Perceptions of Video Scenarios to Learn Human Pathophysiology among Undergraduate Science Students

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Abstract

Pathophysiology describes and explains the physiological dysfunctions that occur in human diseases. Pathophysiology is content heavy, often leading to medical/biomedical science students adopting a surface approach to learning. To encourage more engagement, we developed clinical simulation practical classes using manikin patients. Students considered these were more effective than paper-based case studies. However, they found the first encounter with the manikins daunting. In addition, they did not have a strong sense of responsibility towards the outcome of their treatment choices largely because they recognized this as a simulated experience. Video is a powerful teaching tool to demonstrate situations that are difficult to explain in words, to see theory applied to practice or create enthusiasm and confidence in the viewer regarding the use of new practices. In this study, we evaluated the effectiveness of exposure to a video scenario, in which a high-fidelity manikin was used as the 'patient', before the students' own interactions with the manikin in later classes. Survey results suggested that the students felt more engaged with the case study. They felt the video helped them appreciate aspects of clinical communication and prepare for their time in the simulation laboratory interacting with the manikin. They saw the video as a useful addition to the written case study notes. Their criticisms were mainly around the production quality. This study supports the use of video scenarios as a valuable adjunct to the teaching of pathophysiology to medical/biomedical science students when using either paper- or simulation-based case studies.

Keywords: blended learning, case studies, pathophysiology, simulation, video

Introduction

The teaching of pathophysiology focuses on the changes in physiological processes that lead to the development and progression of diseases. Human pathophysiology, a core component in health professional programs, is also commonly taught in medical/biomedical science programs. When teaching pathophysiology, students can draw upon and apply newly acquired theoretical knowledge when presented with patient case studies and this is likely to support a deeper approach to learning (Baumberger-Henry, 2005; Dijken et al., 2008). Ideally, such case studies are prepared in consultation with practising clinicians and clinical educators. Further to this, trainee health professionals can also see "pathophysiology in action" during clinical placements where they engage with actual patients. However, it is uncommon for science students to have such exposure as clinical placements are not commonly a feature of their program.

At one Australian metropolitan university, Human Pathophysiology is a second-year undergraduate science subject that has principally used paper-based case studies to reinforce the discipline knowledge presented in the lectures. Although the paper-based case studies are prepared with extensive clinical research and consultation, in the absence of any follow up clinical experiences, they remain 'thought exercises'. To enhance the learning experience, we developed two practical classes within a high fidelity clinical simulation environment. During each clinical scenario, students interacted with a manikin 'patient' (voiced by a hidden operator), and were required to take patient's history and make clinical evaluations and judgments. When we incorporated the two practical simulation classes in our subject, the overall experience was positive and the students believed the classes supported their development of communication, teamwork, leadership, and decision making skills (Chen et al., 2016).

However, due to the high fidelity appearance of the manikins, the students' first encounter with them was often daunting; resulting in less interaction with the 'patient' in the first class compared with the second class. When we further evaluated the student experience of the simulations, we found that they did not have a strong sense of responsibility towards the outcome of their treatment decisions largely because they recognized this as a simulated experience (Chen et al., 2016). Previous studies with nursing students have shown that incorporation of an introductory video vignette using the manikin as a 'patient' resulted in the increased engagement of the students in subsequent encounters with the manikins that was characterized by a greater sense of connection and more understanding and empathy (Power et al., 2016; Johnston et al., 2017).

In the context of teaching, videos are a powerful tool to demonstrate situations that are difficult to explain in words, to see theory applied to practice or (through video demonstrations) create enthusiasm and confidence in the viewer regarding the use of new practices and strategies (Reyna, 2010). Videos allow students to replay events as many times as they need and thus extract essential features that escaped them on the first viewing. Video is a widely used resource in education that is well suited to online learning and it has been shown to increase the motivation to learn with students in many

disciplines (Bell and Bull, 2010; Devi et al., 2013; Forbes et al., 2016). For authored case studies, video dramatization is likely to increase student engagement with case studies (Bravo et al., 2011; Kay, 2012). Therefore, in this study, we produced a video scenario using a manikin as the 'patient'. We designed the scenario to mimic a patient who presented to an emergency department displaying symptoms of a stroke. We had several aims around using the video. The first was to allow the students to become familiar with the manikin's appearance and the simulation laboratory setting. This video also aimed to provide an opportunity for the students to observe how through communicating with the patient and a relative, the clinician attempted to elicit important information that could facilitate diagnosis and decision making regarding treatment. The final aim was to encourage the students to start thinking about the relevant disciplinary knowledge that they could apply to the case study.

