Constructing Optimal Futures for Education

Technology Foresight in Educational Policy and Planning

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ABSTRACT

This article focuses on challenges associated with the use of technology foresight for developing long-term strategies for innovative uses of ICT in education with an emphasis on the role of creativity. The outcomes of two international foresight programmes on the future of education are critically examined. The findings demonstrate the need to address programme participants’ capacity to engage in systematic futures thinking and to emphasise creative aspects of constructing shared visions of the future.

Keywords
Education futures, technology foresight, educational technology

INTRODUCTION

Technology foresight programmes are policy-planning tools that engage key actors and stakeholders in the construction of shared visions of alternative and preferred futures. Their purpose is to help policy makers identify important technological and social developments and inform innovative, long-term policy decisions (FOREN Network, 2001). Technology foresight programmes have become popular for addressing long-term policy needs in education to meet challenges relating to increasingly rapid technological change. Influential international and transnational organisations, including, the OECD, the European Commission, and the World Bank, have actively promoted technology foresight programmes and several regional and national programmes have already been implemented (European Commission, 2009; Istance & Theisens, 2013; World Bank, 2011).

A defining characteristic of technology foresight programmes is their participatory and collaborative nature. Programme planners and practitioners aim to involve representatives of all relevant stakeholder groups in the policy planning process to ensure a common understanding of the issues involved and possible pathways toward the future. The utility of programme outcomes are therefore dependent on participants’ capacity to engage in constructive and critical considerations of possible impacts of emerging technologies over long...
periods of time, commonly extending ten to fifteen years into the future. Programme planners and practitioners use rigorous methods to stimulate futures thinking that are the products of decades of testing and refining within the fields of futures studies and technology forecasting, such as, Delphi surveys, environmental scanning, trends analysis, and scenario construction. However, even with the methods available, issues arise in technology foresight programmes, especially when participants include individuals or groups who have had little or no prior exposure to formal futures planning processes. Participants have to overcome significant limitations that are inherent to futures thinking. Firstly, they face the challenge of addressing an unknowable future. Secondly, they have to negotiate what Istance and Theisens (2013) refer to as the tension between demands for methodological rigour and creativity in constructing justifiable visions of the future that reflect both anticipated technological development and preferred pathways to the future.

Encouraging creative thinking about the future is an especially important aspect of technology foresight, but also a significant challenge for programme planners and practitioners. In constructing visions of the future, programme participants are expected to consider available evidence concerning existing and emerging technologies. This entails a rational process of extrapolating data from current contexts to future contexts. However, the future does not always follow a consistent trajectory. For example, technological breakthroughs may produce developmental leaps that are hard to foresee. Also, technological developments in one field may find novel applications in others, producing changes that can be difficult to foresee. Encouraging creative thinking can produce foresight outcomes that go beyond the limitations of purely rational projections forward in time. This is especially important in regards to the future of education because the technologies that impact educational policy needs and practice are not necessarily developed specifically for educational purposes.

In this article I focus on the challenges of using technology foresight to inform and promote innovative uses of technology in education. In particular, I address the question of how foresight practitioners can engage the diverse stakeholder groups involved in educational policy and planning in the creative construction of novel future contexts for education. I start with a description of the essential components of foresight and how they are expected to contribute to useful visions of possible and preferred futures. Next, I consider the rationale for using technology foresight for educational policy planning. Finally, I discuss factors that can potentially limit creativity in the technology foresight process and how such limitations can be addressed by integrating methods for eliciting highly creative ideas with futures methods.
FORESIGHT AND POLICYMAKING

Technology foresight emerged in the 1980s as a result of well-publicised foresight programmes implemented in the U.K. and the Netherlands that were primarily based on Irvine and Martin’s (1984) seminal research on the use of forecasting methods for informing the allocation of research funding in the UK (Georghiou, 1996). By the late 1990s and early 2000s foresight had evolved to reflect the increasing impact of technological innovations on society and the role of decision makers and consumers in shaping the technological landscape. In 2001, the European FOREN project provided the following general definition of foresight:

“… a systematic, participatory, future-intelligence-gathering and medium-to-long-term vision-building process aimed at present-day decisions and mobilising joint actions.” (p. v, original emphasis).

