are experiencing a challenging time due to the outbreak of the COVID-19 Pandemic worldwide. The outbreak of the virus has caused a state of global panic. The prevalence of this virus is classified as a pandemic according to the World Health Organization. Thus, Saudi Arabia has taken a series of measures, including suspending study at all educational institutions and stages, as well as calling for staying at home and the practice of self-isolation and social distancing. In addition, it has applied precautionary measures, e.g., partial curfews, social distancing, home quarantine, and closing educational institutions. These measures have led to the implementation of online and distant learning in various educational institutions.

Health international organizations have linked COVID-19 to the alarming rise in illness and death rates throughout the world, which has already reached critical levels [1]. Paules et al. [2] state that the outbreak of the COVID-19 Pandemic is not clear and that the situation is getting worse rapidly. This finding confirms the importance of applying precautionary measures and prevention procedures represented in quarantine and isolation of infected or potentially infected individuals. The number of infected

persons has increased, and the virus has spread at an accelerated rate all over the world, which greatly contributes to multiplying the problems that affect all groups of society [3]. As a result, the novel COVID-19 pandemic has affected all life aspects, especially education in all societies.

The staggering rate of technological progress has altered human interactions with computers. Traditional human-computer communications have mostly been physically-oriented, relying on the senses of touch, sight, and hearing [4]. Recent technological developments have evolved to include non-physical communication based on virtual or voice-initiated interactions to induce action from a particular digital device [5]. Some of the most widespread examples of mobile applications of virtual assistants to enable user-device 'conversations' include Apple's Siri, Google's Assistant, Microsoft's Cortana, and Amazon's Alexa [4, 6]. The global implementation of mobile technologies and services has earned a positive reputation, as evidenced by its success in digitally enhancing and benefiting human experiences within a wide range of environments [7, 8]. In the educational context, mobile technologies provide the foundations to build smart interactive classrooms that allow educators to adopt creative and interactive pedagogies to encourage active participation and gather real-time data that

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can highlight students' levels of engagement, understanding, and progress [9].

Academic self-efficacy is defined as an individual's confidence in one's own ability to accomplish academic activities [10]. It is highly linked to academic achievement in students. By increasing a student's academic self-efficacy, the student would be able to attain better academic performance [11]. Self-efficacy is a strong predictor of academic achievement and success [12]. Additionally, there is a considerable link between general self-efficacy and academic success among students [13].

Learning to form questions coherent enough to ensure the voice assistant acts on the correct information, for example, can develop critical thinking and organizational skills towards enhanced academic self-efficacy [14]. Modern uses of mobile technologies, such as voice assistant applications, allow for more effective education by broadening learning opportunities [15] and by increasing opportunities to develop self-efficacy through varied capabilities to search for information, take and transcribe notes, keep records, solve problems, and set reminders.

Research on using mobile learning in education in Saudi Arabia aligns with the Saudi Vision 2030, which aims to rely less on the nation's oil and more on establishing a knowledge-based economy. Students are to be equipped with knowledge, skills, and aspects of characters that can contribute not only to the economy but also to educational development and lifelong learning [16]. As such, the modernization of educational practices that foster critical thinking, self-motivation, and academic self-efficacy, and the use of sustainable learning strategies, is a priority. To sum up, the previous considerations highlight the importance of searching for adequate learning tools to develop academic self-efficacy coping with the requirements of incorporating modern technology in education, such as using mobile interactive voice applications.

2 Research Problems

The higher educational system in the Kingdom of Saudi Arabia has undergone drastic advancements over the years. The outbreak of COVID-19 resulted in a rapid transition to online teaching and learning. Although many mobile applications are widely accepted by students, knowledge of their effects on users' psychological and educational outcomes is scarce.

COVID-19's disruption to face-to-face teaching has provided a timely opportunity to explore innovative and new ways of applying technology in education [17]. With the Saudi Vision in mind, which focuses on lifelong learning and implementing modern technology in education, the author was prompted to investigate using mobile interactive voice assistant applications in higher education specifically and their contribution to academic self-efficacy during COVID-19 pandemic. Although most students are quite 'tech-savvy' and rely on voice assistants, such as Siri and Google Assistant, many reported that they were unaware of the feasibility of employing voice assistants in their studies.

Therefore, the author identified a gap in the literature and the practice that warranted investigation. In addition to the scanty research of mobile educational applications within the Middle East, it would be valuable to examine how mobile interactive voice applications develop students' academic self-efficacy, especially with the new emphasis on remote learning due to the Covid-19 Pandemic, which forced students into an unknown situation, away from typical, teacher-led classrooms.

