

## Smart Partnerships to Increase Equity in Education

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### ABSTRACT

This exploratory analysis of smart partnerships identifies the risk of increasing the digital divide with the deployment of data analytics. Smart partnerships in education appear to include a process of evolution into a synergy of strategic and holistic approaches that enhance the quality of education with digital technologies, harnessing ICT “smartly” both in relation to learning and support of the partnership itself. To guide strategic development as data analytics start to emerge in the schooling sector, two cases of large multi-stakeholder partnership initiatives aiming to increase access to education with ICT nationwide in India and Malaysia are analyzed. Mapping the partners’ collaborative activities in Davis’ Arena of change with digital technologies enabled the identification of both local and global influences in that ecological framework, which inform the choice of partners and their roles to increase equitable access to education. Research and development is recommended so that multi-stakeholder partnerships leverage data analytics alongside technology enhanced learning in the schooling sector with strategies that proactively increase equity.

### Keywords

Smart partnerships, Multi-stakeholder partnerships, Digital equity, Technology enhanced learning

### Introduction

Developments in learning technologies are enabling researchers to envision “smart” learning environments that supplement the role of teachers and learners using data analytics and other tools to enhance learning and administrative processes as they happen (Kinshuk, Chen, Cheng & Chew, 2016). Smart multi-stakeholder partnerships will be necessary to leverage these technological tools effectively as many schools and related educational agencies do not have the required expertise or infrastructure. However, the notion of a smart partnership is emergent and there is very little research to draw upon. We therefore present an exploratory analysis of the evidence to date, both in relation to literature and our own case studies, in order to identify areas for future research and development. The main goal of this paper is to define, illustrate and discuss Smart Partnerships in education, a theme that was assigned to thematic working group 1 for the 2015 EDUsumMIT (see <http://www.curtin.edu.au/edusummit/>).

### The foundations of smart partnerships

While the concept of “smart partnerships” in education is still emergent, there is growing interest in “smartness,” generally associated with the use of technology, and particularly the collection and analyses of data, to improve aspects of day-to-day life. We now consider a selection of the literatures on “smart” and partnerships pertinent to the development of schooling and digital technologies in education in order to conceptualize and define smart partnerships in education.

### The increasing focus on “smartness”

The term “smart” suggests innovative and transformative changes driven by new technologies. It brings up notions of data-driven decisions and technology-enabled data-sharing, plus communications and collaboration, all leading to continuous improvement (Kitchin, 2016). Currently, smart cities are of great interest globally with the common aim to use ICTs to transform systems and services, so that the quality of life and work is improved (e.g., Albino, Berardi

& Dangelico, 2015; Kitchin, 2016). As such, the concept of smart cities is not limited to the diffusion of technologies, but also focuses on people and community needs. Smart cities are presented as large organic systems that connect various sub-systems including for example, transportation, energy, education, health care and buildings (e.g., Dirks & Keeling, 2009; Kanter & Litow, 2009).

Through reviews of the literature, various scholars have attempted to identify the core components or dimensions of a smart city. We focus here on a useful categorization of a smart city as three interconnected categories (Nam & Pardo, 2011; Meijer & Rodríguez Bolívar, 2015). *Technology* is a key attribute of a smart city and central to all definitions through an expectation that data-driven, networked technologies can be used to reconfigure aspects of daily life. This is argued to make smart cities more interconnected and efficient through the use of technology to engage in complex analytics, modelling, optimization and visualization (Harrison et al., 2010; Washburn et al., 2009; Meijer & Rodríguez Bolívar, 2015). The second critical factor in smart cities is its *people* and how they interact – i.e., “smart people” can be an important component in smart cities. This factor comprises a range of aspects including “lifelong learning, social and ethnic plurality, flexibility, creativity, cosmopolitanism, open-mindedness, and participation in public life” (Nam & Pardo, 2011, p. 287). Creativity is recognized as a key driver of the smart city and thus, education, learning and knowledge have central roles to play (Nam & Pardo, 2011; Thuzar, 2011). Finally a “*smart community*” is also recognized as critical, emphasizing the need for members and institutions to work in partnership to transform their environment (Berardi, 2013). Thus, collaboration is central and the involvement of all stakeholders, including the citizens of the city, is essential (Meijer & Rodríguez Bolívar, 2015). It also highlights that the strong support of key leaders is fundamental for success.

In some countries schools that make substantial use of technology to improve teaching, learning, management and administration have been described as “smart schools.” In Malaysia for example, the concept of smart schools has been utilized for around 20 years and is central to current education policy. The smart school term denotes “a learning institution that has been systematically reinvented in terms of teaching/learning practices and school management in order to prepare children for the Information Age” (Choi, Lee & Lee, 2015, p. 344). Thus, as well as technology improving education, the young people will be equipped for the workplace and for contributing to society. In common with people being a critical factor in smart cities, Choi and colleagues (2015) argue that the most important elements of a smart school are the teachers and students.

Smart learning environments and smart classrooms use technology to tailor learning to the needs of individual students, providing immediate feedback and support (e.g., Kinshuk et al., 2016). More recently, with the increasing focus on big data, data analytics has been advocated as a means of empowering both teachers and learners to improve learning experiences and outcomes (Clow, 2013). Learning analytics systems record numerous details about learners’ online activities providing information about engagement and progress, as well as predictive modelling such as attainment and dropout/retention (Clow, 2013; Papamitsiou & Economides, 2014). Thus, learning analytics can facilitate meaningful feedback, timely interventions and data-driven decision making in teaching and learning. The use of learning analytics in online learning environments is set to become increasingly used in higher education, where it is currently more developed, and also in school contexts (Johnson, Adams Becker, Estrada, & Freeman, 2015; Johnson et al., 2016).

