ANNEX 3

CHARTING THE FUTURE OF ADULT LEARNING RESEARCH AGENDA IN SINGAPORE

Consultative Paper by the Subgroup on

Innovative Technologies for Adult Learning Research

31 March 2020

Note

This consultative paper is an output of the Subgroup of the Taskforce on the Future of Adult Learning Research Singapore on the focus research area 'Innovative Technologies and Adult Learning Research'. It provides the Subgroup's recommendations, drawing out the novelty and strategic importance, scope, capacity, and translation in addressing the focus research area. The principal authors are: Helen Bound, Tan Seng Chee, Kan Min Yen and Bi Xiao Fang. The authors would like to acknowledge the helpful comments and suggestions on the draft provided by Tan Woei Wan, Looi Chee Kit and Eric Chua.

The views and suggestions presented in this paper are those of the authors as listed. The contents are intended for discussion and generating ideas, and are not necessarily the views or policy prescriptions of the Institute for Adult Learning (IAL).

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Introduction

This consultative paper seeks to capture the thinking and approaches the Taskforce has developed to date in the area of Innovative Technologies and Adult Learning Research, within the context of the future of research in adult learning. The bulk of the paper then addresses the areas identified in the scope for innovative technologies and adult learning — learning innovation and technology, context and capability development, and the business of education and impact.

Novelty and Strategic Importance

Innovative technologies and learning are the core foci of this area of research. With the current focus on artificial intelligence (AI), it is important to delineate this as a subarea of innovative technologies as a whole that we envision to be pursued strategically. AI (and its subfield of machine learning) constitutes a particular category of research that can be integrated well with adult learning, but certainly does not constitute the only technological means to accomplish adult learning research; other areas such as suitability of use/application (translation), student assessment and modelling, and human-computer interaction (e.g. through different computing devices) are also meaningful and useful strategies that undergird this taskforce area and the entire adult learning research area as a whole.

As a tool. While innovative technologies immediately indicate novelty, such technologies by themselves are rarely helpful for adult learning, unless coupled with appropriate understanding of learning. This link is not only novel but of strategic importance in considering how to move forward thinking, policy and its implementation in developing Singapore's workforce and in community engagement and interaction. The potential of innovative technologies can far outstrip traditional understandings of learning based on largely cognitive, behaviourist approaches encapsulated in competencies and ideas of skills that bring to mind technical skills and generic skills. To make effective use of advances in technology, it is necessary to also bring our thinking of learning and skills forward in tandem to better reflect the complexities of everyday lives and system ecologies; that is, a shift to a focus on learning and technology as a tool, and a shift away from the technology unto itself.

Future-oriented. We also draw attention to a future-oriented understanding and innovative technologies for learning. By 'future-oriented', it is necessary to consider what it means for citizens, workers, institutions, employers, organisations and policy makers to develop people for unknown futures. Our education policies have evolved over the years in changing contexts, from efficiency-driven, to ability-driven, and to the current learner-centric value-driven phase. The current emphasis is to maximise the potential of every individual for the knowledge economy. We need to develop workers with a growth mindset, curiosity of mind, and a sense of social responsibility. To prepare for the rapidly changing socio-economic-political landscape, the focus is on the unknown, as whatever scenarios may be envisaged, none may be currently realised. This necessitates different ways of thinking about research itself, perhaps requiring a shift from research on to research with stakeholders. Additionally, researchers need to carefully consider the conceptualisations they bring to their research and if they are rooted in discourses, forms of production, environments of old, and ask the question "will the conceptualisation(s) be forward-thinking and future-oriented?"

Holistic. In addition, the future trend in adult learning research is expected to be holistic in several ways. First, being holistic in how workforce and community development is

conceptualised, shifting from a traditional focus on skills and competencies to a broader understanding of capabilities as integrated and contextual (see e.g. Bound et al., 2019, the integrated practice model). Second, being holistic means the recognised need to study the ecosystem and systems that support innovative technologies and adult learning to their impact on daily practices. When smart and intentional design and use of technology focus on learning that meets the needs of the society, economy and individuals and their communities, research can powerfully impact both policy and practice.

Interdisciplinary. A final aspect is the need for interdisciplinary research. To date, much of the research in this area has been largely siloed within specific disciplines, but there are signs of collaborations with like-minded disciplines, perhaps not dissimilar to the fields of study traditional to adult learning — psychology, sociology and to some extent, anthropology. There is clear potential of disciplines working together that do not normally do so; for example, 'education'/learning researchers working with analysts, organisational development researchers, or neuroscientists. Such cross-disciplinary collaborations contribute to the development of new directions of adult learning research building on emerging research techniques and methodologies that will contribute deeply to the research, generating epistemological dialogue, new ways of working for researchers, new techniques and different uses of specific technologies.

Proposed Scope

Figure 1 encapsulates the proposed scope of this paper. We recognise the potential of driving innovation in adult learning with technologies, such as AI, machine learning, analytics, user modelling, human-computer interaction, big data and extended reality technologies. The new division of labour between man and machine — catalysed by the availability and capture of massive data and its subsequent analysis — means that in every aspect of work and life, adults are responding to the introduction of new technologies and developing innovative ways to utilise them to solve issues. Concurrently, there is a demand for adults to master these technologies.

