Short Report

Bringing literature to life: A digital animation to teach analogue concepts in radiographic imaging during a pandemic - Lessons learnt

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What was the problem?

The fourth industrial revolution is upon us, bringing with it modern trends and new imaging equipment and techniques to radiography. While resource-rich institutions have successfully moved from analogue to digital equipment, many institutions in resource-constrained countries still depend on analogue equipment to deliver radiographic services to their communities.[1] Radiography relies heavily on analogue and digital machines to create images for diagnostic purposes, and it is important that radiography students are trained in both these aspects to align their skills with the available resources in different healthcare settings.[2] Undergraduate radiography students in our department have to attend both work-integrated learning and formal face-to-face contact sessions.

In 2020, these students were unable to physically engage with analogue equipment as a result of a shortage of automatic film processors (AFPs) at clinical training sites, exacerbated by movement restrictions imposed during the COVID-19 pandemic. Students had to learn about analogue radiography equipment from static textbook images, similar to that shown in Fig. 1. Not being able to physically engage with AFPs led to students disconnecting from the learning material and not fully comprehending the dynamic nature of the AFP. The AFP is a complex piece of equipment that relies on many sequential steps, such as radiographic film moving in and out of the chemical tanks, the temperature and circulation control system and simultaneous replenishment tanks pumping chemicals back into the tanks (Fig. 1).

A solution to the problem

In 2020, COVID-19 restrictions led to radiography students not being able to access analogue equipment, resulting in students not being able to visualise the dynamic nature of the AFP. To overcome this challenge, the idea arose of creating an online digital animation to explain AFP, based on the static image in Fig. 1, to illustrate analogue imaging in real time. The lecturer who taught the second-year radiographic imaging module, which includes AFP concepts, developed a customised animated recording of the physical processes involved in AFP to demonstrate the basic processes that the film undergoes. In collaboration with the Education Innovation Department, University of Pretoria (UP), we created basic animations based on general static images found in the radiographic imaging textbooks using 3D animation software (3D Studio Max (Autodesk Inc., USA). Second-year radiography students enrolled for the radiographic imaging module were requested to do an assignment for formative assessment purposes. Students watched the short, animated film, illustrating the process, with extra features enabled, including narration and close-captions. During the formative assessment, students had to disable the extra features, watch the animation again and write an essay explaining the events depicted in the animation. For self-assessment, students re-enabled the narration and caption feature and revised their essays. After engaging with the animation, we invited students to participate in a reflective focus group interview to share their experience of the learning opportunity.

Lessons learnt

From the focus group interview, students' experiences could be categorised into two major themes, namely, theme 1: the AFP animation without narration as an inquiry-based learning tool; and theme 2: the AFP animation with narration and captions as a passive learning tool.

Theme 1: The AFP animation without narration as an inquiry-based learning tool

In this theme, students mentioned that they preferred the animation without narration. Students were intrigued by the animation. 'I was looking at the video [animation] and I was wondering what was happening. So, watching the video made me want to find out what is happening. Visualizing made me want to read more on it.'

Another student touched on self-directed learning and taking ownership of the process, when watching the video without narration prompted her to conduct further research in the form of in-depth reading to enhance her understanding of the events illustrated in the animation. 'I don't think I would do as much research, because now I understand so much about that automatic processor [animation].' This self-directed teaching strategy is well aligned with Kolb's model of experiential learning.[3] In this model, students are involved in four aspects, which are:

- going through a new experience or gaining a new perspective of an existing experience
- interpreting and reflecting on the experience
- a learning experience is put into a new context
- the learner applies new understanding to reality to test its validity.[3]

Students were exposed to a new experience in visualising the AFP in a dynamic teaching format. Students then reflected on the video (animated film) in relation to the theory, enticing them to conduct further research. This exercise led to a learning experience which students could use to complete their assignment, ultimately testing the validity of their experience.

Theme 2: The AFP animation with narration and captions as a passive learning tool

Students' responses revealed that the functionality and value of the animation was largely influenced by their learning styles, which varied from visual and auditory to written. One student expressed it as follows: 'It [the animation] made it a lot easier because then you can visualize it, because we don't use it every day, ever'. Learners often create better internal representations of content when watching videos, compared with learning from static images only.[4] Although online videos have many benefits, the content is watched as opposed to hands-on experience, and the extent of the benefit will depend on the detail portrayed in the video. Contrary to the previous student's reaction, another student was frustrated by the narrations and captions, saying that 'The voice was distracting. I am trying to look at the picture and, you know, trying to understand [but] the words kept coming.' The student expressed frustrations that align with Mayer's 'redundancy principle', according to which multiple stimuli should be kept separate to eliminate the extraneous cognitive processing load.[5] In Mayer's 'cognitive theory of multimedia learning model', three fundamental principles, derived from cognitive science, must be considered when using animations: (i) the dual channels principle, whereby students have separate visual and auditory processing stations; (ii) the limited capacity principle, when students can only process a limited number of concepts illustrated in the animation; and (iii) the active processing principle, in which there is active engagement with the animation.[5] Some students reported that the narrated animation was a valuable passive learning tool, as it provided a visual element to the learning material. However, the high cognitive load may have hindered deep learning.

