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10.4103/jehp.jehp\_1094\_20

# The effect of multi-stage mobile training based on Gagne instructional design on learning, retention, and satisfaction of health volunteers

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## Abstract:

**BACKGROUND:** One of the most important ways to acquire knowledge in the present age is education based on new technologies, including mobile learning. The purpose of this study was to investigate the effect of a multi-stage mobile training based on Gagne instructional design on learning, retention, and satisfaction of health volunteers.

**MATERIALS AND METHODS:** In this interventional study, 112 health volunteers a Health Centre in Mashhad during 2019–2020 were enrolled. The participants were randomly divided into two groups: mobile education based on Gagne model ( $n = 56$ ) and conventional lecture ( $n = 56$ ). A researcher-made questionnaire was completed by the eligible subjects before, after, and 2 months after the intervention to assess their learning, retention and satisfaction in educational methods. Face validity, content validity, and reliability of the data collection tool and model fitness indices were confirmed. Content validity of data collection tools verified by experts and its reliability was calculated to be 0.78. The collected data were analyzed in SPSS-25, using descriptive (mean and standard deviation [SD]) and analytical statistical tests (independent  $t$ -test).

**RESULTS:** The results showed that 2 days and 2 months after the intervention, learning, and retention rate was significantly higher in the mobile learning based on Gagne model group in comparison to conventional lecture group ( $P < 0.001$ ). Furthermore, the intervention group was generally satisfied with the mobile training method.

**CONCLUSION:** Mobile learning based on Gagne model is recommended for improving learning, retention among health-care workers

## Keywords:

Health workers, learning, mobile phone, personal satisfaction

## Introduction

The first decade of the twenty-first century has been called the knowledge era, and the purpose of this naming is the comprehensive development of human knowledge and awareness. In addition, due to the rapid changes that are taking shape in the instructional environment, implementation of mobile-based education systems to provide new services and

technologies in the field of teaching and learning has been raised as a basic need.<sup>[1,2]</sup>

The mobile learning system worldwide provides a suitable environment for those people who are unable to attend traditional-instructional classes due to work or personal commitments. This system uses its unique features, such as: reducing training time, facilitating the transfer of instructional subjects and education independent of time and

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**How to cite this article:** Mofrad S, Zarifsanaiey N, Bazrafkan L, Shahraki HR. The effect of multi-stage mobile training based on Gagne instructional design on learning, retention, and satisfaction of health volunteers. *J Edu Health Promot* 2021;10:219.

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Received: 01-09-2020

Accepted: 19-10-2020

Published: 30-06-2021

place, and provides potential capacity for rapid and uniform access to education for communities.<sup>[3,4]</sup>

The goal of mobile learning is not just to transfer knowledge, instead, to create active and interactive learning. In this regard, paying attention to quality standards and compliance of programs of this type of education with criteria, goals, and patterns of instructional design should not be forgotten.<sup>[5]</sup> Effective teaching begins with effective planning. Instructional design provides a systematic process for planning instructional events using instructional principles. Instructional designers apply the principles of learning education to their instructional design methods.<sup>[6]</sup>

There are different patterns in instructional design. One of these patterns is Gagne's instructional design pattern.<sup>[7]</sup> Gagne's instructional design pattern is one of the classic patterns. It incorporates the principles of the general elements of successful training, whether that education is technology-based or traditional education.<sup>[8]</sup> Gagne offers activities called instructional events which includes nine consecutive training events: (1) Attracting attention; (2) informing about instructional goals (3) calling on prior learning; (4) presenting instructional materials; (5) provide learning guidance; (6) performance tests; (7) provide feedback; (8) performance appraisal; and (9) facilitate reminiscence and transfer of learning.<sup>[8,9]</sup>

Learning in this model is considered hierarchically. This feature shows that learning some knowledge and skills; in other words, learning outcomes, are prerequisites for learning some other outcomes.<sup>[10]</sup>

The "Health Volunteers" project has been implemented throughout the country since 1993.<sup>[11]</sup> The purpose of this project is to convey health messages by health volunteers to the community in addition to teaching the necessary materials and skills to them. Health volunteers are housewives, or working women who volunteer to provide a variety of services, including health education, diagnosis, and referral of clients to health centers in the community. Health volunteers are responsible for providing education to a large part of the population covered. Therefore, choosing the appropriate teaching method and proper training of this group will increase learning in the field of health and promotion of self-care in the society, which is one of the essential goals of the World Health Organization.<sup>[12,13]</sup>

