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**Informal learning with technology: Challenges, issues, and best practices**

**Discussion paper of Thematic Working Group (TWG) 2, EDUsummIT 2017**

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**Introduction**

There has been an interest in the relationship between informal and formal learning since a call to action was made at EDUsummIT 2009: ‘To better understand student technology experiences in informal learning environments, in order to inform learning in formal settings’. A TWG was formed in EDUsummIT 2011 with a focus of studying how mobile technologies connect the informal with the formal (Lai, Khaddage, & Knezek, 2013). The TWG continued its work in EDUsummIT 2013, and a framework with four categories: pedagogical, technological, policy and research challenges was developed to better understand the challenges and issues (Khaddage, Christensen, Lai, Knezek, Norris, & Soloway, 2015). The framework provided a structure for the discussions that took place at the 2015 EDUsummIT in Bangkok (Khaddage, Müller, & Flintoff, 2016). Using this framework, a number of solutions were identified including teacher professional development, increasing the focus on collaborative and self-directed learning approaches, and increasing funds to develop infrastructure. In the 2015 EDUsummIT, one of the main foci of discussions thus was the challenge of how to ensure that educational institutions recognize and accredit informal learning.

In the last three EDUsummITs, our discussion has moved beyond a focus on the technology to enabling learning to take place as and when required, seamlessly, without any constraints. However, it was noted that such learning has yet to be widely adopted in classrooms. In EDUsummIT 2017 the TWG will consider informal learning with technology in relation to the school ecosystem and in particular the best practices for bridging the formal with the informal (and non-formal).

Definitions of formal and informal learning are slippery and contested. We propose viewing all learning as having both informal and formal attributes. Even so, some forms of learning whilst being extremely valuable are not yet recognized by school systems. With potential benefits including learning across time and space, and engaging with a wide range of knowledgeable others, it is essential to develop a better understanding of the interrelationship between young people’s digital practices within and outside school.

**What does the literature say?**

**The potential of technology**

Technology, such as social media and mobile devices, offers many benefits for informal learning such as new and more immediate ways of accessing and creating knowledge, greater social interaction, engagement anytime and anywhere, and new modes of representation (Cox, 2013; Davies & Eynon, 2015; Erstad & Sefton-Green, 2013; Erstad, Kumpulainen, Mäkitalo, Schrøder, Pruulmann-Vegerfeldt & Jóhannsdóttir, 2016). Technology enables young people to engage in participatory and collaborative authentic knowledge production practices that are interest-driven (Ito et al., 2013; OECD, 2016). However, most young people only engage in passive interaction such as communicating with their friends and posting photographs in social networks (Barron, Martin, Takeuchi & Fithian, 2009; Clark, Logan, Luckin, Mee & Oliver, 2009; Ito et al., 2010).

Technology can disrupt the boundaries between types and sites of learning (Furlong & Davies, 2012; Greenhow & Lewin, 2016). Formal educational institutions are increasingly trying to harness the potential of technology for making connections to the different types of learning that take place (Furlong & Davies, 2012; Ito et al., 2013; Rajala, Kumpulainen, Hilppö, Paananen & Lipponen, 2016). This is often driven by political demands to improve outcomes and address issues such as student retention by making learning more engaging and relevant (Fallik, Rosenfeld & Eylon, 2013; Kumpulainen & Mikkola, 2016).

**Defining informal learning**

Knowles (1950) was the first researcher to introduce the term informal learning to the literature but he primarily focused on adult workplace learning. Since Knowles (1950), we see numerous definitions of informal learning, including:

* Laurillard’s (2009) defines informal learning in relation to young people as “… there is no teacher, no defined curriculum topic or concept, and no external assessment. The informal learner selects their own ‘teacher’, who may be a peer, or may not be a person; they define their own ‘curriculum, as what they are interested in learning about; and they choose whether to submit to ‘assessment’ by others” (p. 12).
* Similarly, Davis and Eynon (2015) suggest that informal learning is “what happens outside the structures and boundaries of formal education, the topic or focus of which is determined by the person doing the learning, on their own or with others” (p330). Although talking about adult learning, Rogers (2014) adds to this definition when he states that informal learning involves “the everyday experiences through which we learn a great deal without ever being conscious of ‘learning’” (p18).
* Barron (2006) sees informal and formal learning as a continuum of learning, she has an ecological perspectives. Formal and informal learning intersect and intertwine.
* Colley and her colleagues (2003) argue that all every kind of learning has elements of formality and informality. They conceptualise these attributes under four headings: purpose (intentional/unintentional), process (structure, pedagogy, support, assessment, etc.), location (including norms and structures such as timetables in educational institutions), content (high stakes knowledge to leisure interests).
* Radović & Passey (2016) conceptualise the differences between formal, non-formal and informal learning through consideration of learning activities (teacher-directed, club/interest group initiated, initiated by individual or others), learning support (teacher, club/society community, parent/family/friends) and learning setting (school, club/society venue, home).