Here, foresight is defined as an instrument that can be applied to a broad range of policy domains and levels, in which social groups, public authorities, and the general public play a central role. Its purpose, insofar as it is a vision-building process, is to provide an open forum to stimulate critical thinking and creativity among stakeholders to address current and future challenges.

The conceptual framework illustrated in Figure 1. draws from extensive research and evaluations conducted by several pioneers of technology foresight, such as B. R. Martin, L. Georghiou, J. C. Harper, and R. Popper.1 It is a general framework intended to describe the foresight process as applied to any policy domain. The framework describes four activity phases: inputs, reflection, construction and intelligence building. These phases engage the various stakeholder groups at different points and in different tasks in the overall foresight process as described below. Foresight is not a linear process, so these phases are not sequential; rather, participants can be expected to go back and forth between the phases as new concepts and technological possibilities emerge and are explored.

1. For more detailed information on the body of research that currently informs technology foresight, see for example The Handbook of Technology Foresight: Concepts and Practices (Georghiou et al, 2008).
Figure 1. Conceptual framework for foresight activities addressing educational issues.

The characteristics of the primary phases are:

1 **Inputs** – In this phase, participants are supplied with all information relevant to the foresight process. This includes: clear descriptions of the expected outcomes of the foresight activities; introductions to the methods to be used, i.e. the forecasting methods and other futures methods; data on relevant social and technological trends; and relevant concepts. Programme coordinators, futures experts, and subject-area specialists will generally dominate this phase.

2 **Reflection** – This phase involves a dialectical process of negotiating shared meaning of relevant concepts. This is a particularly critical phase in foresight activities because participants are often dealing with concepts relating to technologies and social developments that may be very foreign to them. This process will be repeated as new concepts emerge to describe the potential futures identified in other phases. All stakeholder groups are active in this phase although subject-area experts play a dominant role in identifying concepts in need of clarification.

3 **Construction** – It is in this phase that futures methods are the most prominent as participants construct visions of what the future can look like on the basis of anticipated technological and social change. The construction phase will often give rise to new concepts for consideration that have not
emerged in the other phases, and require re-initiation of the reflective phase to establish shared meaning. Dominant in this phase are the stakeholder groups that are likely to be most affected by policy decisions resulting from the foresight programme. It is their immediate environment that is subject to change and, thus, their vision that carries substantial weight. Depending on context, this can include educators, educational administrators, parents, and students.

4 Intelligence – In this phase participants critically evaluate the various alternative futures that they have explored. The purpose of this activity is to identify potential weaknesses, strengths, risks, and benefits in the envisioned alternative futures. Ultimately, the key question guiding this phase is, “What kind of future do we want, why, and how do we attain it?” In this phase all stakeholders are active, but policy makers and stakeholder groups that can exert influence on decision-making processes are dominant as the primary focus here is on issues relating to implementation.

Foresight programmes produce at least three types of immediate outcomes, i.e. outcomes that can be identified and observed during, and immediately following, the four phases of foresight previously described. These are categorised here as substantive outcomes, communicative outcomes, and subjective outcomes.

– Substantive outcomes – any products that are intended to describe the alternative futures constructed in the foresight process.

– Communicative outcomes – new formal and non-formal networks resulting from interactions between the various stakeholder groups participating in the foresight activities.

– Subjective outcomes – the personal learning that occurs during the foresight activities, including awareness of the dynamics of technological change; familiarisation including futures methodologies; and increased appreciation for the need for long-term planning.

While all of these outcomes are important for the aims and objectives of foresight programmes, the substantive outcomes are the ones that tend to receive the most public attention. They are the outcomes that have immediate informational value for policy makers and other stakeholders, because they are the ones that are intended to reflect programme participants anticipations and preferences for the future. As a primary outcome of the construction phase of foresight programmes, i.e. the phase that involves the broadest range of stakeholder groups, the substantive outcomes are also those that pose the most significant methodological challenges. In particular, the question of how futures methods are used to prompt participants, whose familiarity with futures methods or specialised knowledge of the relevant policy domain is likely to vary, to construct visions of the future that suggest proactive measures to real-
ise preferred futures, rather than describing mere reactive reflections on current trends. In the following section, we will consider some of the methodological challenges associated with the use of technology foresight for educational policy planning.