There are many issues, however, in the use of learning analytics in educational contexts (Clow, 2013; Papamitsiou & Economides, 2014). Educators may not find it easy to ask the right questions of the data or interpret the results. The complexity of such systems could act as a deterrent to uptake as could the need to change practices. There are also concerns about the ethical issues surrounding data collection from individuals at such scale and potential for surveillance (Slade & Prinsloo, 2013). Finally, its usefulness relies on the embedding of online learning into teaching and learning practices, which itself requires sufficient architecture.

Smartness can lead to improved services through timely feedback to inform decision-making and interventions. Therefore, through the engagement of technology, people and communities, smartness is data-driven with analytics available in real-time and requires collaboration of stakeholder groups or at least their representatives. Technologies are essential but the knowledge and creativity of individuals working with partners at multiple levels within and across institutions are equally important. This leads to consideration of the literature on partnerships in education.

## Partnerships in educational contexts

Partnerships in education can be summarized as “a mutually satisfying relationship, which typically involves the free sharing and exchange of knowledge and ideas to the benefit of [all] parties” (Falloon, 2015, p. 216). Partnerships should be viewed as a process rather than an event, concern relationships between both institutions and people, and are dynamic (constantly evolving) (Grobe, 1990). Grobe (1990) suggests that levels of involvement can vary from *support* (e.g., one-directional provision of resources) to *co-operation* (greater levels of participation with shared decision-making and short-term goals) and ultimately *collaboration* (greater levels of commitment and involvement, complex, with longer-term goals).

Although the literature has been drawn together over decades, it mainly relates to partnerships such as those between schools and parents, or those partnerships across and between educational organizations. While this body of literature provides useful information about the impact and range of activities the partnership supports, evidence about their functioning and success factors is limited. Instead we turn to literature on public-private partnerships and multi-stakeholder partnerships in education with a view to identifying the enabling factors/success indicators of partnerships, including those involving ICT in education initiatives. Partnerships that bring together a range of stakeholders are frequently advocated as a way of improving or expanding education (Draxler, 2008; Sarvi, Balaji & Pillay, 2015) as well as enhancing the capability and capacity of its members (Davies & Hentschke, 2006; Draxler, 2008). Such partnerships pool knowledge and expertise can provide additional funding and/or other resources, share responsibility and risk, and generally focus on solving large-scale, complex problems in response to needs (Davies & Hentschke, 2006; Draxler, 2008; LaRocque & Lee, 2011).

Public-private partnerships (PPP) are generally understood as joint government and industry initiatives whereas multi-stakeholder partnerships generally refer to partnerships that bring together a wider range of public, private and civil society stakeholders. In education, they are seen as a way of obtaining greater involvement of the private sector, improving and strengthening education systems by making education relevant for the economy, developing programs targeted to specific groups, and improving infrastructure (Draxler, 2008; Education International, 2009). For example, as cited in Pillay and Hearn (2009), the experience of the Organisation for Economic Co-operation and Development shows that PPPs can play a vital role in mobilizing the scale of resources required for developing ICT infrastructure, applications and locally relevant content, as well as developing the human capacity required for harnessing the full capacity of ICT (Ichiro & McNamara, 2003).

Such partnerships are not without their challenges. PPPs for example can weaken government control and activity, through a shift away from education as a public good towards the privatization of education with a subsequent loss of public accountability (Draxler, 2008; LaRocque & Lee, 2011). In addition, partnerships can face difficulties due to the complexity of underlying contracts between partners and insufficient capacity in the non-state sector (LaRocque & Lee, 2011). Moreover, despite intentions to improve equitable access to education, partnerships targeted with improving educational services can decrease equity (Patrinos, Barrera-Osorio & Guáqueta, 2009). For various reasons, there may also be resistance from some stakeholders (Patrinos et al., 2009).

Although the research evidence of the impact of PPPs and multi-stakeholder partnerships in education is limited, some success indicators were identified:

- The involvement of a broad set of stakeholders including the local community (Cassidy, 2007; Geldof, Grimshaw, Klein, & Unwin, 2011)
- Clear and shared aims and objectives (Cassidy, 2007; Draxler, 2008; Geldof et al., 2011; Falloon, 2015; Sarvi et al., 2015)
- Appropriate risk allocation and risk sharing (Osei-Kyei & Chan, 2015)
- Strong commitment from high-level leadership (Ministries of Education, companies) to ensure buy-in from all participants (Grobe, 1990; Osei-Kyei & Chan, 2015; Sarvi et al., 2015)
- Effective and open communication mechanisms (Grobe, 1990; Osei-Kyei & Chan, 2015)
- Shared decision-making and ownership (Grobe, 1990; Draxler, 2008)
- A clear finance plan (Sarvi et al., 2015)

- Effective management through change management strategies, strong regulation, joint accountability, monitoring and evaluation (Cassidy, 2007; Grobe, 1990; Draxler, 2008; Falloon, 2015; Osei-Kyei & Chan, 2015)
- Commitment to capability and capacity building (Cassidy, 2007)
- Mechanisms for sustainability (Draxler, 2008; Geldof et al., 2011)

Thus, success of partnerships depends on the effect of their actions on education, improved teaching and learning, better infrastructure and management of education systems, greater participation and engagement by the community and broader commitment by all sectors of society to enhancing education quality. It also depends on partnership size which affects sustainability and resilience. For example, Eickelmann (2011) found that schools sustaining innovative practice with ICT continued to engage with more partners whereas schools that had become less innovative had dropped partners. However, the relative importance of critical success factors can vary from country to country (Chou & Pramudawardhani, 2015) and, by implication, some factors may be unique to a specific context.