In the health system, training classes are routinely organized in health centers. However, one of the problems with this method is that learners sometimes do not attend these classes for some reason, for example, forgetting class time, not having time to attend class, commuting problems, child care problems, or family

responsibilities. Even those who attend the class may forget some of the material taught. The use of new communication technologies, such as smartphones, can overcome these problems.<sup>[14]</sup>

Various studies have been conducted to compare the effectiveness of e-learning based on the Gagne model in comparison with conventional instructional methods. In Zhang *et al.*, entitled "Assessing Learning in E-learning Environments," e-learning designed traditionally compared with e-learning designed using Gagne's instructional principles. Finally, proving the method in which Gagne's instructional principles have been used has had a positive effect on learning.<sup>[15]</sup>

Tambi *et al.*, in their research, proved that the use of the Gagne instructional design model to design the content of e-learning courses in Bioinformatics Lesson was effective in enhancing students' learning compared to designing this course without using this model.<sup>[16]</sup>

Given that no study has been conducted in this field at Shiraz University of Medical Sciences (SUMS), this study investigated the effect of instructional design based on Gagne patterns on health volunteers through mobile learning in the form of stages. In fact, this study seeks to answer the question of whether teaching by learning the most common pattern of Gagne in comparison with the traditional method affect the learning, retention, and satisfaction of health volunteers under the supervision of health center No. 2 in Mashhad in 2019–2020.

## Materials and Methods

This research was an intervention study with an intervention group (mobile education based on Gagne model) and a control group (conventional lecture method) by holding a pretest-posttest from March 2019 to February 2020. The study population was female healthy volunteers under the supervision of the Health Centre No. 2 in Mashhad. Inclusion criteria were having satisfaction, having a smartphone, age range of 18–40, and having an education level of at least a diploma. According to the statistics reported from the organization and given the mentioned criteria, the statistical population was about 210 people. Exclusion criteria included migration, lack of proper cooperation, and cancellation of the project. The sample size using the Morgan table was 112 people. The simple random sampling method was used, employing a table of random numbers. These 112 subjects attended the briefing session. Then they were randomly divided into two groups of 56 people. In both groups, a pretest was performed, and intervention a posttest was taken, and 2 months after the intervention, a follow-up test was taken [Figure 1].

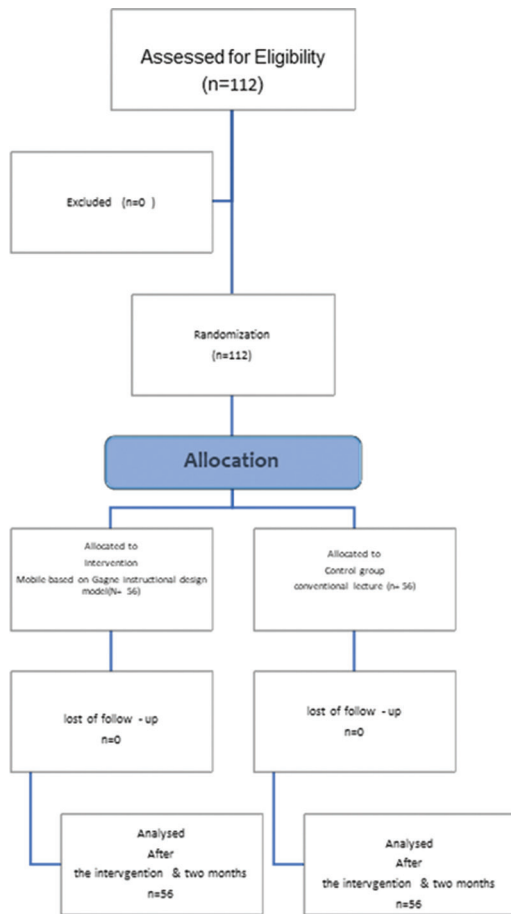


Figure 1: CONSORT flow diagram of the study

### Stages of research

After receiving the consent to research the University Research Council and obtaining ethical permission from the ethics committee and the necessary coordination with the teaching hospitals of SUMS, the researcher began the research process.