Materials and Methods

The study was carried out in the Spring Session (August to early November) of 2017 using a purposive sampling method in the second year undergraduate Science subject Human Pathophysiology taught by the Faculty of Science of a metropolitan university in Australia. The University's Human Research Ethics Committee (ETH17-1717) approved the study.

Class structure

A video introducing a specific case study was developed to explain what would happen in a real-life case consultation. The video consisted of the communication between the clinician and a nurse, and between the patient and the clinician and a relative of the patient. In this pilot, the script was prepared in consultation with clinicians and nurses. The patient was the manikin voiced by the simulation technician following a script. A clinically experienced Human Pathophysiology lecturer played the clinician and a community center nurse played the nurse. The video was five minutes in length, commencing with the nurse providing a patient handover to the clinician. The scenario ended with the clinician advising the patient and a relative what procedures would need to be undertaken. Written narratives of the case were included in the student notes that supported the class.

The case scenario was developed around expected physiological changes a patient with an ischemic stroke was likely to present. In the notes, the case reads:

> '*Wally walked into the Emergency Department with the assistance of his wife, Ginny. She reports that an hour ago, they were sitting and chatting while watching some morning TV; she saw that he was drooling from the right side of his mouth, he was leaning to his right side, and the remote that he had been holding in his right hand had fallen to the ground.*

On admission the following observations were made: Blood pressure: 185/55 mmHg; Temp: 37°C; Pulse: 80 bpm; Blood glucose: 6.7 mmol/L; Respiratory rate: 12 /min; SaO_2: 94% on room air.

Ginny gave the key features: He is 55 years old. Last serum cholesterol was "a bit high". He takes a cholesterol-lowering drug. He takes a blood pressure-lowering drug. He ceased smoking five years ago. His father died recently: "he had a heart attack", so their GP has asked Wally to take aspirin regularly. Due to gastric upset, he only takes it intermittently and never bothers to ask for alternatives.

Upon examination, the following were observed: slurred speech, right facial palsy, marked loss of sensation in his right arm, weak sensation in his right leg'.

The students watched the clinical simulation video in class during the fourth week of the teaching session. Following the viewing of the video, students were asked the following questions,

(1) Firstly, make a note of any findings that you judge to be abnormal or possibly abnormal.

(2) Why might you ask Ginny if Wally stopped talking unexpectedly?

(3) What are neurological problems observable at the presentation? That is what neural pathways and/or parts of the nervous system do you think are damaged?

(4) What particular disease best accounts for Wally's presentation?

(5) What do you think were the possible steps that lead to Wally's current disease?

(6) Looking at the previous answers, are they any particular non-neurological tests you think should be performed?

(7) Why would Wally's GP have suggested he take aspirin?

(8) *What pharmacological interventions will Wally require the immediate treatment?*

The students were also scheduled two simulation case studies practical classes that took place in the simulation laboratory a few weeks later. These included one 'patient' with myocardial infarction in week nine and one with a duodenal ulcer in week ten, the details of which have been previously published (Chen et al., 2016).

Study Design

To evaluate this innovation, the authors created a survey, as a suitable instrument specific to this context was unavailable in the published literature. The questionnaire consisted of 10 statements (Table 1), and students were asked to rank each statement on a five-point Likert scale from *Strongly Disagree* to *Strongly Agree*. The statements addressed whether students felt the video case study was easy to follow and benefitted their learning. Open-ended questions were included that allowed students to compare the experience of watching a case played in a real-time setting with a paper-based narrative. The survey was anonymous and voluntary. It was paper-based and was handed out to the students who watched

the video. Among the 365 enrolled students, 332 students returned the survey form. The demographic information of the whole class was drawn from records made available by the central Student Administration Unit. With 90% of the students responding, we considered the information was representative of the whole cohort.