Drawing together the selected literature reviewed above, we argue that Smart Partnerships in education involve the use of technology to facilitate and support the partnership but also have a focus on improving teaching and learning through smart schooling. Smartness leads to improvement, in our case in learning, through data-driven decision-making support systems that increase efficiency in the day-to-day management of teaching and learning.

## **Towards a definition of Smart Partnerships**

In addition to an ongoing review of relevant literature, the conceptual development of Smart Partnerships the work for this paper entailed interconnected stages, forming a spiral of activities leading towards the development of a definition of smart partnerships.

In the year preceding the 2015 EDUSumMIT, potential smart partnerships were identified and explored by members of the working group. Some were initially described in a report produced to support UNESCO Institute for Statistics (Twining, et al., 2015). The illustrations were purposefully developed to be wide ranging, including provision for learners, teachers, administrators, service providers, agencies in both school based and out of school provision. Initial analyses suggested that Smart Partnerships include the following key characteristics:

- Synergetic complementary contributions from partners, with clearly defined roles and responsibilities
- A vision that embraces a shared understanding across partners of how educational change can be brought forward by the partnership and is future focused
- Alignment between the defined goals and the paths undertaken to reach them
- Metrics that are used by the partners to keep the initiative on track and build sustainability
- Resilience so that the partnership is sustained
- Technology access is improved for equitable purposes, including reduction of the digital divide.

At the 2015 EDUSumMIT thematic working group 1 (TWG1) discussed these characteristics. Discussion centered on issues such as the stakeholders involved in partnerships, ways to ensure the participation of all stakeholders, the tension in developing a shared vision, trust and respect across and between partners, the need to address scalability and to ensure sustainability, and how to apply ICT “smartly.”

To deepen understanding of smart partnerships, three illustrations were selected for further analyses each of which was identified as having many or all of characteristics of a Smart Partnership. While the sampling approach was convenient, the illustrations were also selected to be as different from each other as possible. *Integrated ICT in schools and communities in rural and remote regions*, in India, is large-scale, organic approach with evidence of sustained growth addressing needs of underserved children and youth. The *MARA SmartEdu Partnership*, in Malaysia, is linked with the Government’s vision of smart schools that adopts a largely top-down approach. *OpeningupSlovenia’s* multi-stakeholder partnership takes the form of intersecting projects among which there is analysis of big data (Urbančič & Orlič, 2016).

Davis’ (in press) *Arena* is an ecological framework can enable perception of influences from the local to the global scale. This ecological perspective has assisted the development of inclusive worldviews that promote more equitable

approaches to education, supporting UNESCO’s work and recommendations that began with the World Summit on the Information Society (ITU, 2015). This framework, conceptualized as an Arena of Change with Digital Technologies in Education (see Figure 1), was deployed to inform the updating of UNESCO’s global survey of ICT infrastructure schooling (Twining et al., 2015). The Arena of Change with Digital Technologies in Education (Davis, in press) was used as a tool to critically analyze each of the illustrations and it helped to clarify the interaction between global and local educational ecologies on four main axes: political, bureaucratic, professional, and commercial (including community and open educational resources).

An Arena map of each illustration was constructed (Figures 2-4) to identify the partners and organizations involved and the range in which they operate, and also to clarify the interaction between global and local educational ecologies on the four main axes. The mapping process was useful for identifying the remit of partners in the partnership, as well as demonstrating the synergistic relationships across partners. A large number of overlapping and nested ecologies indicated complex local, regional and global interactions.

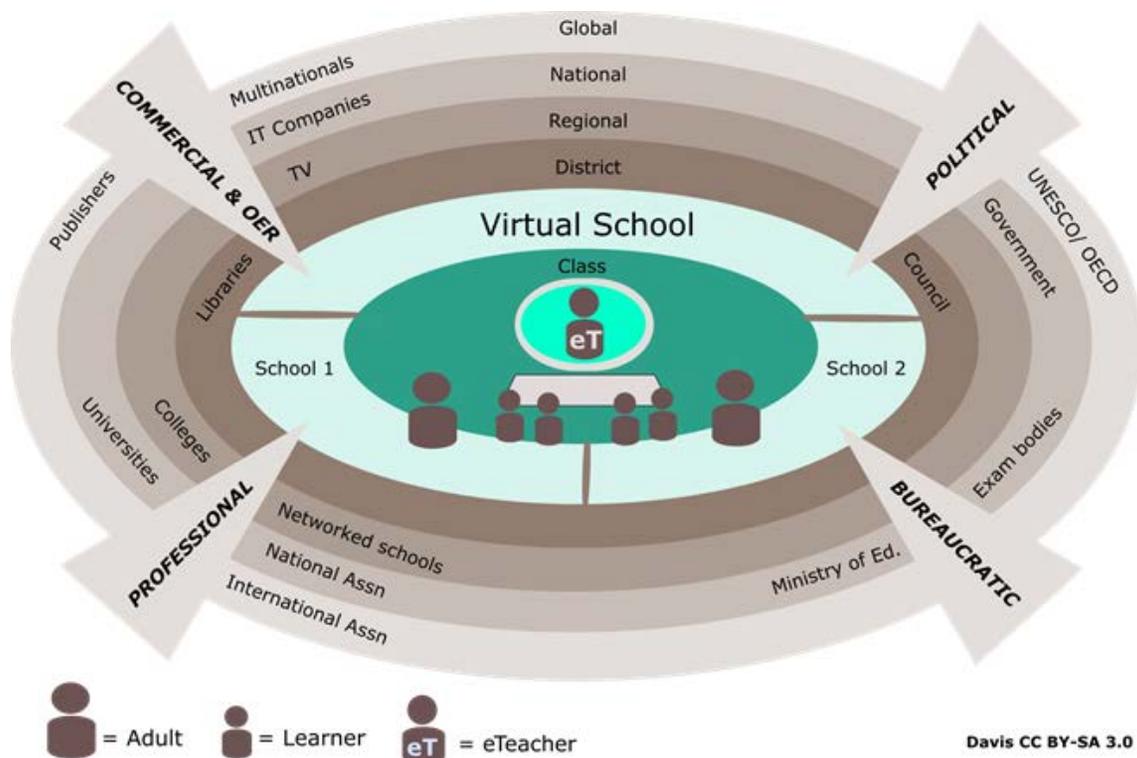


Figure 1. The global arena of change with ICT in schooling (Twining et al., 2015, p. 6)