Studies conducted globally indicated how the Internet can empower youths and enhance self-efficacy [18, 19]. They were done on using mobile applications in learning in Saudi Arabia [20]. Research on using mobile applications and self-efficacy, as a combination in higher education, is rare in Saudi Arabia, despite its effectiveness in students' performance [21]. Practitioners in educational technology are highly abreast of its advancements [22]. A few studies on mobile interactive voice assistant applications in education have been recently published [23-26]. However, both research and application are still in their infancy. Despite the recent publication of these Middle Eastern studies, most published studies were in the West; research on this topic elsewhere, especially in the Middle East, remains scant. Against this background, the present research paper highlights theory and practices through investigating the effectiveness of using mobile voice interactive applications developing students' academic self-efficacy in a Saudi Arabian higher educational context during COVID-19 pandemic.

3 Research Questions

The paper seeks to answer the following questions:

1. What is the effectiveness of using mobile interactive voice assistant applications in developing academic self-efficacy of Saudi university students during the COVID-19 Pandemic?
2. What is the statistical significance of the participants' mean scores in the post-testing of academic self-efficacy according to the grade point average (GPA)?
3. What is the statistical significance of the participants' mean scores in the post-testing of academic self-efficacy according to the mobile digital skills?

4 Research Hypotheses

The research hypothesized the following:

1. There are statistically significant differences between the mean scores of the participants in the pre-post testing of academic self-efficacy favoring the post-testing.
2. There are statistically significant differences between the mean scores of the participants in the post-testing of academic self-efficacy according to the GPA.
3. There are statistically significant differences between the mean scores of the participants in the post-testing of academic self-efficacy according to the mobile digital skills.

5 Research Significance

The paper has both practical and academic contributions. The potential outcomes include developing academic self-efficacy of university students during the COVID-19 Pandemic using mobile interactive voice applications. The paper academically contributes to science as it presents a reliable instrument for measuring and assessing university students' academic self-efficacy. Results of the paper can help education stakeholders and program designers upgrade educational courses and programs for enhancing the educational process through incorporating mobile interactive applications in teaching and learning.

6 Definitions of Terms

6.1 Mobile applications

Rupnik & Krisper [27] defined mobile application as a computer software that runs on a smartphone or tablet. The confluence of information and communications technologies allows mobile applications to be developed. They provide a novel application paradigm for information systems as well as a new area of research.

6.2 Interactive voice assistant

Yadav, A., et al. [28] defined a voice assistant as the software that can conduct tasks and present various services to a person based on their stated orders. This is accomplished by a synchronous process that involves the recognition of speech patterns and then the production of synthetic speech in response.

6.3 Academic-self efficacy

Academic self-efficacy describes "a person's confidence in their abilities to organize, execute and regulate performance to attain designated types of performances (p.57)" [29].

7 Literature Review

The literature review summarizes the two bodies of research guiding this study: academic self-efficacy and the use of mobile interactive voice assistant applications in the educational domain. It is vital to understand the backgrounds of Siri and Google Assistant as front-runners in the voice assistant race and how they can be interwoven with social cognitive theory and increased academic self-efficacy.

7.1 Academic Self-Efficacy

Situated within Bandura's [30] social cognitive theoretical framework, self-efficacy refers to a person's belief in their ability to perform adequately in a given situation (see also Bandura, [31]). It is a generalized term transferable to different programs of study, including across educational settings [32]. Academic self-efficacy, more specifically, refers to the student's belief that they can perform well by

mastering academic content and processes. Indeed, the positive impacts of academic self-efficacy have been well-documented [33-36]. Academic self-efficacy plays a vital role in educational and personal growth, as it influences students' educational and occupational interests and expectations [37] and fosters students' motivation and attaining learning outcomes [14]. Highly self-efficacious students tended to use their abilities to overcome barriers to successfully complete challenging tasks [38].

Academic self-efficacy is also positively related to intrinsic value and self-regulating strategy use [39]. As such, fruitful teaching-learning experiences require high levels of self-efficacy [40]. Furthermore, students with high academic self-efficacy are more likely to approach their studies strategically through true cognitive engagement. In contrast, students with low academic self-efficacy are more likely to adopt an approach that allows them to perform at that moment but does not result in deep learning [41]. In higher education, academic self-efficacy can highly affect student persistence, motivation, and success. Robbins et al. [42] performed a meta-analysis of 109 studies across nine psychosocial and study skill constructs and discovered that academic self-efficacy has a significant role in both cumulative GPA and factual memory.

