Reflections on practice: Technology-enhanced strategies to promote long-term student learning

Mrinal Musib
Department of Biomedical Engineering
National University of Singapore
Funding in part for this project was provided through FoE, Technology Enhanced Learning (TEL) Grants
Why TEL -abled intervention...

• Promotes long term learning and continuous/adult learning
• More relevant to what students would encounter in real workplace (preparing for future)
• Helps attain outcomes
• Students (particularly engineering) pick em fast...
• Tech driven world...AI/3D printing/VR/Tissue engineering/robotics and what not...
Rationale and process for continuing and ongoing TEL embracement

• Specific TEL strategies apply to specific modules, NOT all TEL’s fits all...

• Story of gradual assessment, adoption, adaptation (based on module needs) and continuous evolution...re-assessment...continuous cycle...

• Gen ‘Z’, tech-savvy students, easy to sell TEL to such students

• Promotes understanding of **fundamental yet critical concepts**, not always possible through traditional pedagogical means

• **My Motto**: modify/apply specific TEL’s to appropriate modules; not the other way around...

• **Always...always...always**...keep outcomes to be attained in mind...and look back later how it promoted authentic/long term student learning
TEL strategies adopted

• Creating and integrating scenario-based learning (SBL) strategies for long-term student learning
• Using 3D printed medical device prototypes to promote ‘tactile’ and ‘visual’ learning
• Using virtual reality and augmented reality (VR/AR) in lectures to promote student learning
Are conventional lectures and tutorials sufficient to teach “Engineering Ethics”?

- Make it more relevant to our students and closer to real-life
- Minimal student engagement and insufficient participation
- Boring (as per some students 😞)
- More emphasis on active, interactive and authentic learning
- Create ample opportunity for students to rationalize thought process and make ethically educated decisions

Module: EG2401 (Engineering professionalism) (about 80 students)
Implementation methodology

Essential components:

1. **Key component**: Design and development of a relevant script by me that represent potential ethical scenarios that the students may face during their professional careers.

2. **Enactment** of the script/scene by the students (active and interactive component)

3. **Post-enactment activities** that involves identification of the ethical context followed by an open ended discussion and possible/probable conclusions that may be derived from the script/context

4. **Converting the scripts into comic strips/videos and using them as flipped classrooms for active and authentic learning**

- **Musib, M** (2019). Reflection on Practice: Enhancing undergraduate students’ learning of ethics through relevant lecturer-developed skits/plays and animated comics for longer-term learning; *AJSoTL* (accepted, 9, No. 2, November 2019).

- **Musib, M** (2019). Creating and integrating relevant educational cartoons with scenario-based learning strategies to impart long-term ethics learning; *J Innovation and Learning; 25(1); 50-63*
Learning outcomes

• Students get more opportunity to examine the nature and social impact of the issue and then apply ethical theories to understand how policies are formulated and justified as well as analyze the options.

• Active participants in their own learning while examining the critical skills necessary to make appropriate decisions.

• This method will allow the lecturer to present abstract and complicated topics in ethics in a more relevant and inspiring manner.

Radical shift in how learning is accomplished in classroom. Fun enacting (activity based) the skit in class (with a touch of humour).
Assessment of the technique implemented

Evaluation criteria

• Student feedback (both qualitative and quantitative)
  (I developed a student feedback form specifically for this project)

• My own reflections

• Individual and focussed group discussions

• Comments/feedback from external experts and from my esteemed colleagues
Student Feedback (Quantitative)

1. The scenario-based approach increased my creativity, curiosity and interest in the subject.
   - Strongly Agree: 50%
   - Agree: 20%
   - Neutral: 20%
   - Disagree: 5%
   - Strongly Disagree: 5%

2. Timely feedback and/or encouragement was offered by the lecturer.
   - Strongly Agree: 50%
   - Agree: 20%
   - Neutral: 20%
   - Disagree: 5%
   - Strongly Disagree: 5%

3. The post-enactment discussion was relevant and engaging.
   - Strongly Agree: 50%
   - Agree: 20%
   - Neutral: 20%
   - Disagree: 5%
   - Strongly Disagree: 5%

4. I would prefer this mode of learning ethics than traditional lectures & tutorial sessions.
   - Strongly Agree: 50%
   - Agree: 25%
   - Neutral: 20%
   - Disagree: 5%
   - Strongly Disagree: 5%
Preface:
It was 2 days to the prestigious “Innovating The Future” science competition. Three university students in Team Alpha were putting their final touches to their newly developed portable water filtration system. There was a sudden “snap” sound and the filtration membrane broke apart. A brief panic ensues...

