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Assessing Interactive Video Systems Used as a Training Tool for Medical Assistants

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ABSTRACT
The purpose of this project was to create an interactive video tool for students entering the medical assistant profession. Demand for medical assistants has drastically increased within the last decade. The interactive video narratives are intended to help prepare medical assistants to better interact with a range of difficult patients. This study aims at providing a more controlled and realistic approach to handling patient / medical assistant interactions. It is hypothesised that this training will be more successful than previous conventional training programs. The interactive videos created for this study will be evaluated in a controlled experimental setting to assess the effectiveness of using these videos as a training tool for medical assistants.
Keywords :— Human-Computer Interaction, Education, Interactive Video, E-Learning, Medical Assistants.

I. INTRODUCTION

A medical assistant is a [1] :

"…complete administrative and clinical tasks in the offices of physicians, hospitals, and other healthcare facilities. Their duties vary with the location, specialty, and size of the practice".

According to the Bureau of Labor Statistics [1], there will be an expected 23% increase in demand for medical assistants within the next decade. Baby boomers entering retirement and old age are the primary cause of the high demand in this medical profession. There is no formal approach to entering the medical assistant field, but most enter primarily through a postsecondary education program. Generally, it takes on average one year to become certified as a medical assistant through a postsecondary education.

Medical assistants are often primarily responsible for performing administrative and clinical tasks [1] :

- Recording patient history and personal information
- Measuring vital signs, such as blood pressure
- Helping the physician with patient examination
- Giving patients injections or medications as directed by the physician and as permitted by state law
- Scheduling patient appointments
- Preparing blood samples for laboratory tests
- Entering patient information into medical records

The above is a list of general responsibilities, which vary depending on the location in which medical assistants practice their occupation. Most of the responsibilities deal in some shape-or-form with interacting with patients. Few postsecondary institutions provide real patient-to-student training to expose students to crucial interpersonal skills, situational awareness and effective problem-solving skills.

The State University of New York (SUNY) is a postsecondary institution that offers an associate's degree of applied science on its Broome campus. This qualification allows students to enter the medical assistant profession. The medical assistant curriculum exposes students to using real world applications, equipment, systems, and practices [2].

Academics working on the program, training potential medical assistants have identified a number of problems with current pedagogical practices. Key among these is the fact that during the program students are not exposed to many scenarios where they would have to interact with a 'real' patient who is not cooperative, perhaps a patient that is susceptible to changing moods and emotions.

Since many of the day-to-day responsibilities of a medical assistant deal in some shape-or-form with interacting with patients, this deficiency can potentially cause problems when the new graduates enter the workplace. This paper describes the steps taken to introduce a number of new tools and training modules which aims to present students with 'real-world' scenarios. It is hoped that these new tools will provide an environment that can test a student's flexibility and problem-solving and provide skills that will be useful in their future careers.

II. LEARNING STYLES

A number of researchers have recognized that different students may prefer different learning styles and techniques.

Learning styles group common ways that people learn. Most people actually prefer a mix of learning styles. Some people may find that they have a dominant style of learning, with far less use of the other styles, others may find that they use different styles in different circumstances [3, 4, 5, 6, 7].

Using multiple learning styles for learning is a relatively new approach. This approach is one that educators have only recently started to recognize [6, 7]. Traditional schooling used (and continues to use) mainly linguistic and logical teaching methods. Many educators utilise a limited range of learning and teaching techniques. Many schools still rely on classroom and book-based teaching, much repetition, and pressured exams for reinforcement and review. The standard seven learning styles are listed here [3, 7] :

- Visual (spatial)
- Aural (auditory-musical)
- Verbal (linguistic)
- Physical (kinesthetic)
- Logical (mathematical)
- Social (interpersonal)
- Solitary (intrapersonal)

Why Learning Styles? Understand the basis of learning styles

Your learning styles have more influence than you may realize. Your preferred styles guide the way you learn. They also change the way you internally represent experiences, the way you recall information, and even the words you choose. We explore more of these features in this chapter.