Data analysis

Each questionnaire response was tallied to determine the extent to which the science students agreed or disagreed with each statement. This number was converted into a percentage of the total number of students.

A multivariate statistical approach, Exploratory and Confirmatory Factor Analysis procedure was used (Williams et al., 2010). This statistical approach has been previously found to be useful for interpreting self-reporting questionnaires in educational psychology and health interventions (Thompson, 2004). The main objective of the Factor Analysis was to validate and reduce a large number of variables into a smaller set of factors. This process ensures that there is a relationship between variables and latent constructs (O'Rourke et al., 2013). The extraction method used was Principal Component Analysis, and Varimax with Kaiser Normalization as a rotation method. The Kaiser-Meyer-Olkin (KMO) measure and Bartlett's test of sphericity were used to determine if the data were suitable for Factor Analysis. The Cronbach's alpha was used to determine the internal consistency of the questionnaire items. Qualitative Data were analyzed using NVivo thematic analysis. The internal consistency of the questionnaire was gathered by Cronbach's alpha which measured the scale reliability.

Results

Survey validity

The sample had a high KMO (Kaiser-Meyer-Olkin) Measure of Sampling Adequacy (.873) (Table 2) and the scree plot suggested taking two factors (Figure 1). Looking at the Total Variance Explained by each factor, the two factors covered 56% of the total Variance. The factor loadings ranged from .617 to .796 (Table 3). The Cronbach's Alpha was .858 which is considered a good measure of internal consistency.

Demographic data of the participants

There were 365 students enrolled in the Spring Session of 2017 and 11% were international students. English was the sole language for 161 (44%) students, while 204 students also spoke another language (s) at home (56%). More than half of the students were aged below 20 (58%), and 58% of the whole class were female.

Student feedback on learning experience

This was our first trial using a video presenting the interactions among the clinician, nurse, patient and a relative, to the undergraduate Science students. Qualitative analysis of the comments is shown in Table 4. Nearly 80% agreed that the video was easy to engage with (Figure 2.a), and 65% agreed that the format of introducing the case using conversations between the characters was better than paper-based narratives (Figure 2.b). As one student commented *'It does help more on understanding the case than the paper-based format'*. One aim of the video was to teach the students how to communicate with patients to obtain essential information for initial diagnosis and subsequent treatment, and 77% of the students did agree that the video helped them understand how to do this (Figure 2.c). Nearly 90% of students believed that video gave them a good idea of the hospital environment (Figure 2.d). However, some felt they would need to see a variety of settings within this environment to appreciate fully it (e.g. *'The videos are great. More variety of videos on what we could expect in those hospital settings. Dos and Don'ts would be helpful'.)*. The script was written using an inquiry style between nurse and clinician and between clinician and the relative. However, the language was relatively simple to facilitate student understanding. Notably, nearly 90% of students understood the concepts presented in the video (Figure 2.e).

The video aimed to give the students an overview of the simulation laboratory setting and the appearance of the manikins, with whom they would interact later in the session. Encouragingly, 77% of the students thought the video prepared them for the simulation sessions (Figure 2.f), and 61% consider this an excellent example of how to engage with the manikin patients (Figure 2.g). One student stated, *"the video case study has provided me with an idea of what we are expected to do during the simulation prac in wk 9 &10".*

Although the majority of students enjoyed the use of a video format for case studies, less than one-third of the students wanted it to replace the paper-based narratives (Figure 2.h). Instead, students could see the value in having the same information presented in multiple ways. One commented that "*I think both formats should be used, the video gives a lot of information which would be better on written paper*" and, "*definitely like having both formats, but the video does a really good job of providing setting and insight".* Another student would not want to use one to replace another due to "*A different form of learning but do not think it's more effective".* The paper-based case studies were considered to provide specific and concrete information, as they commented *"The paper-based is good as it helps in identifying key components",* as *"video may be too fast to write down notes on every concept". "The paper-based is good as it helps in identifying key components whereas the video is good as we see the interaction. More engaging".*

As there is a trend to move learning online, we also evaluated student acceptance of this format to be further developed into online tutorials. About two-thirds of the students welcomed such an idea, which allows self-paced learning without face-to-face assistance from a tutor (Figure 2.i). A student commented, *"Would be good for online tutes because they can*

review it multiple times". Finally, students reported that they would recommend this learning format to their peers (Figure 2.j).

