Feedback-guided analysis as an approach to understanding student adoption of online learning

Extended Abstract

The fast and unpredictable changes and increased complexity of today's world led to significant challenges that press new demands on the education system. Worldwide, most academic institutions shifted their learning frameworks to an online learning model to limit physical interaction and slow the spread of the coronavirus. This unprecedented shift posed a major adjustment in learning. Universities varied in their degree of readiness for online learning and their views towards the new setup. However, at the same time, it led to an incredible opportunity for innovation in education. Across countries, schools needed to find alternative ways to support their students' learning outside of the physical classroom. This had led them to adopt asynchronous and/or synchronous technologies, mainly relying on digital tools and platforms such as learning management systems, as new modes of instruction.

Even though the adoption of technology in learning has increased over the past two decades, academic institutions around the world were not prepared for the sudden shift to purely online learning. In the Philippines, public schools have existing Alternative Delivery Modalities (ADM) that utilize different modes of instructional delivery including online learning. However, the scale of deployment of these ADMs is small, and the employment on a large scale only happened during this pandemic, thus presenting key operational challenges in implementation. Government education agencies and schools were faced with several concerns relating to policy on governance structure, teacher management, and student management. Teachers, who were used to traditional teaching methods, were compelled to embrace technology despite their lack of digital literacy. In addition, schools found a significant decrease in enrollment among students due to economic, psychological, and academic reasons. Clearly, the digital divide and uneven access to online learning resources have presented a range of unique challenges and difficulties to academic institutions. Thus, this study seeks to answer the question "How can online learning and other e-learning modules/methods help achieve an adequate level of student performance?"

Systems thinking is used to understand the value of online learning to students in the context of higher education. A series of group model building workshops were conducted among university students who took their courses in a purely online learning environment for more than one semester. This research uses feedback-guided analysis to draw insights from the experiences of university stakeholders as a case into this issue to construct conceptual models analogous to the cultural adaptation template. This systems based framework is adapted qualitatively for its high-level structure of the relationships between the state of cultural paradigms, community, ecosystems and human health and well-being, which are all embedded in schools such as, for example, cultural and educational customs, formal education system, the political nature of educational governance and bureaucracy. This template specifically highlights the important role of sociocultural norms (paradigms) amidst the adoption of online learning and other innovative forms of delivering educational materials. The adaptation of the framework is then used to drive the value of key variables to understand system behavior, identify leverage points and, eventually, design scenarios to generate insights.

By projecting the cultural adaptation template to a technological infrastructure for education problem space, it expresses our dynamic hypothesis (Figure 1) which is tailored to the context of academic institutions by highlighting the feedback structures that play a dominant role on how the adoption of technological infrastructures for online learning can lead to a paradigm shift in education. This further emphasizes how the 'State of the School System' implies the need to adopt technologies for education continuity, with or without a pandemic. This, in large measure, explains the importance of shifting from the traditional knowledge transfer to creating a new mindset with greater emphasis on experiential learning through virtual environments. The challenge is to identify the leverage points that are powerful enough to influence perspectives and underlying assumptions on a purely online learning as observed in the 'Beliefs on Education'. For instance, resistance across institutions engaged in continuing education has been observed in literature.

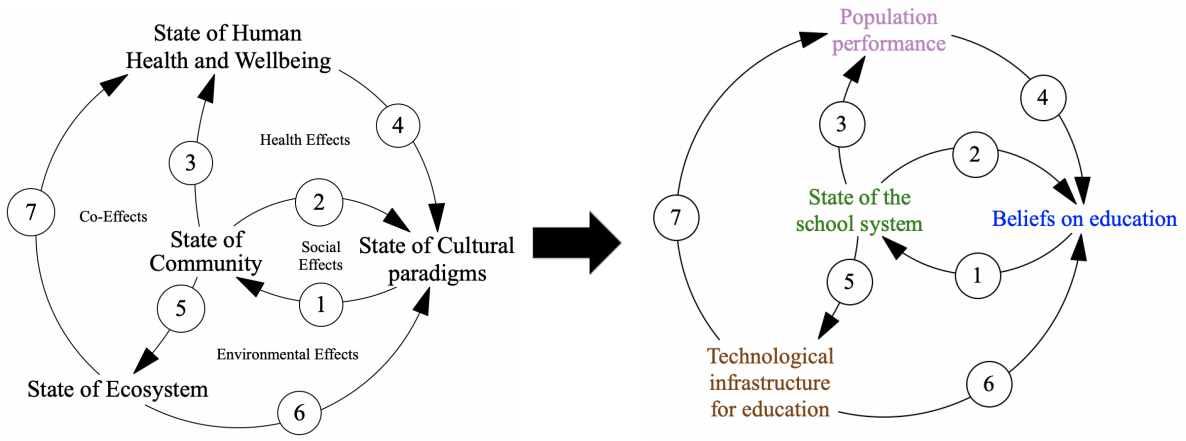

Figure 1. The technological infrastructure for education problem space based on the cultural adaptation template with state-change processes: L1 – Planning and goal setting activities; L2, L4, L6 – Learning activities; L3 and L5 – Individual and collective activities; and L7 – Natural processes.

