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INNOVATING EDUCATION FOR A BETTER TOMORROW

INTERNATIONAL UNIVERSITY CARNIVAL ON E-LEARNING (IUCEL)
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Preface

by the Editors

Centre for Academic Development (CADE) Universiti Putra Malaysia had the privilege and honour of organising the International University Carnival on E-Learning 2022 (IUCEL2022) in collaboration with the Ministry of Higher Education Malaysia (MoHE). The event was supported by the Department of Higher Education, MoHE and the Public University e-Learning Council (MEIPTA). IUCEL2022 which was organized virtually on Gather, a metaverse platform from 28th to 30th June 2022, has marked UPM's capabilities to unearth the talents of 294 e-learning innovators representing 38 institutions from 10 countries (Malaysia, Germany, China, South Korea, Jordan, Iraq, Singapore, Philipines, Indonesia and Myanmar). IUCEL2022 was successful in providing a platform for educators to facilitate the dissemination and sharing of their innovation on e-learning which are aptly reflected through the papers presented in this e-proceedings.

We invited all presenters of IUCEL2022 to submit their extended abstract in June 2022. The selection of 163 articles from diverse disciplines was then concluded in September 2022. All papers were subjected to substantial peer review to ensure their originality, significance and impact on higher education..As a result, we are confident that this e-proceedings will be of interest to a diverse readership.

The theme of IUCEL 2022 inspired the title of this e-proceedings, "Innovating Education for a Better Tomorrow". We would like to take this opportunity to thank Professor Dr. Ismi Arif Ismail, the Advisor of IUCEL2022 as well as Associate Professor Dr. Wan Marzuki Wan Jaafar, the Chairman of IUCEL2022, for their vision and exceptional leadership in making the event a reality. We would also want to express our profound gratitude to all authors (as well the reviewers) who put in immense effort to contribute to these e-proceedings.

Finally, we would like to put on record our gratitude to all staff members at CADE, who made IUCEL2022 a resounding success.

Digital Comics as an Alternative Teaching and Assessment Tool for Biotechnology Courses

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Abstract

Storytelling has been long applied in teaching and learning. Nevertheless, application of storytelling through digital comics for teaching and learning Biotechnology is still limitedly explored. This presentation highlights the initiative of using digital comics as an alternative teaching and assessment tool for Bioprocess Technology and Environmental Biotechnology. The courses were taken by 136 students of Resource Biotechnology programme at Faculty of Resource Science and Technology, UNIMAS in Semester 1 and 2 2021/2022. Engaging digital comics entitled Ahmad's FYP story, To RIP: Landfills or Composting?, Save Our Souls and From Textile Waste to Biofuel were topics of Environmental Biotechnology. The resulting comics produced by the students were disseminated to selected schools and matriculation centres and also in social media. Upon the created and used in the teaching and learning session of the aforementioned courses. Questions that assess students' understanding were also integrated in the comics in order to engage the students to think and reflect whilst reading the comics. We have also used comics as a means of a graded assessment whereby the students were required to produce digital comics related to the implementation of the approach, the students' average scores for both courses have improved by 30 to 36%. This is further supported by the positive feedback from the students indicating good acceptance of the approach. The initiative has also resulted in several added values amongst the students such as enhancement of art skill, digital skill, science communication skill, storytelling skill, community responsibility besides promoting the culture of learning during leisure time. Moreover, the comics also have a potential to be used as life-long learning materials in both formal and informal contexts besides having the commercial potential to be marketed in the form of digital or printed comics. In summary, the positive impacts of this initiative have clearly proved the efficacy of digital comics as an alternative teaching and assessment tool for Biotechnology courses.

Keywords: Biotechnology, Digital comics, Storytelling, Science Communication

Background of the Research

In conventional setting, science is always seen as an isolated field from daily concepts and activities. Oftentimes, this has challenged the students to understand scientific concepts clearly. One of the effective strategies of teaching and learning is by storytelling. Comics are examples of platforms that can be used for storytelling purposes. The effectiveness of comics in enhancing learning outcomes and attracting wider audience has been well established for many years (Aulia et al., 2020).

The strengths of comics lie in the pictures. As the old adage says, a picture is worth a thousand words. Unlike words, pictures hold a universality. The effect of the visual language of pictures is enormous where it triggers the audience to recognise, process and recall the information better than words (Levie and Lentz, 1982). Having the combination of pictures and words, comics have higher efficacy of communication rather than pictures solely and this can be benefitted for stimulating students' imagination and logical thinking (Rozkosz and Wiorogorska, 2016). Furthermore, with the advancement of technology, the landscape of comics has been changed tremendously. Digital comics have come into play and have widened the flexibility of today's comics. Considering all the aforementioned advantages, digital comics can serve as a powerful tool in education, henceforth overcoming the challenges of teaching and learning science.