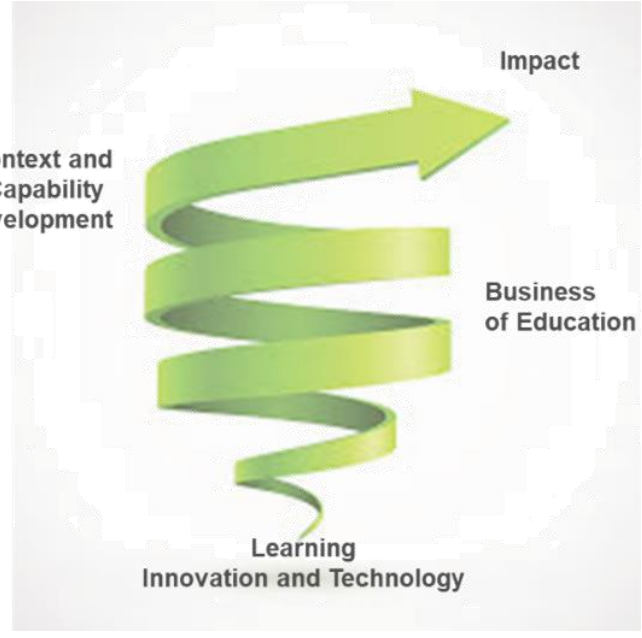

Figure 1. The proposed scope of technology and adult education

The paper makes reference to multi-disciplinary collaborations among researchers. This is an implicit aspect of the scope of research outlined in Figure 1. Currently, cross-disciplinary approaches seem to be rare indeed. There is rich potential for cross-disciplinary studies in the area of learning, technology and innovation. For example, combining ethnographic data, survey data based on the ethnographic findings, analytics and neuroscience with a focus on learners' development of meta-cognitive capabilities in and across different contexts could contribute not only to deepening our understanding of development of meta-cognitive capabilities, but also potentially contribute to the development of online heuristic tools that generate further data for ongoing analysis that could help to improve learners' meta-cognitive capabilities. The power of multi-disciplinary approaches to context and capability development in relation to technology enables studies that consider context, capability development and issues such as inclusion and gender, and institutions such as family, which is important for Singapore to grow its inclusiveness agenda. Much learning occurs outside of educational institutions — at work, in the family, and within communities. The use of innovative technologies offers dual possibilities. One is the use of technology and accompanying analytical techniques that require the crossing of disciplinary boundaries. Additionally, there is considerable potential here to develop new directions of adult learning research by building on emerging research techniques and methodologies, which will contribute deeply to future trends in adult learning research, generating epistemological dialogue, new ways of working for researchers, new techniques and different uses of specific technologies.

Learning Innovation and Technology

In this document, the choice of the phrase 'learning innovation and technology' is intentional: to remind ourselves that moving forward, all three components — learning, innovation and technology — need to be integrated in their realisation in relation to research. This would mark a shift from predominant approaches in research studies in this sub-area, from studies that focus on the technology as the innovation, where learning is often understood largely as individual and cognitive, to studies that focus on learning and treat technology as being a tool for enabling, affording and/or supporting learning, individually and/or collectively. Put simply, the shift in research on adult learning revolves around a more forward-looking understanding of learning, shifting from learning as primarily cognitive and individual, to learning as social and highly contextualised and interactive among humans or between humans and technologies.

This is a critical shift for research and has the power to underpin research that supports future-oriented development. It marks a shift from learning as acquisition of knowledge as a product and reproduction of knowledge, to learning that is social and contextual where knowledge is co-created and/or further enriched and developed with the aid of technologies. How learning is understood informs the design of technologies and their pedagogies. Moving forward, Singapore needs workers who are future-oriented; technology can play a powerful role in contributing to the development of a workforce that is future-oriented if both the socio-cultural aspects of learning and cognition are addressed and integrated into technologies designed for learning.

Currently, learning innovation is often mistakenly deemed as synonymous with the use of technology. Regrettably, there is no guarantee that the use of technology contributes to or equates to innovative learning design. For example, the IAL's baseline survey of the TAE Landscape (Zan, 2019), which included adult educators and training providers from the private

sectors and institutes of higher learning (IHLs), found that the most commonly used learning technologies were audio-visual aids, recorded lectures and discussion, and collaborative platforms such as Google Docs, in that order. These technologies are generally used as a replacement of hard copy content that has simply been transferred online. There is nothing innovative about these practices. The belief that the use of technology is synonymous with innovation is similarly reflected in much of the literature in this field. Many studies in the field of technology and learning concentrate on the types of technology and their use, often employing individual and cognitive approaches. Furthermore, Bi et al. (2020, forthcoming) also found that the training providers merely used such 'innovative technologies' to convert their traditional classroom learning to blended learning to correspond to government initiatives administratively in order to get their subsidy approved. A smaller proportion of studies has been found that considers the pedagogical aspects of the use of different technologies for learning, and the socio-cultural aspects of learning. Additionally, studies investigating technology and adult learning beyond the boundaries of educational institutions are difficult to find. Kirkwood and Price (2014) lamented that the scholarly approach to teaching, learning and technology is lacking because too much research attention has focused on the technology as both the object of study and agent of change, while neglecting design considerations from the teaching and learning perspectives. They suggest a change from asking what technologies can be used to asking how technology may help to achieve the desired learning outcomes. Tan (2017) has similarly argued for foregrounding learning in the use of technologies for adult and lifelong education. This dearth of research that privileges learning design where technology is an enabling tool has great potential to inform both the design of innovative technologies for learning and the design of and support for learning.