FORESIGHT METHODS

There is no specific collection of methodologies distinct to technology foresight. Instead, technology foresight relies on rigorous methods that have been developed within the fields of futures studies and technology forecasting. These include both quantitative and qualitative methods. The former are primarily used to provide statistical evidence for anticipated technological and social change, and the latter for eliciting subjective judgments and value statements regarding possible futures. Popper (2008) identifies a third category that he refers to as “semi-quantitative” methods. These are methods that are used to quantify subjective judgments and value statements resulting from the qualitative methods. In this section, we focus specifically on the qualitative methods used in technology foresight as they relate to the construction and evaluation of alternative futures.

The role of qualitative methods in technology foresight differs in significant ways from their role in other forms of social research. In most social research, qualitative methods are used to reveal meanings and values as they relate to the contexts being studied (Merriam, 2002). This may involve the construction of new meaning, but only to provide an enriched description of subjects’ personal or social experiences. The aim of technology foresight, on the other hand, is to actively engage participants in the construction of future contexts that do not currently exist. These contexts do not have, and may never have, any empirically verifiable reference for the programme planner, foresight researchers, or the participant. Because technology foresight focuses on non-verifiable contexts, planners and practitioners face unique methodological challenges. This is especially the case when individuals and representatives of stakeholder groups are involved who have limited knowledge of the relevant policy domain, or little, if any, exposure to formal futures methods.

Foresight programme participants are expected to produce outcomes that effectively address possible long-term implications of technological and social change. To achieve this, participants need to break out of their current contexts – to look beyond the familiar and imagine a variety of conceivable, sometimes even bizarre, options. For many, this is harder than it sounds. The familiarity and comfort of the present exert a strong influence that can work against the objectives of technology foresight. Thus, unlike most social scientists that regard the current temporal context as part of the operational locus of their research, the foresight practitioner needs to address it as a possible limiting factor.
THE ZONE OF TEMPORAL CONFIDENCE

Soheil Inayatullah (1990) claims that one of the primary goals of futures studies is, “… to create a new sense of time; to stretch time by including a longer vision of time within our forecasts, decision making, and living.” (p. 131).

While I agree with Inayatullah’s sentiment, I would challenge his choice of words. I do not believe that our “sense of time” is the issue; rather that it is our capacity to entertain the possibility of significant change over varying lengths of time. I will refer to this capacity in terms of what I call the “zone of temporal confidence” (ZTC). By this I mean the span of future time over which an individual or group is able and willing to consider a reasonable and justifiable possibility of significant change. The ZTC is not meant to refer to a precisely quantifiable measure; rather, it is a conceptual construct intended to describe how certain individual and group characteristics can affect foresight outcomes. I will describe a ZTC as being “wide” to refer to a strong capacity for long-term thinking extending anywhere from ten to fifteen years, or more; and as “narrow” to refer to capacity for long-term thinking that is limited to five to ten years, at most.

The basis for the ZTC is derived from several years of engaging university students, experienced educators, and policy makers, having little or no prior familiarity with futures methods, in a range of foresight and future-oriented workshops, university courses, and training sessions. In these interactions I have found that, even when the nature of the task at hand and the purpose of the futures methods used, have been carefully explained, the majority of participants still demonstrate a tendency toward cautious short-sightedness that can negate the objectives of the activity, thus constituting a significant barrier to constructive futures thinking. Unlike trained futurists, who are able to exert a wide ZTC, often extending decades or even centuries into the future, these laypersons demonstrate a relatively narrow ZTC. Their capacity for envisioning change may extend to 5–10 years, but beyond that, they become very sceptical about the reliability and utility of future technology projections.