As noted by many, there is a lack of consensus regarding the complex, slippery concepts of in/non-/formal learning (Colley, Hodkinson & Malcolm, 2003; Sefton-Green, 2004; Sefton-Green, 2013; Rogers, 2014; Werquin, 2010). One of the main issues in relation to conceptualizing informal learning is that it is difficult to define the boundaries between in/non/formal learning. This is particularly problematic given the potential of mobile technology to facilitate learning at anytime and anywhere as boundaries become even more difficult to discern. Khaddage, Müller and Flintoff (2016) argue that the difficulty of developing a shared understanding of informal learning is one barrier to the development of pedagogies that bridge different types of learning. We must be mindful of how other stakeholders view informal learning however. For example, students in higher education and their teachers broadly understand informal learning in the traditional way, as something not related to formal learning, although some teachers view informal and formal as intertwined (Lai & Smith, 2017a). More recently, some researchers have focused instead on sites of learning across space and time including in-school and out-of-school (Erstad, 2012; Rajala et al., 2016). This conceptualisation of ‘learning lives’ focuses on boundary crossings between different learning practices (Erstad, Gilje & Arnseth, 2013; Erstad et al., 2016).

In EDUsummIT 29017 we will explore this further to see whether we can develop a shared understanding of how to conceptualise in/non/formal learning.

**Connecting the informal to the formal through technology**

The benefits of connecting to informal learning practices in formal contexts include authenticity, greater engagement, opportunities to develop 21st century skills and the potential to enhance learning (Banks et al., 2007; Fallik et al., 2013; Hung, Lee & Kim, 2012; Ito et al., 2013; Lemke et al., 2015). Schools can draw on everyday knowledge and skills held by young people, their families and the wider community (Banks et al., 2007; Erstad et al., 2013; Kumpulainen & Mikkola, 2016). Policies are also being developed to formally recognise, validate and accredit the in/non-formal learning that occurs in the home, community and workplace (see Werquin, 2010; Yang, 2015). Non-formal learning such as after-school clubs can connect academic and everyday knowledge, enabling students to focus on interest-driven activities with more flexibility and without high-stakes testing but still benefiting academic learning (Deng, Connelly & Lau, 2016; NRC, 2015). However, non-formal learning opportunities are not commonplace for students although its academic value is recognised by teachers (Birdwell, Scott & Koninckx, 2015).

Technology has created new possibilities for connecting learning across sites, connecting people with shared interests, and for integrating informal and formal learning practices (Laru & Järvelä, 2015). Everyday digital practices include social media, gaming, mobile technologies, engaging in online communities and digital making, all of which could be utilised to support teacher-initiated learning activities (Erstad et al., 2013; Sørensen, Danielsen & Nielsen, 2007). Although social media in education has been a research focus for some time (Crook, 2012; Selwyn, 2007), classroom use remains low partly because young people have not been equipped with the skills required to effectively use it to support formal learning (Clark et al., 2009; Dabbagh & Kitsantas, 2012; Mao, 2014). Similarly, it is argued that learning from gaming requires teacher support and scaffolding (Kluge, 2016). Mobile technologies can support ‘seamless learning’ (Chan et al., 2006) across different contexts with varying degrees of support from self-direction to teacher guidance (Sharples, 2015; Wong, 2013). In practice, young people make limited use of mobile technologies to engage in self-directed learning activities that support school learning without teacher guidance (Boticki, Baksa, Seow and Looi, 2015). The common theme here is that teacher support is critical and that teachers need to develop pedagogical knowledge about connecting formal and informal learning. This remains a significant pedagogical challenge despite growing interest from policy makers and practitioners (Khaddage et al., 2016; Lai, Khaddage & Knezek, 2013; Rajala et al., 2016). Yet it is important to address it given the continuing growth in young people’s digital practices and increased opportunities for informal learning that technology offers, and that generic digital tools do not usually provide pedagogical support (Laru & Jarvela, 2015).

**Rationale for continuing to develop our understanding of informal learning through technology**

Due to the rapid uptake of technology in many societies and the developing digital youth culture, there has been greater interest from policy makers, educators and academics in connecting formal and informal learning (Erstad & Sefton-Green, 2013; Sefton-Green & Erstad, 2016). For example, UNESCO, OECD and many individual countries have developed policies relating to the recognition and validation of informal learning in relation to lifelong learning and adulthood. Many developing countries are exploring ways of reaching rural communities through mobile technologies and outreach work. Non-formal schooling (eg afterschool clubs) is a major part of the education ecosystem in many countries. There has been much recent interest in supporting learning across contexts at school level and thus funding has been targeted at educational research to contribute to knowledge in this area (e.g., H2020 at EU level). As digital technologies become more ubiquitous is it becoming increasing important to investigate how they can be used to bridge formal and informal learning.