Research shows us that each learning style uses different parts of the brain. By involving more of the brain during learning, we remember more of what we learn. Researchers using brain-imaging technologies have been able to find out the key areas of the brain responsible for each learning style [4, 5, 7].

III. INTERACTIVE VIDEO

To achieve the best results from any learning system, it is often prudent to communicate information by combining multiple learning. Interactive videos were chosen for this medical assistant project, as they incorporate several of these learning styles. The possibility of incorporating multiple learning styles into one training tool was deemed possible.

Interactive videos require the viewer to focus, as the video will not progress unless a participant presents a stimulus to the system. A form of active over passive learning, which has shown to have significant pedagogical benefits [4, 5, 8, 9].

Interactive video narrative tutorials combine several learning style techniques which is what makes them more effective than traditional training methods. Both visual and auditory learning styles are accommodated within interactive videos and media. The learning activity can be completed in both a social and/or a solitary environment, supporting both intrapersonal and interpersonal learning styles. Interactive videos are often also based around a form of tutorial that involves decision making, hence they often benefit individuals who are strong in logical thinking - since the learners need to understand how each step plays a role in completing a task. Interactivity and social aspects can also support kinaesthetic and linguistic learning styles [4, 5, 10, 11].

Many online Video on Demand (VoD) streaming services are now available. The popularity of these services is shown by the fact that YouTube has risen to be the second most commonly used search engine online because of its visual and auditory method of carrying and displaying information [12]. Those growing up surrounded by this streaming technology, where they can share and view videos are often more accustomed to seeing information than reading it.

Research has shown that over 70% of individuals retain information quicker and for a longer period from videos over oral and written forms of presentation. Videos also grasp viewer attention for longer periods of time [10, 12, 13, 14]. There has therefore been a shift traditional manual and written training methods is due to the increasing use of video media.

Companies and instructors have become aware of this shift in learning and a growing number have adopted videos to train staff/students. Interactive video narrative software has given employers and instructors the means to measure an employee's/student proficiency based on their interaction with the videos. The ubiquity of smartphones and mobile devices have enabled students and employees to take their lessons and training material on the go and view them anywhere [9, 12].

Video as a tool to train and teach can be more effective compared to traditional teaching methods but it can also have a number of shortcomings. Passive video alone can become bland, and linear, requiring little to no interaction from the student/employee viewing the video, beyond pressing the play button. This means that it requires a certain level of continuous focus from the viewer. The longer the passive training period, the higher the chances that material is not being grasped, attention lowers and retention decreases from the student/employee [10, 12, 13].

Interactive video narratives have the potential to make up for many of these shortcomings of passive video training system. To create an effective interactive training video there are four steps required [12] :

Introduction to the Experience

- The trainee is introduced to the expectations and learning objectives of the interactive video.

Observation and Reflection

- This stage requires the trainee to observe and digest the information displayed in the video. After the trainee digest the information, they are to reflect on what they have observed and find a connection on how the video relates to their expectations and job requirements.
- This stage will allow trainees to interact with different methods and answer any questions or make any decisions on choices given to them by the video.

Understanding

- This stage is an assessment on the trainee.
- Asking a series of questions pertaining to material that were specifically covered in the training video will allow instructors to measure understanding and retention of information.

Active Experimentation

- The final stage is the exploration of any and all possible outcomes of the interactive video training.
- This stage allows trainees to grasp different outcomes and realize the plethora of ways that a task can fail or succeed.

These characteristics were taken into consideration when developing the interactive video system for medical assistant training purposes. Whether it is a student, employee, doctor or medical assistant, not having a properly developed tool to train and develop skills can sometimes cause more harm than good. Hence it was important that the tool was assessed thoroughly.

IV. CASE STUDIES

The following sections introduce a number of interactive video training systems. These case studies provide the opportunity to examine in depth, the important factors to be considered when producing such complex learning systems.

