Forensic Science International: Synergy 2 (2020) 82–85

Contents lists available at ScienceDirect

Forensic Science International: Synergy

journal homepage: https://www.journals.elsevier.com/forensic-science-international-synergy/

Choose your own murder: Non-linear narratives enhance student understanding in forensic science education

Tim Thompson

Professor of Applied Biological Anthropology, School of Health & Life Sciences, Teesside University, Borough Road, Middlesbrough, TS1 3BX, UK

ARTICLE INFO

Article history:
Received 13 November 2019
Received in revised form
15 January 2020
Accepted 15 January 2020
Available online 21 January 2020

Keywords:
Learners
Higher education
Education 4.0
Forensic ecology
Twine

ABSTRACT

Higher education teaching in the forensic sciences tends to follow a traditional format of lectures followed by practical laboratory sessions. Sometimes this approach is not possible or viewed as not innovative enough. The free, open access software Twine was used with final year undergraduates in forensic and crime scene science in a UK university in order to create an interactive learning experience based around the creation of non-linear stories. Evaluation of this approach demonstrated the positive impact on student understanding when compared to the traditional lecture model. Students found the experience engaging and were keen to use Twine again.

Forensic science education tends to follow a very traditional model – that of lectures supplemented by seminars and practical laboratory sessions. This model is widely accepted, despite being criticised for lacking creativity [1]. Nonetheless, it is commonplace in all higher education institutions.

Detailed discussion of forensic science pedagogies is few and far between. In 2012, Rankin et al. [2] discussed the appropriateness of teaching forensic practice and content in a culture of rapid change and fluidity in the national and international sector. Here questions were raised about how well universities were preparing students for work in practice. Bolton-King et al. [3] have also highlighted the potential disconnect between university study and active case work within the sector. San Pietro et al. [4] went further, by opining that US forensic science education has become so specialised and lacking any effective industrial mentorship as to be undermining the discipline. It should be noted that others (e.g.: [5]) have pointed out that it is not actually a university's responsibility to prepare graduates for work in the forensic sector, but rather to provide a rounded, engaging and rewarding educational experience. Nonetheless, in some countries academic forensic teaching is very closely associated and linked to actual practice [6]. Unfortunately, a recent review of the literature by Kennedy and Wilkinson identified "no original research studies that satisfactorily examined the long-term effectiveness of teaching methodologies with specific regard to the teaching of Forensic and Legal Medicine" (2018; 63) [7].

The methods and techniques taught in many forensic classes often need to be applied in the field, and problems resulting from the disconnect between theory and practice have been highlighted for the forensic sphere [8]. Actual active forensic field work may be possible in some circumstances (such as described by Ref. [9] along the US-Mexico border) but where it is not, this may lead to the use of simulated scenes. In a learning environment, simulation "exists as a spectrum of educational activities" [10]; 261) and for students of forensic subjects this can simply equate to working in a laboratory setting. The benefits of a simulated or experiential approach for the students' learning experience in the forensic sciences is well accepted (e.g.: [6,9–12]. Within medical education it has been shown that adding more realistic components to a teaching scenario (even simply wearing scrubs) improves long-term information recall when in that same context [13]. Thus, to improve forensic practitioner performance in the field, the field needs to be reproduced in the learning environment. Unfortunately, this is not always possible.

There is a challenge for educators at times when simulated scenes cannot be supported. In these occasions, other interactive approaches should be explored. Technology-enabled learning may offer a potent alternative. There are a number of examples of innovative interactive technological and/or digital teaching sessions in the forensic context. For example, educators working in the

E-mail address: t.thompson@tees.ac.uk.

https://doi.org/10.1016/j.fsisyn.2020.01.009

field of peace studies have successfully adopted technology-assisted teaching in Cyprus, although the outcomes where not as positive as hoped [14]; Taylor et al. [15] used the game Minecraft to support their learning sessions due to its popularity; Erolin et al. [16] found positive responses from their students following use of VR and online approaches to teaching anatomy; Twitter has already been used by this author to facilitate different learning connections in forensic science modules since micro-blogging has been shown to have key benefits for learners in higher education [17–19], particularly regarding the immediacy of content provision and the power to connect with researchers directly.

Technology-enabled learning also supports the new Education 4.0 framework [20,21], particularly with regard to learning occurring anytime in anyplace, a personalised approach to learning, self-determination regarding how to learn, and independent learning.