**Exemplars of innovative practices**

Kumpalainen and Mikkola (2016) describe hybrid learning as bridging the intersection of academic (formal) and everyday (informal) funds of knowledge, including various different discourses, literacies and media practices, which they argue are often marginalised in school contexts. They also note that young people move between different sites of learning whilst “simultaneously engaging in academic learning activities” (p. 29). Finally, they suggest that tensions arise at intersection of the academic and everyday leading to both types of practices being challenged and reshaped.

To exemplify hybrid learning, Kumpulainen and Mikkola (2016) describe how primary-aged students in Finland engaged in a year-long project to develop the school musical. They focused on the script writing activity undertaken by students aged 11 and 12, small groups of whom took responsibility for separate segments. Provided with netbooks and tools for collaborative writing and synchronous communication (a chat channel), the majority of the work was undertaken outside lessons, with some taking place at the weekend. The students had greater flexibility with regards to when, where and with whom they worked. The chat channel enabled the young people to engage in informal discourse, whilst seeking help, evaluating each other’s contributions and providing feedback. This alternative online learning space enabled the students to engage in new collaborative literacy practices within and outside school.

Boticki et al (2015) developed a mobile learning platform for primary aged children enabling them to spontaneously capture media, comment and share. The system also enables students to receive prompts, either periodically or triggered by location, to scaffold learning. Shaped by ideas of seamless learning (Chan et al., 2006), the intention was that young people would use the technology for both teacher-directed and self-initiated activities that are potentially linked to school learning. The system was used mostly when directed by the teacher to do so; the authors conclude that most students had not yet reached the stage when they would self-initiate learning activities. To be successful, teachers need to provide pedagogical support and structure.

In another example of seamless learning, the Personal Inquiry project utilised mobile technology, including data-gathering equipment, and pedagogical scripting mediated through the technology to support science learning across multiple contexts (Jones et al, 2013; Sharples et al, 2014). Students participated in projects initiated through formal and non-formal contexts, gathering authentic data from science experiments conducted at home and outdoors. In these contexts, students used a range of mobile devices and digital resources and had greater autonomy (Jones et al., 2013).

At Utrecht University of Applied Sciences (Hogeschool Utrecht) a concept of designing education has been developed (van Bergen, Blauw, van den Bogaart, van de Kant & Zitter, 2016). One of the pillars in that concept is that learning is viewed as a social activity. Students gain knowledge on their own and put that knowledge to use in context with peers. Working in learning teams, they collaborate on assignments given by the teacher within a blended learning environment. In face-to-face sessions on campus they present their solutions and ask questions of their peers and the teacher. In this concept informal learning is a logical part of the whole process, even more so as learning teams are not limited to classmates, but through social media like Facebook and Twitter can have members from all over the world (or at least all over The Netherlands). The learning platform at the university offers easy access to those social media. There are thus no boundaries on formal learning, since students can involve informal learning as they please. In 2016, the secondary education trainee teachers at the University used the same concept for their pupils in the schools when they did their internship. In this way, formal and informal learning are integrated through technology. The same concept has also been used for training refugee teachers in Kakuma, although mutual connectivity and connectivity between teachers and students has been a challenge.

**Challenges**

There remain many challenges to pursuing the aim of connecting formal and informal learning in relation to pedagogy, technology, policy and research (Khaddage et al., 2016; Kumpulainen & Sefton-Green, 2014; Schuck, Kearney & Burden, 2016; Wong, Chai, Aw & King, 2015).