Revisiting the literature after the mapping exercise enabled TWG1 to identify seven characteristics of Smart Partnerships which were subsequently refined to form a definition. Each illustration was analyzed for evidence of these seven characteristics to establish whether or not, each could be considered a smart partnership. Preliminary analyses demonstrated that only one could be described as a smart partnership. The illustrations and literature review were developed further after the EDUsummit.

### Characteristics of Smart Partnerships

Grounded in our work to date, we propose that Smart Partnerships in education have most or all of these seven characteristics:

- (1) Include partners within and across education (including teachers, their organizations, and researchers), government (of education, commerce & law enforcement etc.), industry, communities, and civil society (e.g., non-governmental organizations, NGOs).

- (2) Have a shared purpose (values, concept vision) that evolves into a synergy (more than a sum of the parts).
- (3) Have a strategic and holistic approach.
- (4) Enhance the quality of education with digital technologies (ICT).
- (5) Harness ICT smartly (e.g., evidence immediately deployed to improve performance).
- (6) Recognize their role in the emergent process(es).
- (7) Facilitate their own organizations to change.

While it is possible to have a smart partnership with a limited scope, a large initiative to enhance the quality of education with digital technologies (ICT) for a region is more likely to be sustained with a Smart Partnership that encompasses all seven characteristics listed above. It is also noted that a Smart Partnership may include one or more smaller Smart Partnership(s) within it. However, where few of characteristics are evident, the “smart” nature of the partnership is very limited.

## **Two illustrations of potential smart partnerships**

Two of the illustrations of potential smart partnerships are elaborated and discussed in this paper, both of which aim to promote equity; and each of which has been developed with one author as a key informant. The Slovenian illustration, OpeningupSlovenia, was considered to be at too early a stage to inform our current work and so, it was moved to the appendix.

### **India: Integrated ICT for underserved children and youth**

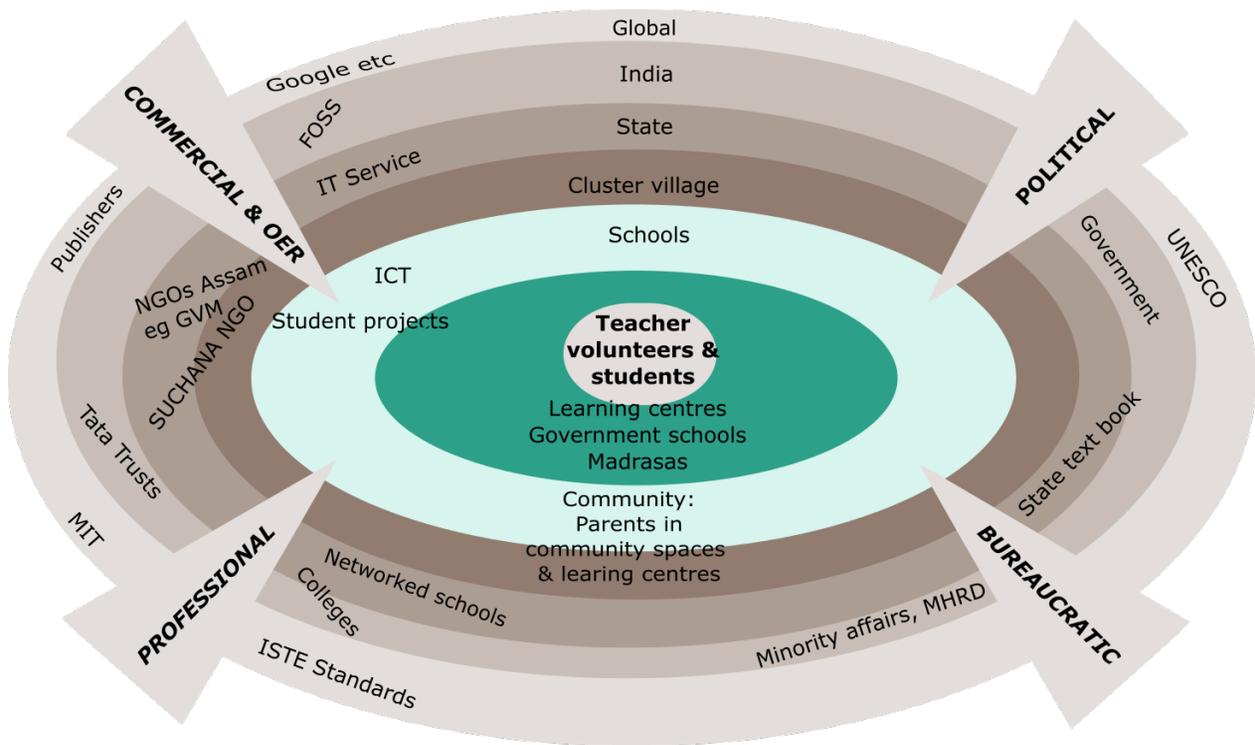
The Integrated approach to Technology in Education (ITE) is an initiative of the Tata Trusts in twelve mostly rural locations in Eastern and Northern India reaching over 17,000 underserved children by 2015 and continuing to grow. Initiated in 2012, the central concept of ITE is to integrate digital technologies into the curriculum and pedagogy of participating schools and learning centers (Charania, 2012-2014). Adopting a constructivist pedagogical framework, ITE seeks to improve teaching and learning, and foster authentic and project-based learning for young people in some of the most underprivileged Indian regions. The students, mostly first time computer users, create learning artifacts such as weather charts, jute production in India, or population density in different cities to deepen their learning of curriculum content. In this way, technology is embedded within curriculum design and pedagogy (Charania & Davis, 2016).