In the problem space diagram, the 'State of Community' now describes the policies and investment priorities to enable and promote online learning and teaching, or the 'State of School System. 'State of Human Health and Wellbeing' considers the level of 'Population Performance' in measuring the extent of the academic institution's contribution to the quality of learning, research and teaching experience prompted by school activities, curricula and policies. 'State of Ecosystem' is the 'Technological Infrastructure for Education' to take into account the extent of support systems in academic institutions. Finally, the 'State of Cultural Paradigms' is the 'Beliefs on Education' or the existing worldviews and shared orientation on education. Such worldviews and personal beliefs can shift depending on the strength of the learning activities, in this case the experiences gained from the academic institution (L2), in acquiring knowledge and skills through formal education (L4), and the adoption of technologies into teaching and learning (L6).

The preliminary specific system-of-interest based from the students' perspectives about online education during the pandemic shows a strong emphasis on accessibility of online learning materials as it largely contributes to overall performance and focus on online learning. Considering that most universities are transitioning back to face-to-face classroom setup, our initial findings suggest that students opt to retain aspects of the online learning environment as part of the support given by academic institutions aside from the traditional mode of conducting physical classes. Main advantages such as flexibility of a learning schedule and objective method of knowledge were emphasized as key drivers aside from the relatively low incurred costs. However, lack of peer contact and social interaction as well as need for self-discipline and additional motivation were some of the possible drawbacks.

The specific system-of-interest done so far captures one side of the story, namely the perspective of the students. Moving forward, group model building sessions with other university stakeholders such as educators and university staff need to be conducted to reflect their own mental models on how the shift to purely online contributed to their performance at work as well as their perspectives on education and the policies implemented at the university-level and country-level. Model development could be further enhanced as the understanding of online education and educational technologies evolves over time which may also vary across countries. For instance, the involvement of other academic institutions would allow greater range and diversity of ideas on online learning effectiveness and evaluation. This makes it more meaningful to convert the conceptual models into quantitative stock-and-flow diagrams to enable scenario analyses such as adoption of different modes of learning (i.e., flex model, blended learning) to aid administrators and education officials in their strategy and decision-making.

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Supplementary Materials

Figure 1. The technological infrastructure for education problem space based on the cultural adaptation template with state-change processes: L1 – Planning and goal setting activities; L2, L4, L6 – Learning activities; L3 and L5 – Individual and collective activities; and L7 – Natural processes (Dyball & Newell, 2015). The links are numbered in the text with an "L" followed by its respective number. The subsystems and state-change processes represented by each arrow are described briefly in Tables 1 and 2, respectively.

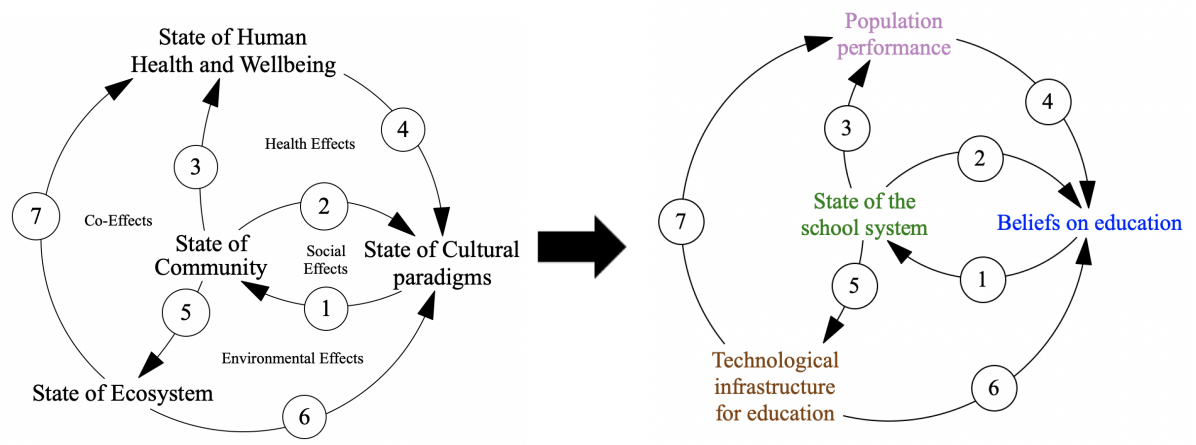

Table 1. Overview of problem space subsystems in the technological infrastructure for education problem space, as guided by CAT

CAT subsystems	Problem space subsystems	Overview
State of Cultural Paradigms	Beliefs on education	This represents the shared worldviews on education (both as individuals and as a collective).
State of Community	State of the school system	This is the set of rules governing and promoting education.
State of Human Health and Wellbeing	Population performance	This is the general state of health and wellbeing as well as performance of the population in an educational institution.
State of Ecosystem	Technological infrastructure for education	This includes physical infrastructure, software as well as human activities and institutions.

