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Exploring Visualisation in Teaching and Research

By Dr Eiman Abdel Meguid, School of Medicine, Dentistry and Biomedical Sciences, and Dr Joe Allen, School of Social Sciences, Education and Social Work

In this reflection, we are addressing Goal 4 of the 12 SDGs THE 17 GOALS | Sustainable Development (un.org). Aligning curricula with the need for technological innovation can be achieved by applying Visualisation approaches to the areas of Biomedical Sciences, Anatomy and Embryology, as well as the representation of complex research ideas in the Social Sciences. It is far more relevant to change the way we present curricula rather than change the fundamental knowledge and the research concepts themselves. This approach will strengthen both face-to-face and digital online learning by making them both more inclusive and effective. Today, innovations, in the context of the 4th industrial revolution, are needed to fulfil the sustainable development goals. Here we highlight the use of advanced visualisation techniques to guide the evolution of inclusive quality education in line with SDG (Goal 4).

This article is based on a published book chapter by Dr Abdel Meguid on “Exploring Visualisation for Embryology Education” in the Biomedical Visualisation Book Series Volume 11, by Springer Publishing, as well as a short course by Dr Allen on Creative Thinking for PhD candidates. This was held in the Autumn 2021 in the School of Social Sciences, Education and Social Work (SSESW) and the findings of a research paper based on collage were presented at a conference in Trinity College Dublin by Brenda Brady a PhD candidate in SSESW.

Educators around the world are usually interested to use innovative technologies to make their sessions more interactive. In the pre-pandemic period, the utilization of such technologies was optional, however, COVID has changed the situation dramatically as what was optional earlier became a necessity. During the pandemic, educators had to implement various technologies in their online sessions to make the subject more visual and interesting.

What is Visualisation?

Visualisation (VIS) is the junction/intersection between technology, science and visual arts. It is conveying complex information by using a series of images by using visual methods. Visualisation demonstrates the numerous options we have in using technology to enhance, support, and challenge education, clinical settings, and professional training. This approach engages the learners and guide their understanding. The scope of implementation of visualisation and collage encompass most of the educational and clinical fields’ subjects such as medicine, radiology, surgery, dentistry, veterinary medicine, allied health professions, biomedical sciences,

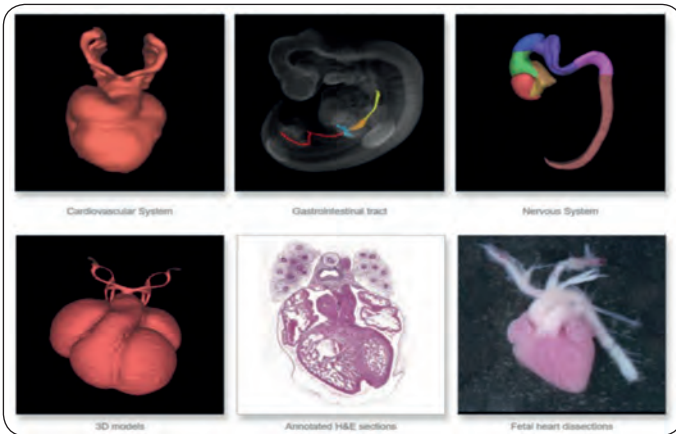
microscopy, engineering, social sciences, and life sciences. The utilisation of these advanced innovative technologies has grown at an exceptional rate over the recent period as the way we view and examine data currently differs completely from what has been done in previous years. With the development and innovations in imaging and data visualisation and collage techniques, attracting students’ attention became much easier through interaction and engagement. This in turn has made teaching and learning much more effective than it has ever been.

Not only were these technologies been used to facilitate visualisation, but also to engage our future leaders with their educational environment. Never have we had such a variety of innovative technologies available to engage our students. Therefore, this is a perfect time to display and highlight the effect of its implementation to improve student’s education, understanding and engagement.