Focus on learning

Studies that move beyond traditional psychological theories of cognition, and/or behavioural theoretical approaches are continuing to emerge. There is a growing number of studies that seek to understand adult learning and technology in authentic contexts, capturing the richness and complexity of learning in situated contexts and understanding the complex interactions of the specific with the universal (Sawchuk, 2019). This shift in focus, still in the making, is important strategically, as it reflects the reality of adult learners' lives and their constant exposure to learning opportunities in everyday life and work. Thus, when considering research in innovative learning and technology, it is necessary to focus on learning, rather than privilege the technology. Technology is merely a tool that can enable learning.

Understandings of learning drive practices; future research that encapsulates the complexity of learning in contexts is particularly important in the sub-field of technology and adult learning for the reasons outlined above. Despite the availability of alternative views of learning in contexts, traditional practices that rely on classroom delivery and a focus on learners being able to reproduce content (as opposed to developing future-oriented capabilities) remain the dominant model in our educational institutions, private training organisations and in the thinking of many learning and development (L&D) professionals. Such beliefs about learning, encapsulated in the metaphor of learning as acquisition (Sfard, 1998), drive practices, including practices involving the design and use of technologies for learning. The acquisition model of learning does not engender innovation, deep learning or stretch the use of technologies for learning or drive the development of future-oriented capability development. Additionally, technologies bring forth possibilities to move beyond subject- or discipline-specific framing of knowledge and learning (Elias, 2011), setting up possibilities for learning that is holistic, authentic and dialogic, and positioning learners as co-constructors of

knowledge (Bi et al., 2020; Bound, Chia & Karmel, 2016; Bound et al., 2019; Scardamalia & Bereiter, 2014; Tan & Tan, 2014).

Innovative learning technologies have a strong potential role to play in developing future-oriented capabilities among learners. Lave and Wenger (1991) proposed that social interaction is a necessary means for appropriating social practices and discourse as a person develops his or her relevant expertise in a community. Paavola and Hakkarainen (2005) suggested that beyond social interactions, the production of knowledge artefacts as a tangible product could overcome the nebulous knowing and tacit understanding of learning through participation. The knowledge artefacts created also represent the state-of-the-art knowledge of a community, yet they can be objects for further discussion and improvement. This interaction and symbiotic relation between the technology and its users affords infinite opportunities for continual knowledge advancement. In this regard, approaches to knowledge creation or knowledge building (Scardamalia & Bereiter, 2014; Tan & Tan, 2014) can be applied in workplace learning where there is an intentional goal of innovation and creation of new products and services. Bound et al. (2019), for example, reported studies on how dialogical inquiry could be used in formal course settings to engage adult learners in collaboratively constructing meaning through dialogues and interactions with multiple artefacts (e.g. research articles, case studies, or personal experiences). Through interacting with peers and with artefacts, the learners explored and made sense of a range of perspectives and co-constructed knowledge as a group. Another critical difference from the acquisition model of learning is the empowerment of learners to exercise shared control over topics for inquiry and academic interactions, thus developing a sense of agency among learners. Such approaches to adult learning could be scaled up and explored further, to enrich the adult education sector with a healthy range of instructional approaches, especially those that aim at developing 21st-century skills and knowledge creation capacity among learners.

The examples of possible alternative, more complex conceptualisations of learning bring many possibilities for research to better understand how to support learners' growth and development in a way that positions them as future-oriented (Lee, 2012; Bound, et al., 2016) and able to thrive in changing contexts. Such a focus requires connecting learning to purpose (Kwek et al., 2017), be it in relation to learning in educational institutions, work, community or family settings. Given the current focus of much research on learning and technology that privileges the technology, these alternative understandings of learning are critically important for moving the research agenda forward.

The potential of innovative technologies for learning

Innovative technological research has much to contribute when clever design and use focus on learning that meets the needs of the society, economy and individuals and their communities. For instance, the original cMOOC (connectivist MOOC) conducted by Siemens (2004) is a good example of the use of technology to connect learners, to extend the learning community and to encourage the agency of learners. Learning technologies offer rich opportunities for developing complex, sophisticated capabilities, such as teamwork, critical thinking, learning-to-learn and other such future-oriented capabilities.

It is useful to be instructive on how we feel the AI technologies can be well integrated into the agenda of research on adult learning, as much attention has been placed on AI. Importantly, we distinguish between AI and the narrower subfield of machine learning. Machine learning research discovers and identifies patterns within data through unsupervised activities (as with

statistical analysis), and in its supervised version, through training with answers, it can automatically infer the categorisation of data. Machine learning research by itself can only identify patterns or do appropriate categorisation, when given appropriately collected and engineered data. AI, in contrast, can be construed as subsuming machine learning, but also enlarging the scope of research to encompass how artificial systems can be cleverly engineered to help decision support and perform vision and language processing. AI can make use of machine learning in accomplishing these goals. Finally, the scope of innovative technology as described within this area is not limited to AI technologies, but includes other technologies and existing technologies when they are appropriately and innovatively applied in context.

In contextualising AI and the use of other innovative technologies, a clear contrast with adult learning is seen when we recognise the importance of informal learning that happens within the work environment that is not directly credentialed, as with the standard academic context of coursework. Thus, a crucial application of nascent AI technology centres on this paradigm difference:

- Use technology to identify and assess when workers have achieved competency in necessary skills on the job, without the need for formal coursework; that is, can we identify when explicit skills are being applied on the job? Can we then assess how well those skills are being applied? How and when do we apply a formal examination of their skills (if needed), and then offer certification of those skills in some form of (stackable) credentialing?
- Use technology to best identify which job functions human workers can excel at; that is, with the improvement in AI technologies, identify and prescribe best practice guidelines for an optimal balance between human–machine partnerships in performing work duties. Then, identify and build AI technologies that augment (rather than replace) human abilities.
- Pushing the last point further, forecast new future skills that will be in demand and skills that will be made obsolete by advancing capabilities from technologies.

