

Integrating Technology into the Teaching and Learning of Economics

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The Advent of New Technologies

We are living in an age of new technology where almost every aspect of our lives has been penetrated by its permeating reach. While technology had hitherto referred to the revolutionary development of the Internet or the ubiquitous use of computers, the era of new technology has been characterised by the development of autonomous devices. These are devices which are capable of sensing their environment and have the ability to learn and make decisions independently. This new development brings exciting prospects and yet a number of challenges to our lives.

One of the challenges pertains to the risk of technological unemployment, a form of structural unemployment. John Maynard Keynes first made reference to technological unemployment when he highlighted the risk associated with our discovery of new means of economising the use of labour outrunning the pace at which new uses for labour can be found. In recent years, warning signs pointing to the accuracy of Keynes' prophecy have emerged. For example, autonomous cars which are capable of navigating without human input are becoming a reality. Closer to home, Changi Airport has also been running trials for autonomous cleaning robots and automated guided vehicles to ferry passengers between terminals. Amidst these sweeping changes, it is clear that more power-

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ful technological advancements have led to a wave of capital goods that is effectively substituting labour. While significant disruptions may not be felt by the current working population, the sweeping winds of change will hit the next generation hard. The onus is hence on them to understand how to harness the winds of change to their advantage, or risk being displaced by new technology.

Integrating Technology into the Economics Syllabus

As educators in Economics, it is also important that we stand ready to embrace the use of technology in the delivery of Economics lessons. While the prospects of an autonomous artificial intelligence (AI) being developed to substitute for an Economics teacher are low, the didactic value of infusing

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technology into Economics lessons is high. Whether Economics students ultimately turn out to become policy-makers, business owners, designers or engineers, they will need to appreciate the role of technology as a multiplier force, an enabler and a social leveler.

As with other disciplines, the best way for students to appreciate the value of a concept is through experiential learning. This means infusing technology into the way Economics classes are conducted. From this experience, students will discover how technology can be an engaging and effective tool for learning. They will have the opportunity to witness how technology can be used to boost productivity in the classroom, and at the same time be cognisant of the possible drawbacks of using technology as a learning tool. This basic literacy in technology will help them acquire the skills and knowledge necessary to exploit technology and understand its practical application (or limitation) in future.

Understanding the Economy – Honing Decision-Making Skills through Gamification

When one talks about the use of technology in education, the gamification of learning is always an approach that comes to the fore. Other than maximising engagement through inspiring students to continue learning, epistemic games provide a means of simulating learning objectives and outcomes. Unlike the physical sci-

ences such as Chemistry and Physics where simulations can be carried out in a laboratory, Economics involves problem solving at a different level. A familiar saying about the conduct of macroeconomic policy is that it is like trying to drive a car while looking only in the rear view mirror. Hence, understanding the decision-making process through an economics lens requires iterative and exploratory learning. There is scope for game development to fill this gap.

While the chalkboard approach to teaching has worked well in imparting the relevant knowledge, students need to develop a cognitive and intuitive understanding of the role of a policymaker to better develop their critical and inventive thinking skills. Hence, a role-playing game which allows students to assume the role of a policymaker tasked with reviving an ailing economy can help. While some may argue that a board game like Monopoly can equally fill the gap, there are differences between physical board games and gamification that works using technology as a platform.

Physical games take place in real time, which rewards players who can recognise patterns and think quickly on their feet. While it adds on to the entertainment factor, this may not necessarily be the goal in an educational game. Like physical games, online games follow a turn-based style of play, where players take turns when playing. The main difference is that being physically separated, players can take their time to decide on their next

move. For example, a player can toggle between computer screens or consult their lecture notes while waiting for their competitors to play their turn. It is hard for the same deliberative nature of the game to be brought forward in a physical setting, where other players are waiting impatiently for one to make his or her move. This way, the nature of an online game rewards analysis and preparation, which has a positive impact on learning. Specifically, students will be able to consult and internalise the key concepts relating to policy effectiveness and policy limitations in a more effective way.

Court and Thwart

To illustrate the above proposition, a simple gameplay for studying macroeconomics is suggested below.

- Once all four players have logged into the game server, each player will draw a scenario card which describes the macroeconomic predicament of their country. These economies face problems ranging from anaemic growth to high inflation and unsustainable government debts, mirroring the contexts usually observed in the world. When a player mouses over the scenario card, case studies of real world examples (e.g., 2008 U.S. Great Recession) will be presented in a pop-up window.
- The gameplay requires students to accumulate policy tool cards to tackle the specific macroeconomic problems. Tool cards can

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be additive in nature, e.g., expansionary fiscal policy can be combined with monetary policy to give a greater boost to national income to tackle slow growth. On the other hand, supply-side policies are needed to address structural problems in the economy, such as structural unemployment associated with a mismatch of skills.