Visualisation in the Medical Sciences

Teaching is commonly taught in large groups, via didactic lectures, however, this approach is not recommended as it is not engaging. When studying, learners face significant challenges in understanding complex, multiple, and simultaneous events which are likely to increase student cognitive load. Moreover, some subjects such as embryology, its content is nonlinear, and this makes its teaching challenging. The rapid development of the embryo increases the difficulty in discovering the level of details in every stage. However, by using visualisation, this becomes much easier and clearer as understanding embryology requires 3D visualisation of multiple events that occur rapidly and simultaneously within a brief period. Consequently, a visualisation tool such as the HDBR atlas have been embedded in some schools within tutorials to supplement student understanding of the three-dimensional morphological concepts in embryology once knowledge-based learning outcomes have been addressed by other means.

The core theme enclosed in this reflection emphasizes the creation of effective visual tools to convey complex data and ideas. Additionally, it highlights the revolutionary technological advances that have led to innovative discoveries in teaching, research, and health care. It spans from microscopic level all the way to patient care. Furthermore, it demonstrates how we can view information in a much more accessible, innovative, and engaging way through visualisation. This cutting-edge visual technology not only creates and integrates platforms for teaching and education, but also visualises biological structures and pathological processes, and aid in visualisation of the historical arenas as well. It is fascinating to see that science is now starting to take visualisation seriously, putting techniques to the test, to find out what happens when we visualise.



Reprinted with permission from Springer Nature Customer Service Centre GmbH: Nature/Springer, Biomedical Visualisation Book Series, Volume 11, Exploring Visualisation for Embryology Education: A Twenty-First-Century Perspective, Eiman M. Abdel Meguid, Jane C. Holland, Iain D. Keenan et al, 2022.

HDBR Atlas ‘Organ Systems’ visual menu (<http://hdbratlas.org/organ-systems.htm>) (pictures in the top row) and HDBR Atlas ‘Development of the Heart’ visual menu (<http://hdbratlas.org/organ-systems/cardiovascular-system/heart.html>) for embryology teaching (pictures in the lower row) (Website Resources for Visualisation in Embryology)

What is Collage?

While the term “collage” refers to any combination of found images, paint, text, and three-dimensional objects, this discussion will focus on two specific forms of collage. The first one is an arrangement on a piece of card or paper of random words and images from magazines and newspapers. The second type of collage is an electronic document produced in Microsoft PowerPoint which allows the creator to gather several images and words on a specific theme on one page.

At the beginning of the Creative Thinking course, a series of ambiguous images, with the themes of searching and journeying, stimulate discussion on the complexities of developing a PhD and the processes of discovery involved. This is the first of a series of activities which encourage metaphorical thinking and the capacity to explore research questions and themes from a range of perspectives. One of these activities involves using the Japanese poetic form of Haiku to represent the research theme or question. Haiku consists of three lines, with five syllables in the first and third lines and seven in the second one. The conciseness of Haiku supported students in capturing their central research ideas, as in the two examples below from the creative thinking course in 2021.

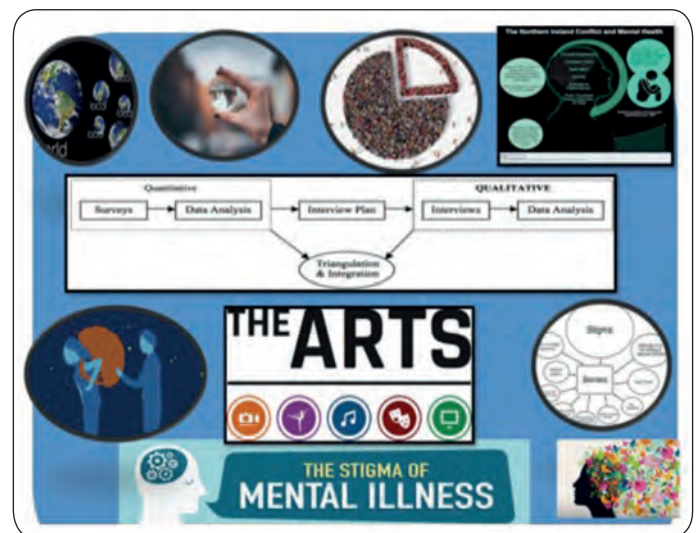
- | | |
|-----------------------------|---------------------------------|
| Buildings tell | Clean hydrocarbon |
| Stories of the city | By using unique solvents |
| Dividing its spaces | Improving process |
| (Community Research) | (Environmental Research) |