Fast-paced changes in technology now offer possibilities previously undreamed of. Indicative examples of such technologies and their potential uses are found in Appendix 3-A. *The challenge of how learning is understood, of recognising that learning is a very human, social process, that much knowledge in one context changes in another context, and that knowledge is co-created, can mark the difference between using technology to replace people or using technology to augment growth and development of people.*

Contexts and Capability Development

The term ‘context’ is variously used, informed by the researchers’ epistemological stance. For example, context may refer to the big picture of policy, economic, social and political discourses and trends, as well as to what some label as meso-contexts, such as institutions and industry ecosystems, in addition to what in the learning literature is referred to as ‘situated contexts’, such as specific learning spaces (classroom, workplace, or community event). Socio-cultural approaches, for example, argue that contexts mediate everyday decisions and thinking about the use of technology in and for learning and in everyday lives. A psychological

cognitive perspective, on the other hand, rarely acknowledges or accounts for context. Such different perspectives highlight the need for multi-disciplinary research that brings together, for example, the complexities of authentic, real-world experiences of technology with cognition.

The term 'capability development', as used here, is a marker for that which is beyond notions of skills and competencies. The term 'capability' seeks to look beyond narrow framing of competencies as knowledge, skills and attributes, or skills as typically a consideration of technical and the addition of generic skills. The term 'capability development' originates from Amartya Sen (1999), an economist who links development, quality of life and freedom. The capability approach links capability, functioning, agency, human diversity and public participation in generating valued capabilities. Sen (1999) argues that the capability to function relates to the quality of life and to the assessment of an individual's capability to function. Whether the term 'capability' or other terms are used, the intent is to deliberately move beyond current notions of skills and competencies, in order to be able to prepare and continuously develop adults for changing contexts that require the ability to function and transit across multiple contexts in order to flourish. Whatever the terminology used, research related to technology and adult learning needs to address real workforce development and community issues holistically. Again, many research studies share a specific use of a technology for developing a specific 'skill' or small set of skills. Such studies contribute to knowledge and understanding, *yet, we need to move beyond this more limited framing of the use of technology for capability development.*

That being said, a specific critical capability in relation to technology and adult learning is digital literacy; it is a core underpinning capability. What we know about adults' digital literacy in Singapore comes from the Programme for the International Assessment of Adult Competencies (PIAAC) Survey of Adult Skills in 2015, which offered an assessment of adult Singaporeans' problem-solving skills in technology-rich environments (PSTRE), including some aspects of the functional and cognitive dimensions of digital literacy. The findings show that adult Singaporeans in the younger age groups (16—24-year-olds and 25—34-year-olds) had considerably higher percentages of attaining advanced proficiency in PSTRE, compared to the OECD average, but those in the senior age groups (45—54-year-olds and 55—65-year-olds) posted lower percentages in the attainment of basic and advanced proficiency for PSTRE than the OECD average, with the majority of respondents failing the ICT core test (OECD, 2016). The below-average PSTRE performance of senior adult Singaporeans suggests that part of the active Singapore workforce may not be equipped with the requisite digital skills sufficiently to effectively use ICT in the workplace. Furthermore, this wide variation in the level of digital literacy and PSTRE could pose a challenge to the efforts of developing a smart nation and will impede the effort in innovating adult learning with technologies. As a result, the question becomes how to effectively address this issue. Because specific capabilities, such as being digitally literate, are used in conjunction with other capabilities, the approach of classroom training is limited. Thus, despite digital literacy being critical, there is little research on how to develop such capabilities effectively.

So, while studies on specific capabilities using technology can advance our knowledge and understanding to some extent, what these studies do not help with are questions that, for example, educators, learning and development, community leaders and policy personnel are asking: "How to get my workers to be digitally literate in relation to the new technologies my firm is using? Why is it that when as an L&D professional I provide eLearning, workers access it in limited ways? How do we link training and workplace learning? How to create a culture of learning? How to develop digital literacy in community settings? How to meet learning processes of different generations?" Technology has a role to play in addressing such

questions. A different approach to research is called for. Researchers in the area of innovative learning and technology need to work *with* relevant stakeholders, *in* the specific contexts to uncover the questions being asked on the ground and to collaborate with different disciplines to undertake research that is meaningful and applied. *Collaborative stakeholder engagement in the research, along with multi-disciplinary approaches, has the power to not only deliver on applied research, but also requires epistemological dialogues that delve into developing new methodologies and relations with stakeholders.*

Holistic research approaches, such as hinted at above, readily lead to what can be called an ecological or systemic approach. This section has so far focused on capability development as it relates to individuals or groups. However, capability development is also required for the multiple different players in supporting the use of technology for capability development.

Encompassing holistic framing — ecological and systemic approaches

It is rare internationally, and even rarer in Singapore, to find literature related to technology and adult learning that investigates how different parts of a system connect, relate to each other, enable or limit opportunities for the clever design of technology for learning to be carried through into everyday practices. This is surprising as it is an area of research that has considerable power to inform policy at a national level and inform change processes.