Although some students were very positive about the production of the video itself, (comments included *"fabulous"* and *"good video, helped a lot"*), others were critical of the quality of the production. Specifically, the quality of audio and lighting was commented on. One student remarking that the *"audio is a bit off, but the subtitles fix it mostly"*. Others highlighted the need for professional actors to portray the different roles reporting being disappointed with the acting, *"it helps students understand what they'll be doing but the awkward acting doesn't represent a real-life clinical situation".* One student recommended the use of *"real documentary videos. Same cases, same participants but real documentaries",* which speaks to the value placed on being able to watch a scenario unfold. Despite these criticisms, the opportunity to view the interactions between simulated patients and health professionals was also considered useful for example, "*the video is good as we see the interaction. More engaging"* and *"I felt like I learned a little about clinical interaction".*

Going forward students had several recommendations for future case study presentation including increasing the length and complexity of the videos, *"I think some more simulation case study videos should be provided to us to give us a familiar environment to understand the pathological condition properly. More advanced and longer videos with some more information should be shown".* There were also recommendations regarding the layering of information, with videos providing an overview followed by breaking down the information and then looking at it in more detail: *"I think we should do a video case study beginning of every tutorial, followed by the wet lab or the manual case studies"*.

Discussion

This study provides further support as to the effectiveness of using video both to demonstrate communication skills that can facilitate diagnosis and treatment decision-making in case studies and to promote a better understanding of discipline knowledge. In this case, the resource was used for students outside the health professions, whose experience of patient-clinician interactions would be largely restricted to their own personal medical experience, and whose motivation to engage with the disciplinary knowledge of pathophysiology is likely to be different to that of students of the health professions. The video was filmed in the simulation laboratory as a means of better preparing the students for their practical simulation experiences later in the session.

An understanding of the physiological dysfunction that underlies human diseases is central to the practice of health professionals, and it is drawn upon at all stages of the delivery of healthcare from diagnosis to monitoring to treatment to evaluation. As medical/biomedical science graduates commonly pursue careers in medical research and the pharmaceutical and medical device industries, such knowledge is invaluable to them. By its nature, pathophysiology is content heavy, and students may adopt surface approaches to their learning. Contextualizing the teaching using authentic

case studies is likely to support deeper approaches to learning (Prosser and Trigwell, 1999; Struwig et al., 2016; Floyd et al., 2009; Kulak and Newton, 2014; Nicholson et al., 2016). For this reason, the inclusion of case studies is widely recommended and used in pathophysiology (Van Dijken et al., 2008; Vorderstrasse and Zychowicz, 2012; Baumberger-Henry, 2005). Presentation of case studies as written narratives is a commonly adopted approach. However, for the reader, the experience of such written narratives is unlikely to be very rich particularly for those who have spent only limited or no time in clinical environments. Simulated clinical scenarios are principally designed to give trainee health professionals the opportunity to practice and evaluate skills in the safe and heavily monitored environment (Harder, 2010). Our previous study and the findings reported here highlight another avenue for their use (Bravo et al., 2011). That is the provision of opportunities for medical/biomedical science students to see the manifestations of clinical signs and symptoms they have learnt about and apply their learnings through making diagnoses and proposing medical procedures (Baumberger-Henry, 2005). In this paper, we have shown how to enhance the clinical simulation experience by using video dramatizations of nurse-clinician-patient & family interactions linked to the case study.