Although there are some works that reported the use of storytelling through comics for teaching and learning science courses, nevertheless little is still applied for biotechnology courses. Furthermore, with the transition into digital era, the approach needs a constant enhancement and diversification in terms of the contents and platforms used. Here, we present our initiative of using digital comics as a means of teaching and learning as well as an assessment tool biotechnology courses.

Description of the Initiative

The initiative was exemplified for Bioprocess Technology and Environmental Biotechnology course, which were taken by 139 students of Resource Biotechnology programme at UNIMAS in 2021/2022 session. The use of digital comics was applied for two purposes namely for teaching and learning and also as an assessment means.

For teaching and learning, we produced several comics: Ahmad's FYP story, To RIP: Landfills or Composting?, Save Our Souls and From Textile Waste to Biofuel, which were designed to communicate selected topics of the two courses. For instance, Ahmad's FYP story is a result of the transformation of lecture notes of two of the topics in Bioprocess Technology. Additionally, in all comics, we have included a few questions in order to trigger the students to reflect on the topics presented. All of the aforementioned comics were posted on eLEAP, a learning management system at UNIMAS and Telegram groups.



Figure 1: Amongst the Biotechnology Comics Produced by the Authors

In the second exercise, we used comics as a means of a graded assessment whereby the students were required to produce digital comics related to the topics of Environmental Biotechnology. The resulting comics produced by the students were compiled as an e-book and

named as 'Super Biotech Comics', which was then disseminated to the public. This aims to facilitate students' learning during leisure time and to encourage science communication amongst the students. Furthermore, this will indirectly train the students to be responsible scientists by communicating science through the general public.

The efficacy of comics for teaching and learning as well as an assessment tool was evaluated based on students' academic performance as well as their feedback according to two surveys conducted after the completion of the courses.

Significance/ Usefulness of the Initiative

The efficacy of the adoption of digital comics for teaching and learning and also as an assessment tool was assessed in two separate surveys. In the first survey, the efficacy of Ahmad's FYP Story as a teaching and learning material was assessed by 57 respondents. Table 1 outlines the top four reasons why Ahmad's FYP Story is favoured by the respondents. Majority of the respondents (98.2%) agreed that Ahmad's FYP Story has helped them to understand the topics better than lecture notes.

Table 1: Top 4 Reasons Why Ahmad's FYP Story is Favoured by the Respondents

Reason	Percentage of respondents (%)
Visuals are attractive and easy to be understood	84.2
Terms used are less formal yet useful in facilitating the understanding on the topics	73.7
Comics can be accessed at everyone's pace, making them flexible	61.4
Storytelling is effective in facilitating the understanding on the topics	61.4

About 54.4% of the respondents stated that they accessed Ahmad's FYP Story by mobile phones either via messaging system or social media. This clearly shows the flexibility of comics when used as a teaching and learning material. In line with the emerging use of mobile phones in these modern years, the use of digital comics in teaching and learning is seen suitable to support mobile learning. This has also helped to create personalised learning, which can encourage the students to engage more in their learning.

The effectiveness of our comics can be associated with the positive feedback from the students as summarised in Table 1. The use of visuals and less formal words presented in the form of daily events of a scientist at the lab was proven helpful in attracting students' interest in understanding the subject matter. Visual learning materials are deemed beneficial for long-term learning process (Ozdemir, 2017) whilst the use of less complex terminologies in comics may motivate learners with moderate to lower reading ability in grasping the subject matter (Affieldt et al., 2018). The aforementioned findings clearly show that learners' motivation can be enhanced by the adoption of comic-based learning tool. Conventional means such as textbooks and lecture notes on the other hand, may have limited capabilities to convey the scientific concepts in fun and entertaining ways, making the contents seem to be complex and daunting to be processed by students.

The usefulness of the comics as a teaching tool for our courses was assessed based on pre-test and post-test scores of 57 students. The improvement of the scores by about 30-34% for the

topics (Table 2) shows the positive effect of the comics in facilitating students' understanding. The promising results from our work are in parallel with many previous studies that reported the potential of comics as a tool in science education (Akcanca, 2020; Badeo et al., 2021).