An example of an ecological approach in relation to the capability development of the adult education sector would involve policy bodies, educational institutions and providers of adult learning, educators, technology designers, professional bodies, licencing bodies and so on. What organisations and institutions are involved in depends on the purpose of the research and the research questions. Ecological or systemic approaches have the capacity to bring together powerful decision makers to affect change that can be built into research design. Such approaches in the field of adult learning are only now beginning to be used in Singapore — small examples are to be found in the research projects conducted by the Institute for Adult Learning (e.g. Bi et al., 2020).

Other issues, such as the nature of the technology, the way it has been introduced, market, industry and policy forces, discourses and practices among different players in an ecological system, can shed light on, for example, resistance to the introduction of some technologies, and how to move beyond restrictive policies and discourses that may be contributing to the resistance (assuming the technology is appropriate). Understanding relations between institutions, technology providers, educators and learners can be highly strategic in policy development nationally, as well as in institutions, enterprises and community organisations. Such understanding also informs teaching and learning practices that can contribute to innovations in learning and technology. An ecological perspective (Bronfenbrenner, 1994) enables the examination of interfaces among various levels in the system (Tan et al., 2018). For example, the national policies (macrosystem) need to be responsive to global changes and trends as well as the local development. Any policy related to the use of technologies in capability development or in specific educational institutions needs to take into consideration the broader nationwide infrastructure and system, such as the smart nation initiative, communities of practice and connections among institutions and organisations, and individual organisations' local and situated contextual characteristics.

Systemic approaches recognise changes as "holistic, contextualised, and stakeholder-owned" (Carr-Chellman, 1998, p.370), and that changes in one part of the system will affect other

parts; thus, the need to act on related factors and components in a holistic manner. It is also critical to recognise the complexity and self-adaptive properties within a system. That means while extensive planning might be considered, there could be flexibility and spaces for revision due to changing circumstances. This allows us to leverage the self-organising potential of the organic and dynamic system (Ng, 2010). Adopting the complex adaptive systemic view translates into an approach that engages various stakeholders to participate in the research and policy-making process to achieve a delicate balance between top-down direction and ground-up organic development. To achieve a functional complex adaptive system, we need to build up the human capability, especially the various levels of leaders (instead of just the top leaders). Fullan (2015) suggested that a leader from the middle "liberates a greater mass of people to become engaged in purposeful system change, and ultimately to own the changes that they create together" (p.26). *In the context of using technologies for adult education, this would mean engaging various stakeholders in the research and policy-making processes.* Taking systemic and ecological perspectives helps us focus on the nested systems that interact with one another and have invisible and reciprocal forces that affect one another. Importantly, they also can be drivers for change in and of themselves when research design includes the stakeholders as change agents.

We need to examine the collective ecosystem of a learning environment where technology is a part of the system to support decision making and sense-making. In this age where the use of technology pervades every part of our life, it may not be meaningful to compare technology-enhanced against non-technology-enhanced approaches. The focus could be on studying human–robot interactions and principles for this distribution. For example, if we want to employ learning augmented by artificial intelligence, we need to work out the principle of the design of the learning environment such that the learners are engaged in critical aspects of learning (e.g. critical thinking, sense-making) while machines provide the necessary data and visualisations to aid in decision making.

How relevant are educational institutions?

Long traditions of learning taking place in hallowed education institutions are increasingly under threat. The challenge, writes Nübler in his International Labour Organisation report, is that "transformative changes require societies to develop technological knowledge, new belief systems and new institutions" (Nübler, 2016, p.21). Educational institutions work within a political, social and economic frame, while at the same time creating their own frames that interpret and reinforce discourses, and establish rules that control, guide and restrict human and organisational behaviours, and/or develop trust and collaboration (North, 1990). Institutions can play a powerful role in shaping possibilities for the future, either through inaction, reinvention or something in between. To change paradigms, educational leaders and other parts of the ecosystem need to not only re-imagine possibilities but also be brave enough to pioneer new sets of relations, ways of thinking and different kinds of practices. Research has an important role to play and provide support in such re-imagining.

Technology and the Business of Education

Capability development through the use of technology impacts the business of education in both public and private sectors. The use of technologies for learning and for supporting learning requires educational businesses to think differently about their business models, learners and competitors. The 'Opening Up Education' taskforce (European Commission, 2013) notes that traditional educational systems are local, but for some time now, there are growing numbers of cross border and collaborative initiatives promoting learner mobility. Business models that take a one-size-fits-all approach have been criticised because they fail to meet the changing context-specific needs. Changes in labour markets as a result of growing knowledge economies across the globe require technologies, design and support of learning that meet the constantly changing needs of adult learners. In addition, current technological developments tend to facilitate greater openness and flexibility (Kahle, 2010). These changing contexts in turn impact the way business is done by educational providers, enterprises, government agencies — in short, any organisation that supports learning through the use of technology in some form. To understand emerging and changing relations of production in the educational sector, the impact on workers who support or drive learning, on learners themselves, and importantly on business relations and models is an important area with considerable implications for both policy and practice.

For example, research related to technology and the business of education might include how to support educators to adopt relevant and powerful learning technologies and what that means for their role, their employment and employability and how they are engaged by education providers or for supporting learning in other organisations. Research might also include studies of how educational institutions are changing, through their relations with industry, the use of technology to support such relationships, and to support learning in and across multiple spaces, and what this means for the required capabilities of educators, for labour relations, for what counts as 'success', how the culture and structure of the organisation is changing, policy implications and so on. The importance of such research is that it has strong implications for policy at a national level, for institutional policy, processes, discourses and organisational development, and not least for those working in the sector.