The Arena for the ITE smart partnership in India is depicted in Figure 2. At the center is a learning center for adolescents in a public school in which trained coordinators and teachers implement ITE. These are nested in clusters of villages at the district level in which parents, committees and their leaders are also central stakeholders for implementation. At the state level is the non-governmental organization (NGO) who hosts partnerships between district authorities and the Tata Trusts. In relation to global and local ecologies, the political axis includes the state party and national party while the bureaucratic axis identifies the provision of textbooks at the state level plus the Ministries of Education and Human Resource Development (MHRD) at the national level. UNESCO lies at the intersection of these axes. On the professional axis are Tata’s Institute of Social Sciences and the external evaluators of ITE at state level. At the global level are the Massachusetts Institute of Technology (MIT), International Society for Technology in Education (ISTE) standards, and interns from the University of California at Berkeley. The Tata Trusts are positioned at the intersection of the professional/commercial axes and the NGOs (e.g., Suchana NGO) at the commercial/political axes intersection. On the commercial (community/OER) axis some companies such as Google and the NIT (Next Infocommunications Technology) service provide tools and infrastructure used by students and teachers.

More detail of the development, including an analysis of Smart Partnership characteristics, is provided in Charania and Davis (2016) which identifies evidence of all characteristics authenticated through external evaluations (Myers & Zhao, 2013). Key points are provided below with numbers of the seven characteristics previously listed, indicating the characteristics identified:

- The scaling up of the partnership across four phases has involved many partners including NGOs, schools, communities and service agencies - even police in one community. (1)

- The visibility of students’ artifacts online facilitates dissemination across India, supporting others to adopt and adapt the approach to meet their learners’ needs. The digital artefacts smartly serve multiple purposes, even though analytics have yet to be deployed. (2, 3, 4, 5)
- The central role played by the Tata Trusts and their commitment is acknowledged as a strength. This enabled partners to scale their impact in collaboration with many other stakeholders who may become less peripheral in future as they facilitate their own organizations to change. This is likely to be most challenging for such influential stakeholders who have conflicting interests. (6, 7)



Davis CC BY-SA 3.0

Figure 2. Arena of the ITE initiative in India with learners in schools and madrasahs at the center

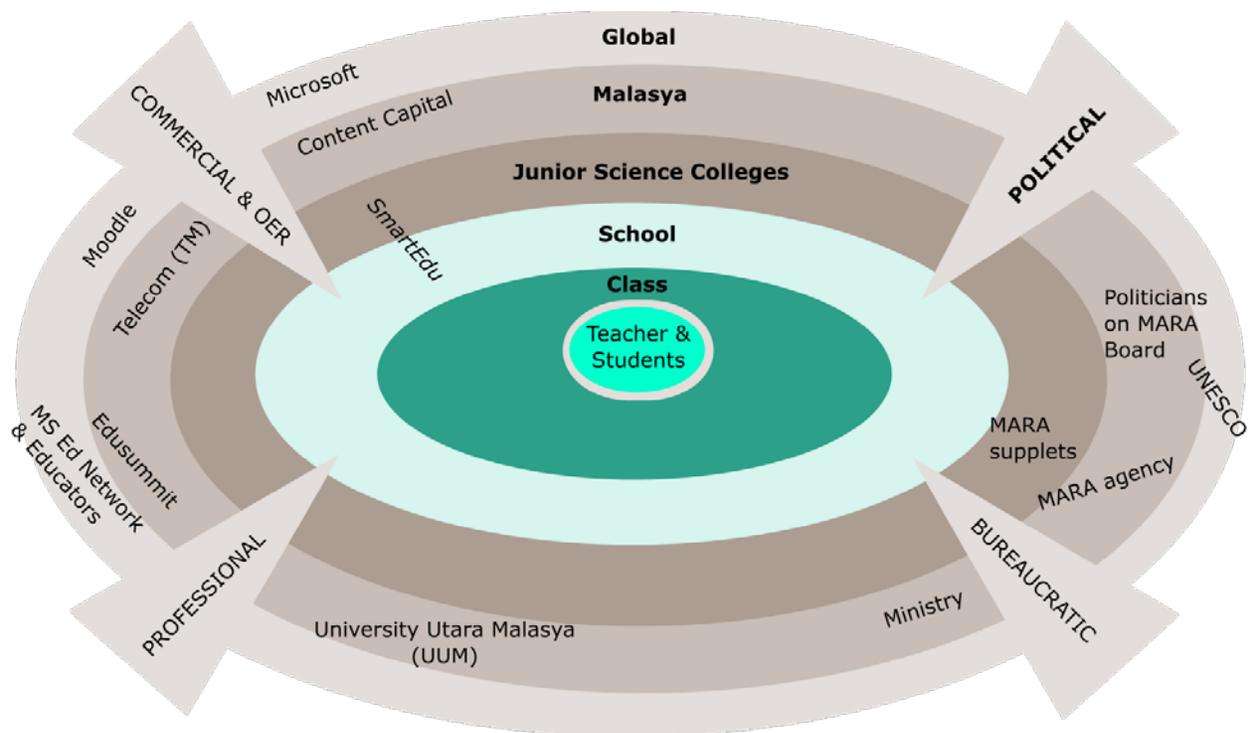
### Malaysia: MARA “Learning Powered by Technology”

The Malaysian education system is highly centralized with each school following the same curriculum, policies and teaching programs. Two different agencies manage schools: the Ministry of Education and the MARA agency (translated as Council of Trust for the People) under the Ministry of Rural and Regional Development. National policy in Malaysia articulates a vision to transform schooling, and reduce the digital divide between urban and rural students by providing quality Internet-enabled education to all schools throughout Malaysia (Ministry of Education Malaysia, 1998; 2012).