A. Computer World

Curtis Plott, executive vice-president of the American society for training and development, stated that [15] :

"There are a number of trade-offs between types of training. With Computer Based Training (CBT) and video, the cost comes from the development of the course, but delivery is relatively inexpensive."

Developing computer software in the 1980s and 1990s took was particularly expensive. A large amount of time was needed to complete the complex programming required to develop the sophisticated visual programs that would train employees to complete challenging tasks in the work place. This drove up development costs. Although, early video training systems were useful, it was a technique that rarely if ever was implemented due to its costly drawbacks [15].

B. Instructor vs Video

In the 1990s research was undertaken to discover if there was any significant difference in student performance based on material covered by an instructor-led course or an interactive video led course [16]. The course material was on the PC application (WordPerfect), and instruction took place over a three-week period. With 53 participants in the instructor-led pool and 43 in the interactive video, this research study did not find any significant difference in the participant's performance [16].

However, there was a significant difference found in the participant's reactions and feedback. The research found that most participants preferred the instructor-led course. Participants attributed this preference due to the instructor-led course being [16]:

"clearer, easier to understand and more comfortable"

This work has since been mainly discounted by academics in the field. A number of researchers have since stated that the development of accurate and realistic interactive video content is superior, since it is often necessary to present realistic scenarios that meet the expectations of its viewers [11, 13, 14, 15, 17, 18].

It is believed that previous research showed that video wass not the most preferred method of learning because it is a technological approach. It is possible that humans instinctively have an innate human approach to learning that perhaps conflicts with a technological approach. A technological approach of learning is often linked to the use of any tools such as computers and interactive videos to enhance and communicate information [13, 14].

Hence, it is possible that one of the greatest drawbacks to utilizing an interactive video to communicate information is that the fact that the user is not interacting with another person. Current interactive videos do not relate or interact with the feelings of a student who is frustrated or discouraged because they do not seem to grasp the material, which is precisely what a human approach to learning offers [15]. Interactive videos simply react to stimuli and provide a finite and standard reaction to the user. Perhaps incorporating a more human learning approach to interactive videos can help present a more realistic learning experience to its users.

C. National Library of Medicine (Turin)

A well renowned 2012 study attempted to establish the effectiveness of an interactive educational video as an instrument to refresh and reinforce the learning of a nursing techniques [19]. The study consisted of 250 students currently enrolled in the Turin University Nursing course. Half of the participants viewed a video training on an effective technique for moving uncooperative patients in a supine position to a lateral position. The control group was given written instructions on how to perform the technique. The results showed that there was on average a 6.19-point difference between those students who viewed the video instruction to those who read the instructions [19] :

"The difference between the two groups was statistically significant ($P < 0.05$), so viewing the video led to a better performance in comparison with simply reading up on the technique."

The study provides compelling evidence for using interactive videos as tools for training medical assistants [19]. Using text as instructions often leaves too much ambiguity and depending on the reader, can often leave a trainee to interpret the instructions if written in text. Moving images shorten the gap between trainee and their task and remove the

realm of misinterpretation. Interactive videos can heighten focus, retention and convey accurate information to the medical assistants that leaves little to the imagination which limits assumptions. This in turn lowers error rates while increasing the retention of information [11, 13, 16, 19].

It is suspected there is difficulty in recollecting a series of steps if the format that they are presented in is written. The human memory has difficulty remembering a list that longer than 6-7 items when the memory is still being transcribed into short-term memory [20]. This results in a steeper learning curve and longer sessions of training and repetition. The video recording in the article referenced above uses several formats for conveying information to the human mind. Auditory and visual learning styles were used in the video. The resulting outcome being a significant improvement in scores in the experimental group than that of the controlled group that used text as its only format for conveying information.

