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ANALYSIS OF DESIGN OF FREE ONLINE ANIMATIONS IN BIOCHEMISTRY BASED ON MULTIMEDIA LEARNING PRINCIPLES

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ABSTRACT

Background: MBBS Ist year students are expected to learn concepts in Biochemistry that helps them understand the principles behind the diagnosis and management of diseases. Medical students have been shown to access free online animations to aid learning. Richard E Mayer proposed multimedia learning principles that could be used to design animations to maximise learning. To the best of our knowledge, there are no studies that have evaluated the design of online freely available animations based on Mayer's multimedia learning principles that foster generative processing. In this study, the objective was to evaluate the online animations in Biochemistry based on criteria of multimedia learning principles (that foster generative processing) proposed by Mayer.

Material and Methods: A total of 102 animations belonging to various topics in Biochemistry relevant to MBBS Ist year students, as per the curriculum suggested by National Medical Commission(NMC) were shortlisted through online search using www.google.com and www.youtube.com. These animations were then scored based on their compliance with multimedia learning principles that foster generative processing.

Results: Shortlisted animations had a median score of 10 (interquartile range=0). Only 4% of animations had a score of 15 (maximum score =15). In contrast, 96% of animations had score of 10. Personalisation principle was violated in 96% of animations. Image and multimedia principles were complied with in 100% of the animations.

Conclusions: Majority of online free animations in Biochemistry that we assessed do not comply with all the design principles of multimedia learning that foster generative processing. Creators of online animations should use the Mayer's multimedia learning principles that encourage generative processing, while designing the animations in order to maximise their potential for learning by MBBS students.

Keywords: Mayer's principles, Biochemistry animations, MBBS students, Medical Students

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INTRODUCTION

MBBS Ist year students are expected to learn complex molecular concepts in Biochemistry that helps them understand the scientific basis behind the diagnosis and management of diseases [1]. Animations on Biochemistry topics are freely accessible through popular search engines like www.google.com and www.youtube.com. Online animations are accessed by MBBS Ist year

students in order to learn complex concepts in Biochemistry [2]. Based on Cognitive theory of multimedia learning, Richard E Mayer proposed multimedia learning principles that could be used to design animations to maximise learning [3-7]. Students have been shown to learn better with animations based on multimedia learning principles when compared to graphics [8]. There are hardly any studies that have evaluated the

design of freely available online animations in Biochemistry based on Mayer's multimedia learning principles that foster generative processing. Our objective in this study was to evaluate the free online animations in Biochemistry based on Mayer's multimedia Learning Principles that foster generative processing to determine if they could act as effective learning aids for MBBS Ist year students.

MATERIALS AND METHODS

This is a cross-sectional study involving analysis of online animations. Ethical approval was not needed for this study for two reasons- First, this study does not involve human subjects; second, all the data (animations) used in this study is available online for public. Study Sample included 102 online animations in Biochemistry.

A total of 27 topics under Biochemistry were chosen from Ist year MBBS syllabus prescribed by National Medical Commission (NMC) of India in 2019 [1]. Animations relevant to these topics were searched on www.google.com and www.youtube.com using relevant key words. For the purpose of our study, an Animation was defined as follows- "Animation refers to a simulated motion picture depicting movement of drawn or simulated objects" [9].

Inclusion criteria for the animation to be shortlisted were-

1. Animation should fit the above definition
2. Animation should have content relevant to the topic

An Exclusion criteria was-

1. Animations that require payment or creation of login id for access.

A total of 102 animations were shortlisted based on the above criteria.

Mayer's multimedia learning principles, based on cognitive theory of multimedia learning, are evidence based guidelines that could be used to design multimedia like animations for effective learning. Mayer proposed 9 principles that could be used to design multimedia to facilitate learning. We chose 3 principles amongst these- Personalisation, Image and multimedia principles. Personalisation principle states that words used in the multimedia presentation should be in conversational style rather than formal style.

Image principle suggests that there is no evidence to show that speakers image on the screen would help learning. Multimedia principle states that presenting words and pictures in a multimedia presentation is better than words alone. Voice principle was not included because of lack of strong evidence supporting its use. It has been shown that these principles promote generative processing [3,4]. Generative processing is a type a cognitive processing required for deeper understanding of content of multimedia presentation. It depends on learner's motivation to exert effort. It involves organising the knowledge being presented and integrating it with previous knowledge.