Within academic self-efficacy, achievement depends upon interactions between personal behavioral factors, such as abilities, confidence, beliefs, motivation, and environmental conditions [30]. Therefore, situational factors are vitally important for nurturing students' feelings of academic self-efficaciousness. A student could be more or less efficacious when completing particular tasks or in certain academic situations [30, 43]. According to Aufflick et al. [44], teachers increase students' self-efficacy through confidence-building tasks. In a university context, improved attention to theory, as well as design and analysis, help improve self-efficacy, ultimately highlighting the fact that although mobile learning decreases reliance on teachers, the teachers must continue to analyze best practices and be present in the learning process to scaffold learning.

7.2 Mobile interactive voice assistant applications and education

Voice assistants are fulfilling a science fiction dream of talking to our devices. Apple's Siri and Google's Google Assistant are applications that run on speaker devices or smartphones. They pick up keywords to start a search process. Once one detects a particular keyword, it takes the user's voice and sends it to a specialized server, interpreting the user's command. The server will then supply the voice assistant with appropriate information to be read out via the user's device or provide instructions to complete tasks, such as playing a requested medium, opening an application, setting the alarm, etc. [6, 24].

With advancements in artificial intelligence and natural language processing, it has become possible for the information to be accessed more quickly via Intelligent Personal Assistants (IPAs), which operate using automatic

speech recognition. This issue requires a form of input into an application, such as voice or uploaded images and any pertinent information, to provide help and guidance to the user, all the while using natural language as part of a “conversation”. It may also lead to the IPA carrying out actions at the user’s request [23, 45]. As IPAs are currently mainly installed on smartphones, tablets, and smart speakers, they can provide a multitude of answers to their users with an element of immediacy.

Elazhary [46] discussed a more inclusive education system in Saudi Arabia, allowing students to speak their assignments, avoiding traditional note-taking, and increasing self-confidence. This system could let students with weak literacy discuss work not usually fully accessible to them. It could also help low achievers to build on their academic self-efficacy, using their voices to perform searches, albeit with well-phrased questions, to ensure an appropriate return answer. Winkler et al. [26] confirmed that voice assistants, including Google Assistant, allow users to interact in an increasingly natural way, allowing teenagers to increase problem-solving skills, thus supporting Elazhary’s [46] findings.

Nwaizugbu and Augustine [47] conducted a study to determine the impact of mobile technology on self-efficacy in education, the numerous activities students do using mobile technology to boost their self-efficacy, and the consequences on university students’ performance. The findings demonstrated that employing mobile technology for learning purposes can significantly improve students’ self-efficacy and academic performance. Nevertheless, Ogunbeni & Nwosu [48] conducted a study to investigate the academic self-efficacy and usage of mobile technology by university students. Results showed that academic self-efficacy and utilization of mobile technology-based library services had a weak positive connection (Pearson $r = 0.084$).

8 Methodologies

8.1 Research Design

This research paper investigates the effectiveness of using mobile interactive voice applications for developing academic self-efficacy of Saudi university students during COVID-19. It follows the one-group quasi-experimental design (with pre-post testing procedures) because the research procedures cannot fully control some aspects, such as students’ motivation and sampling. The treatment group was instructed using mobile interactive voice applications.

8.2 Research Participants

The participants were (48) female students in the final semester of the second year (aged 20-21) studying in a Human Resources Diploma Program at Princess Nourah Bint Abdulrahman University in Riyadh, Saudi Arabia. They

were randomly selected to participate. The author received approval for applying the research from the university. Before administering the scale, the author obtained an ethical content via persuading the participants about the study significance. They were informed that any personal information obtained from them would be confidential, and the information would only be used for scientific research goals. The participants were distributed according to the following variables, as shown in table (1).

Table 1: Distribution of the sample according to the variables.

Sample		Research sample variables	
Percentage	Frequency		
4.2%	2	Good	Grade point average (GPA)
35.4%	17	Very good	
60.4%	29	Excellent	
100%	48	Total	
20.8%	10	Good	Mobile digital skills
39.6%	19	Very good	
39.6%	19	Excellent	
100%	48	Total	

The table shows that all the research variables were represented in the light of the sample.

8.3 Instrumentation

An online Arabic Academic Self-Efficacy Scale was administered to the participants. It was a five-point Likert scale to measure the degree of the participants’ responses: strongly agree, agree, neutral, disagree, and strongly disagree. It included 21 items, and it was developed in three steps. First, the items were developed based on the existing self-efficacy theories and the widely adopted motivated strategies for learning questionnaire [49] and the general self-efficacy scale [50]. Second, content validation was conducted with input from subject matter experts, focusing on technology-based teaching methodologies. Some items were added, modified, and deleted in this stage, most often due to the lack of cultural relevance, lack of face validity, or improper phrasing. Finally, Cronbach’s alpha and average inter-item correlation were used to demonstrate the internal consistency of the scale.