* Despite decades of debate, a lack of consensus over the definition and boundaries of formal and informal learning still exists, an issue which is exacerbated because the boundaries are blurry and complex. This is a major barrier to the development of bridging pedagogies (Khaddage et al., 2016).
* Many young people do not make sophisticated uses of technology beyond passive interaction such as communication and uploading photographs partly due to a lack of skills (Barron, Martin, Takeuchi & Fithian, 2009; Clark, Logan, Luckin, Mee & Oliver, 2009; Dabbagh & Kitsantas, 2012; Ito et al., 2010).
* Young people’s digital practices are shaped by context and may not readily transfer across sites (Crook, 2012).
* There has been limited uptake of the different approaches put forward to date despite strong interest by both policy makers and practitioners (Khaddage et al., 2016; Lai et al., 2013; Rajala et al., 2016).
* Students need to have ubiquitous access but in many countries either the infrastructure is not in place (Davis & Eynon, 2015) or smartphone use may be viewed as disruptive (Hsi, 2007; Merchant, 2012a).
* Structural constraints such as accountability, high-stakes testing, subject silos, a prescriptive curriculum and risk aversion affect the flexibility required to integrate informal learning with formal practices (Erstad & Sefton-Green, 2013; Ito et al., 2013; King, Kersch, Potter & Pitts, 2015; Adams Becker, Freeman, Giesinger Hall, Cummins & Yuhnke, 2016; Schuck et al., 2016).
* Teacher resistance to change (Chen & Bryor, 2012; Weigel, James & Gardner, 2009) and time constraints (Birdwell et al., 2015; Chen & Bryor, 2012).
* Some have voiced concerns about the pedagogisation of everyday life (Sefton-Green & Erstad, 2016) and student resistance to invasion of personal spaces (Weigel et al., 2009).
* There are relatively few models of good practice for bridging formal and in/non-formal learning (Merchant, 2012b).
* The understanding of the interrelationship between using technology in school for learning and using technology outside school for a wide range of learning activities remains limited (Cox, 2013; Hung et al., 2012). Researching informal learning as it happens is difficult (Khaddage et al., 2016).
* There is a danger that social divides in relation to technology provision, technology access and engagement, and family support, could be divisive and increase the gap between those who reach their full potential and those who do not.

**Key issues and questions**

We propose to focus on a number of questions in order to advance the field:

* What are the key pedagogical, research, and policy issues related to the bridging of formal and informal learning through technology?
* How can we ensure that harnessing technology-enhanced informal learning in school contexts is inclusive?
* How can we address moral and ethical issues related to blending formal and informal learning through technology?
* What are the implications of bridging formal and informal learning through technology for assessment practices?
* What support structures need to be in place to scale-up the integration of technology-enhanced informal learning in school contexts?
* In what ways can different stakeholders be mobilized to support informal learning with technology?

We have begun to discuss some aspects of the above questions, summarised below:

**Key pedagogical issues**

This depends on the position we view informal learning from. If viewed from the perspective of the teacher, then informal learning is viewed as potentially augmenting formal learning. If viewed from the perspective of the student, it could be viewed as an invasion of private space. We are however concerned with pedagogical issues and the teaching perspective because we are focused on education and how to inform educational policy makers and practitioners.

From a classroom teacher’s perspective, there will be many challenges in relation to incorporating informal learning. It will require pedagogical change and that suggests the need for professional development. What about teacher resistance to change? What kinds of support will students need to make sense of their informal learning in relation to the formal? How can informal knowledge be applied within the classroom? How can it be integrated or harnessed? What about divides in terms of access to technology, digital literacy and levels of engagement. These need to be accounted for in pedagogical strategies. However, a classroom teacher has oversight of what happens in the classroom but less influence over what happens outside the formal walls of school.

Four ways that teachers could encourage students to engage in informal learning to augment the formal (Lai & Smith, 2017b) are:

* Increase students’ interest in their formal course to trigger informal learning.
* Encourage student agency and become self-directed and independent learners who take responsibility for their learning.
* Emphasise the importance of informal learning, providing resources to foster it and/or teaching informal learning skills.
* Model how informal learning is done.

Three ways in which technology could be used to facilitate the integration of formal and informal learning are:

* Acting as a bridge to bring informal learning resources into the classroom (e.g. video conferencing with a community expert).
* Facilitating informal learning practices in the classroom (e.g., game-based learning, the use of social media).
* Enabling learning to take place across contexts - seamless learning (Chan et al., 2006).

A necessary step to enable the integration of informal learning in formal educational contexts is to ensure that teachers (both pre- and in-service) and their students develop digital competence. Digital competence is defined as “the ability to explore and face new technological situations in a flexible way, to analyse, select and critically evaluate data and information, to exploit technological potentials in order to represent and solve problems and build shared and collaborative knowledge, while fostering awareness of one’s personal responsibilities and respect of reciprocal rights/obligations” (Calvani, Fini et Ranieri, 2009, p.161). Those who claim that young people develop digital competence through their everyday digital practices ignore the existence of digital inequities that reinforce pre-existing inequities at the different levels of the social ecosystem in which learning and development of learners happen (Gorki, 2009). Developing digital competence within educational systems should help address questions posed by Cox (2013) in relation to informal learning: “Is the information acquired by the learner appropriate and reliable? Does the learner have the skills to discriminate between valuable resources and useful/misleading ones? Is the learner able to scaffold his or her learning experiences to be able to build a body of knowledge and profound understanding?” (p. 12).