D. Preserving Reality

One commonly shared concern regarding the use of interactive videos as a tool for training is the perspective they impose on the viewer [12, 18]. Interactive videos are created through a perspective and dependent on the viewer, that perspective may not be realistic or natural. Jewitt found [18] :

"The idea that video data either captures 'what is really going on' or 'adulterates and distorts events beyond usefulness' are clearly diametrically opposed. Both perspectives are, however, founded on a desire to capture and preserve reality and are connected by an underlying focus on reality and objectivity."

When presenting a video of a situation/scenario, the perspective of the video must be realistic and as accurate as possible as to what can be expected in the real world. If the video strains too far from what is realistic, then it essentially becomes unrealistic and it loses its usefulness.

These diametrically opposed perspectives present a daunting problem specifically for the use of this technology in the medical field. Presenting an interactive video on how to approach and diagnose a patient who is being difficult is not a task that can be solved with a 3-step process or with a standard set of questions.

Many if not all situations and interactions require a certain level of flexibility and improvisation. There are many variations that exist between patients, situation, and medical practitioners. All of which can and will affect how a situation and prognosis unfolds. It is difficult to present a perspective in an interactive video that could be understood and realistic across the spectrum of perspectives.

Once a video system has been created and finalized, it then becomes increasingly difficult to make any changes to it to adhere more accurately to the situations that a medical assistant would have to confront. It becomes harder to add additional content and flexibility to the more layers, adding to the video would only increase its complexity.

V. DEVELOPMENT/IMPLEMENTATION

The researchers worked with academics from the SUNY Broome campus to develop a number of scripts that simulated 'real-world' situations that a medical assistant would be faced with in the work place. A small number of scripts were selected and filmed. All filming took place in a real doctor's office.

Fig. 1 A Scene from the Interactive Video Training System

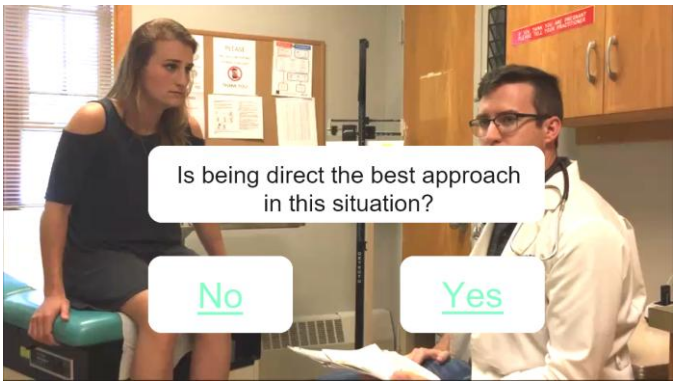

Fig. 2 Asking a Question within the Interactive Video Training System

The training system shown in Figures 1 and 2 is based around a patient seeking needles from a medical assistant. Within the training system, the student watches the scenario unfold (Figure 1) and at certain key points, the video stops and the user has to make a decision as to what to do next (Figure 2). The pathway through the video clips is determined by the decisions made by the user. The user is also given feedback on their decisions, in particular the consequences of making wrong choices.

Once the system was implemented, it was necessary to run user experiments to see if the system actually improved learning among the student medical assistants.

VI. METHOD

There are two critical goals this study aimed to achieve.

- The first goal was to enhance the material covered in medical assistant classes at SUNY Broome. In particular this project hoped to improve the material

available to teach inter-personal skills among the students.
- The second goal was to increase the retention rate of the information delivered during the medical assistant courses.

The purpose of interactive videos is to enhance the learning experience of those watching it. This offers and opportunity for a study to be undertaken to compare the retention rate of information using standard practice of teaching/learning to the video system. The aim of this study is to produce data that supports the notion that interactive videos enhance the learning and retention rate of information.

A single group of students from SUNY Broome's medical assistant program were monitored as they used the interactive video training system and went through the scenarios. A questionnaire, based on Likert scale questions, was then be used to gather feedback on the participant's interaction with the system. Once the training had concluded, a quiz was administered to the participants requiring them to remember the material covered in the interactive video.