Impact

Given the new research focus on adult learning, and in particular, adult learning and technology, accountable and responsible dissemination of funds requires some knowledge of the impact that is being created. This is a field of research in and of itself, and as with other fields related to adult learning, new approaches and multidisciplinary approaches have much to offer. Learning analytics is one such field. However, a consideration of what is measured and how it is measured reflects what is valued; it is therefore important to ensure that a range of perspectives and approaches are encouraged and developed. Selwyn (2010), for example, argues that the social scientific accounts of the study of educational technology that assume predetermined characteristics do not necessarily reflect the realities 'on the ground'. New technologies do not operate in a vacuum, but are embedded within social contexts that shape the purposes, design and use of the technology. It is necessary for researchers to appreciate that technology is socially constructed and negotiated, and to develop realistic accounts that

are context-rich, and include, for example, the capturing conflicts and politics that underpin the design, use, challenges and possibilities of technology in and across the multiple contexts of adult lives.

Consequently, to assess the holistic impact of new development, such as the innovative use of technologies for learning, a traditional evaluation approach that focuses on predetermined objectives and standards may not work. Scriven (1974), for instance, suggested a "goal-free evaluation" model that intentionally prevents the evaluators from developing a tunnel vision circumscribed by the programme goals and objectives, so that the evaluation can uncover what the programme actually does and the corresponding impact — intended and unintended — on the stakeholders. Stufflebeam (2013) proposed a comprehensive model that examines multiple aspects of a programme: Context, Input, Process and Product (CIPP). It aims to examine the entire life cycle of a programme, moving from the conceptualisation of the programme, through its implementation and delivery, to judgments about the quality of the outcomes and decisions about future iterations. The CIPP model aims at improving a programme, rather than just proving the values and worth of a programme. It benefits multiple audiences and provides critical information sought by programme managers to make better decisions. It also puts processes in place to systematically collect data and issue formative reports to promote more effective programme management. The CIPP model also benefits the program's participants, as their views and experiences are documented, analysed and reported to stakeholders holding organisational positions that are strategic for taking action on the findings.

While we consider the contexts for employing innovative technologies, conversely, technologies can also create impact on our social life, thus changing the contexts reciprocally. For instance, the use of social media and mobile apps is increasingly seeping into the socio-political space, as evident in events that happened in various economies, such as Hong Kong. Thus, a holistic framing would include investigation into the social, moral and values aspects of the use of innovative technologies.

In short, studies of the impact of research should take into account that what is being 'measured' is what is valued. Additionally, such studies can overlap with what is often referred to as translation and/or developmental research, where impacts, in the form of developing specific tools, applications of processes, models and so on, are integral to the project. Evaluation and measurement are not the same, and funding of such processes requires careful consideration, as it has the potential to shape research and desired research outcomes.

Research Capacity Building and Translation of Research

There are two aspects of research capacity building addressed here:

1. Building research capacity as it relates to innovative technologies and adult learning research as scoped in this paper
2. Considerations of research design and translation to strengthen research capacity and capability

These are discussed under the one heading of capacity building and translation, as they are not necessarily separate activities; that is, designing research with an eye on the potential

for translation is also a means of building capacity and capability for all involved, researchers and stakeholders.

Research Capacity Building

Capacity building in relation to technology and adult learning research. As part of developing local research capacity in the area of technology and adult learning, a structured community of practice (CoP) needs to be established, consisting of local researchers in this field, across disciplines. This CoP, which needs to be funded, will be held approximately twice per year, with the organisation of the half- to one-day event being the responsibility of different institutions on a rotational basis. The purpose of the CoP is to share current research and to have a dialogue about challenges and issues in researching technology and adult learning, and to establish a strong network among local researchers.

In addition, across those involved in the CoP, a database of national and international researchers, and as appropriate, stakeholders, needs to be developed as a resource for the CoP members to plan and conduct events, and develop research proposals. This is a means of capturing and making explicit the success and reach of the CoP.

Separately or as part of the work of the CoP, at least once a year, an international researcher relevant to the field of technology and adult learning research needs to be invited to share with the local research community in an open forum. The international researcher may be in Singapore as part of a project that is locally (or internationally) funded, in which case, one of their deliverables would be to lead a provocative discussion about any one or more of the following, research in the field, challenges and issues, methodological approaches or other relevant topic that is timely.

Capacity building activities applicable to all Subgroups. The value of the Symposium was in bringing together a diverse group of researchers from across disciplines, systems and nations. The exchange of ideas and discussion wove a rich tapestry of ideas, approaches and considerations. This was an invaluable opportunity to grow networks and build relations for knowledge flow to conceive potential cross-disciplinary approaches to research in adult learning. In order to contribute to the building of research capacity in Singapore and develop and extend international networks and collaborations, it is recommended therefore that NRF fund a regular international conference for adult learning researchers that is deliberately cross-disciplinary, and that addresses each of the four strands identified by the Future of Adult Learning Research (FoALR) Agenda. In conceptualising such a conference, that consideration needs to be given to related conferences in the field (e.g. Adult Education in Global Times 2020 Conference to be held in Vancouver, June 2020).