Twine (https://twinery.org/) is a free, open access, browser-based software which lets one create branching narratives – that is, stories for which reader can choose what to do. It is akin to the 'Choose Your Own Adventure' books created for children. It is text driven and requires little understanding of programming. Fig. 1 shows how the elements of the story are linked together to create the non-linear structure.

Despite a general lack of research [22], Twine has been used in a number of learning and teaching contexts, since it taps into the notion that modern (particularly younger) students are engaged in a 'participatory culture' and are not simply consumers of digital content [23] and supports multidisciplinary activities [24]. Poole [25] argued that the use of technology and digital tools allows for the active construction of historical interpretations by the users themselves, and we can also argue the same of learning and understanding of forensic knowledge. The creation of non-linear games has been shown to be engaging and effective in other educational science contexts, such as medicine [26], computer science [24] and physics [1]. They also support a 'trial and error' approach to learning which can be very effective [22]. Finally, the use of Twine has also been argued to improve computational fluencies and digital literacy skills [23] – key aspects of the Education 4.0 initiative.

1. Method

Twine was applied in a final year undergraduate module which focussed on the theory and application of forensic ecology. Nineteen students studying for forensic science or crime scene science degrees took this module, which was core or optional depending on

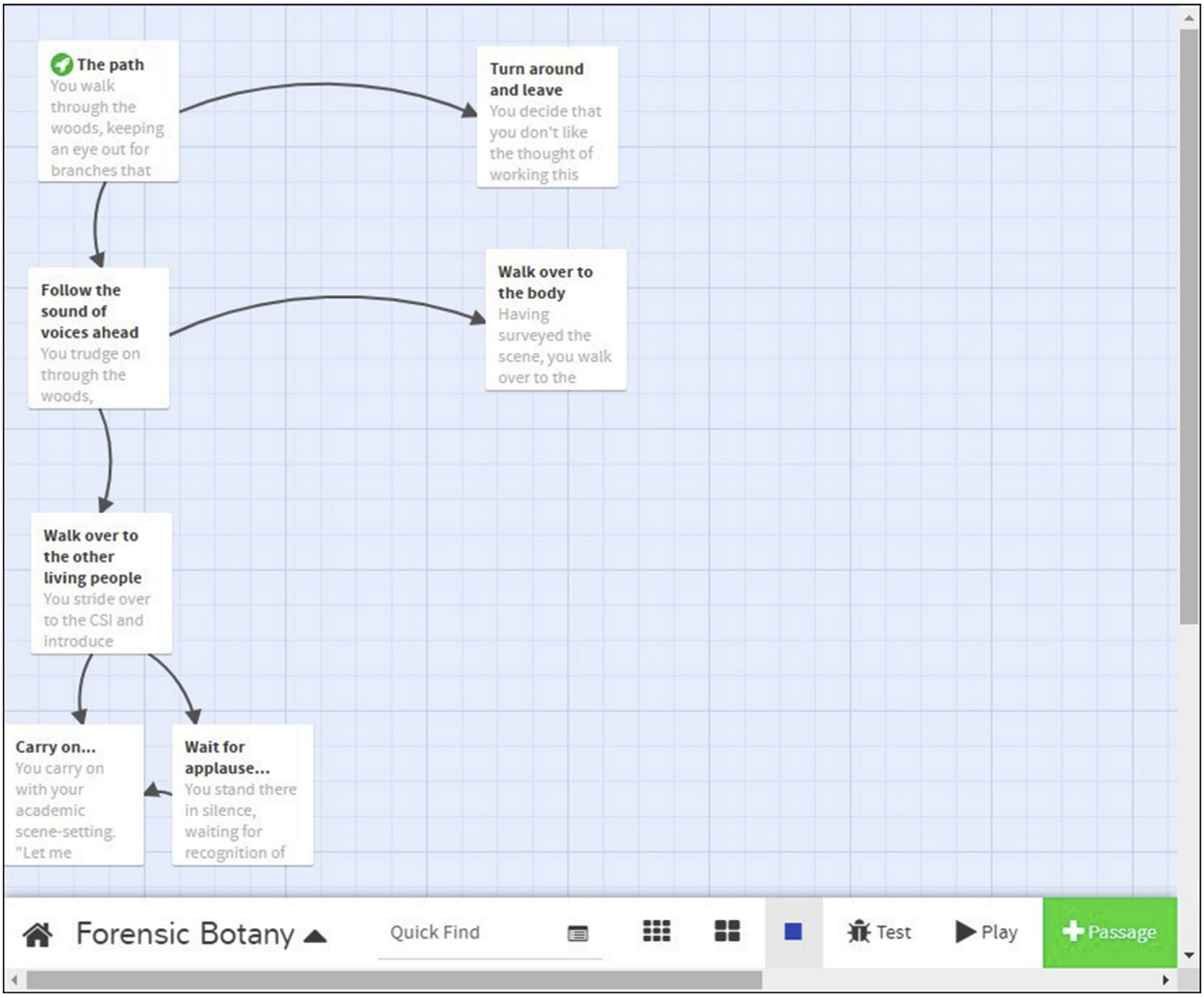

Fig. 1. The mechanics of Twine to create a story.

the route of study. The module runs with one three-hour session per week, for eleven weeks. The assessment is a presentation and an unseen written examination. Twine was deployed in the third week during a session on forensic botany. The objective was to take an iterative approach to creating a story in the expectation that repeated engagement with their stories would allow for greater cementing of that knowledge. Students first sat through an introductory talk about the subject and were then set into groups to write a story using Twine which had forensic botany as the focus. The lecturer gave an example of how Twine could be used in this context, partly to address the requirement to give adult learners 'permission to play' and provide signalling that non-formal behaviours were now being encouraged [27]. No other condition was applied to the story. Students were encouraged to discuss their stories in their groups. After 20 min, the lecturer led a discussion on the principles of forensic botany after which the students were tasked with revising their stories based on this new information. The academic then led discussions on methods used in forensic botany, again after which the students went back to modify their stories. Finally, the academic spoke about the limitations of forensic botany and the students subsequently had one final period to adjust and develop their stories. The session ended with the students presenting their forensic botany-based stories.