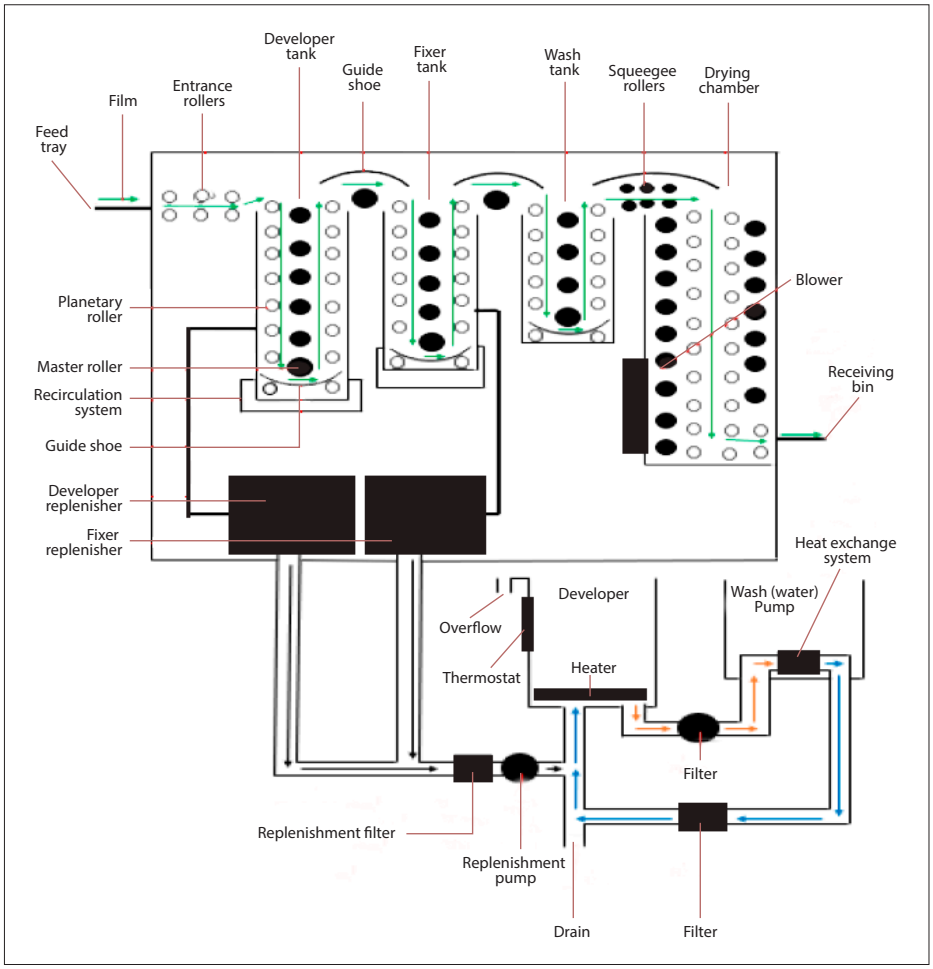

Fig. 1. Redrawn illustration of the automatic film processor (AFP).

What will I keep in my practice?

The animation without narration served as an effective inquiry-based learning tool and we will use it again to teach AFP concepts. Inquiry-based learning gives learners an opportunity to formulate their own explanations from evidence at their disposal and relate it to scientific knowledge and theories.[6] Learners can communicate and explain their findings, which translates into deep learning and long-term knowledge retention. The online environment further creates the ideal platform for inquiry-based learning, which has benefits such as students taking ownership of their own learning and inquiry skills. During the COVID-19 pandemic, all teaching across the globe dramatically transitioned to online platforms.[7] Using the online animation as an inquiry-based learning tool was an appropriate and welcome method of teaching during times of limited physical access to equipment.

What will I not do?

We will not use the animation with narration and captions as a primary teaching tool for AFP, but rather keep it as an additional resource for students - should the need arise. The animation with narration showed potential to be an effective visual aid for learning, but had minimal engagement opportunities and thus supported passive learning. Many students were distracted by the extra features, which hindered their learning. In future, when developing online multimedia, such as animations, we will not combine multiple methods of delivery such as narration and caption, but rather limit the animation to one form of communication if the animation is to be used as a teaching tool.

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Evidence of innovation

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