Using the developed scale, the second aim was to obtain preliminary data using a small sample of university students to investigate the effectiveness of using mobile interactive voice applications (Siri and Google Assistant) for developing academic self-efficacy of Saudi university students during the COVID-19 Pandemic.

Validity of the academic self-efficacy scale:

For calculating the validity of the internal consistency between the score of each question and the total score of the

scale, the author used the correlation coefficient by administering to a survey sample consisting of (20) students, as shown in table (2).

Table 2: The validity of the internal consistency between the score of each statement and the total score of the academic self-efficacy scale (N= 20).

Statement numbers and correlation coefficients between the score of each statement and the total score of the scale						
6	5	4	3	2	1	statement No.
0.77**	0.77**	0.69**	0.75**	0.76**	0.76**	correlation coefficient
12	11	10	9	8	7	statement No.
0.77**	0.72**	0.61**	0.58**	0.76**	0.68**	correlation coefficient
18	17	16	15	14	13	statement No.
0.63**	0.71**	0.69**	0.68**	0.78**	0.78**	correlation coefficient
			21	20	19	statement No.
			0.61**	0.73**	0.62**	correlation coefficient

(**) significant at the level of 0.01

Table (2) shows that the values of correlation between the score of each statement and the total score of the scale range (0.58: 0.78). They are statistically significant at the level of (0.01), indicating the high and adequate validity of the scale, which make it valid as a research instrument for measuring the students' self-efficacy.

Reliability of the scale:

In order to verify the reliability of the questionnaire, Cronbach's Alpha formula was computed, as shown in Table (3).

Table 3: Reliability of the scale.

Cronbach's alpha coefficient	number of statements	Instrument
0.94	21	Academic self-efficacy scale

Table (3) shows a high reliability of the scale as the value of Cronbach's Alpha coefficient is statistically significant at the level of (0.01).

9 Procedures of Experimentation

Learners were motivated and prepared to use a voice assistant in carrying out the course tasks as they learned that voice assistants are used to help people complete tasks, search for information, request support, and process requests. Moreover, these voice assistants can help students in their learning process by providing rapid and effective and simplifying some classroom tasks, using devices that allow set time and reminders. Students also prefer to use the voice assistant to get the information instead of using the

computer. Thus, an internal assessment was conducted to measure the internal requirements in terms of:

- Identifying whether the applications are installed on the devices of the participants or not.
- Identifying how to use the phone as well as access and adjust its settings.

It was found that the applications used in the search (i.e., Google Assistant-Siri) are among the basic applications of the devices, whether they run on the Android or IOS operating systems. Subsequently, the participants were asked to activate them to ensure the availability of applications that required testing.

On Android devices, students have to follow these steps: Select settings, applications tool, automatic applications, assistant application, then activate the application. On IOS devices, students have to follow these steps: Assistant and voice input, assistant application, access the text displayed on the screen, access the screen, and screen flash. Assistant applications can help users according to the information shown on the screen. Some applications are consistent with the services of the operator and voice input to provide complete assistance.

Characteristics of the students were analyzed and identified. They were female students enrolled in the course of Computer Applications in Human Resources Diploma Program at Princess Nourah Bint Abdulrahman University in Riyadh, Saudi Arabia in the academic year 2020-2021. All students speak Arabic, and their ages range from 20 to 21 years old.

The applications used in the search (Google Assistant-Siri) were analyzed to identify the tasks that students could perform using these applications, such as:

- Check and send e-mail
- Online search
- Open applications
- Send messages
- Set time
- Set reminder

The applications' functions help students organize time, implement and deliver tasks on time to the course professor, comprehend the complex topics, and master the skills included in the course (Microsoft Access- Microsoft Excel).

The experimentation was implemented by assigning the students some tasks performed through (Google Assistant-Siri), such as task management, daily planning, and obtaining the answers by searching on the Internet. Figure (1) shows the mechanism of implementation.



Fig.1: The implementation mechanism of voice command

A clarification of the figure is as follows:

- First, the user gives a voice instruction to the device in the form of speech.
- The device listens carefully to the user's instructions.
- It recognizes speech/voice instruction.
- After listening, if it identifies the voice, it converts speech to text.
- Then, the program performs the task.
- If it does not identify speech, it will provide some suggestions to the user to choose which operations are required to be performed by the application.