Many of the key players in foresight programmes addressing education are likely to have little specialised knowledge of, or insights into, advanced technological development and the dynamics of long-term technological change. This can contribute to an overall narrow ZTC that programme planners and practitioners need to account for if programme outcomes are to serve their purpose of informing policy makers about anticipated and preferred futures. Existing futures methods do not adequately address this limitation and, consequently, produce short-sighted results that fail to communicate foreseeable transformations within social systems.
THE RATIONALE FOR FORESIGHT IN EDUCATION

The need for foresight in educational planning has been justified with several arguments. One is the “crisis argument” that claims that the educational system is at or near a crisis stage due to slow uptake of new ICTs in educational environments and practices. Several lines of reasoning advance this argument. One is that educational institutions are slow to adopt emerging technologies, resulting in a technological gap between formal educational environments and learners’ everyday technological realities, thereby failing to cater to the needs of modern learners and society (OECD, 2001a; Levin & Arafeh, 2002; OECD, 2013). Another is the “digital natives” argument based on the claim that today’s school-age youth constitute a qualitatively different type of learner than previous generations, because they have grown up immersed in high-tech environments (Prensky, 2001; Howe & Strauss, 2000). Several researchers have challenged both of these arguments. In an extensive review of research literature, Bennett, Maton & Kervin (2008), argue that many of the claims made by proponents of the “crisis argument” are, at best, based on questionable empirical evidence and little or no theory. It has, however, been suggested that there is a weakness in the research itself, in that it is based on out-dated points of reference that fail to take into account changing technological and social landscapes (Kennedy, Krause, Judd, Churchward & Gray, 2008).

Another line of reasoning related to the “crisis argument” is based on Kurzweil’s (2005) theory of exponential technological change. Kurzweil mapped milestones in several technology related fields over long periods of time and found that they follow an exponential curve, i.e. that as we approach the current time period, the milestones occur with greater frequency. The conclusion drawn from this is that educational institutions, already lagging behind technological development, will suddenly find themselves at a severe disadvantage as the rate of technological change surpasses their ability to catch up (Moravec, 2008). Critics have pointed out a myriad of weaknesses in Kurzweil’s theory. In particular, Modis’ (2006) scathing critique of Kurzweil’s assumptions, methodology, and rigour where he unequivocally states, “Kurzweil and the singularity enthusiasts are indulging in some sort of para-science, which differs from real science in matters of methodology and rigor,” would seem to effectively negate any potential contribution that Kurzweil may offer up for meaningful discourse. Nevertheless, there is an instinctual sense of relevance in Kurzweil’s sentiment that is, at least in part, validated by the seemingly ever-changing technological landscape around us in modern times.

A final argument for foresight in educational planning is based on the assumption that the primary objective of education is to prepare learners to effectively deal with the myriad of situations that they may encounter in their futures. This is eloquently summed up in Dewey’s (1897) statement that, “… it is impossible to prepare the child for any precise set of conditions. To prepare him for the future life means to give him command of himself” (p. 6).
Thus, education, in and of itself, is regarded as a future-facing activity that should logically be formulated on the basis of at least some sense of the future, if not a well-articulated vision of it. This argument is difficult to refute for the simple common-sense reason that an understanding of education as anything but a future-facing activity would seem to negate its purpose. Yet, it could be argued that, insofar as education is a future-facing activity, its primary resources are rooted in the past histories of human endeavour; i.e. we teach our learners to ‘stand on the shoulders of giants’.

While the arguments described above are clearly inconclusive, they are indicative of growing concern about how technological developments affect education and how new and emerging technologies are integrated in education. In particular, the arguments suggest that educators and educational policy makers need proactive strategies to deal with rapid technological development. In other words, rather than formulating policy reactions to technological innovations once their effects are felt in educational environments, educators need to proactively prepare for technological change before problems arise. Technology foresight provides a forum where key actors and stakeholders can collaboratively explore the dynamics of technological change and, most importantly, think about how they can act now to affect desired change. Thus, the purpose of technology foresight is to produce outcomes that not only describe possible change but also aim to inspire whole communities to pursue certain types of change. This may not address all of the concerns expressed by the proponents of the arguments that I have described, but at least it offers constructive ways to expand discourse on education to start to confront them.

Even if we accept that technology foresight is important and useful for educational planning, there is still a question of how it is best conducted. Thinking constructively about the future is hard work. It involves detaching oneself from the familiarity and comfort of current contexts and considering all of the myriad of possible pathways that forces driving change, be they technological or social, can lead us onto. A failure to transcend the present context can lead to short-sighted outcomes that, instead of describing potential long-term futures, merely describe extensions of current trends. While current trends are certainly an important component of the overall futures equation, too much emphasis on them can obscure possibilities or opportunities for radical change. Overcoming peoples’ tendency to view change as linear and rational poses significant methodological challenges for foresight programme planners and practitioners.