#### Step 1: Prepare instructional content

For the subject of education, the instructional content of common cancers in women was prepared using library reviews and authoritative internal articles on the website of the World Health Organization. The instructional content in the intervention group was designed and approved based on the instructional design model of Gagne under the supervision of 5 health education professors as follows:

Instructional content in the form of multimedia content (a combination of short text, video clip, photo, and audio) was sent step by step to the intervention group through one of the social networks, according to the learning path. In this social network, meetings were held interactively with questions and answers. The role of the instructor was to facilitate this stage and provided the necessary guidance to learners

and tried to encourage everyone to participate in the discussion.

The learning route, according to Gagne 9-step instructional events model, as shown in Figure 2.

In the control group, training content transferred in PowerPoint format as a class training with discussion in a training session.

#### Step 2: Intervention

After obtaining a license from the Health Department of Health Centre No. 2, a briefing session was held for health volunteers selected by random sampling. The objectives of the study were explained for the research samples. After receiving informed written consent, individuals were randomly divided into two groups: intervention (mobile education) and control (lecture). Then the pretest questionnaire was completed by the candidates. Finally, the control group received the relevant training in the form of lectures and completed the posttest questionnaire in the same session. The intervention group also received instructional content designed based on the Gagne model within 3 days through one of the social networks under mobile. Finally, they completed the posttest and satisfaction questionnaire in person 2 days after the intervention. Two months after the training, the retention questionnaire was completed by both the groups. It should be noted that the instructional content and the instructor were the same in both methods.

Data collection tools in this study included a researcher-made questionnaire to assess the level of learning and retention in the field of common cancers in women as follows:

- Demographic information on age, education and marital status)
- Learning and retention level (20 multiple-item questions, each correct answer earned one score, and the wrong answer earned zero score, and total scores were between 0 and 20). It should be noted that retention and learning questions were similar. A retest was taken before training, immediately after training in the control group, and 1 day after training in the intervention group and 2 months after the end of the training course from both groups in order to assess the retention level
- Satisfaction level (13 questions on a six-point Likert scale from completely satisfied (5) to completely dissatisfied (1), total score from a minimum of 13 to a maximum of 65), which was completed by the intervention group. In this questionnaire, questions raised about the level of satisfaction with the instructional content, the method of education, the effectiveness of the method of education, as well as general satisfaction.



Figure 2: Gagne 9-step instructional events model

Content validity of questionnaires confirmed after the design by calculating the content validity index (CVI), and content validity ratio (CVR) was reviewed and approved by eight experts. The CVR score for all items was higher than 0.75, and the CVI score was higher than 0.8 after modifying some items. Test-retest method was used to determine the reliability of the knowledge section questionnaire on 30 health volunteers with 2 weeks interval. The correlation coefficient between the two-stage results was 0.79.

The reliability of the satisfaction questionnaire was calculated to be 78% using Cronbach's alpha method.

The collected data were analyzed using SPSS 25 (SPSS Inc., Chicago, Illinois, United States), and descriptive and analytical statistics. In the descriptive statistics section, indicators such as mean and SD of scores were used. Furthermore, in the inferential statistics section, an independent *t*-test was used to compare pretest and posttest of repeated measures test.

### Ethical considerations of research

The ethics committee of SUMS has approved this project (IR.SUMS.REC.1398.1320). Basic and relevant information regarding the goals and process of

performing the work were provided to all subjects before the start of the research. Informed consent was obtained from the participants in the study. Participants were reassured that any personal information of individuals is considered confidential, and only general statistics are provided.

## Results

First, the research samples were examined in terms of quantitative and qualitative demographic variables [Table 1].

The mean age of participants in the virtual group was  $31.2 \pm 5.2$ , and in the lecture group was  $31.0 \pm 4.2$ , which there was no significant difference between the two groups ( $P = 0.78$ ). In addition, the groups under study were homogeneous in terms of other contextual variables such as education level and marital status.

Mean difference and SD of scores in the two groups of control (lecture) and intervention group (mobile multi-stage training based on Gagne mobile-based instructional design pattern) were compared. Repeated measurement test was used to compare the mean training score of research samples before and immediately after the intervention and 2 months after the intervention in both groups [Table 2].

The results of the independent *t*-test showed that there was no significant difference between the scores of the studied groups before the intervention. However, the average scores of learning and retention in the virtual group were significantly higher than the lecture group.