**Key research issues**

In relation to research, how can we research bridging formal and informal learning through technology? Should we lock down the perspective we view this from? (a narrow pedagogical perspective or a wider one) or try to consider the issues from multiple points of view? What kinds of data do we need to better understand these issues and how can we get funding to do that? We suggest that we could work towards this by conducting ethnographic studies that collect observations and representations in different context of use of digital technologies. We also need studies that analyse the learning transfer across sites of learning.

**Key policy issues**

In relation to policy, what changes are needed to support bridging informal and formal learning? What needs to happen in relation to assessment policies? What needs to happen in terms of the continued emphasis in many countries on accountability and prescribed curricula? Policy changes have to take into account a holistic view of digital inequities and inequalities in education systems.

***Ensuring inclusivity***

Divides can occur through access to technology, different levels of digital literacy or digital competence (as discussed above) and also through levels of engagement. What can we do about students who have access to digital technology and digital literacy skills but chose not to engage in informal learning opportunities? This could widen the gap between students if informal learning in school is about extending learning beyond formal requirements and the curriculum. How can such students be motivated to engage in such informal activities? Alternatively, if links can be made between the formal curriculum and students personal interests then more engagement in formal learning could be triggered. Alternatively, adopting authentic learning projects can make teaching and learning more meaningful and interesting. For example, students in India while engaging with a social science chapter on water resources, actually study the water resources in their own village, make a video about it, measure water daily usage and keep a diary to analyze usage across families in a spreadsheet.

***Moral and ethical issues***

As well as issues of inclusion, some express concerns over the ‘pedagogisation of everyday life’ (Sefton-Green & Erstad, 2016). That is, if teachers try to draw on students’ informal learning practices it may be perceived as an invasion of personal and private spaces. From an alternative perspective, integrating the formal and informal could be seen as government colonisation or the control of schools/governments of domestic life through blurring boundaries between school and home (Stevenson, 2011).

***Implications for assessment practices***

On the one hand it could be argued that informal learning should not be assessed because by doing so it formalises the learning activity. Irrespective of this, there are cultural tensions in relation to high-stakes testing and the need for teachers to prioritise preparation for formal assessment in some countries which could act as a barrier to integrating informal learning activities with the formal. Assessment practices are also a particular issue. How can the classroom teacher identify and accredit informal learning? Given that formal learning could be considered as the tip of the iceberg why not recognise informal learning activities? Formal assessment leads to capital that has an exchange value (enables progression, to obtain employment etc). Why ignore the valuable skills and knowledge that are developed and acquired outside schools?

***How can we scale-up the integration of formal and informal learning through technology?***

Are we at too early a stage to consider this question? To move forward we need to clarify what we mean by technology-enhanced informal learning in school and where the boundary lies between the informal and the formal. If the boundary is entwined with assessment then the value of informal learning activities may not be recognised. In many cases, formal assessment drives activities and without it interventions may never be truly integrated. An alternative distinction could be who initiated the learning activity - if the teacher initiated it then it could be considered as formal and if the student initiated it (deliberately or unconsciously) then it could be considered as informal (although there will be some blurry overlap here). Both kinds of activity could feed into assessment if student understanding about a curriculum topic is enhanced. So how can teachers capitalise on what goes on outside school and particularly where technology is concerned. Here we see that we may not be able to address this question at the current time, as we return to basic issues relating to connecting informal and formal learning through technology.

***How can different stakeholders be mobilised to support informal learning?***

The issue is that many teachers and parents have little understanding of what informal learning (narrower or broader view) can do to the young people. Here, it is important to share exemplars and to provide professional development for teachers. But beyond teachers, how can we make different groups of people (families, friends, community members etc.) aware of the importance of informal learning? How can we make such groups aware of what they can do to support/augment formal studies?

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**References**

Adams Becker, S., Freeman, A., Giesinger Hall, C., Cummins, M., & Yuhnke, B. (2016). *NMC/CoSN Horizon Report: 2016 K-12 Edition*. Austin, Texas: The New Media Consortium.

Banks, J.A., Au, K.H., Ball, A.F., Bell, P., Gordon, E.W., Gutiérrez, K.D., & Zhou, M. (2007). *Learning in and out of school in diverse environments: Life-long, life-wide, life-deep.* Seattle: LIFE Center and Center for Multicultural Education (University of Washington).

Barron, B. (2006). Interest and self-sustained learning as catalysts of development: A learning ecology perspective. *Human Development, 49*(4), 193–224.

Barron, B., Martin, C. K., Takeuchi, L., & Fithian, R. (2009). Parents as learning partners in the development of technological fluency. *International Journal of Learning and Media, 1*, 55–77. doi:10.1162/ijlm.2009.0021

Birdwell, J., Scott, R. and Koninckx, D. (2015). *Non-formal learning could help to build character and close attainment gap: Learning by doing*. London: DEMOS.