In 2014, 12 MARA Junior Science Colleges (similar to high schools) in rural areas were selected for an innovative approach to schooling called “Learning Powered by Technology”. As part of the initiative, all 12 colleges were provided with technology infrastructure for administration, learning and teaching including high speed wireless connectivity, architecture design; content repository and cloud computing through the nationwide online platform, SmartEdu (see Nordin & Davis, 2015). A program of professional development for two or three teachers from each college (“change ambassadors”) was implemented and coordinated by teacher educators at Universiti Utara Malaysia (UUM), primarily focusing on pedagogy and content. These change ambassadors subsequently had responsibility for professional development and supporting teachers’ use of the SmartEdu platform at their college. Each teacher involved created a course for their subject area, uploading learning materials, activities, quizzes and assignments

onto the SmartEdu platform. Representatives from each college showcased their school's outcomes at the MARA cation Summit in November 2015. Five participating teachers were subsequently selected as Microsoft Innovative Educator Experts.

The Arena for this potential Smart Partnership in Malaysia is presented in Figure 3, placing a teacher with class of students at the center. The interaction between global and local ecologies on the political axis are nodes with politicians who sit on the MARA governance board while the Ministry and MARA agency is positioned on bureaucratic axis. As with the previous illustration from India, UNESCO lies at the intersection of the political/bureaucratic axes. The Universiti Utara Malaysia as coordinator of the professional development program is placed on the professional axis. On the commercial axis is range of providers that support SmartEdu. Telecom (TM) provide the wireless network and Content Capital providing the learning platform are present at national level; Microsoft software (MS) is placed at the global level plus its MS Educator Network and Innovator Educator program.



Davis CC BY-SA 3.0

Figure 3. Arena of SmartEdu initiative in Malaysia centered on a school classroom with a teacher and her students

Analysis of the initiative using the characteristics of Smart Partnerships suggests that only the final characteristic was missing (#7 in the list of smart partnership characteristics). Key points are (followed by the number(s) of the characteristic(s) covered):

- Partners across government, education, business and industry are stakeholders in the initiative. (1)
- Partners designed and implemented the initiative which was underpinned by four clear and shared aims, including ICT and equity. These aims are operationalized through the provision of the online platform and centralized professional development. Each partner has a clearly defined role. (2, 3, 4, 6)
- The analytics linked with the digital learning platform, SmartEdu is not accessible to inform the partnership. However, like the ITE initiative, artifacts are emerging online to inform development. (5)

## **Discussion of smart partnership illustrations**

Of the two cases described, only one, the ITE initiative in India, can be recognized as a Smart Partnership with all seven characteristics. The characteristics are discussed below.

### **Smart Partnerships have partners within and across education government, industry, communities, and civil society**

As stated, each illustration has partners within and across education, government, industry, communities, and civil society. For ITE in India (Figure 2), the multi-stakeholder partnership evolved strategically and holistically over time as the intervention matured and mainstreamed in the public system. In the first year of the initiative when it was implemented across four learning centers the lead stakeholders were an NGO and the Tata Trusts (Charania & Davis, 2016). The initiative was scaled up in the second and third years of the program, increasing the number of the NGOs adopting the program from 1 to 18 and the number of young people participating from 1000 to 22000. Partnerships were also established with education departments in districts and their states that spread across India as interest grew in adopting the ITE program in public schools. This led to the Tata Trusts working with teachers, schools and district education authorities. Local communities comprising of parents, village committees and heads, and youth forums were also involved and continue to be important stakeholders for implementation on ground. Higher education and related professional networks are also key partners, forming global networks which have expanded over time. Partnerships have been established with U.S. Universities, whilst industry partners include Google and telecom providers. Involving a wide-range of stakeholders can improve educational outcomes (Draxler, 2008; Sarvi et al., 2015) and is a characteristic of a successful partnership that increases equity (Cassidy, 2007; Geldof et al., 2011).

In Malaysia, the SmartEdu initiative (Figure 3) comprises a partnership across government, education, business and industry. The Ministry of Education is the lead partner with overall responsibility with other partners providing the services and resources to the schools. Telecom (™) and Microsoft provide the technology facilities in the colleges while an e-learning company and a university provide the professional development. The participating schools are also active partners in that the “change ambassadors” and other teachers work together to implement the initiative on the ground with colleagues, students and parents. Commitment from a high-level leader such as a Ministry of Education has assisted buy-in from participants (Osei-Kyei & Chan, 2015).

These illustrations thus provide ample evidence of partnerships within and across education government, industry, communities, and civil society in each of the partnerships. They also highlight the complexity of the structure of these partnerships. Drawing on Grobe (1990), these partnerships are complex because they have multiple partners, often with multiple partners from each sector, and each partner has substantive responsibility within the initiative. There are also two or more levels of partnerships in each of the projects. It is also noticeable is that the structure of the partnerships continues to change. The ITE partnership in India for example, has continued to evolve as the partnership expands and matures and this results in complex dynamic structures.