To coincide with each session, the students were asked to complete an evaluation questionnaire (Table 1). Scores were given on a scale of 1–10, with 10 being the most positive. The purpose of this was to ascertain how they felt the use of Twine affected their learning. The first question was kept the same in each week to normalise the results. Subsequent questions were designed to evaluate the impact of a standard teaching session (in Week 2) and the session with Twine (Week 3). This study was interested in the students' own perceptions of understanding and engagement, and so the evaluation focused on this rather than other factors such as grade attainment.

2. Results

The student groups created a number of interactive stories, including:

- A case of murder by botanical poisoning occurring in real-time
- A jungle-based case of poisoning by plant in the first person
- A forensic investigation on a farm where plants were a form of evidence
- A meditation on the inevitability of death

One-tailed paired T-tests were applied to determine whether there was a statistical difference in student understanding of the subject matter as a result of different teaching approaches. Students were asked to score their understanding of how the weekly topics related to forensic and crime scene science (Table 1) before and after each teaching session. Teaching overall was seen to have a positive impact on understanding ($p < 0.05$), however the application of Twine had a more significant impact ($p = 0.0006$) than the traditional approach ($p = 0.001$). For comparison, there was no statistical difference between the popularity of forensic ecology over time (Table 2).

The statistical significance of the one-tailed paired T-tests for the question regarding the interactivity of the teaching sessions was $p > 0.1$ ($p = 0.32$). Students viewed the use of Twine very positively in a learning environment (Table 3).

3. Discussion

The data produced from this evaluation of Twine as a learning tool suggests some interesting conclusions. Although both the traditional and Twine-based teaching sessions produced significant improvements in the students' understanding of the subject matter, the Twine session had a greater impact. This can be seen in the average increases for the two approaches of 2 (median) for the traditional approach compared to 3 (median) for the interactive approach. The student responses also show that the traditional lecture improves understanding, but the degree to which that occurs varies (increasing understanding scores by −1 to 7). In contrast, the use of Twine increases understanding by a more consistent amount (1–5). This implies that a traditional lecture does not suit all students, but that the use of a more interactive, group-based Twine session caters for a wider range of student learner styles and is thus more effective across a cohort. Even the students who did not want to use Twine again (Table 3) showed an increase in understanding (range = 1 to 5). Twine allows users to draw on many forms of cultural knowledge [23] and this will include different aspects and perspectives of forensic knowledge. It allows the student to "reject the authoritative single voice" ([25]; 306) and create their own understanding of the subject. This will be

Table 2
Scores for the 'My interest in forensic ecology' question by week.

Week	*Mean*	*Median*	*Min*	*Max*
1	8.8	9	6	10
2	9	10	5	10
3	8.6	8.5	7	10

Table 1
Evaluation survey questions.