Boticki, I., Baksa, J., Seow, P., & Looi, C. (2015). Usage of a mobile social learning platform with virtual badges in a primary school. *Computers & Education, 86*, 120-136. <http://dx.doi.org/10.1016/j.compedu.2015.02.015>

Calvani, A., Fini, A. et Ranieri, M. (2009). Assessing digital in secondary education. Issues, models and instruments. In M. Leaning, (Ed.), *Issues in information and media literacy: education, practice and pedagogy* (pp. 153-172). Santa Rosa, CA: Informing Science Press.

Chan, T-W., Roschelle, J., Hsi, S., Kinshuk, Sharples, M., Brown, T., Patton, C., Cherniavsky, J., Pea, R., Norris, C., Soloway, S., Balacheff, N., Scardamalia, M., Dillenbourg, P., Looi, C.K., Milrad, M., & Hoppe, U. (2006). One-to-One technology-enhanced learning: An opportunity for global research collaboration. *Research and Practice in Technology Enhanced Learning*, *1*(1), 3-29. doi:10.1142/S1793206806000032

Chen, B., & Bryer, T. (2012). Investigating Instructional Strategies for Using Social Media in Formal and Informal Learning. *The International Review of Research in Open and Distributed Learning, 13*(1): 87–104. http://dx.doi.org/10.19173/irrodl.v13i1.1027

Clark, W., Logan, K., Luckin, R., Mee, A., & Oliver, M. (2009). Beyond Web 2.0: Mapping the Technology Landscapes of Young Learners. *Journal of Computer Assisted Learning, 25*(1), 56–69. doi: 10.1111/j.1365-2729.2008.00305.x

Colley, H., Hodkinson, P., and Malcolm, J. (2003). *Informality and Formality in Learning: A Report for the Learning and Skills Research Centre*. London: LSRC.

Cox, M.J. (2013). Formal to informal learning with IT: research challenges and issues for e-learning. *Journal of Computer Assisted Learning, 29*(1), 1-21.

Crook, C. (2012). The ‘digital native’ in context: Tensions associated with importing Web 2.0 practices into the school setting. *Oxford Review of Education, 38*, 63–80. http://dx.doi.org/10.1080/03054985.2011.577946

Dabbagh, N., & Kitsantas A. (2012). Personal Learning Environments, Social Media, and Self-regulated Learning: A Natural Formula for Connecting Formal and Informal Learning. *Internet and Higher Education, 15*(1), 3–8. <http://dx.doi.org/10.1016/j.iheduc.2011.06.002>

Davies, C., and Eynon, R. (2013). Studies of the Internet in Learning and Education: Broadening the Disciplinary Landscape of Research. In W. H. Dutton (Ed.), *The Oxford Handbook of Internet Studies* (pp. 328-349). Oxford: Oxford University Press.

Deng, L., Connelly, J., & Lau, M. (2016). Interest-driven digital practices of secondary students: Cases of connected learning. *Learning, Culture and Social Interaction, 9*, 45-54. doi:10.1016/j.lcsi.2016.01.004

Erstad, O., Kumpulainen, K., Mäkitalo, Å. , Schrøder, K.C., Pruulmann-Vegerfeldt, P., & Jóhannsdóttir, T. (2016). Tracing learning experiences within and across contexts: A Nordic approach. In O. Erstad, K. Kumpulainen, Å. Mäkitalo, K.C. Schrøder, P. Pruulmann-Vegerfeldt & Jóhannsdóttir, T. (Eds.), *Learning across Contexts in the Knowledge Society* (pp. 1-14). Rotterdam/Boston/Taipei: Sense Publishers.

Erstad, O. (2012). The learning lives of digital youth – Beyond the formal and informal. *Oxford Review of Education, 38*, 25–43. http://dx.doi.org/10.1080/03054985.2011.577940

Erstad, O., Gilje, Ø., & Arnseth, H.C. (2013). Learning Lives Connected: Digital Youth across School and Community Spaces. *Comunicar, 40*, 89-98. http://dx.doi.org/10.3916/C40-2013-02-09

Erstad, O., & Sefton-Green, J. (2013). “Digital Disconnect? The ‘Digital Learner’ and the School” In O. Erstad and J. Sefton-Green (Eds.), *Identity, Community, and Learning Lives in the Digital Age* (pp. 87-104.) New York: Cambridge University Press.

Fallik, O., Rosenfeld, S., & Eylon, B. (2013). School and out-of-school science: a model for bridging the gap. *Studies in Science Education, 49*(1), 69–91. doi:10.1080/03057267.2013.822166.