Table 2: Pre-Test and Post-Test Scores of the Efficacy of Comics as a Teaching Tool

Topic	Pre-test Mean (%)	Standard Deviation	Post-test Mean (%)	Standard Deviation	p-value
Medium Formulation	57.4	2.0	87.4	0.90	0.000*
Downstream processing	54.2	2.3	87.5	0.95	0.000*

n=57; *p<0.05

In the second survey, the use of digital comics as an assessment tool was assessed by 107 respondents. Figure 2 shows the summary of students' feedback. Majority of the students agreed that producing digital comics has helped them to develop creativity and science communication skill. Moreover, the assessment has motivated them to be more responsible for communicating biotechnology to the public. Nearly all respondents (99.1%) agreed that science communication should be conducted through an informal way such as through comics. About 97.2% agreed that the assessment involving science comics should be continued in the future. Based on the findings, it can be concluded that the implementation of comic assessment has helped to change the students' perception about the importance of creative and artistic means such as comics in science communication. The significance of integration of art into science through comics is apparent and has been highlighted widely in the literature. Nichols and Stephens (2013) stated that integration of arts into learning can promote critical thinking, problem solving skills, empathy and tolerance for others. Similarly, Dhanapal et al. (2014) also agreed that learning science through the arts can improve thinking skills and reasoning abilities.

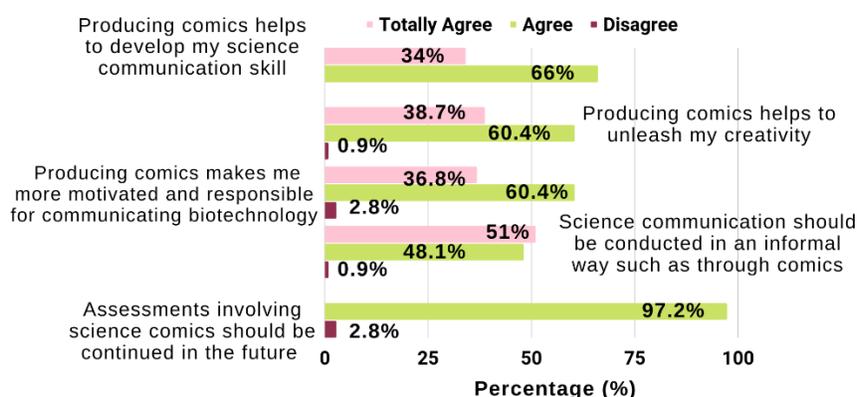


Figure 2: Students' Feedback on the Use of Digital Comics as an Assessment Tool

Upon the completion of the comics, we also assessed the students' average scores for the topics presented in the comics. The results show that their understanding on the topics presented in the comics have improved from 55 ± 2.2 to 89 ± 0.9 . The significant improvement of the scores clearly suggests the positive effects of the use of digital comics as an assessment tool on students' motivation and attitude towards learning biotechnology.

Table 3: Pre-Test and Post-Test Scores of the Efficacy of Comics as an Assessment Tool

Pre-test Mean (%)	Standard Deviation	Post-test Mean (%)	Standard Deviation	p-value
54.6	2.2	89.1	0.87	0.000*

n=107; *p<0.05

Impact of the Initiative Towards Education or Community

Our initiative has a notable impact on science education and community. Our comics can serve as new learning resources for teaching and learning biotechnology in both formal and informal contexts and in either digital or non-digital form. This will not only facilitate the students in the field but also the community through the dissemination activities on various platforms such as social media. Interestingly, our Biotechnology comics can be important resources for learners with hearing disability who have to rely on visual learning materials. We are keen to translate our biotechnology comics into Malay language, aligned with our aim to promote science literacy amongst the local community in Malaysia more effectively.

With regards to the adoption of digital comics as an assessment tool, this exercise has equipped the students with digital, art and science communication skill besides inculcating a sense of community amongst them considering the sharing activities of their comics through various platforms. The development of the above-mentioned skills may benefit the students in various contexts especially when they enter the workforce. Moreover, the comics produced by the students serve as their lifetime digital products, which have potentials to be copyrighted and marketed in the future.

Commercialisation Potential

One of our comics, Ahmad's FYP story has been copyrighted (AR2022Q02105) under Malaysian Intellectual Property Corporation (MyIPO). All of the comics have the commercial potentials to be marketed in the form of digital or printed versions. We are looking forward to transforming our Biotechnology comics into animated versions, which also have wide potentials to be marketed as educational videos.

Conclusion

In summary, the present initiative has given useful insights into the promising applications of comics as a creative and meaningful approach in teaching and learning biotechnology. Our biotechnology comics have wide potentials to be used as learning materials in diverse contexts. The flexibility of comics, which can be applied either formally or informally, in the form of digital or printed materials and as social media content has leveraged the potential of comics as a versatile educational means. The positive effects of our approach clearly suggests that innovative curriculum approach can promote student engagement and increase their motivation to learn science better. Although we demonstrated the approach within the science context, the utility of comics as a teaching and learning means is considered generally applicable across both science and non-science fields.

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