Table 2. Influence links in the technological infrastructure for education problem space diagram, as guided by the CAT

Link	Processes represented by the link

L1	Planning and goal setting activities, driven by beliefs on education, that include the design and implementation of policies on school systems.
L2	Processes whereby observations and assessments of the state of the school system influence the modification of beliefs on education to take these observations and assessments into account.
L3	Individual and collective activities, influenced by the state of the school system that directly affect the population performance, from physiological, psychological, and social functioning.
L4	Processes whereby observation and assessments of the state and evolution of population performance and wellbeing influence the modification of beliefs on education to take these observations and assessments into account.
L5	Individual and collective activities influenced by the state of the school system that direct affect the structure and functioning of involved technological infrastructure for education.
L6	Processes whereby observation and assessments of the state and evolution of relevant technological infrastructures for education influence the modification of beliefs on education to take these observations and assessments into account.
L7	Processes whereby the built environment for education directly affects the population performance including human physiological, psychological and social systems.

Figure 2. A causal loop diagram highlighting key variables concerning access to technology and school culture. The arrows represent causal links and are labeled in accordance with the numbering scheme used in the Cultural Adaptation Template. Each arrow has been assigned a polarity. The state-change processes represented by each arrow are described in Table 3. The resulting system diagram is a schematic representation of the different mental models of university students, which represents one of the many specific system-of-interests that could be derived from the problem space of Figure 1. Color-coding reflects the subsystem to which the variables belong: state of the school system (green), beliefs on education (blue), technological infrastructure for education (brown), and population performance (violet).

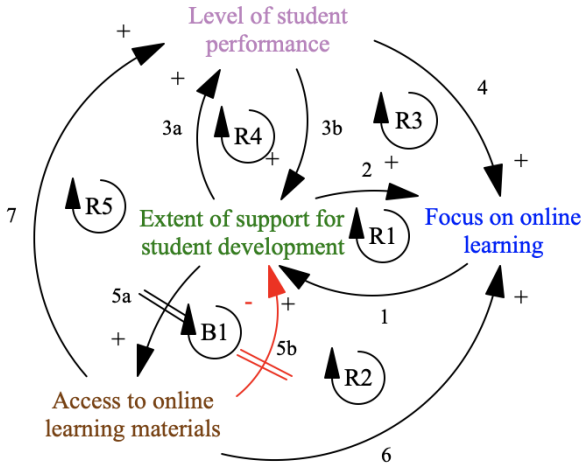

Table 3. Causal links for student performance on online learning system of interest, as guided by the CAT

Link	Processes represented by the link
L1	This link is positive. Design and implementation of policies that promote support for student development during the pandemic is driven by focus on online learning. Processes include the communication of results from stakeholder consultations, feedback and survey, which are reflected on how academic policies are adapted for online learning and teaching.
L2	This link is positive. Focus on online learning is reinforced through observations that memos released by the university are significant in bridging communications to support student development, from preparations of classes to actual implementation throughout the semester or school year. This can also be observed on the programs designed by schools to promote student development, research, collaboration and participation. Together, L1 and L2 form a reinforcing social effects feedback loop.
L3a	This link is positive. Activities and decisions to support student development are designed to promote student wellbeing and performance. Key factors that influence the support for student development include: mental health services, financial aids and scholarships, academic support, library and IT services and available facilities (including work-from-home setting).
L3b	This link is positive. Activities involved in student performance influence the extent of support for student development. Processes include student engagement on school activities from classroom level to university level. These are also reflected in terms of academic achievement, time spent on studies and social activities, recreation as well as level of participation in class and in extracurricular activities.

L4	This link is positive. Observations that most of the students have relatively experienced during the pandemic towards a completion of a course study show an impact on their focus on online learning. For instance, procrastination prior to an assessment provides no guarantee of properly absorbing the asynchronous materials.
L5a	This link is positive. Individual and collective activities implemented by the university to ensure that support on online learning is provided. Some participants expressed benefiting from the technological support provided by the university through portable learning packages and use of desktops and laptops for student loans. Yet, delays are evident in the process of fostering educational technological support, especially during the onset of the pandemic when structures were not yet in place.
L5b	This link is negative. Individual and collective activities implemented by the university on accessibility of technological infrastructures for online learning influences the extent of support provided for student development. Processes include the consistency of technological support and its sustainability. In most cases, support is primarily given at the start of the semester which tends to overwhelm the university. Students opt for troubleshooting on their own, rely on their family and colleagues or other online sources instead of waiting for a response from IT support of the university.
L6	This link is positive. This link suggests that technological infrastructure for education influences our beliefs on education. Participants expressed that technological infrastructure has replaced the use of classrooms which for some stakeholders could make education more inclusive, while for others could be a factor to skip the school year. Also, schools that are technologically-advanced have an impression of offering a better learning experience.
L7	This link is positive. It relates how the technological infrastructure influences human health and wellbeing. For instance, participants raised health concerns with their prolonged and extensive screen time during online learning. To some extent, some of them mentioned that it has triggered loneliness as well as depression. Technology, on the other hand, has benefits in communication and in connecting with people where some students participate in Zoom calls for study group purposes.

Figure 4. Expertise needed based on the problem space (Figure 1).