Research Design and Translation

At the Symposium, the idea of Collaboratories was suggested, particularly in relation to ensuring implementation of research findings. As identified at the Symposium, this means that stakeholders are engaged from the very beginning of the design of the research, and continue to be engaged throughout the research. Partnership approaches to research exist in many different disciplines (Israel et al., 2005). Such approaches are variously called community-based participatory research, participatory action research (Whyte, 1991), critical action research (Kemmis & Taggart, 2000) and participatory community research (Jason et al., 2004),

to name a few. What these approaches have in common is that power is shared with community partners who are engaged in the research process. The approach benefits the communities involved, either through direct intervention or by translating research findings into interventions and policy change (Israel et al., 2005).

Collaborative, participatory research represents a shift from doing research on things and people to doing research with those involved/affected/impacted. This is both an epistemological and ontological shift, recognising the distributed nature of knowledge and that humans exercise considerable agency when given the opportunities and supportive conditions.

Translational or intervention research that lends itself to participatory approaches may be considered a poor cousin to more traditional research approaches. In addition, participatory research is clearly methodologically different to more traditional approaches, potentially raising questions about the value and credibility of using these approaches. To develop the capability in and the valuing of participatory approaches, it is recommended that:

a. Such approaches be encouraged through sending clear messages to applicants that participatory approaches are valued.

b. The NRF establish a fund that supports research that seeks to put into practice research findings from projects that have been previously funded under the Adult Learning Fund.

Research Agenda Generated from "Innovative Technologies and Adult Learning Research"

(RQ1): What new understandings of learning can innovative technology bring about to reflect the complexities of everyday lives and system ecologies beyond the cognitive and behaviourist understanding of learning with the focus on competencies and skills?

(RQ2): How can we work together with stakeholders to conduct research to maximise the potential of every individual for the knowledge economy, develop their growth and curiosity mindset and a sense of social responsibility to tackle the unknown scenarios?

(RQ3): With the holistic conceptualisation of workforce and community development, how to develop individual's capabilities, rather than just competencies and skills, integrated with and contextualised within the ecosystem and systems supporting innovative technologies and adult learning?

(RQ4): How can we conduct multi-disciplinary research, e.g. educational research, data analytics, organisational development research, neuroscience, to make contributions to the development of the new directions of adult learning research, generating epistemological dialogue, new ways of working for researchers, new techniques and different uses of specific technologies?

(RQ5): How can such multi-disciplinary research enable Singapore's inclusiveness agenda by considering the issues like inclusion, gender, intuitions such as family?

(RQ6): Taking learning as a social and highly contextualised and interactive process among humans or between humans and technologies, how can knowledge be co-created and/or further enriched and developed with the aid of technologies?

(RQ7): To capture the richness and complexity of learning in situated contexts, how to understand learning and technology in authentic contexts to reflect the reality of adult learners' lives and their constant exposure to learning opportunities in everyday life and work?

(RQ8): How do adult learners co-construct knowledge as a group by using knowledge artefacts created to overcome the nebulous knowledge and tacit understanding of learning through participation?

(RQ9): How to leverage learning technologies to develop complex, sophisticated capabilities such as teamwork, critical thinking, learning-to-learn, and other such future-oriented capabilities?

(RQ10): Innovative technology is defined as both new and existing technologies appropriately and innovatively applied in context. How does it treat differences of learning and knowledge co-construction differently across different contexts, e.g. to replace people or to augment growth and development of people?

(RQ11): How can research in technology and adult learning address real workforce development and community issues holistically, rather than only developing a specific or a small set of skills?

(RQ12): How can technology play a role in linking training and workplace learning, creating a culture of learning, developing digital literacy in community settings, and meeting learning

processes of different generations by using a multi-disciplinary approach and stakeholder engagement?

(RQ13): How can policy bodies, educational institutions and providers of adult learning, educators, technology designers, professional bodies and licencing bodies work together ecologically to contribute to the research design and the capability development of the adult education sector?

(RQ14): In the context of using technology for adult education, how can we engage various stakeholders in the research and policy-making processes to achieve a delicate balance between top-down direction and ground-up organic development?

(RQ15): How are educational institutions changing with the use of technology to support their relations with industry, learning in and across multiple spaces? What are the implications of these changes for the required capabilities of educators, labour relations and policies, and the culture and structure of the institutions?

(RQ16): Defined as socially constructed and negotiated, how is technology used to develop realistic accounts that are context-rich, capturing conflicts and politics that underpin the design, use, challenges and possibilities of technology in and across the multiple contexts of adult lives?

(RQ17): It is recommended therefore that NRF fund a regular international conference for adult learning researchers that is deliberately cross-disciplinary, and that addresses each of the four strands identified by FoALR, and that in conceptualising such a conference, that consideration be given to related conferences in the field.

(RQ18): How can we conduct collaborative and participatory research with things and people involved/affected/impacted in recognition with the distributed nature of knowledge and human agency with given opportunities and supportive conditions?

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Appendix 3-A: Examples of how advanced technologies can be leveraged for innovative learning

The following are indicative examples of how the advanced technologies of AI, education data mining, learning analytics and extended reality can be leveraged to enable potential innovative transformation of learning.