E. Materials

Informed consent forms were needed to outline the research goals, procedures, risk and benefits of the participant's participation throughout the study. The researchers contact information was made available to the participants in the consent form. A laptop the interactive training system was prepped and ready for each user. The Likert scale questionnaires were also available for final evaluation of the experience using the system.

F. Process

Participants who signed the consent form were taken to an isolated room/office where they will be interacting with the video training system - a laptop was provided. Instructions were provided to the participant on how to operate and manoeuvre through the training system. The participant will was asked to talk out loud and voice their thoughts as they go through the video system - a form of cognitive walkthrough. This includes the participant voicing what they think is the correct choice and be as vocal as possible while going through the video system.

This cognitive walkthrough was one of the primary modes of gathering data regarding whether the interactive video system is functional and achieves the objectives. The medical assistant students completed the task using a computer with screen recording software installed. This recorded all activities undertaken by users within the system.

A table listing each participant and their response to each scenario was kept and recorded by the attending researcher. This table was intended to keep track of all the participant's responses to questions. The data gathered from this table was then used to gauge whether any question contained a higher frequency of incorrect answers in comparison to other questions. After a 1-2-week hiatus, the researchers provided each participant individually the same questions covered in the interactive training video system. The goal of this step is to gauge the participant's retention rates.

The results are expected to show that participants obtain higher marks when using interactive training video systems. It is expected that there will be a correlation between using the video training system and retention of correct patient and medical assistant decisions.

G. Questionnaire

A questionnaire, based on Likert scale questions (Figure 3) was also used to assess how participants felt using the video narrative and how prepared they feel to address the issues from the training system in the real world (but prior and post to using the interactive training video). We expect a shift in the responses in the Likert after the students have used the interactive video system.

The questions asked were as follows :

Fig. 3 A Questionnaire Based on Likert Scale Questions

Evaluation:

- I find the interactive video easy to use
- I have a better understand of how to communicate with a difficult patient
- I find the interactive video to be flexible to work with
- My interaction with the video is clear and understandable
- Using interactive videos improves my job/class performance
- The information is presented in a useful format
- Using interactive videos increase my job/class productivity
- The scenario presented in the video is realistic and what I expect to encounter as a Medical Assistant

Satisfaction:

- As a user, I am satisfied with the look of the interactive video
- I feel better prepared to interact with patients
- As a user, I am satisfied with the ease of navigation of interactive video
- As a user I am satisfied with the level of feedback the interactive video gave me

VII. RESULTS

Results from the participant's answer logs, Likert scale questionnaires and cognitive walkthroughs show that, as predicted, there is credibility to the following hypotheses:

- Participants will score high marks using the interactive videos
- Strong problem-solving skills will directly affect the result in participant's scores
- Interpretation of questions will affect answer choices

Min: **60**
Fir Qua: **80**
Med: **80**
Thi Qua: **95**
Max: **100**

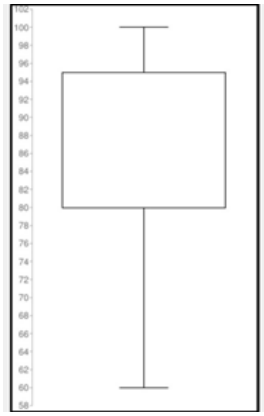

Fig. 4 A Box Plot Analysis

Figure 4 shows a boxplot analysis of participants answer choices and scores. According to this figure, 87.5% (7/8) of participants scored within 80%-100%. Interviews conducted with participants revealed participants found the difficulty of the choices to have declined as they progressed through the interview video. Participants explained that as the video progressed more information was revealed to the participants which made deciphering the correct course of action easier. The dataset shows 71% of total errors occurred by answer choice #2. The rate of incorrect answer choices drops by 42% after answer choice 3.