Furlong, J., & Davies, C. (2012). Young people, new technologies and learning at home: Taking context seriously. *Oxford Review of Education, 38*, 45–62. <http://dx.doi.org/10.1080/03054985.2011.577944>

Gorski, P.C. (2009). Insisting on Digital Equity: Reframing the Dominant Discourse on Multicultural Education and Technology. *Urban Education, 44*(3), 348-364.

Greenhow, C. & Lewin, C. (2016). Social media and education: Reconceptualizing the boundaries of formal and informal learning. *Learning, Media and Technology, 41*(1), 6-30. doi: 10.1080/17439884.2015.1064954

Hsi, S. (2007). Conceptualizing Learning from the Everyday Activities of Digital Kids, *International Journal of Science Education, 29*(12), 1509-1529. doi:10.1080/09500690701494076

Hung, D., Lee, S. S., & Lim, K. Y. T. (2012). Authenticity in learning for the twenty first century: Bridging the formal and the informal. *Educational Technology Research & Development, 60*(6), 1071–1091.

Ito, M., S. Baumer, M. Bittanti, D. Boyd, R. Cody, B. Herr-Stephenson, H. Horst, et al. (2010). *Hanging Out, Messing Around, and Geeking Out: Kids, Living and Learning with New Media*. Cambridge, MA: MIT Press.

Ito, M., K. Gutierrez, S. Livingstone, B. Penuel, J. Rhodes, K. Salen, J. Schor, J. Sefton-Green, and S. Watkins. (2013). Connected Learning: An Agenda for Research and Design. Irvine, CA: Digital Media and Learning Research Hub.

Jones, A., Scanlon, E. & Clough, G. (2013). Mobile learning: Two case studies of supporting inquiry learning in informal and semiformal settings. *Computers & Education 61*, 21–32.

Khaddage, F., Christensen, R., Lai. K. W., Knezek, G., Norris, C., & Soloway, E. (2015). A model driven framework to address challenges in a mobile learning environment. *Education and Information Technologies, 20*(4), 625–640.

Khaddage, F., Müller, W., & Flintoff, K. (2016). Advancing Mobile Learning in Formal And Informal Settings via Mobile App Technology: Where to From Here, and How? *Educational Technology & Society, 19*(3), 16–26.

King, H. Kersh, N. Potter, J., & Pitts, S. (2015). Learner-led and boundary free: Learning across contexts. In J. Hohenstein & H. King (Eds.), Learning Beyond the Classroom (pp. 39-50). *British Journal of Educational Psychology*. Monograph Series II (11).

Kluge, A. (2016). I Am Connected, Therefore I Am: Polycontextual Bridging in Education. In E. Elstad (Ed.), *Educational Technology and Polycontextual Bridging* (pp.129-148). Rotterdam/Boston/Taipei: Sense Publishers

Knowles, M. S. (1950). *Informal Adult Education*. New York: Association Press.

Kumpulainen, K., & Mikkola, A. (2016). Toward Hybrid Learning: Educational Engagement and Learning in the Digital Age. In E. Elstad (Ed.), *Educational Technology and Polycontextual Bridging* (pp. 15-38). Rotterdam/Boston/Taipei: Sense Publishers.

Kumpulainen, K. & Sefton-Green, J. (2014). What is connected learning and how to research it? *International Journal of Learning and Media, 4*(2), 7-18.

Lai, K. W., Khaddage, F., & Knezek, G. (2013). Blending student technology experiences in formal and informal learning. *Journal of Computer Assisted Learning, 29*(5), 414–425. This is a TWG paper.

Lai, K. W. & Smith, L.A. (2017a). Tertiary students’ understandings and practices of informal learning: A New Zealand case study. *Australasian Journal of Educational Technology, 33*(2), 115-128.

Lai, K. W. & Smith, L.A. (2017b). *Relationship between informal and formal learning: University educators’ perceptions and roles.* Submitted for publication.

Laru, J. & Järvelä, S. (2015). Seamless Learning Despite Context. In L-H Wong, M. Specht & M. Milrad (Eds.), *Seamless Learning in the Age of Mobile Connectivity* (pp. 471-484). Singapore: Springer.

Laurillard, D. (2009). The pedagogical challenges to collaborative technologies. *International Journal of Computer-Supported Collaborative Learning, 4*(1), 5–20.

Lemke, J. L., Lecusay, R., Cole, M., & Michalchik, V. (2015). *Documenting and assessing learning in informal and media-rich environments.* Cambridge, MA: MIT Press.

Mao, J. (2014). Social Media for Learning: A Mixed Methods Study of High School Students” Technology Affordances and Perspectives. *Computers in Human Behavior, 33*, 213–223.