As part of the module on stroke and other neurological disorders, the students watched a video dramatization of a stroke case study in addition to receiving a written version of the same case study. As well as a means of enhancing the students' experience of the case study, the video served as a method of introduction to the University's simulation facilities that the students would use for other case studies later in the session. The video was well received by the students, and their perception was that it enhanced their learning experience. However, the majority of students did not see such videos as a replacement for written notes, rather as a valuable addition to them, seeing positives in both formats. As a means of preparing the students for the simulation facilities, the use of the video was judged successful. The principal criticisms of the video regarded its production highlighting a potential challenge in promoting student engagement with such resources. Regardless of this concern, the findings of this study support the notion that a multimedia approach to the delivery of case studies is likely to enhance the student experience and engagement with them that may support better outcomes in learning (McConville and Lane; Clifton and Mann; Stanley et al., 2018).

Limitations of the study include that data was only captured for the first iteration of the session and it will be important to repeat the evaluation with future cohorts and when more such videos are incorporated into the subject. Studies in educational technology showed that when students are not prompted to reflect on new technological innovations, they tend not to see the value of it (BrckaLorenz et al., 2013). Another limitation of the study was the lack of either follow-up individual interviews or focus groups as qualitative data would support a more in-depth understanding of student perceptions of the use of the videos.

In summary, using video is an effective approach to demonstrate situations that are difficult to explain in words, such as interpersonal interactions and communication skills. In addition, such videos appear to be a valuable tool in preparing

students for subsequent clinical experiences. In the specific context of pathophysiology, such videos can enhance the teaching of case studies as they allow students to observe how the content they learn is manifested and applied using authentic situations or simulated scenarios. Simulation laboratories are not available in all universities, especially those without medical or allied health faculties. Using videos alone to show the presenting professionals and patients and their interactions (whether these are authentic participants or actors) is still likely to promote greater engagement and thus hopefully more in-depth approaches to learning.

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Table 1: Survey questions to gauge student's attitude towards video simulations for learning

Item	Question
1	The stroke simulation video was easy to engage with
2	Compared with paper-based case study the simulation video was a better way to present the case scenario
3	The simulation helped my understanding of how clinicians communicate
4	The simulation video gave me some idea of a typical hospital setting
5	I understand what the conversations in the video were supposed to represent
6	I feel the video has prepared me for what I will experience during the simulation in weeks 9 and 10
7	I feel I will be better able to engage with the manikins during the simulation experience from watching the video
8	I think that paper-based cases should be replaced by the videos
9	I think the video would be a useful format for remote learning (such as online tutorial class)
10	I would recommend the simulation videos to my peers

Table 2: Measure of sampling adequacy for Factor Analysis (KMO and Bartlett's Test)

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.873
Bartlett's Test of Sphericity	Approx. Chi-Square	1257.396
	df	55
	Sig.	.000

Table 3: Standardised solutions by CFA for the two-factor model. The questionnaire measured two constructs: Value of simulation video and Value of paper-based scenarios.

	Factor	
Item	**Value of simulation video**	**Value of paper-based scenarios**
6	.796	
7	.705	
4	.679	

5	.662	
3	.621	
1	.617	
8		.780
2		.738
10		.702
9		.663

323

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Table 4. Qualitative Data analysis by NVivo thematic analysis that identified five themes from the data

Themes	Reference count
Negative comments	1
Paper-based scenarios are better	6
Paper-based and videos are good	10
Positive comments	16
Video needs improvement	16

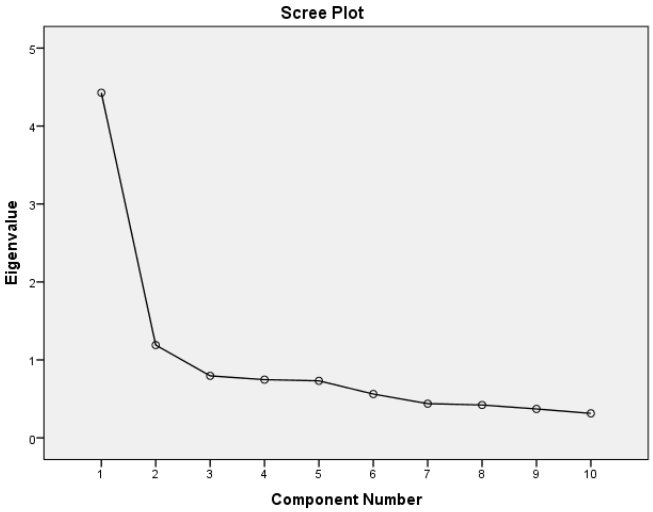

Figure 1: Scree Plot showing the two factors: Value of simulation video and Value of paper-based scenarios validated with Factor Analysis.