Table 1 shows the participants answer logs. According to the table, there is a significant improvement in scores of all participants with 82.5% of scenarios answered correctly and a 17.5% error rate. The answer log shows 91.7% of correct answers were made between scenarios three-five with only a rate 8.3% in errors. Further inspection of the answer log reveals that 71% of all total errors occurred prior to question three. With a correct rate of 37.5%, participants received the overall lowest score in answer choice two. Interviews with participates revealed that they had difficulty interpreting the question being asked and felt there was no definitive correct answer to the question.

TABLE I
INTERACTIVE VIDEO ANSWER LOG: QUESTION SUCCESS RATE

	Success Rate 100%	**Success Rate 37.5%**	**Success Rate 87.5%**	**Success Rate 100%**	**Success Rate 87.5%**	**Average Score 82.5%**
Participants	**Choice 1**	**Choice 2**	**Choice 3**	**Choice 4**	**Choice 5**	**Score %**
Participant 1	✓	X	✓	✓	X	**60%**
Participant 2	✓	X	✓	✓	✓	**80%**
Participant 3	✓	✓	X	✓	✓	**80%**
Participant 4	✓	X	✓	✓	✓	**80%**
Participant 5	✓	✓	✓	✓	✓	**100%**
Participant 6	✓	✓	✓	✓	✓	**100%**
Participant 7	✓	X	✓	✓	✓	**80%**
Participant 8	✓	X	✓	✓	✓	**80%**

This feedback supports the idea that there are certain limitations to interactive training videos. Limitations such as being able to clarify a question/statement. These limitations can and will lead to potential errors in the dataset and inaccurately evaluating a participant's knowledge and training. When a definitive answer must be selected even though the participant is left with too much uncertainty. This finding means that a system must be robust and flexible enough to account for the multitude of ways that a question/state can be interpreted by a participant. If the system is not robust enough, then its evaluation of the participants has no validity and the system must be re-examined.

Participants commented on the usefulness of the interactive videos as a tool for observing patient-doctor interactions. An interview with participant 6 revealed that current practice for problem solving and handling difficult patients is through student acted mock scenarios. This means two-three students in the same class would act out a scenario. These scenarios involve one or two students acting as patients and the other students as the medical assistants charged with resolving the situation. Participant 6 explained a short coming of this practice. Students acting in these scenarios are familiar with each other and may even have befriended each other. This makes being impartial difficult in a hypothetical situation. Participant 6 explained that intimately knowing who you're acting with can make it difficult to place yourself in a realistic situation.

In short, class based mock scenarios lose a degree of realism when actors personally know each other. The interactive video provided participants an opportunity to observe a scenario which felt more realistic than material covered in class.