(Google Assistant-Siri) was also used to create and set reminders for the required tasks and activities.

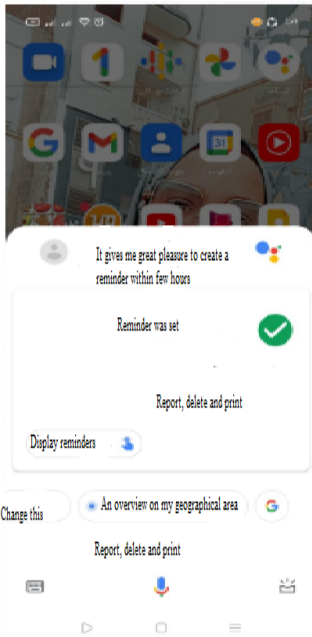


Fig.2: The process of creating reminders

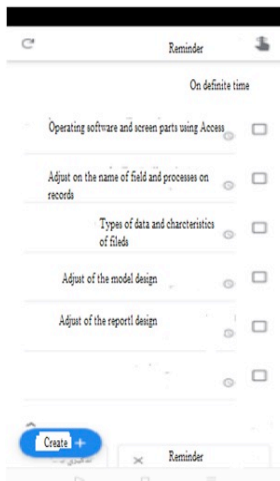


Fig.3: Showing reminders

Figure 2 and figure 3 show how to create a reminder of the tasks and activities required from the students, after accessing it through the voice assistant. This helps the students to organize and manage time in a more organized way, enabling them to perform and deliver the specific tasks and activities on time.

Open the calendar and add the required tasks inside it to help the students identify all their tasks.

March 2021

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30				

Fig.4: Accessing calendar and adding tasks

Figure 4 shows how the students can benefit from the calendar application after accessing it through the voice assistant to add tasks inside it. Furthermore, this makes it easier for the students to explore the tasks to be performed because it is considered as an organizational map for everything that is required to be accomplished. Ask students to check the e-mail and reply to the requirements of the course's professor.

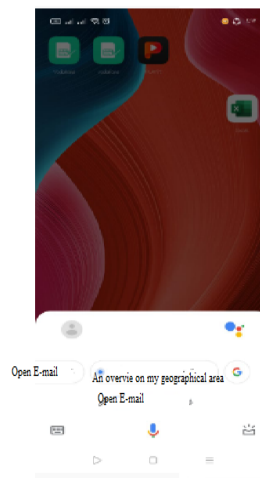


Fig.5: Accessing E-mail

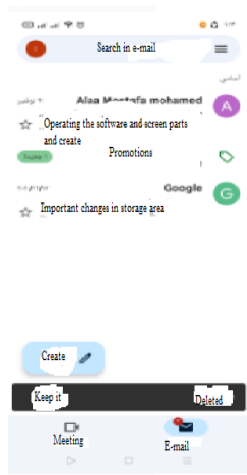


Fig.6: Checking E-mail messages

Figure 5 and figure 6 show how to access and benefit from the e-mail application after accessing it through the voice assistant. The students can check the received messages and respond to the assignments sent to them by the course professor.

Ask them to search for some advanced skills in (Microsoft Access - Microsoft Excel) software by opening the YouTube application and searching via it.

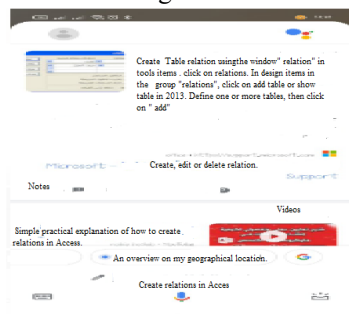


Fig.7: Accessing YouTube application

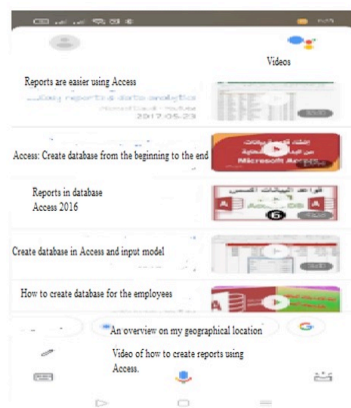


Fig.8: Search within YouTube application

Figure 7, 8 shows how to search for specific skills by opening the YouTube application after accessing it through the voice assistant. Accordingly, the students can search inside it for the skill required to be learned.

Send SMS messages to the course's professor as a type of rapid communication with the author when she is offline.