Introducing collage-making as a form of visualisation for the expression of complex research questions seemed an appropriate way of offering students more opportunities to engage with images as a means of articulating their research ideas. The course also built on the notion that collages have the capacity for modelling ideas about and conceptualising research (Holbrook and Pourchier, 2014).

The use of arts-based approaches in research draws from authors such as Yuen (2016), who identified creative methods which allow researchers to access the intuitive processes involved in research. The visualisation of complex research ideas using the collage technique was found to be a highly valuable experience by the students on the Creative Thinking course.



Collage 1. Arts based Approaches to the Treatment of Mental Illness



Collage 2. Stigma of Mental illness

The two electronic Collages 1 and 2 above were on the theme of Mental Health and Arts Based Approaches and were presented at a recent Conference at Trinity College Dublin (Brady and Allen, 2022). This collage is typical of most of the electronic ones in its rectilinear structure and its gathering of images on the theme. They present as posters, which illustrate the themes rather than using the images as instruments of analogy and metaphor, as was evident in the paper-based collages. Most of the electronic collages had no text added besides that already included in the images.

In the process of making paper collages such as in Collage 3, students were able to use and find words which represented ideas from their research, while pictures were used in the main for the electronic collages. The predominance of words in the paper collages suggests that the students were using the process of collage-making to theorise and to uncover their thoughts and feelings about the subject. Their attitudes to their final work, as conveyed in their presentations of their collages to the group, seemed to be more emotive than those of the students who made electronic collages. The paper collages gave more of an impression of layers of exploration and meaning making. However, the contrasts between the two forms of collage did not detract from the impact of the collage making process on either group.



Collage 3. Exploration of women's suffrage in Northern Ireland

Animation versus Static Pictures

Research confirmed that animation is not considered superior to static pictures, as it may impede learning by increasing the extraneous cognitive load, whereas static pictures on the other hand offer time to review information if it is needed. Additionally, it increases the long-term student knowledge retention. Several description-based publications have reported on the immense value of the highly visual resources that have been used to facilitate teaching and learning (Yamada et al., 2006; Evans, 2011).

Merits of using visualization/collage

By implementing visualisation/collage, educators can effectively develop the course content, by adopting the twenty-first-century interactive resources to support the learner-centred teaching methods. Undoubtedly, visualization of sciences can be improved with strategic adaptations that utilizes technology and media. The pandemic has simply provided insight into the pros and cons of these technologies and innovations. Certainly, the continual integration of technology into education is essential to improve the learning outcomes and to address the cognitive burden associated with the volume of education and training (Gaur, 2020). The judicious use of technology and the creative adaptations are imperative to ensure timely, effective, and impactful delivery of education despite the constraints evolved during or even after the pandemic (Saverino, 2020).

To aid student learning, we need to further develop our pedagogical approaches and interactive resources by implementing the power of visualisation/collage to facilitate students' learning. To improve student performance, we recommend that more time and effort should be devoted to the creation and implementation of the visualisation-based digital technology through photos, videos and simple animations. Technology-enhanced learning strategies and modalities that support the understanding of the three-dimensions, have the potential to develop deeper understanding.

For twenty-first-century students, visual learning would contribute to increased interest, interactivity, engagement and understanding of the educational content. The transition to incorporate visualization/collage is becoming essential as the global educational environment at present is moving towards 3D visual tools for the sake of clearer presentation that would facilitate student understanding.

To conclude, using visualisation and collage resources and approaches can be used to explore and to effectively express ideas at a deeper level complex process.

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Internet Resources:

For Visualisation in Embryology HDBR Atlas (<http://hdbratlas.org>).

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