**FORESIGHT IN EDUCATION**

The results of shortsighted outlooks can be seen in the substantive outcomes of many foresight programmes that focus on educational policy issues. While a systematic evaluation of the substantive outcomes of education-related fore-
sight programmes would be helpful, such an exercise is beyond the scope of this article. Instead, we will consider the substantive outcomes of two large-scale, international foresight programmes on education, both of which list among their objectives to promote foresight and futures thinking in educational planning at national and regional levels. The first is the OECD’s Schooling for Tomorrow (SfT) programme (OECD, 2001b), and the second is the European Commission’s Future of Learning (FoL) programme (Redecker et al., 2011). In particular, I will use these examples to highlight methodological issues that foresight practitioners need to address; especially in cases where participants include individuals who have little, or no, experience with futures methods; as is often the case with education-related foresight programmes.

**OECD: Schooling for Tomorrow**

Starting in the late 1990s and running to 2008, the OECD implemented their “Schooling for Tomorrow” foresight programme which involved stakeholder representatives from a number of OECD member states (Istance & Theisens, 2013). Among the outcomes of the project were a series of scenarios, published in 2001, that describe several alternative futures for education within a 15–20 year timespan (OECD, 2001b). The scenarios represent three paradigms of possible trajectories of change within school systems: persistence of the status quo, re-schooling movements that reconfigure and strengthen educational institutions, and de-schooling movements that dismantle existing institutional frameworks.

Two scenarios were developed under each of these paradigms. The status quo scenarios reflect contemporary issues relating to school systems’ resistance to change and increasing privatisation. The remaining four are intended to describe possible change over time. In all of the scenarios, the central forces driving change are all easily recognisable as expressions of issues that were prominent in educational discourse at the time that the SfT programme was implemented, including; schools as learning organisations, home-schooling and open schooling, community integration, and teacher-shortages. This, in itself, is not problematic as it is reasonable to assume that, as prominent trends, they would influence the future of education and, in some cases, emerge as dominant models. More problematic, however, is that the scenarios do not reflect the possibility of change within on-going discourse. This is an unrealistic projection. Even if the models described in the scenario do persist in educational discourse over the next 15–20 years, we can expect, at least, that meanings of key concepts will evolve as they are explored, tested, and refined. Thus is the nature of discourse.

Another limitation of the OECD scenarios is what could be construed as a miscalculation regarding the potential for ICTs to be significant drivers of change. ICTs receive little attention in the scenarios and are discussed only in very general terms with little mention of specific existing, or emerging, technologies. Yet, at the time that the scenarios were being constructed (the late
In the 1990s there were already indications of significant technological shifts, including: the proliferation of wireless networking; rapid diffusion of mobile phones; laptop computers replacing desktops as preferred platforms; the emergence of social media; and exponential increases in data storage and computer processing capabilities. By regarding ICT development as a very general driver of change, rather than focusing on the possibilities opened up by specific emerging technologies, the potential impacts of a range of foreseeable technological changes are overlooked.

European Commission: The Future of Learning

The European Commission’s Joint Research Centre – Institute for Prospective Technological Studies implemented a foresight programme in 2009 under the title, The Future of Learning: New Ways to Learn New Skills for Future Jobs. The FoL programme resulted in a series of six scenarios that describe possible changes in learning environments in the years 2020 to 2030 from the perspectives of six imagined personas. Unlike the SfT scenarios, ICTs figure prominently in the FoL scenarios and the “potential of ICT” is specifically described in relation to each. However, again, we see evidence of a very conservative expectation of change over the time period being considered. In fact, all of the ICTs described in relation to the scenarios exist today and existed at the time that the scenarios were published, including augmented reality, social media, 3D virtual environments, data mining, e-portfolios and others. Thus, there is a general failure to anticipate technological change and no apparent attempt made to inspire consideration of new technological possibilities.