Week	One	Two	Three
Topic	*Introduction*	*Climate Change*	*Botany*
Questions	My interest in forensic ecology is …	My interest in forensic ecology is …	My interest in forensic ecology is …
	My interest in climate change is …	My understanding of how climate change relates to forensic & crime scene science is …	My understanding of how forensic botany relates to forensic & crime scene science is …
	My understanding of how climate change relates to forensic & crime scene science is …	How would you rate last week's session in terms of engagement and interactivity?	How would you rate our last session in terms of engagement and interactivity?
		My interest in forensic botany is …	Did you find the iterative process (me talking, going back to your story, me talking, going back to your story) helpful in understanding the subject?
		My understanding of how forensic botany relates to forensic & crime scene science is …	Was Twine a useful tool to help support your learning?
			Would you like to use Twine again in our lessons?

Table 3
Popularity of Twine as a learning tool.

	Was Twine a useful tool to help support your learning?	
Would you like to use Twine again in our lessons?	*Yes*	*No*
Yes	50%	0%
No	25%	25%

an important contributing factor to the higher levels of understanding Twine supports. Previous work using non-linear storytelling in science education also found an increase in student understanding following traditional teaching but a greater increase following the story approach [1].

As can be seen from Table 2, the popularity of the subject remains high over the three-week period. This is not surprising since the students have elected to study this topic. Variation in the minimum score column is likely due to individual preferences regarding the changing weekly content.

As a cohort, the students did not feel that the interactivity provided in the teaching sessions were significantly different from each other. This is surprising since Twine is explicitly an interactive tool and the stories were written in groups. It could be that the students defined 'interactivity' as 'interacting with the lecturer' or simply that for them doing activities on tablets or laptops is not an interactive experience. Research has shown that adult learners are more comfortable using digital devices such as tablets and phones in playful learning contexts [27] and so the use of Twine may not have been viewed as any different from usual activities. Despite this, most students (75%; Table 3) felt that Twine was a useful tool, although not all wanted to use it again. This could be for a number of reasons, but Walsh [27] notes that factors such as the perceived seriousness of the course and value-for-money can be influential factors in these situations. This issue is not just with Twine, but rather with gamification within higher education more broadly [20]. Finally, work has also shown that Twine is a particularly powerful took for engaging women [23] and this cohort was entirely female. Future work should explore whether the use of Twine influences other pedagogical factors such as attainment and retention.

Forensic science educators are under significant pressure to develop effective and engaging learning sessions for their students. This is even more challenging when resources are thin. The use of the free software Twine in a higher education context has been shown to improve student understanding compared to more traditional approaches to lecturing. Further it supports the widening participation agenda and would benefit educators working in more challenging environments.

Declaration of competing interest

There are no conflicts of interest associated with this evaluation. This work has not been submitted or presented elsewhere.

CRediT authorship contribution statement

Tim Thompson: Conceptualization, Data curation, Formal analysis, Methodology, Project administration, Resources, Software, Validation, Visualization, Writing - original draft, Writing - review & editing.

Acknowledgements

I would like to thank Dr David Errickson (Cranfield University) who devised the module which we used for this work, and to Dr Amber Collings (Teesside University) who convenes the module for supporting this activity.