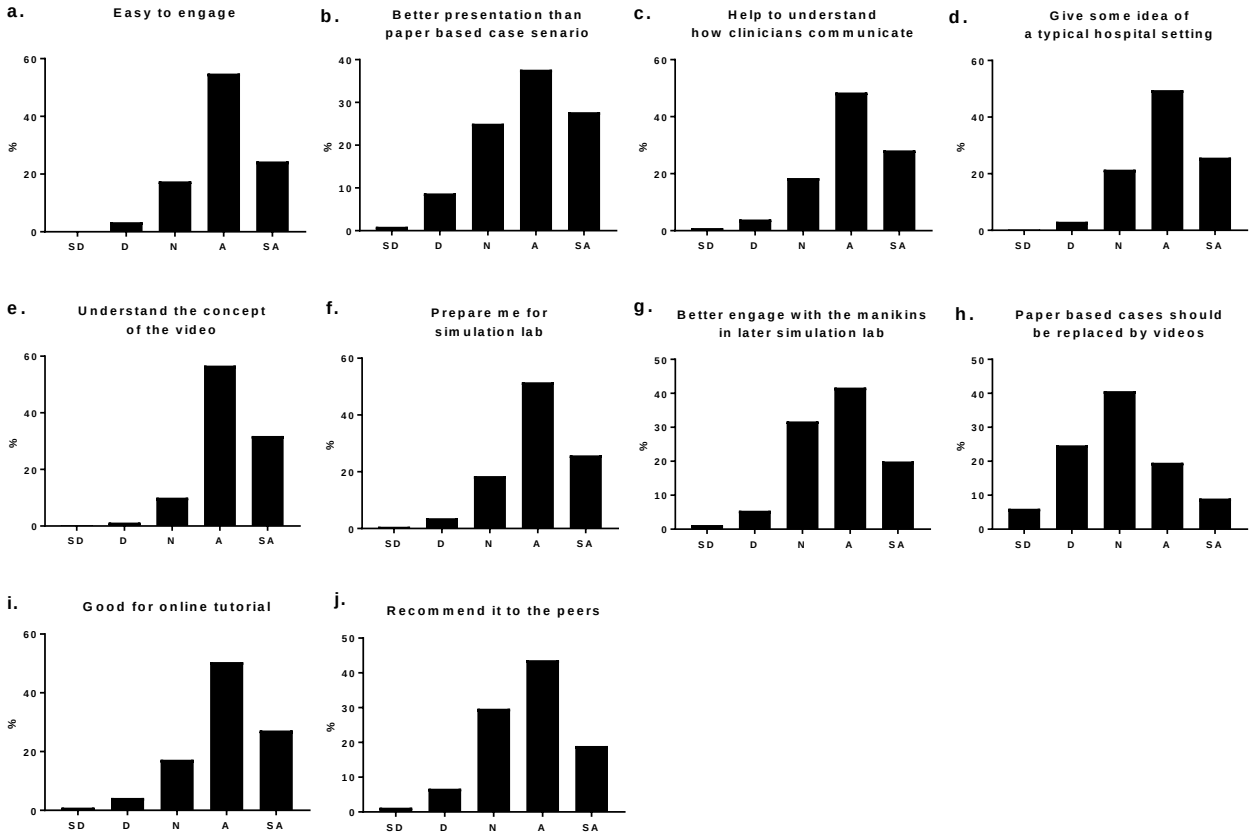

Figure 2: Students' responses to the questions in the evaluation form (Table 1). The results are expressed as the percentage of total answers (N=332). SD: strongly disagree; D: disagree; N: Neutral; A: agree; SA: strongly agree.