Neither the SfT nor the FoL scenarios are likely to be of much use for long-term planning since they essentially only describe the impact of contemporary trends (some of which are arguably already dated) extended over long periods of time, rather than highlighting change dynamics and possibilities for significant change. That is not to say that the efforts were entirely futile. They were, no doubt, successful in introducing futures thinking and foresight processes to various stakeholder groups and increasing their capacity to engage in long-term planning. Nevertheless, they fail to provide new perspectives that could inspire radically different pathways toward preferred futures.

Creativity in Foresight Processes

Humans have a natural creative ability to imagine alternative futures; and we routinely exercise this ability. For example, as we consider how we will travel to work the following day we may mull over several options ranging from cycling to getting a ride from a co-worker. As we do so we weigh the pros and cons of each according to some criteria, all of which exist only in the future. This type of planning is indicative of creative future-oriented processes at work; ones that take us beyond the realm of the real to imagined realms of the possible. It is this capacity for imaginative thought that is the foundation for
our ability to articulate visions of the future that can potentially inspire us to radically alter the way we do things. Yet, this creativity is an underutilised capacity in many foresight programmes and may even, in some cases, be constrained by the methodological choices made by programme planners.

The purpose of technology foresight is not merely to present choices for possible futures on the basis of evidence of ongoing technological developments. It is also to elicit and describe collective value judgments regarding imagined futures to indicate which ones are preferred. There is, however, no guarantee that the most optimal future will emerge from the foresight process. Herein lies the problem; and there are two sides to it. First, the most optimal future may not be one that can be directly extrapolated from the empirical evidence that is fed into the foresight process. Second, participants in the foresight process may not be adequately stimulated to formulate an inspiring vision of the most optimal future.

The first side of the problem stems from methodological factors that limit foresight participants’ opportunity to be creative in their construction of visions of possible futures. The second, results from a narrow ZTC among participants that has not been sufficiently attended to in the initial stages of the foresight process. In the following sections I will describe ways that these problems can be addressed by introducing methodological approaches into the foresight process that stimulate creative thought and coax participants to think beyond the limitations of their ZTC. In particular, I will describe how I have combined elements of “design thinking” with futures methods to encourage the generation of creative visions of long-term futures in education.

**Design Thinking**

Design thinking is an emerging solution-oriented method for addressing complex challenges in creative and innovative ways. Following Amabile (1997), I define creativity as the application of the imagination to the generation of new ideas, and innovation as the implementation of those ideas. Thus, design thinking presents a two-pronged approach to addressing issues by combining the generation of new ways of thinking about existing challenges with considerations of the practical implications of putting them to use. Design thinking can be viewed as a structured brainstorming process with special measures to promote the generation and refinement of highly creative ideas. In the application of design thinking, participants work in design teams. The process consists of five basic steps (Hasso Plattner Institute of Design at Stanford, n.d.):

1. **Empathy** – Participants develop their understanding of the issue by familiarising themselves with the perspective of those who are affected by the issue being addressed.
2 Define – Participants analyse the issue to narrow their focus on the specific problem definition that will guide their work.

3 Ideate – Participants generate ideas about how to solve the problem that they have defined. Participants are encouraged to generate as many ideas as possible within a given period of time. Judgment is suspended until later in the stage, when participants select ideas to develop further.

4 Prototype – Participants construct a visual model that represents the idea, or ideas, that they have chosen to expand on.

5 Test – Participants present their prototype and explain their idea to other teams to elicit feedback and consider how their idea might be implemented.

Several of these steps overlap with common practices in foresight programmes, such as defining challenges and building relationships between the various stakeholder groups. The steps that I want to especially highlight are those that directly concern the creative and innovative processes. These are ‘ideating’ and ‘prototyping’. Ideation is the generation of creative ideas relating to the issue, or issues, being addressed. The prototyping stage involves bringing ideas to life, so to speak, by constructing visible and tangible representations of them. Both provide helpful ways to effectively integrate practices that encourage highly creative thinking in foresight methods without significant modification. To illustrate this, I will describe how I have used these elements of design thinking in combination with futures thinking to elicit creative ideas for preferred futures. My intention is primarily to suggest ways to overcome potential methodological issues in the construction phase of foresight programs that can limit the generation of creative visions of preferred futures.