Example 1: Use of educational data mining and learning analytics as feedback to enhance deep learning

The field of multimodal analytics to expand learner modelling beyond explicit student answers, by measuring non-verbal signals as well as environmental information, is leveraging hardware advances in sensors, development of algorithms to process massive amounts of data, and blending multiple data streams from sensors, recording devices and digital learning environments. Chua, Dauwels and Tan (2019) reported how a multi-modal automated monitoring system was developed to study co-located collaborative learning. With the advancement of technologies comes the need for new methodological approaches and new analytical techniques that advance research in the sub-field of innovative technologies for adult learning. For instance, Lee and Tan (2017a, b) developed network analysis techniques to examine students' ideas in online forums and identify ideas that are promising to the ongoing discussion. Additionally, analytical processes, such as predictive learning analytics, can be used for different purposes, enabled by technological advances, such as in identifying and measuring patterns in learning data and extrapolating future behaviours. It empowers adult learners as they progress through online training, and allows them to be self-regulated in order to solidify their learning and develop positive habits that will carry over into their daily work tasks.

Example 2: Nudged situational learning

The use of ICT to optimise self-directed learning by connecting like-context (like-minded, like-aged and co-located) people together in their learning:

The future of adult learning will need to cater to a diverse cohort of individuals distributed over a wide spectrum of ages, abilities, languages and contexts. In common, they will all need to seek upskilling and meaningful, deliberate experiences to enrich their technical and/or soft skills. They will not likely be sitting in the classroom, or report back to a tertiary physical institution to continue their learning journey.

AI and the centralisation of data collection through the ubiquity of mobile apps offer a key service provision as a platform for monitoring and facilitating learning experiences. We take inspiration from other areas where casual, temporally spaced facilitation has been key, such as in meditation (e.g. Calm, Headspace) and transportation (e.g. Uber, Grab). Through collaborative filtering and user modelling, AI can help connect like-context (like-minded, like-aged and co-located) cohorts of individuals, injected with suitable diversity requirements, together in their learning. Specific areas to be explored include:

- What social groupings (if any) aid adult learning?

- What nudging or concentration techniques facilitate learning?
- What user-provided data needs to be gathered to complement data already being collected?
- What skills and courses provide a clear and meaningful pathway for adult learners?
- What AI techniques can provide useful recommendations and better modelling of such learners?
- How can AI techniques recommend groupings (peers, teacher-student) that end with meaningful, long-term experiences between individuals (digital kinship, social engineering).

For adult learners, time management and the fragmentation of responsibilities over the day imply that contextually aware nudging can help strategise and provide timely reminders for adults to continue to invest in their reskilling efforts.

Example 3: Enhancing career advancement and employability with AI

Actively learning to reskill. How can AI assist an individual to actively learn to reskill himself/herself based on the individual's interest, passion, time and schedule; the match of the individual's capability to the course's pre-requisites (without overwhelming him/her); the individual's needs to succeed in getting his/her dream job; the effectiveness of the course (and course instructors) to the individual's future career and job prospects; the cost and availability of the courses; future trends in workforce demands/needs; among others? The key is minimum effort, maximum gain. When AI recommends a course or article/book to read, can it better inform and explain to an individual of its impact on their future career and job prospects (e.g. expected salary, prospective companies, success stories) locally and internationally?

Trends drive the power of masses. How can AI learn to automatically identify future trends in the local and international workforce demands/needs as well as growing interests of the masses to recommend the formation of self-sustaining, self-help communities of educators and learners? The key here is not to allow AI to replace, but rather to augment possibilities; the human touch is important for learners.

Example 4: Extended reality for adult learners

Extended reality (XR) is the umbrella term for virtual, augmented and mixed reality, encompassing the spectrum of real and virtual environments. The benefits are through the creation of situated learning experiences via simulation, and the development of visualisations or virtual worlds for experiential and embodied learning that would otherwise not exist. This is an example where debriefing capabilities of the facilitators are critical; such capabilities that are needed for effective use of the technology for learning should not be assumed, but built into research design. A similar approach is required, whatever the technology — e.g. XR.

XR overcomes the limits of dangerous environments, physical inaccessibility, time and history, and ethical situations; e.g., simulating chemical plant processes, flying through the solar system, a historical period or a simulating medical procedure on a virtual patient.

A unified XR platform that enables quick implementation of different learning methods and applications is not yet available and the pedagogy of how such technology is best applied to optimise re-skilling/up-skilling is not well understood.

Example 5: Curation and adaptation of learning resources

There is now a plethora of learning resources in the wild, and efforts have been made to collect and curate these resources manually, codifying them against learning standards (Nesbit et al., 2002). Currently, curriculum developers need to manually curate and adapt learning resources for use within a local context. Recent advances will enable personalised and adaptive integration of learning resources. Current machine learning techniques can retrieve appropriate materials relevant to the learner's stated learning goal — both multimodal lecture context and appropriate assessments. Subsequently, these materials can be adapted through recent advances on deep generative techniques and customised for specific learners. This focus on individual learners and its impact on the depth of learning, the processes of learning, the ability to use what has been 'learnt', and much more, needs to be researched to avoid the trap of the technology being primary and the learners and learning assumed to be solely individual and largely a matter of acquisition, rather than as social and integral to context.

Research that uses such techniques and technologies has potential to capture and understand learners' *experience* of technologies and use of technologies for learning. Rethinking research design to encompass greater complexity would provide built-in feedback cycles for designers, researchers, educators, institutions and other users. For example, claims that adults value course designs containing options, personalisation, self-direction, variety and a learning community (see e.g., Ausburn, 2004) are not uncommon. Digging deeper to understand learners' strategies for learning, their motivations, their metacognitive development and how and why they use technologies for different purpose, their experience of the use and applications of big data, learning analytics etc would provide important empirical-based understanding that could inform the design of learning and various platforms and technologies. It is always important to consider new understandings not as finite or definitive, but as having a temporal dimension and as emergent.