**Table 1: Mean and standard deviation of quantitative demographic variables in two groups of lectures and mobile-based education group**

Variable	Sub group	Control (n=56)	Virtual (n=56)	P
Education	M diploma	44 (78.6)	42 (75.0)	0.64
	F Associate Degree	3 (5.4)	6 (10.7)	
	Bachelor	9 (16.1)	8 (14.3)	
Marital status	Single	12 (21.4)	11 (19.6)	0.82
	Married	44 (78.6)	45 (80.4)	
Age		$31.0 \pm 4.2$	$31.2 \pm 5.2$	0.78

**Table 2: Comparison of between-group and intra-group of intervention and control samples in terms of learning and retention levels**

Group	Pretest	Posttest (2 days after the intervention)	Follow up (2 months after the intervention )	P		
				Time effect	Group effect	Time x group effect
Control	$11.3 \pm 1.8$	$16.4 \pm 1.2$	$14.9 \pm 1.8$	<0.001	0.02	0.01
Virtual	$11.1 \pm 1.7$	$17.1 \pm 1.2$	$15.9 \pm 1.4$	<0.001		
Between group comparison P	0.58	0.01	<0.001			

Although the results of the repeated measures test showed that the learning and retention scores in both groups were significantly higher than the pretest scores. The significance of the group effect indicates a significant effect of the intervention.

The satisfaction of the training method in the intervention group was assessed [Table 3].

In almost all items related to satisfaction, the results showed that more than 90% of the mobile-based education group was satisfied with the content and this instructional method. Moreover, they agreed that this teaching method could be complementary to the conventional lecture method. The relationship between demographic variables and satisfaction levels was examined. The results showed that there was no significant relationship between age, sex, marital status, level of education, and level of satisfaction.

## Discussion

In this study, the amount of learning, retention, and satisfaction of health volunteers who were trained in the multi-stage mobile learning method based on the Gagne model was investigated in comparison with the learning rate of retention and the satisfaction of health volunteers who have been trained traditionally and commonly. The results indicate that both learning and retention increased in both groups, but Gagne's mobile learning method has had a more significant impact on the level of learning of the intervention group regarding common cancers in women. Learners were satisfied with mobile learning based on Gagne instructional model. However, most of them wanted this teaching method to be conducted in combination with the conventional lecture method.

The results of the present study are in line with the results of most previous researches that have been conducted in the field of applying the Gagne instructional design model. Findings of the study by Berger-Estilita and Greif showed that there was a significant difference between the learning and retention of the experimental and control groups in the science lesson. Moreover, the experimental group (Gagne model multimedia training) has benefited from better learning and retention.<sup>[16]</sup>

**Table 3: The satisfaction of the training method in the intervention group**

Questions	Very satisfied (%)	Satisfied (%)	Neutral (%)	Un satisfied (%)	Very unsatisfied (%)
How satisfied are you with the instructional content	53.5	44.6	1.8	-	-
How satisfied are you with the amount of information given about common cancers in women	55.3	44.7	-	-	-
Receiving content via mobile phone was attractive and varied for me	64.3	35.7	-	-	-
In general, how satisfied are you with this type of training (by mobile phone)	44.7	42.8	-	12.5	-
I am satisfied with this way of teaching because there is no space limit (I can be educated anywhere and there is no need to attend class)	87.5	12.5	-	-	-
I am satisfied with this way of training because there is no time limit (I can be trained at any time of the day or night)	94.6	5.4	-	-	-
Step-by-step instructional training content made me learn better	50	48.2	1.8	-	-
I prefer this teaching method to the traditional teaching method (lecture)	32.1	35.7	7.1	21.4	3.6
This teaching method can be a complement to traditional teaching (lecture)	82.1	16.1	1.8	-	-
I learn more by attending class and listening to lectures	16.1	60.7	5.4	17.8	-
Mobile education (in terms of internet access) is expensive	17.8	69.7	-	12.5	-
I would like to participate in similar courses again	44.7	55.3	-	-	-
It was a pleasure for me to participate in this course	48.2	46.4	5.4	-	-

Oyarzun *et al.*, in their study, also proved that the rate of content learning in the training course implemented with a combined learning approach (traditional learning and mobile learning via mobile phone) was significantly more than learning in the traditional group. Besides, the level of students' satisfaction with learning in a combined way was significantly higher than the satisfaction of traditional group learners.<sup>[17]</sup>