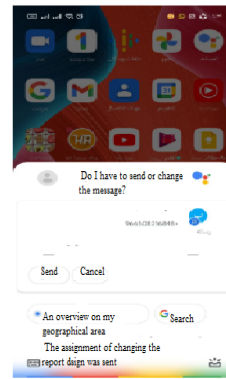


Fig.9: Sending SMS messages

Figure 9 shows how to take advantage of the SMS application after accessing it through the voice assistant. Moreover, the students can send messages that they need to respond to immediately, in case the course professor is not connected to the Internet.

The students also benefited from the speed of access to the participants' WhatsApp group, which empowered them to help each other and discuss what was presented on the Blackboard learning platform.

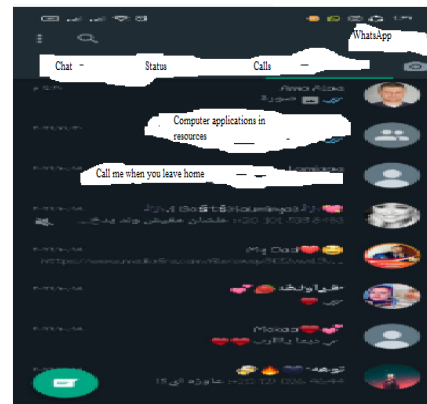


Fig.10: Accessing WhatsApp application

Figure 10 shows how to access to the group that was created on WhatsApp through the voice assistant to start discussions within it between the students and the course professor and the students with each other in order to exchange information and experiences.

10 Results

Statistical analysis

The author analyzed the obtained data using Statistical Package for the Social Sciences (SPSS) and the following statistical methods:

- Pearson Correlation coefficient for estimating the validity of internal consistency
- Cronbach's alpha coefficient for estimating reliability
- Mean
- Standard deviation
- T-Test for calculating the significance of differences between groups
- One-way ANOVA analysis of variance

Testing the first hypothesis

H 1: There are statistically significant differences between the mean scores of the participants in the pre-post testing of academic self-efficacy favoring the post-testing.

Table 4: Indication of differences between the mean scores of the participants in the pre-post testing of academic self-efficacy (N = 48).

Effect size	ETA square	Sig	(T) Value	Std. Deviation	Mean	Test	Variable
Big	0.193	0.01	2.68**	11.79	82.97	Pre	Academic self-efficacy
				8.39	86.75	Post	

Table (4) shows the first hypothesis is verified as the participants obtained higher mean scores in the post test, indicating a "t" value of (2.68). Since the extent of confidence in the results of differences attributed to the statistical significance, regardless of the effect size of those differences, the effect size is estimated using the "ETA square". The value of the ETA square was (0.193) which indicated that the effect size is large. This finding indicates that the effect size of the independent variable (mobile interactive voice assistant applications) on the dependent variable (academic self-efficacy) is high, confirming the effectiveness of mobile interactive voice assistant applications in developing academic self-efficacy of Saudi university students during the COVID-19 Pandemic.

Testing the second hypothesis

H2: There are statistically significant differences between the mean scores of the participants in the post-testing of academic self-efficacy according to GPA and digital mobile skills.

- A) Differences according to the GPA

Table 5: The one-way analysis of variance between the mean scores of female students participating in the post-test of academic self-efficacy according to GPA.

Variable	Source of variance	Sum of Squares	Df	Mean Square	F	Sig.
Academic self-efficacy	Between Groups	636.675	2	318.338	5.361**	.008
	Within Groups	2672.325	45	59.385		
	Total	3309.000	47			

Table (5) clarifies that according to GPA, a statistically significant difference between the mean scores of the participants was found (good, very good, and excellent). To find out differences in favor of any level of GPA, Post Hoc-LSD was carried out.

Table 6: Results of Post Hoc LSD test.

Excellent	Very good	Good	Mean	GPA
-8.689	-1.411		81.00	Good
-7.277*			82.41	Very good
			89.68	Excellent

(*) significant at the level of 0.05

Table (6) shows that there are statistically significant differences between the mean scores of the experimental group students in the post-testing of academic self-efficacy according to GPA (good, very good, and excellent), favoring students who obtained the (excellent) level. In other words, students with a higher GPA (i.e., excellent) achieved higher academic self-efficacy compared to those with a lower GPA.

- A) Differences according to mobile digital skills

Table 7: One-way analysis of variance between the mean scores of female students participating in the post-testing of academic self-efficacy according to mobile digital skills.

Variable	Source of variance	Sum of Squares	Df	Mean Square	F	Sig.
Academic self-efficacy	Between Groups	226.374	2	113.187	1.652	.203
	Within Groups	3082.626	45	68.503		
	Total	3309.000	47			

Table (7) shows that the participants achieved no statistically significant differences in the post-testing of academic self-efficacy according to mobile digital skills. This finding means that digital mobile skills had no impact on the level of students' academic self-efficacy developed through using mobile interactive voice assistant applications.