Problems:

Prof X

Alex

Adam

Albert

Snap!

Guy's! What was that sound? Did I hear something snap?

Adam, did you touch the membrane again? I told you not to touch it anymore!

Sorry, I was just trying to adjust it...

See! I told you many times again and again to leave it as it is! Why are you so stubborn? Look at what you’ve got ourselves into! The competition is only two days away!

You should just fix your head! Now all our efforts for the past one year have gone to waste!

I’m sure we can fix this... I’m sure we can...

Ok guys, calm down. Deep breaths... Playing the blame game won’t solve anything. Let’s call Prof X and see if he can help us out.

Good idea!
Hello! How’s it going? Excited for the big day?

Hi Prof. X. We are facing a little problem here. We really need your help...

Oh don’t you worry! I’m sure it’s just a tiny problem that you boys can handle. It must be nerves making you nervous! With those smart brains of yours, you boys will be able to fix it in no time... oh I’ve got to hang the line now! My wife’s calling me...

Ciao! Good luck son!

Wait Prof. X! You need to listen to me! Don’t hang up yet!

Maybe I was wrong. I guess we’re all alone now.

I’m truly sorry guys. Let’s just carry on with what we have and submit it. I’m sure the judges will look past our mistakes. There’s still the theory section to pull us through.

That’s not a bad idea.

That IS a bad idea. I have a better plan that will make this work for sure!

What is it?

On the competition day...

So, you guys fixed it huh? I wonder what kind of membrane you used and where you got it from...

That’s none of your business you coward! Stand aside and feel jealous while we win this!

...and our winner for the "Innovating The Future" competition is Team Alpha!

See Albert! What’d I tell you? You could’ve been here savouring this glorious moment with us but you chose not to. You can now live with jealousy!

Alex... even though we’ve won... I really think...

You think that this is a great idea? Of course! Who’d you think came up with this?

Hold on a minute!
Musib, M (2019). Reflection on Practice: Enhancing undergraduate students’ learning of ethics through relevant lecturer-developed skits/plays and animated comics for longer-term learning; AJSoTL (accepted, 9, No. 2, November 2019).

Musib, M (2019). Creating and integrating relevant educational cartoons with scenario-based learning strategies to impart long-term ethics learning; J Innovation and Learning; 25(1); 50-63

Thanks to colleagues in CIT, particularly Mr Prakash and Mr Shyam for the cartoons
Using 3D printed medical device prototypes to promote ‘tactile’ and ‘visual’ learning

Module: BN3301 (Introduction to Biomaterials) (about 80 students)
Strategy

• Use 3D printing technology to print complex medical device prototypes
• Such prototypes ‘looks’ and ‘feel’ very similar to an actual device that are implanted into patients
• Students and ‘see’, ‘touch’ and ‘feel’ the various surfaces and contours of the ‘medical device’ components...
• Authentic and closer-to-industry learning process, thus students are more actively engaged...
The student learning outcomes and module learning outcomes have been easily achieved using the medical device prototypes/models as a tool to explain critical concepts.

The lecturer has been proficient and very knowledgeable on medical devices and biomaterials and usage of such prototypes facilitated our learning.

Pivatidevi P, Suleiman, SN, Narayanamurthy, K, Musib M. “Going beyond powerpoint; using 3D printed medical device prototypes to promote ‘tactile’ and ‘visual’ learning”. (under review, AJSoTL)

Further elaborate during tomorrow 9am talk: “Using 3D printed medical device prototypes to promote ‘tactile’ and ‘visual’ learning”.

Using virtual reality and augmented reality (VR/AR) in lectures to promote student learning

Module: BN3101 (Biomedical Engineering Design) (about 70 students)
Student feedback

- Enhanced interaction between lecturer and audience
- Gives deeper insights into medical technology
- Better visualization for better interaction and deeper understanding
- Eye-opening experience, more realistic
- Great for hands-on learning experience, easier to understand and remember
- More engaging (than traditional lectures)
- Creates digital objects as substitutes physical objects which imitates real-life
- Study the medical problem/technology despite being in a large group
- Promotes exploration of other modes of learning
- Provides great insights to critical thinking and reasoning
- Future of learning and work
Conclusion from TEL strategies adopted

- Promotes active and authentic learning
- Helps attain learning outcomes
- Promotes long-term student learning and closer to real-life learning