Wei Hang Woo, in his study, proved that the use of Gagne's model in instructional design facilitates learners' learning. It should be noted that perhaps the reason for the greater effectiveness can be considered the Gagne's theory. Gagne's basic idea about learning is that learning any new subject requires recalling previous material. Relating new content to learners "prior knowledge, while increasing the quality of teaching and providing education, increases learners" learning.<sup>[18]</sup>

Our study also showed that Gagne's mobile-based multi-stage training method had improved the learning and retention of health volunteers after 2 months. One of the main factors influencing the effectiveness of an instructional method is applying an instructional design method suitable for shaping the teaching and learning environment. In the present study, using Gagne multi-stage design model, an active and interactive learning environment was provided for learners. This way, the attention of practitioners was drawn to the topic by asking questions, and design scenarios, and they gradually led to deep and lasting learning by recalling past learnings, practicing, and applying what was learned in different situations. On the other hand, the instructional content of the course was multimedia. Multimedia has a great appeal for learners with the right combination of media such as text, figure, image, video, and audio. It draws their attention to the instructional content and immerses the learner in the instructional process.<sup>[19]</sup>

How education is provided is also very important. In the present study, a mobile-based learning method was presented. Mobile learning is one of the learning methods that provide learners with flexibility in time and place and speed of learning. Furthermore, learners can reach the master level in knowledge and skill with practice and repetition.<sup>[20]</sup> Education in our research was provided to learners through one of the social networks. Research has shown that social networks can provide an interactive and participatory environment.<sup>[18]</sup> In the present study and according to the designed path, the learners discussed with each other shared their experiences and asked questions. Moreover, the role of the instructor in these sessions was to facilitate the learning environment, and it largely compensates for the physical separation from other learners. Therefore, Gagne's instructional design principles and mobile capabilities can be one of the ways to increase the learning and retention rate, which reduces the need for physical presence for training.

Satisfaction with education and training materials has an effective role in learning. Therefore, one of the issues we addressed in this study was the level of satisfaction of the intervention with the instructional method.<sup>[20]</sup> The results showed that most participants were satisfied with this method. One of the main benefits of multi-stage mobile learning method based on the Gagne model is that participants are able to learn from anywhere and at any time. Moreover, this method supports self-paced Learning and allows students to learn at their own pace. This approach gradually engages learners in active and interactive environment. Evidence showed that these characteristics play an important role in learners' satisfaction.<sup>[17]</sup> Encouraging collaborative learning is another feature of multi-stage mobile learning method based on the Gagne model. This approach facilities

sharing knowledge in social networks thus enabling interactions among learners and teacher.<sup>[16,18]</sup> However, the participants of our research preferred this teaching method to be combined with the in-person method. One of the strengths of face-to-face classes that cannot be ignored is a close relationship between learners and each other and the instructor. This environment can create a sense of belonging to the group. The face-to-face classes provides rapid feedback from classmates and instructors, which plays a vital role in their attitude and satisfaction.<sup>[9]</sup> Therefore, combining mobile methods with face-to-face classes can play an essential role in both learning and student satisfaction. In this regard, in-person classroom must be taken into account in the design of mobile Based Gagne instructional design courses.

Our study showed that mobile Based Gagne instructional design is an effective, and interactive method in health volunteers training. Furthermore, the results of this study can be used as a basis for conducting future research in other health groups.

This study was done only in a single health center. Regarding study limitations, further research is suggested with larger sample sizes.

## Conclusion

Investigating the findings of the present study indicates that mobile education based on Gagne multi-stage model as an active and student-centered learning strategy leads to increased learning of the learners. Explicit and understandable expression of goals, providing lessons in a structured and regular manner, the activeness of the student during education, and the connection of new subjects with previous knowledge, while increasing the quality of teaching and providing education, increases the retention of learners. Moreover, the existence of an instructional model that includes all these elements can bring the current situation to the desired level. It is also recommended to combine this method with face-to-face classes for better learning, retention, and satisfaction of the learners. The results of this study can be used as a basis for conducting future studies on the effect of training methods on the level of learning of health volunteers. Further research is suggested with larger sample sizes.

## Acknowledgments

This article was the result of a master's thesis research project at SUMS. We are grateful to the research counselor of SUMS for supporting this study, the Clinical Research Development Centre for the statistical analysis, and Virtual School of SUMS for developing electronic content. We also wish to thank the health volunteers for their sincere help and cooperation in conducting the present study.

## Financial support and sponsorship

Nil.

## Conflicts of interest

There are no conflicts of interest.

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