- Rival players can thwart other players' attempts to fulfil their goals. For example, throwing out a "Small National Income Multiplier" card against another player's fiscal policy tool card means that the effects of an expansion in government spending on the economy will be reduced.
- The first player to address all goals wins. After each game, players can document their learning points in an online log-book for posterity.

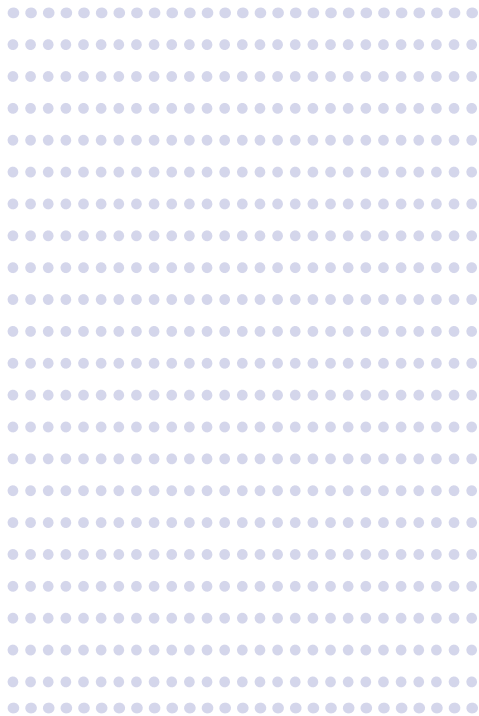
When put in place, repeated games and iterative game experienc-

es will allow the student to start out with different macroeconomic contexts. The impact on learning allows students to adopt a more hands-on perspective in understanding real world economic issues and develop a deeper understanding of the multifaceted considerations associated with policymaking.

Augmenting Efficiency: An Exoskeleton Suit for Economics Students and Teachers

While the prior approach works through interaction between different players using an online platform, technology can take a more direct role in facilitating the learning process. Although autonomous technologies replace the need for human labour, there are a number of other technologies which augment the effects of human labour, thus bringing about greater efficiency and productivity.

I watched a YouTube video recently which showcased the Panasonic



Assist Robot. In the video, factory workers wearing huge robot exoskeleton suits were shown lifting bulky objects without breaking into a sweat. These suits work by embedding engines in the suit that automatically coordinate and amplify the effects of human movement. The end result is that they reduce the energy which a person needs to use to perform an action, such as lifting a bulky object. Other than saving manpower needs, these suits also reduce the likelihood of workers sustaining injuries, hence reducing their downtime and boosting productivity. Over time, this allows the firm to produce maximum output

with minimum cost, hence fulfilling the textbook definition of productive efficiency.

It is tempting to imagine the amount of work effort saved if technology can be deployed to do the heavy lifting for Economics students. However, the most grueling aspect of an Economics student's work is not in lifting bulky objects, but in writing an Economics essay. Indeed, students often lament about how tedious and time-consuming it is for them to produce a full-length Economics essay. If writing an Economics essay is tough, it would be injudicious to think that marking the same essay



(or for that matter, dozens of such essays) would be a breeze. Having an intelligent Economics essay writing software equipped with a marking module would hence serve as a valuable exoskeleton suit for both students and teachers.

Limited Autonomy to the Machines

However, in designing an Economics essay writing software, care must be taken not to give too much autonomy to the machines. For example, in 2012, Les Perelman from the Massachusetts Institute of Technology demonstrated that long and incoherent essays could achieve higher scores at the Scholastic Assessment Test's (better known as the SAT) writing test compared to well written essays. This is because SAT essays were marked by an automated scoring machine (e-Rater), and Perelman proved that computer systems like these could be "gamed" because they often focused on factors associated with good essays, such as strong vocabulary and good grammar. Hence, as long as an essay was peppered generously with such factors, the writing did not necessarily have to make sense in order to attain a good score.

Hence, instead of seeking to develop an autonomous artificial intelligence (AI) that can do all of a student's or teacher's work (i.e., a robot marker like e-Rater), a semi-autonomous software should be the end goal. Specifically, the software does not churn

out essays for students, but instead guides them on the proper steps to writing a balanced, content-rich and contextual essay. This step requires human factor input by both teachers and students. First, teachers need to programme in the rubrics associated with a good quality essay. Next, students need to follow the guide and offer additional inputs at each stage to complete their essay plan. Finally, having a systemised essay writing software also means that a marking module can be included to alleviate some of the teacher's workload.