### **Smart partnerships have a shared purpose that has evolved into a synergy with a strategic and holistic approach**

There is a shared purpose across partners in both initiatives as partners work towards a common goal. The purpose of the Indian initiative is articulated as a set of four key objectives and strategies which broadly relate to enhancing educational outcomes and bridging the digital divide among students in disadvantaged settings. These objectives and strategies are the key focus of initial workshops and events in which new partners participate. Similarly, the Malaysian initiative is grounded in a set of four broad aims which relate to enabling teachers to use digital technologies for learning and teaching in their subject areas. These aims are operationalized through the provision of the online platform and centralized program of professional development. In both, this approach has not only led to a shared purpose among the partners but also supports implementation and most importantly, preserves the integrity and objectives of the initiative. Moreover, partners within each of these initiatives fulfil a specific role or responsibility; complementing each other’s capabilities and resources (human and technical), thus making the partnership stronger through the sum of its parts. Sharing aims and objectives is one of the key characteristics of successful partnerships (Falloon, 2015; Sarvi et al., 2015).

## **Smart partnerships enhance the quality of education with digital technologies that harness the technology smartly**

Given that SmartEdu as part of the Learning Powered by Technology initiative was established in 2014, it is likely that it is too early for evidence of enhanced quality of education to emerge. Despite this, in Malaysia the emergence of a more creative student-centered approach in which both students and teachers use technology for learning and teaching has been noted by the selection of five teachers as Microsoft Innovation Experts.

There is evidence of enhanced quality of education that harnesses technology smartly from the ITE initiative in India. Prior to participating in the ITE initiative, most of the students had seen computers but did not use them at school, and teachers primarily enforced rote learning of content to pass school exams (Charania, 2015). Evaluation of the ITE program (Charania & Myers, 2014) highlights the main impacts as (i) improving student-teacher relationships, (ii) increased student interest in many subjects including languages, sciences and mathematics (iii) use of constructivist pedagogical processes and (iv) increased student confidence in using digital tools and the Internet. In addition, a “smart” use of ICT has evolved over time as ITE made more efficient use of digital tools to facilitate feedback (and feed forward to new partners). In ITE one of the most useful indicators to drive forward planning is the evaluation of projects created by students. Initial arrangements entailed the sharing of student work by CD and e-mail. This was followed by the creation of a blog through which student projects could be uploaded to the Internet and most recently, a website has been created for this purpose. The inclusion of a discussion forum on this website further extends the feedback process by enabling teachers to share experiences, challenges and best practices. These uses of ICT improve efficiency and support data-driven decisions (Kitchin, 2016) although there is no evidence to date of the adoption of data analytics. However, this does meet with the definition of a “smart school” being a systematic re-invention of teaching and learning practices (Choi et al., 2015).

## **In smart partnerships, partners recognize their role in the emergent process and facilitate their own organization to change in ways that promote sustainability and scalability**

There is no evidence to suggest that partners in the Malaysian initiative have facilitated their own organization to change in ways that may sustain and scale the Smart Partnership. However, participation in the ITE initiative has enabled some of the partners to facilitate change in their own organization. This was particularly evident in a district of Assam. Prior to joining the ITE initiative, the mission of the NGO working in Assam was sustainable resource management. Therefore on joining ITE, staff and volunteers at this NGO had a very limited range of educational strategies. Through adoption and implementation of ITE, they began to work firstly in a small number of adolescent learning centers in villages and later in 50 district schools. This led to implementation of ITE in the state model schools, with the NGO being the implementation organization. The NGO has thus evolved from a grassroots level organization in livelihood and child protection, to become a recognized education resource organization with the credentials to work with the state education department. This partnership between the Tata Trust and the NGO has become the largest scale implementation for ITE.

## **Conclusion and recommendation**

It is striking that our analyses of both illustrations provide evidence of the lack of adoption of data analytics in Smart Partnerships in education and in classroom contexts that are targeting disadvantaged young people, despite increasing adoption in school contexts (Johnson et al., 2016). Some “smart” uses of technology were observed in the most developed partnership (ITE) leading to increased efficiency and changing practices. We are pleased to note that, unlike the findings of Patrinos et al. (2009), there was no evidence of these partnerships increasing inequality or the digital divide; rather, they improved education equality and improved student access to technology through additional infrastructure.

This paper has elucidated the emergent concept of Smart Partnerships and provided a definition. Of the two illustrations discussed here, only one displays all seven characteristics. It is possible that the other example will evolve into a Smart Partnership and we believe that such evolution could increase its impact in education while addressing the digital divide. These illustrations may also prompt smart partnerships to emerge to serve children and youth in other parts of the world.

We conclude that further research into Smart Partnerships is essential to inform the development of scalable innovative funding mechanisms that are likely to secure the resources to unleash the full potential of digital technologies in education. It would be beneficial to conduct more in-depth research into the success factors underpinning the illustrations from India and Malaysia. In turn, findings should be used to refine the definition of Smart Partnerships proposed in this paper. Identifying further examples of full or emerging Smart Partnerships would further strengthen understanding in this field. Moreover, specific research is required to fully understand the role of data analytics in such partnerships and other smart uses of technology to maximize opportunities for data-driven decision making and further improvements to teaching and learning through real-time monitoring and feedback that do not increase the digital divide.

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## Appendix 1. Slovenia: OpeningupSlovenia

In Slovenia, OpeningupSlovenia (OuS) was established in 2014 as a way to promote learning and teaching through ICT and digital content, particularly Open Educational Resources (OER) and Open Technologies for Open Learning. The initiative is designed to provide a case study for the European Commission's policies on open education (European Commission, 2014). Supported by national policy (Republic of Slovenia, Ministry of Education, Science and Sport, 2014) and driven by research, this top-down/bottom-up initiative is a partnership of 15 institutions across all levels of the Slovenian education system i.e., schools, higher education, vocational education and training, lifelong learning institutions and companies (see OpeningupSlovenia <http://www.ouslovenia.net/>). As part of the initiative, partners work together to design and implement innovative cross-sectoral projects including the application of theory and cutting-edge technologies such as Artificial Intelligence and Big Data (Urbančič & Orlič, 2016). The projects are intended to create opportunities to innovate for organizations, teachers and learners to help participants acquire digital skills and develop new ways of learning as well as to support development and availability of OER and open data. By 2015, 27 projects were running, each with a different set of partners. Examples include:

- “My Machine” (<http://mymachine.si/>) in which children from kindergarten and primary schools design their dream machine, solutions are proposed by higher education students with the best ones selected by the children before a prototype is built by students in Technical Oriented Secondary Schools. In addition to schools partners include the Institut Jozef Stefan, Ljubljana and OS Savska naselje. The project is linked to the My Machine Global project (<http://www.mymachineglobal.org>).
- TraMOOC (<http://www.ouslovenia.net/project/tramooc/>) is a project, involving universities, research organisations and industry that started in 2015 to develop high-quality translation of all types of text included in MOOCs, such as assignments, tests, presentations, lecture subtitles, and blog text. MOOC resources are likely to be valuable to schools so they are users, rather than full partners. The online translation platform aims to provide translation between English and the languages of sixteen countries.
- A UNESCO Chair on Open Technologies for Open Educational Resources and Open Learning (<http://unesco.ijs.si/>) at the Institute in Ljubljana, Slovenia was established in 2015 to link these developments with the global network of OER chairs in other countries. The Chair has operated with existing EU FP7 research projects and new projects funded by the Government of Slovenia and European Commission.

The Arena for this potential Smart Partnership in Slovenia sketched in Figure 4 indicates the pivotal role of research projects involving students (S), teachers (T), researchers (R) and policymakers (P) who are placed at its center. In relation to the interaction between global and local ecologies, on the political axis the partners include research institutions together with UNESCO, the European Commission, and a federal agency in the USA, all of whom feed into policy adoption in Slovenia. The Slovenian Ministry of Education and the European Commission are identified on the bureaucratic axis. The professional axis includes selected partners who are currently involved in OuS that are fed research data by students and their teachers: Knowledge 4 All Foundation Ltd., Massachusetts Institute of Technology (MIT), Stanford, the European Organization for Nuclear Research (CERN), and 60 Artificial Intelligence labs. On the commercial/OER axis are research projects that are developing tools for use in Slovenian schools and other educational contexts. Open research methodologies are placed on the professional/OER intersection.

Analysis of OuS as a smart partnership reveals few of the characteristics of a smart partnership to be present. Although the initiative involves a range of partners across government, education and industry and is underpinned by a set of four broad objectives, it comprises of a number of projects which are essentially stand-alone units. In addition, although it is planned that some of the projects will make use of cutting-edge technologies for data analytics, there is of yet no evidence of this.

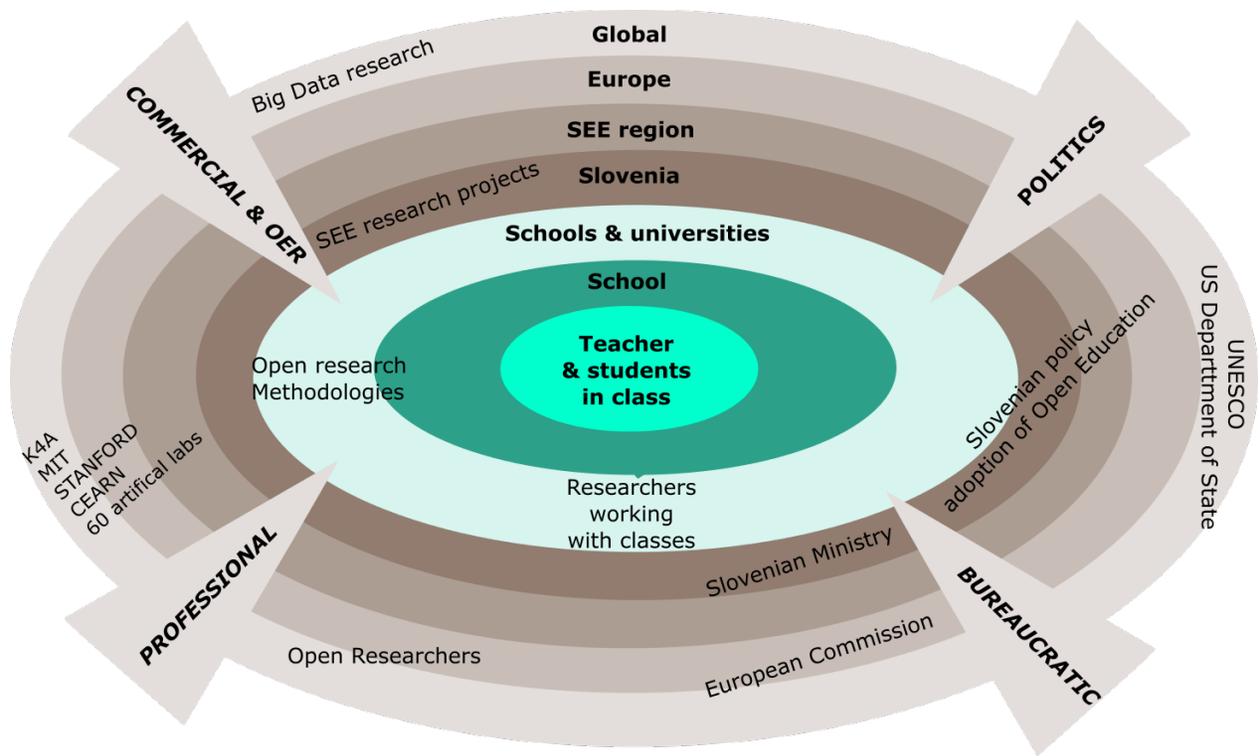


Figure 4. Arena map of OpeningupSlovenia and its partners with students and their teachers in school at the centre who are engaged with researchers

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