Merchant, G. (2012a). Mobile practices in everyday life: popular digital technologies and schooling revisited. *British Journal of Educational Technology, 43*(5), 770-782.

Merchant, G. (2012b). Unravelling the social network: theory and research. *Learning, Media and Technology, 37*(1), 4-19.

National Research Council (NRC) (2009). *Learning Science in Informal Environments: People, Places, and Pursuits.* Washington, DC: The National Academies Press.

National Research Council (NRC) (2015). *Identifying and Supporting Productive STEM Programs in Out-of-School Settings.* Washington, DC: The National Academies Press.

OECD (2016). *Trends Shaping Education 2016*. Paris: OECD Publishing. DOI: <http://dx.doi.org/10.1787/trends_edu-2016-en>

Radović, S. & Passey, D. (2016). Digital resource developments for mathematics education involving homework across formal, non-formal and informal settings. *The Curriculum Journal*. DOI: 10.1080/09585176.2016.1158726

Rajala, A., Kumpulainen, K., Hilppö, J., Paananen, A., & Lipponen, L. (2016). Connecting Learning across School and Out-of-School Contexts: A Review of Pedagogical Approaches. In O. Erstad, K. Kumpulainen, Å. Mäkitalo, K.C. Schrøder, P. Pruulmann-Vegerfeldt, & Jóhannsdóttir, T. (Eds.), *Learning across Contexts in the Knowledge Society* (pp. 15-38). Rotterdam/Boston/Taipei: Sense Publishers.

Rogers, A. (2014). *The Base of the Iceberg: Informal Learning and Its Impact on Formal and Non-formal Learning.* Opladen/Berlin/Toronto: Barbara Budrich Publishers.

Schuck, S., Kearney, M., & Burden, K. (2016): Exploring mobile learning in the Third Space. *Technology, Pedagogy and Education*, DOI: 10.1080/1475939X.2016.1230555

Sefton-Green, J. (2013). *Learning at Not-school: A Review of Study, Theory, and Advocacy for Education in non-Formal Settings*. Cambridge, MA: MIT Press.

Sefton-Green, J. (2004). *Report 7: Literature Review in Informal Learning with Technology Outside School*. Bristol, England: Futurelab.

Sefton-Green, J., & Erstad, O. (2016). Researching ‘learning lives’ – a new agenda for learning, media and technology. *Learning, Media and Technology*. Online first. Doi: http://dx.doi.org/10.1080/17439884.2016.1170034

Selwyn, N. (2007). Web 2.0 *Applications as Alternative Environments for Informal Learning – A Critical Review.* Paper presented at OECD-KERIS Expert Meeting, Chegu, South Korea, October 16–17. https://www1.oecd.org/edu/ceri/39458556.pdf.

Sharples, M. (2015). Seamless Learning Despite Context. In L.-H. Wong, M. Milrad, & M. Specht (Eds.), *Seamless learning in the age of mobile connectivity* (pp.41-55). Singapore: Springer.

Sharples, M., Scanlon, E., Ainsworth, S., Anastopoulou, S., Collins, T., Crook, C., Jones, A., Kerawalla, L., Littleton, K., Mulholland, P. & O’Malley, C. (2015). Personal Inquiry: Orchestrating Science Investigations Within and Beyond the Classroom. *Journal of the Learning Sciences, 24*(2), 308-341, DOI: 10.1080/10508406.2014.944642

Sørensen, B. H., Danielsen, O., & Nielsen, J. (2007). Children’s informal learning in the context of schools of the knowledge society. *Education and Information Technologies, 12*(1), 17–27.

van Bergen, H., Blauw, I., van den Bogaart, T., van de Kant, H. & Zitter, I. (2016). Education design: A didactic concept. The Netherlands: Utrecht University of Applied Sciences.

Weigel, M., James, C., & Gardner, H. (2009) Learning: Peering backward and looking forward in the digital era. *International Journal of Learning and Media, 1*(1), 1-18.

Werquin, P. (2010). *Recognising Non-Formal and Informal Learning: Outcomes, Policies and Practice*s. Paris, France: OECD publishing.

Wong, L.-H. (2013). Enculturating self-directed learners through a facilitated seamless learning process framework, *Technology, Pedagogy and Education, 22*(3), 319-338, DOI: 10.1080/1475939X.2013.778447

Wong, L.-H., Chai, C. S., Aw, G. P., & King, R. B. (2015). Enculturating Seamless Language Learning through Artifact Creation and Social Interaction Process. *Interactive Learning Environments, 23*(2), 130-157. DOI: 10.1080/10494820.2015.1016534.

Yang, J. (2015). *Recognition, Validation and Accreditation of Non-formal and Non-formal Learning in UNESCO Member States*. Hamburg: UNESCO Institute for Lifelong Learning.