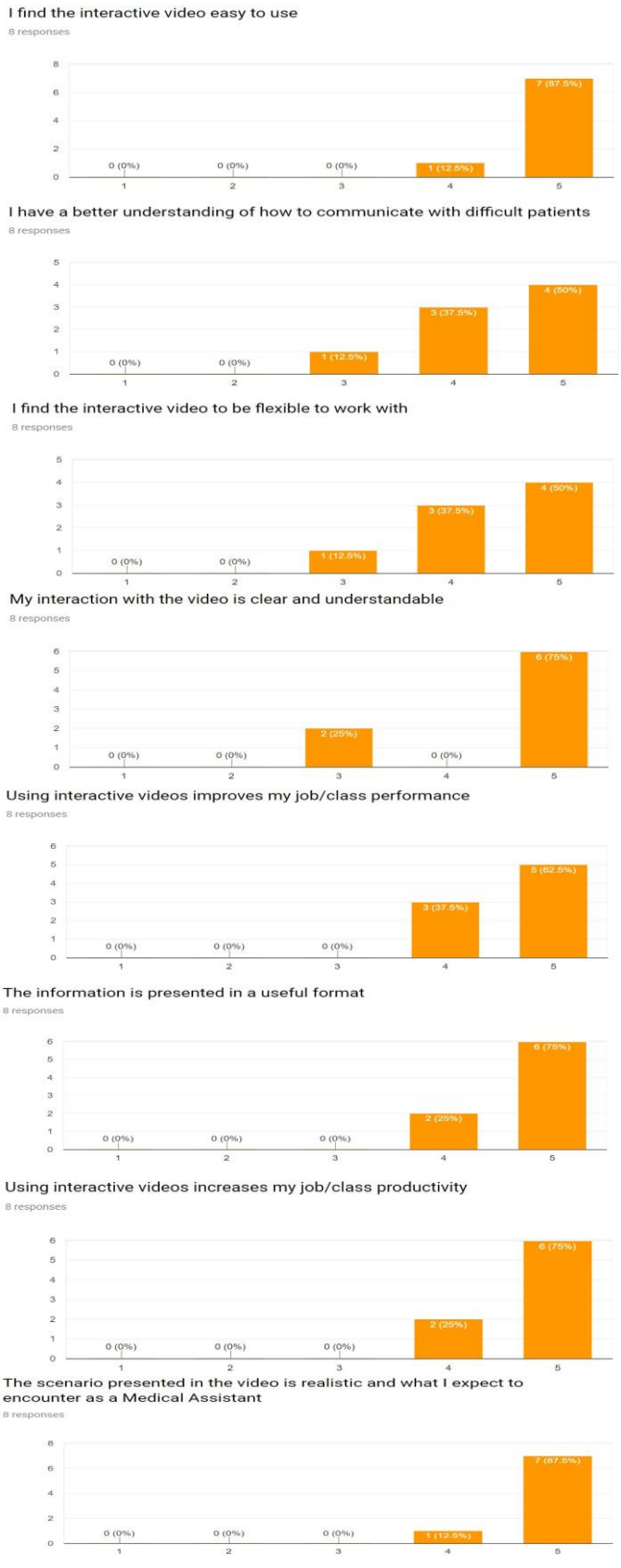

Fig. 5 Lickert Scale Results : Evaluation

Continued interviews with participants showed that most (5/8) found the most useful characteristic of the interactive video is its observational component. Participants believed that being able to see two actors, whom they have never seen before, interact made it easier to focus on body language, word choice, tone, volume and gestures with more control. Control included being able to rewind, pause and progress through the interactive video at their individual pace, an option not available to participants in class.

H. Likert Scale Analysis

Results from the Likert scale questionnaires showed that 66% (8/12) of questions resulted in 100% positive feedback (Figure 5 and Figure 6). Positive feedback in this case refers to feedback received by all participants being exclusively agreed or strongly agreed. Based on this information there is a consensus within the participants. This consensus is that participants feel the information was overall presented in a useful format.

Participants were satisfied with the level of navigation of the interactive video which made it easier to use and interact, which means that their participants found the experience more enjoyable than unpleasant. Participants also agree that the interactive video has improved both their performance in class/work and their level of productivity. Both criteria are notable because performance refers to quality of work, while productivity refers to the efficiency a task/work was completed. Both are important qualities in the medical field, as a high level of performance and productivity is necessary in the effort to preserve the life of a patient.

Though the interactive video lacks a level of robustness to accommodate for any interpretations, participants felt the interactive video along with its content was clear and understandable, and with 87.5% of participants strongly agreeing the scenario depicted in the video was realistic and is the standard of what is expected to encounter in the field.

No question received less than satisfactory feedback in the Likert Scale. Less than satisfactory refers to feedback received from participants that was either disagree or strongly disagree.

Four questions received neutral feedback from participants. These feedbacks are in regard to whether the participants feel they are having a better understanding of how to communicate with difficult patients and the level of flexibility of the interactive video.