In the initial phase of the ideation stage participants generate as many ideas as they can in a given amount of time; focusing on quantity rather than quality. The rationale for this is that research has shown that persistence is a significant contributing factor in the generation of highly creative ideas (De Dreu, Nijstad & Baas, 2011; Finke, 1996). As design teams generate their ideas, the first ideas to emerge tend to be the most obvious ones; i.e., the ones that diverge least from dominant ways of thinking about the issues being addressed. Encouraging them to persist in their pursuit of the task pushes them to go beyond the obvious, to take more risks, and to view the issue from different perspectives, leading to the generation of increasingly inventive ideas. Some of the resulting ideas may border on the absurd, but teams suspend judgment in the ideation stage and include all resulting ideas because they can steer thinking in new directions, leading to new insights and even more ideas. At the end of the ideation stage, team members evaluate the ideas generated and choose the most creative ones to develop further.
In the prototyping stage, team members construct physical models to illustrate their most creative ideas. This is both a playful and hands-on activity in which team members craft an object, or objects, using a range of materials, including modelling clay, building blocks, paper, and whatever else is available. They may even choose to act out a brief skit to illustrate the idea. The rationale for this stage is twofold. First, prototyping involves thinking by doing, thereby engaging a variety of senses and sensibilities in the creative process. Team members have to consider how visual, tactile, and other design elements work together to convey the critical points of the idea that they are developing. The idea itself is not a static entity in this process. As team members construct their prototype, their understanding of the idea that they are trying to convey may undergo significant transformation. Second, prototyping allows team members to separate the idea from the contextual parameters of individuals’ and group dynamics. Team members are reminded that the purpose of the prototype is to convey subjective, and often very abstract, meaning to individuals who have not been privy to the deliberations that gave birth to their ideas. Thus, they have to confront the metaphors and hidden meanings in their creative ideas to effectively communicate them to others.

What emerges from the ideation and prototyping activities can often seem far-fetched and impracticable, even to members of the design team. What needs to be kept in mind, however, is that the team members are trying to convey to others possibilities that go beyond their own specific knowledge domains and experiences. Their goal is not to present a rational plan toward a specific objective (that occurs in later stages of the design process), but rather to inspire others to think in new ways about the challenges being addressed. An idea that seems implausible to one audience, may suggest clear practical applications to others, depending on the knowledge that they bring to bear on the interpretation of the creative idea.

In my experiments with integrating creative brainstorming methods with futures thinking, I have been able to observe how the combination of approaches that encourage creativity and an air of playfulness provide an environment that frees participants from the constraints of formal futures methods, allowing them to explore possibilities that would otherwise not emerge. In one design workshop that included educators, educational administrators, policy makers, and teacher-trainees, participants were asked to generate ideas about how technology can be used to address various challenges that educators may face in the future. Like in foresight programmes, participants were first provided with inputs that described emerging technological developments and their affects on education and society. Next, participants went through a reflection stage, where they defined the issue presented to them and identified specific problem areas needing to be addressed. In the construction stage, rather than focusing on traditional futures methods, participants were introduced to the ideation and prototyping stages of design thinking and urged to work with these approaches in future contexts; considering, not just logical implications of emerging technologies, but also to imag-
ine likely and remote possibilities. Several exceptionally creative ideas emerged as a result of this activity. Two of the ideas were especially ambitious in their goals and viewed by participants, at first glance, as impracticable. However, when the ideas were viewed from other perspectives, they suggested realistic pathways for long-term development.

The first idea described what design team members referred to as “a programmable 3D teacher”. The purpose of this virtual teacher was to simulate an instructor that could be adapted to the specific needs of individual learners, even on the fly. The team’s prototype included an ambiguous clay figure, suggesting a persona that could be moulded and re-moulded to alter specific features as needed. To the team members and members’ of other teams, although considered an attractive idea, it was mostly regarded as unrealistic and with little chance of being realised in the 10 to 15 year time period being considered. An individual with considerable knowledge and experience in software engineering and development, however, reacted very differently to the idea. He translated the metaphorical elements of the idea in terms of his knowledge of computers and software and recognised a practical and realistic application of emerging artificial intelligence technology.

