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New Learning Opportunities in a Networked World: Developing a Research Agenda on Innovative uses of ICTs for Learning and Teaching

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Executive summary

The executive summary briefly describes outcomes of the activities carried out for the project "New Learning Opportunities in a Networked World: Developing a Research Agenda on Innovative uses of ICTs for Learning and Teaching".

The project

The *New Learning Opportunities in a Networked World: Developing a Research Agenda on Innovative uses of ICTs for Learning and Teaching* project seeks to develop a research agenda focused on new opportunities / directions of learning and teaching in an increasingly networked world, and how they can benefit people in developing countries (with an emphasis on people from Low Income Countries). This research agenda is aimed at studying how interconnected information and communication technologies (ICTs) can expand the reach of educational opportunities and improve learning outcomes (i.e., lead to more effective and efficient learning).

To this end a 2-stage project was being carried out by the Open University of the Netherlands and entailed: (1) establishing a southern-led research agenda, and (2) developing a project proposal for a follow-up project with a concomitant Call for Research Proposals. The general objective is to establish an empirically based and developmentally relevant research agenda on issues of new digital learning opportunities in developing countries (DCs) by:

1. identifying and prioritizing key development problems that new digital learning opportunities can address;
2. identifying key developing country exerts, researchers, and institutions in, Latin America, Caribbean, Sub-Saharan Africa, and Asia working on new digital learning opportunities; and
3. laying the groundwork for the development of a new research network on new digital learning opportunities in DCs.

The research consists of two main activities, namely desk research and an group concept mapping study involving a 2-day workshop and a follow-up with experts who could not attend the workshop. These activities are interconnected elements of the consultative approach to establishing a research agenda.

Desk research

Although the desk research was aimed at conducting a targeted (scoping) literature review on innovative uses of Information and Communication Technologies (ICTs) for education in developing countries, efforts were made to cover as many of the characteristics of systematic review as possible, namely: an explicit search strategy, comprehensive sources of information, criterion-based selection, specific research questions, critical appraisal and text mining (Travaglia, Braithwaite, & Debono, 2008).

A combined search in databases Academic Search Elite®, Psychology and Behavioral Sciences Collection®, ERIC®, PsycINFO® and PsycARTICLES® was conducted, applying the Boolean / Phrase "ICT AND developing countries AND education AND research" to select the articles. The search was expanded to allow for related words and requiring a search within the full text of the articles but limited to the period 2010-2014, available full text and peer-reviewed articles. The abstracts, and when necessary, the full texts of articles, were screened to identify those that were most relevant to the projects and the research questions. The articles selected were divided into four categories (i.e., Africa, Asia, Latin America and General) and given to four researchers for further examination of the full texts. During this stage, more articles were added by cross-referencing, but a few were also discarded because they were not relevant. A template was created for a uniform description of the papers. The papers were analyzed

quantitatively, applying text mining techniques and tools (Leximancer, 2014) and complemented by qualitative summaries of papers.

As the qualitative and quantitative analyses did not identify the most recent techno-pedagogical innovations such as MOOCs, networked learning, learning analytics, mobile learning, serious gaming and open linked data (refer to Horizon reports: Johnson, Adams Becker, Estrada, & Freeman, 2014a, 2014b; Johnson, Adams Becker, Estrada, Freeman, Kampylis, Vuorikari, & Punie, 2014c; Innovating pedagogies: Sharples, McAndrew, Weller, Ferguson, FitzGerald, Hirst, & Gaved, 2013; Kennisnet trends in education 2014-2015; Mapping and analyzing prospective technologies: Aceto, Borotis, Devine, & Fischer, 2014), we asked a number of prominent experts to reflect on the most recent developments related to these technologies and how they could be used for the transformation of education in developing countries. The following technologies and their effect on education in the developing countries were discussed: OER and MOOCs, social networking, learning analytics, mobile and seamless learning, serious games and open linked data.

Online Group Concept Mapping study and face-to-face workshop

Group concept mapping and a face-to-face workshop were implemented to provide additional insight into the issues, challenges and trends of using ICT in education in developing countries.