The shortlisted animations (n=102) were evaluated using 3 of the Mayer's multimedia Learning Principles mentioned above. If a principle was complied with in an animation, a score of 5 was given. If a principle was violated, a score of 0 was given. Maximum score for an animation was 15. Total score for an animation was obtained after adding all the scores for individual principles.

Statistical analysis: Descriptive statistics in the form of proportion was used.

RESULTS

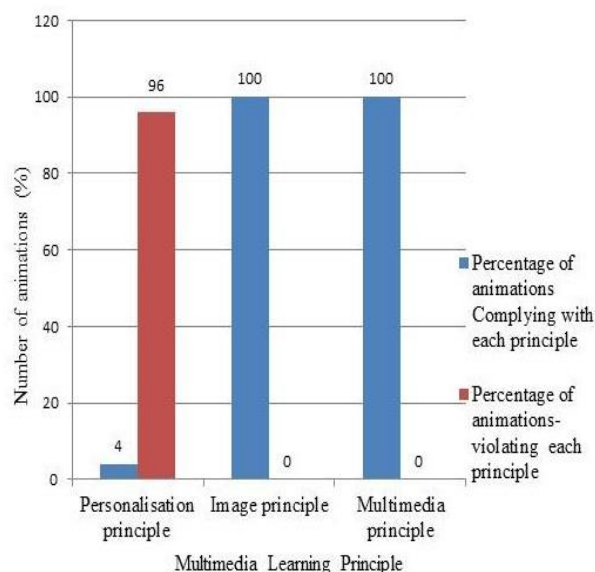
The shortlisted 102 animations had a median score of 10 (Inter Quartile Range=0) out of a maximum score of 15.

Table 1: Distribution of animations based on scoring using multimedia learning principles

No. of Principles	Number of animations (%) (n=102)	Scoring on animations using multimedia Principles (Maximum score=15)
Three	04(4)	15
Two	98(96)	10

Only 4% of the animations complied with all the three principles (personalisation, image and multimedia principles) that foster generative processing. In contrast, 96% of the animations complied with only two principles of the three principles (personalisation, image and multimedia principles). (Table 1).

Figure 1: Distribution of animations based on compliance/violation of individual Multimedia learning principles



Personalisation principle was violated in 96% of animations, as the spoken words in these of the animations were in formal style rather than conversational style. Image principle was complied with in all the animations, indicating that speaker's image was not present in any of the animations. Similarly, Multimedia principle was complied with in all the animations (Figure 1).

DISCUSSION

In this study we evaluated the design of online animations in Biochemistry based on Mayer's multimedia learning principles. Animations have been used by students to learn complex concepts [2]. Even in a classroom setting, students who received lecture instructions with supplemental animations showed better learning outcomes as compared to students that received same lecture instructions without animations [10,11].

The shortlisted animations had a median score of 10 out of a maximum score of 15. Only 4% of animations had an ideal score of 15. Majority (96%) of animations had a score of 10. Only 4% of the animations complied with all the multimedia learning principles. 96% of the animations violated personalisation principle suggesting that students who use these animations may have challenges in organising and integrating

information in these animations potentially resulting in poorer learning. Personalisation involves converting the spoken words in a multimedia presentation from formal to conversational style. One of the major techniques for creating conversational style is to use words like "you" and "I" instead of exclusively using third person constructions. Social cues such as personalisation (ex. using words in conversational style) help the activation of social response in the learner, such as commitment to attempt to understand the content of multimedia presentation. This social response enhances generative processing as the learner tries harder to select, organise and integrate content of multimedia presentation, which in turn leads to better learning outcomes [3]. The other principles- Multimedia and Image principle were complied with in all the animations.

The limitation of the study is that these principles (findings) are more strongly applicable when the topic is complex, pacing of the animation is fast and learners have low prior knowledge of topic [3]. We welcome future studies that could test the effect of these variables on learning through animations.

CONCLUSION

Majority of online animations in Biochemistry that we evaluated using Mayer's multimedia Learning principles do not comply with Personalisation principle of multimedia learning, potentially leading to poorer learning. Medical publishing companies and individuals who create animations could incorporate all the multimedia learning principles during the design of animations in Biochemistry for Ist MBBS students for effective learning.

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