These results tell us that the interactive video may not be robust enough to accommodate all participants and users. The level of interactivity were few in options and the system may improve if it offered more options on how a scenario can unfold. The interactive video itself was fairly linear and provided direct feedback based on whether participant's answer choice was either "Yes" or "No". The interactive video provided a standard generic and direct feedback response. Though all participants received the same feedback from the interactive video, participants who interpreted a question differently do not benefit from the standard feedback given by the interactive video. A participant with a different

interpretation of the question/scenario requires a different explanation for why their answer choice is either correct or incorrect.

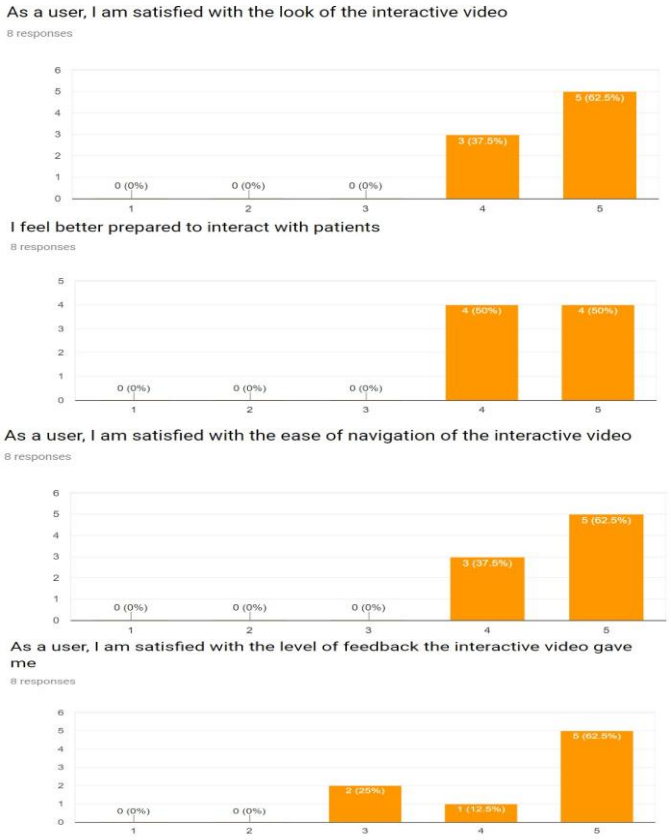

Fig. 6 Lickert Scale Results : Satisfaction

VIII. CONCLUSIONS

An effective interactive video training system considers the multiple learning styles that its audience has. Taking advantage of the multiple forms of communicating an idea and a set of structures steps to complete a task should be the goal of an interactive video. Making sure the instructions and its content are as true to what an employee would experience is key in ensuring the information learned in the videos can be translated into the work force later.

Probably one of the most difficult functions for an interactive video system to implement is the ability to provide several different forms of digesting information. An interactive video should try to meet as many of these requirements as possible.

Additional formats for collecting questions and other forms of feedback from employees and students in training should also be available. Videos can be structured and static in their way of providing feedback. A button only has a set number of functions while an expert in the field can answer and explain the answer to an employee's/student's questions. This would be in the form of a conversation as opposed to an interactive video providing a limited form of feedback.

There are many advantages and disadvantages to using interactive video systems as a form of training. Contemporary video interactive methods have dropped in cost, time and evaluation significantly. This means that interactive videos as a training tool are now more financially sensible – and offer an option to sacrificing a senior employee to train and tutor new employees and students.

Those using interactive videos to learn how to complete a task show dramatic improvement in retention of information and overall have scored higher in studies as opposed to the control groups. Though using interactive videos as a training tool still falls short of providing dynamic feedback to the degree of an actual person, it has merit as an effective tool for increasing retention and act as a supportive learning tool.

Interactive video systems in the work force capture and present realistic task and step-by-step procedures for completing them. Depicting realism in work environments is the most effective way of training new employees while emphasizing company mission statements, goals and purpose of training.

Finally, the research undertaken during this project showed that both the data from the Likert scale and the quiz results showed an increase in both retention rates and overall grasp of core concepts in the medical assistant course material covered.

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