Group Concept Mapping (GCM) applies a structured participative approach to facilitate groups of experts to identify and arrive at a consensus about a particular issue. The analysis depicts, in the form of thematic clusters, the experts' common understanding of the issue under consideration. It uses a structured facilitative multi-step approach including a number of simple and intuitive activities such as idea generation, sorting of ideas and rating of ideas.

The group concept mapping and face-to-face workshop were initially considered separate events. The face-to-face workshop was supposed to generate and discuss ideas, which should then be fed into the Group Concept Mapping (GCM) process. To make the workshop more effective, efficient and appealing, the GCM was conducted prior to the face-to-face workshop. GCM implements the same activities that were supposed to feature in the workshop: generating ideas and structuring them through grouping and prioritizing. GCM facilitated these activities online to collect and analyze the data. The results were then presented to the participants for interpretation. Online GCM gives participants more time for idea generation and structuring (i.e., 10 days for each). In addition it prevents some known negative effects related to the process of face-to-face idea generation and structuring (e.g., brainstorming productivity loss and group thinking). The analysis, which features some advanced statistics such as multidimensional scaling (MDS) and hierarchical cluster analysis (HCA), presents the shared vision of the group on using ICT objectively for education in developing countries. The outcomes of the GCM study are typically visualized in such a way as to facilitate their interpretation. More information on the GCM study is presented in Chapter 3.

The presentation of the results from the GCM study was used as a trigger for small group discussions aimed at gradually refining the scope and themes of the research agenda. On Day 1 the participants were asked to share their thoughts on innovative uses of ICT for education in developing countries in a plenary session. The themes that were discussed included: pedagogical issues related to the implementation of ICT for learning and teaching purposes, teacher training, policy issues, social justice, digital divide and infrastructure. The participants were also challenged to anticipate possible uses of advanced technologies such as learning analytics, cognitive tutors and learning networks. Some preliminary findings of the GCM study were then presented (refer to Chapter 3.). Prior to the workshop, participants also received some documents with results from the GCM - Appendix A (i.e., ideas grouped

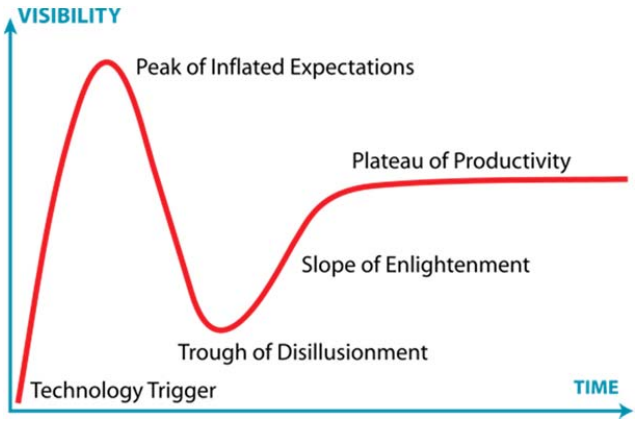
into clusters) and Appendix B (i.e., rating of the ideas on importance and feasibility). After presentation, the participants were divided into small groups for further interpretation of the data. They were primed to look for more general categories that subsume sets of similar clusters of ideas. The groups had a similar vision regarding how to further structure the data. The following, more general categories of clusters, were defined: pedagogical affordances of technology, sustainable development with technologies, access, equity and inclusion, professional development / capacity building, barriers for adoption, teacher concerns and research method (refer to Appendix C). On Day 2, again in groups that were composed differently, the participants were asked to formulate more concrete themes or questions for the research agenda on innovative uses of ICT for education in developing countries (refer to Appendix D).

Summary of the findings

The GCM study identified 16 areas of research interest: international cooperation, learning platforms, research approaches, new job possibilities, integration of technology in the classroom, ICT-enabled pedagogy, teacher competences, teacher concerns, implementation of technology, context-based goals and solutions, accessibility, infrastructure, marginalizing vs inclusion, ICT policy, diffusion of technology, and collaboration for cost-effectiveness. There is a considerable conceptual overlap between the topics identified in the GCM study and those in reports on trends in learning technologies and innovating pedagogies (Horizon reports: Johnson, Adams Becker, Estrada, & Freeman, 2014a, 2014b; Johnson, Adams Becker, Estrada, Freeman, Kampylis, Vuorikari, & Punie, 2014c; Innovating pedagogies: Sharples, McAndrew, Weller, Ferguson, FitzGerald, Hirst, & Gaved, 2013; Kennisnet trends in education 2014-2015; Mapping and analyzing prospective technologies: Aceto, Borotis, Devine, & Fischer, 2014).