A 3-D Approach to Boosting Efficiency

To design such a software, a few key steps are needed:

1. **Distillation:** Every Economics topic has a number of key concepts that are frequently assessed in essays. These are usually concepts that cover a significant scope in the topic, which makes them ideal candidates to assess a student's breadth and depth of knowledge. They can be thought of as parachute concepts since once opened up, they cover a significant scope.
2. **Decomposition:** After these parachute concepts are distilled out, methodologies should be designed to help students answer essay questions based on these concepts. By methodologies, I am referring to the breakdown of the answer structure into a se-

ries of steps. This is known as a decomposition exercise. Where certain steps consist of fixed outcomes, multiple choice answers should be provided. This positions the software for the inclusion of a marking tool which screens the submitted essay plan based on pre-determined parameters (i.e., correct answers).

This is a tricky step because an unintended consequence would be to encourage rote learning or the routine memorisation of essay plans. To avoid this pitfall, the structures should guide students on the steps involved to infuse balance and content rigour into their essays. However, they should not be prescriptive to the extent that they dilute the context in an essay question. Hence, while these structures should steer students into recognising that a balanced and content-rich essay should consist of certain key steps, they should be sufficiently broad to accommodate different contexts embedded in essay questions.

3. **Details:** Once the essay structures have been decomposed into a series of steps, students can follow the steps to draw up essay plans. The interface involves students (i) selecting the relevant parachute concept assessed in the question; (ii) choosing the most relevant essay structure; and (iii) following the designated

steps in the selected essay structure. Other than selecting the correct options to bring them to the next step, students are allowed to add details at each step to infuse contextual elaboration into their answers.

If the above proposal for introducing technology into Economics is put to proper use, meaningful gains in efficiency can be reaped. For example, the marking module can easily collate student mistakes and if bunching of mistakes is found to occur around a specific step, the teacher can concentrate subsequent efforts towards rectifying any conceptual mistake

identified. Such a development would also free up time for the teachers to prepare more highly customised lesson plans, hence making a meaningful contribution to boosting efficiency in the learning and teaching of Economics. Similarly, by developing essay plans using the software, students can assess their own strength of content knowledge as well as their ability to generate arguments in a lucid and balanced manner. This would also allow them to maximise their exposure to a greater number of Economics essay questions within a shorter period of time and accelerate the learning process.

Lego Ideas which allows users to submit creative ideas for Lego designs. If these ideas become commercially successful products, the original designer gets to receive 1% of the royalties. Today, crowdsourcing mainly takes place over the Internet, since web users tend to be more comfortable sharing via web-based collaborations where they are not being physically scrutinised.

With the propagation of free web-based collaboration tools like Google Drive, Basecamp and Dropbox, a crowdsourcing model can be run in the classroom too. This helps to promote collaborative learning and lays the groundwork to fostering equity in the revision process.

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Enhancing Equity – Crowdsourcing Economics Study Materials

Many have touted the Internet to be the greatest leveller of the current generation. Access to the Internet provided a gateway to information which was seen to ultimately lead to better education and health outcomes. While whether this has been achieved in reality can be disputed, there is no denying that electronic information systems allow open sharing of information to occur. Under the new technology era, these open platforms take the form of crowdsourcing sites, which provide a way of using “crowds” to “source” for solutions. The best example of a crowdsourcing model is

Flash Your Cache

For example, I have created a web-based community where students can upload and share their Economics revision flashcards. There are no subscription charges or access restrictions. Through this webpage, students can view one another’s flashcards and assess their level of content mastery. Where questions pertaining to a certain flashcard arise, users can flag them out to me for clarification.

The purpose of this project is twofold. First, the extra step of having to organise their revision notes into a series of discrete flashcards forces students to see through their copious collection of notes and distill the key points for sharing. Second, students who tend to be less com-



portable approaching others for help can now access and share their own study materials, which fosters greater equity. Interestingly, I have observed that having one student share his or her flashcards either emboldens or acts as a positive reinforcement to other students to act in an altruistic manner in sharing their notes too. In the process, this flashcard site, a public good, helps to achieve fairness in access to revision materials.

Looking Ahead

In short, technology has the potential to help educators break out of linear and chalkboard-style learning and augment the way we engage students, teach concepts and evaluate progress. Technology solutions can also allow students to collaborate and share knowledge more easily. However, the

original intent behind the proposed idea is to provide an experiential platform for students to witness the multifaceted roles that technology can play. While the idea of designing an Economics role-playing game or an intelligent essay writing and marking software is attractive, one should always caution against over-reliance on such a tool.

Ongoing human authentication is important and necessary for technological tools to operate properly. For example, with an essay writing

software, educators still need to add value to the marking software by looking beyond the structural layout of the plan to assess possible conceptual errors or application weaknesses. This is in line with the intent and purpose of education — i.e., no learning can ever be made passive to the extent that students withdraw themselves from the process. Similarly, the role of a teacher can be complemented with the use of technology, but it can never be replaced.

Melvin has written three books for 'A' Level Economics students and believes that a strong background in Economics helps students make better decisions in life. He is passionate about harnessing technology to improve the effectiveness of teaching and has rolled out some of these teaching tools under www.thateconsplanner.com.