11 Discussion, Limitations, and Implications

The COVID-19 Pandemic has changed everyday routines in many institutions, including universities in Saudi Arabia. Enhanced reliance on technology has made it vital for teachers and students to become more tech-literate,

inventive, and creative. This paper reported upon a one-group quasi-experimental design in which the Arabic academic self-efficacy scale was developed and validated by the author and piloted to 20 participants. It was delimited to a sample of (48) female students in the final semester of the second year (aged 20-21) in a Human Resources Diploma Program at Princess Nourah Bint Abdulrahman University in Riyadh, Saudi Arabia. It was delimited to the second semester of the academic year 2020-2021. It handled using mobile interactive voice assistant applications (Siri & Google Assistant) as learning tools.

Both the quantitative and the qualitative results converged to suggest that Siri and Google Assistant were effective instructional tools for increasing students' academic self-efficacy. Students reported positive learning experiences with these interactive voice assistant applications. These findings suggested actual effectiveness, serving as promising evidence to support the use of mobile interactive voice assistant applications in teaching and learning. However, it should be noted that interactive voice assistants have the potential to operate slightly differently since they are created by a range of software developers and that future studies could be conducted to examine whether those differences may affect students' academic self-efficacy development levels.

Regardless, the results supported the benefits of using "Siri" and "Google Assistant" in teaching and learning for both teachers and students. These interactive voice assistant applications increased students' confidence in acquiring knowledge in the subjects being taught and their sense of academic achievement in learning tasks. The results go in line with Winkler et al. [26] that similar applications could be used in teaching and learning in other higher education institutions.

Academic self-efficacy plays a significant part in student persistence and motivation leading to better knowledge acquirement and an overall feeling of accomplishment and success [36]. Furthermore, the research results agree with the findings of Nwaizugbu and Augustine [47] that employing mobile technology for learning purposes increased students' self-efficacy and improved their academic performance significantly. On the contrary, the results contradicted with the results of Ogungbeni and Nwosu [48] that academic self-efficacy and utilization of mobile technology had a weak positive connection and Algahtani et al. [51] that students were generally dissatisfied with online study experiences and virtual education was a less-preferred option for education.

The mobile interactive voice applications "Siri" and "Google Assistant" come with numerous benefits (search capabilities, note-taking, transcribing, record-keeping, problem-solving as well as reminders) that should be more fully understood by educators and considered in educational pedagogic repertoires [24]. Further research includes building on previous work [14], inquiring into whether and how to formulate a straightforward question to get a coherent answer on critical thinking and cognitive organizational skills related to academic self-efficacy. Does listening to the

responses from the applications contribute to solidifying student's learning of concepts and notions? As we cannot generalize the results of such a small sample size, in one university, with students of one gender, further research is required to examine how the applications may increase self-efficacy and confidence in a student's own abilities, which, in turn, may increase motivation to learn using the software and also to learn new software. The framework of this study, and the Arabic self-efficacy scale that was developed, could be potentially useful in other sites of education and in other contexts to improve aspects of self-efficacy in education broadly.

There are, of course, limitations of this one-group, pre-test/post-test quasi-experimental study design. This study was conceived as a pilot to develop and validate an academic self-efficacy instrument in Arabic as a preliminary step for assessing the impact of IoMT voice assistant apps on students' development of academic self-efficacy. The development and successful piloting of this instrument are vital contributions to this study. Future research should focus on developing a randomized control trial that applies the intervention in this research to students from universities across Saudi Arabia, alongside a control group of students receiving standard teaching without the support of mobile interactive voice applications.

Although the sample was entirely female and therefore not representative of the Saudi population, it was relevant at the time of publishing due to the Saudi Vision 2030, aiming to empower women specifically, intending to increase their participation in the workforce and social development. In addition, previous studies show that men may be more receptive to new devices. Thus, it is necessary to study female students and how receptive they are as a cohort to innovative technologies, such as interactive voice assistants [52].

Technological developments in the current pandemic have put additional strain on teaching methods worldwide since intensive ICT adoption and smart learning have become a prerequisite in contemporary education. This paper is a brief snapshot of a unique period for a specific and small sample of female Human Resources students at a Saudi Arabian university. However, it is also a stepping stone towards a future where students use mobile interactive voice assistants in developing independent learning skills and increasing academic self-efficacy as active participants in educational innovation.