The second idea was for what team members called a “knowledge attractor”. The purpose of this technology was to gather existing and emerging knowledge relevant to educators on an as-needed basis. The team’s prototype included a helmet to be placed over the educator’s head, which was connected to various sensors to facilitate context-awareness. The helmet would use the contextual data to gather existing relevant information and feed it directly to the educator in an immediately usable format. This, again, was deemed by workshop participants to be a far-fetched idea with little promise for the foreseeable long-term future. The software developer, however, saw this very differently. To him, the idea suggests novel applications of sensor technologies and sophisticated data-mining techniques. The outcomes of such applications may look very different than the metaphorical prototype produced in the design thinking process, but would, nevertheless, be capable of mirroring the essential functions of the desired outcomes.

The process that produced the examples I have described did not diverge in significant ways for common foresight practice. The difference is in the deliberate integration of techniques intended to promote creative thought in the construction stage, i.e. the stage during which future contexts are considered and defined.

As the examples demonstrate, the integration of creativity with futures methods facilitates the construction of innovative contexts that lay the foundation for new forms of discourse about technology and education. The resulting creative contexts look beyond current technological paradigms and, thus, have the capacity to inspire and motivate key players to, not only consider implications and applications of existing and emerging technologies, but also...
to proactively pursue new pathways toward preferred future possibilities. In terms of outcomes, there is a more pronounced awareness of optimal futures being constructed, rather than simply choosing a preferred, technologically deterministic trajectory. Participants in the visioning activity see themselves as empowered contributors to the creation of new, positive futures.

More importantly, the examples demonstrate how creative thought exercises enable foresight programme participants to entertain the possibility of future developments that include technological capabilities that go beyond current tangible technological realities. In deciphering the metaphorical representations presented in the prototypes we can discern suggested applications of remote technological possibilities such as, advanced artificial intelligence, cognitive enhancement technologies and highly sophisticated data mining technologies. All of these technological possibilities feature regularly in futures discourse and are currently being actively pursued by scientists and engineers and can, therefore be reasonably expected to become realities over the next few decades (Bostrom & Sandberg, 2009). These are among the technologies that will inevitably shape education in the future. Thus, it is not untimely for us to consider how we want these and other emerging technological developments to affect future educational environments even though they may seem far-fetched in our current contexts.

CONCLUSIONS

In 2009, Heidi Siwak, a teacher in Ontario, Canada, embarked on a journey of discovery and realization when she challenged herself to acknowledge the change that she was witnessing around her. Reflecting on how her approach to teaching has changed, she states (Siwak, 2013),

“I recognized that the world of education was rapidly changing and that in order to remain relevant and useful to my students I would need to set aside my belief system about education and learn what it means to be a teacher in the 21st century.”

With these words, Siwak succinctly sums up the rationale for changing the way that we address educational policy issues. But, even as Siwak reminds us of the changing role of teachers in the 21st century, we must keep in mind that we have only just embarked on the new century and that their role is still being defined.

Over the next five to ten years we will see a continuing acceleration of the rate of technological change as currently emerging technologies, such as augmented reality, 3D printing, and advanced artificial intelligence, increasingly affect our daily lives (Johnson, Adams Becker, Estrada, & Martín, 2013). Technology foresight is a mature tool that has proven helpful for considering the ways that such novel technologies can affect education. However, there is
more to foresight. The ultimate goal of foresight is to help stakeholders and policy makers decide what they want educational environments to look like in the long-term future, and thus inspire those who have the capacity to realise those visions to act on them. This requires more than mere analytical consideration of current trends. It requires that we also consider what types of futures we might be able to construct given the appropriate technologies. To achieve this requires that we navigate a careful balance between the rigour of tried and true futures and forecasting methods and the free flow of creative thought.

I have argued that foresight planners and practitioners need to be aware of factors that can potentially limit programme participants’ constructive and critical thinking about the future. In particular, they need to carefully consider participants’ overall propensity for considering long-term impacts of changes and technological innovations that may be very foreign to them, what I refer to as their “zone of temporal confidence”. The use of rigorous futures methods does not necessarily overcome these limitations as the examples of foresight programmes that I have described demonstrate. In fact, they may even exacerbate the issue by overemphasising the need for methodological rigour. Integrating futures methods with methods that encourage the generation of highly creative ideas can help overcome tendencies toward conservative caution in futures thinking by pushing programme participants beyond their usual comfort level.

REFERENCES


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