References

[1] R.L. Panjaitan, Implementing a "choose your own adventure" method in teaching basic concepts of sound to primary-school teacher candidate students, J. Phys. Conf. 739 (2016) 1–4.
[2] B. Rankin, G. Taylor, T.J.U. Thompson, Should higher education respond to recent changes in the forensic science marketplace? New Directions in the Teaching of Physical Sciences 8 (2012) 27–32.
[3] R.S. Bolton-King, J.P. Cassella, H. Kara, B.W.J. Rankin, R.M. Morgan, S. Burke, D. Fripp, J.P. Kaye, Increasing the accessibility and impact of justice-related student and practitioner research, Forensic Sci. Int.: Synergy 2 (2020) 60–71.
[4] D. San Pietro, B.W. Kammrath, P.R. De Forest, Is forensic science in danger of extinction? Sci. Justice 59 (2019) 199–202.
[5] M. Cox, Forensic anthropology and archaeology: past and present - a United Kingdom perspective, in: S. Blau, D. Ubelaker (Eds.), Handbook of Forensic Anthropology and Archaeology, Left Coast Press, Walnut Creek, CA, 2009, pp. 29–41.
[6] T. Magalhaes, R.J. Dinis-Oliveira, A. Santos, Teaching forensic medicine in the University of Porto, J. Forensic Legal Med. 25 (2014) 45–48.
[7] K.M. Kennedy, A. Wilkinson, A Student Selected Component (or Special Study Module) in forensic and legal medicine: design, delivery, assessment and evaluation of an optional module as an addition to the medical undergraduate core curriculum, J. Forensic Legal Med. 53 (2018) 62–67.
[8] D.V. Beresford, T. Stotesbury, S.V. Langer, M. Illes, C. Kyle, B. Yamashita, Bridging the gap between academia and practice: perspectives from two large-scale and niche research projects in Canada, Sci. Justice (2019), https://doi.org/10.1016/j.scijus.2019.09.005.
[9] A.J. O'Daniel, K.E. Latham, Teaching forensic science under conditions of humanitarian crisis: toward a critically-informed experiential approach, J. Forensic Legal Med. 65 (2019) 113–118.
[10] P. Bradley, The history of simulation in medical education and possible future directions, Med. Educ. 40 (2006) 254–262.
[11] H.E. Berryman, C.H. Lahren, The advantages of simulated crime scenes in teaching forensic anthropology, J. Forensic Sci. 29 (1984) 699–700.
[12] I.E. Eraña-Rojas, M.V. López Cabrera, E. Ríos Barrientos, J. Membrillo-Hernández, A challenge based learning experience in forensic medicine, J. Forensic Legal Med. 68 (2019) 101873.
[13] G.M. Finn, D. Patten, J.C. McLachlan, The impact of wearing scrubs on contextual learning, Med. Teach. 32 (2010) 381–384.
[14] G. Keleszade, A.E. Ozkul, A. Güneyli, The effectiveness of technology-assisted teaching based on peace training: the case of history of Cyprus, Qual. Quantity: Int. J. Methodol. 52 (2017) 2469–2485.
[15] D.C.P.J. Taylor, H. Mwiki, A. Dehghantanha, A. Akibini, K.K.R. Choo, M. Hammoudeh, R. Parizi, Forensic investigation of cross platform massively multiplayer online games: Minecraft as a case study, Sci. Justice 59 (2019) 337–348.
[16] C. Erolin, L. Reid, S. McDougall, Using virtual reality to complement and enhance anatomy education, J. Vis. Commun. Med. (2019), https://doi.org/10.1080/17453054.2019.1597626.
[17] C. Costa, G. Beham, W. Reinhardt, M. Sillaots, Microblogging in technology enhanced learning: a use-case inspection of PPE summer school 2008, in: Proceedings of the 2nd SIRTEL'08 Workshop on Social Information Retrieval for Technology Enhanced Learning, Maastricht, The Netherlands, September 17, 2008, 2008.
[18] D.P. Domizi, Microblogging to foster connections and community in a weekly graduate seminar course, TechTrends 57 (2013) 43–51.
[19] S. Fausto, F.A. Machado, L.F.J. Bento, A. Iamarino, T.R. Nahas, D.S. Munger, Research blogging: indexing and registering the change in science 2.0, PloS One 7 (2012) 1–10.
[20] F. Almeida, J. Simoes, The role of serious games, gamification and Industry 4.0 tools in the Education 4.0 paradigm, Contemp. Educ. Technol. 10 (2019) 120–136.
[21] A.A. Hussin, Education 4.0 made simple: ideas for teaching, Int. J. Educ. Literacy Stud. 6 (2018) 92–98.
[22] J. Bechkoff, Gamification using a Choose-Your-Own-Adventure type platform to augment learning and facilitate student engagement in marketing education, J. Adv. Market. Educ. 27 (2019) 13–30.
[23] K.M. Tran, "Her story was complex": a Twine workshop for ten- to twelve-year-old girls, E-Learn. Digit. Media 13 (2016) 212–226.
[24] M. Letonsaari, J. Selin, Modeling computational algorithms using nonlinear storytelling methods of computer game design, Procedia Comput. Sci. 119 (2017) 131–138.
[25] S. Poole, Ghosts in the Garden: locative gameplay and historical interpretation from below, Int. J. Herit. Stud. 24 (2018) 300–314.
[26] A.E. Blevins, E. Kiscaden, J. Bengtson, Courting apocalypse: creating a zombie-themed evidence-based medicine game, Med. Ref. Serv. Q. 36 (2017) 313–322.
[27] A. Walsh, Giving permission for adults to play, Journal of Play in Adulthood 1 (2019) 1–14.