The participants showed positive results of using Siri and/or Google Assistant when completing classroom tasks. They understood their course content better after using Siri and Google Assistant; the applications affected their knowledge positively. As M7 stated: "It has a great effect on my education, especially on areas that I did not know about previously". This quote demonstrates students' perception of improved knowledge regarding the use of voice assistants in their learning processes and suggests motivation and positivity. M5 shared a similar view saying, "The applications briefed me on various detailed topics and information and gave me a feeling of more understanding

and knowledge about the topic". M8 suggested that the mobile interactive voice applications increased her cultural and educational knowledge: "The introduction of technology develops the educational and the cultural levels of the students". This finding suggests that using Siri and Google Assistant helped the students access information to build their knowledge related to the course content.

In addition to developing knowledge, students described that Siri and Google Assistant helped them accomplish or successfully complete calculations and computational tasks. As M6 stated: "I used the apps to accomplish the tasks required of me, for example, completing tasks on the Access program like the task related to dealing with backgrounds and calculations". Some students already expressed that Siri and Google Assistant were easy to use. Others discovered that they were easy to use during the pilot study. M1 stated: "Siri and Google Assistant apps make things easier by using a vocal conversation that speeds up the searching process". M2 alluded to the levels of convenience associated with these voice assistants stating, "At the beginning, it was challenging because I didn't know the application very well. It had a good impact. I think that after practicing, it got better".

The students described the importance of time management: The applications helped them organize their time and complete tasks within the required time. For example, M6 emphasized: "I benefited from it in reducing time and effort". M3 stated: "Using these applications reduces the time spent searching since you can use voice or text searches. I will use them forever". It is evident from the students' comments that there was a shift towards a higher level of perceived time management. To conclude, the participants' comments highlighted the considerable developments in their academic self-efficacy due to using mobile interactive voice applications in accomplishing learning tasks.

12 Recommendations and suggestions for further research

The present research paper provides some noteworthy practical implications. The results provoke the importance of implementing mobile interactive voice applications in higher education as learning tools. Implementing mixed-method approach studies may increase the generalizability of the results to other contexts. In addition, maximizing training courses for university teaching staff to optimize their digital competencies in using modern technology in teaching is highly recommended. More research should explore the impact of other digital learning tools on students' academic self-efficacy. The effect of other variables, e.g., gender and age, on academic self-efficacy could be explored. Further, the author recommends the replication of the current research on a larger sample to broaden the findings' verification. Furthermore, research should be conducted to assess the value of these mobile interactive voice applications in various educational contexts.

13 Conclusions

The present research paper mainly sought to investigate the effectiveness of using mobile interactive voice applications for developing academic self-efficacy of Saudi university students during the COVID-19 Pandemic in the light of GPA and mobile digital skills. The results showed that the participants achieved a higher score in the post-test of academic self-efficacy than the pre-test. In addition, statistically significant differences according to GPA were found between the mean scores of the participants in the post-testing of academic self-efficacy. In contrast, there were no statistically significant differences according to mobile digital skills. It could be concluded that using mobile interactive voice applications proved to be effective in developing Saudi university students' academic self-efficacy during the COVID-19 Pandemic.

Availability of Data and Material

The author confirms that the data supporting the findings of this study are available within the article. Raw data can be requested from the author.

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Conflict of interest:

The authors declare that there is no conflict regarding the publication of this paper.

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Appendix (1)
Academic Self-Efficacy Scale

N.	Items	Response Options				
		Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
1	I think I'll get an excellent grade.					
2	I can understand the most difficult topics.					
3	I have confidence in my ability to understand the basic concepts being taught.					
4	I think I can do an excellent job doing the tasks.					
5	I can master the skills I am taught in this course.					
6	I keep trying to do well in the course despite some challenges.					
7	I can set my goals easily.					
8	I strive to achieve the goals I set in advance.					
9	I deal efficiently with any tasks and requirements which are unexpected.					
10	I see that I can solve most of my problems if I strive to work hard enough.					
11	I can think of various solutions to any problem that I face.					
12	I think I can rely on my ability when I face any difficulties.					
13	I have the ability to analyze the tasks in order to tackle them in the simplest way possible.					
14	I calmly deal with difficult situations that I face.					

N.	Items	Response Options				
		Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
15	I doubt the quality of my performance of tasks and requirements.					
16	I can organize my time in carrying out the tasks required of me.					
17	I can count on myself to do the tasks.					
18	I easily waver from performing the required tasks before they are completed.					
19	I ask for help from others to accomplish difficult tasks.					
20	I take the initiative to help my peers solve their problems or tasks.					
21	My colleagues ask me to help them perform tasks and requirements.					