Pedagogies, technologies and context are inherently interlinked, to a greater extent than the reports on trends for learning technologies. Advanced learning technologies such as Open Educational Resources (OER), Massive Open Online Courses (MOOC), mobile learning, learning analytics, networked learning and serious gaming were not depicted in a separate cluster dedicated to technology, but were instead integrated in different contexts (i.e., clusters). The role of context is mentioned either explicitly or inferred implicitly across all clusters identified in the GCM study. This was also found in the desk research where the local context of the technology implementation was identified an important factor for the adoption and adaptation of the advanced learning technologies and methods in education. The workshop participants were aware that reuse of open educational resources, methods and tools did not mean reuse exactly as is (see the Reusability Paradox - i.e., the pedagogical effectiveness of a learning object and its potential for reuse are completely at odds with one another – Willey, 2015), but they knew that it was also about revise, remix and redistribute (see also the Remix Hypothesis – Wiley, 2015). To adapting more effectively open education resources, methods and tools to local context the educators from developing countries could benefit from the availability of open instructional design tools (e.g., CompendiumLD, Learning Designer and Cloudworks – see for more information Conole & Wils, 2013).

The literature review and GCM have already detected some signs of technology leapfrogging (i.e., adoption of advanced or state-of-the-art technology in an application area where immediate prior technology has not been adopted) in terms of both technology and pedagogy. This is also in line with reports on advanced learning technologies. It seems that for OERs, MOOCs and mobile learning the stages of technology trigger, peak of inflated expectations, and even disillusionment have already passed (see below the Hype Cycle; Gartner, 2002).



Research can start at the stage of slope of enlightenment but will require some time before arriving at the plateau of productivity. Relatively little was said in the GCM study with respect to serious gaming and networked learning, but the literature review and the expert reflection on the issues indicate that these research topics could also be positioned at the starting line of slope of enlightenment. Data-driven pedagogies, represented in this project by open linked data and learning analytics, can join the others at the starting line of slope of enlightenment if open linked data is considered part of OERs and learning analytics offers open source software for researching issues in OERs, MOOCs and serious gaming.

The learning technologies mentioned are closely related. For example, MOOCs could be considered a further development of OER, and data-driven learning technologies such as open linked data and learning analytics are also linked to OERs, MOOCs, serious gaming and networked learning. Mobile technologies are considered a hub for access to other techno-pedagogical innovations: OER, MOOCs, serious gaming and networked learning.

According to the participants in the study, cloud technologies could be a solution to infrastructure and access issues. Examples include free general purpose and specific educational applications from commercial vendors like Google, Apple and Samsung and social network sites like YouTube, LinkedIn and Twitter. Teachers could join professional social network LinkedIn groups or become members of international communities of practice like Schoolnet eTwinning.

Towards a Research Agenda

Based upon the combination of the desk research and GCM study, the Call for Research Proposals should stimulate and support proposals that together:

- exhibit a combination of advanced technologies with evidence-based learning and teaching methods,
- apply a range of research approaches (i.e., from design-based research to longitudinal studies),
- target different educational levels, and
- take into account the local context.

A second strand of research relates to teachers and teacher training and specifically research on improving teachers' skills, motivation and attitudes for using ICT in their professional practice.

1. Literature review

The first step was a desk research study (literature review) to identify and prioritize development problems with respect to innovative uses of ICTs for learning and teaching in developing countries that could be potentially tackled by applied research. The review was supposed to deal with problems and opportunities in terms of: diffusion of technology, level and degree of connectedness, sharing computational potential, data capture and eventually analysis and the implementation of more sophisticated tools / techniques such as AI, simulation and gaming to advance learning (i.e., make learning possible, more effective, more efficient, more enjoyable). It entails:

- Identification and prioritization of key development and implementation problems (i.e., failure factors) and successes that have been studied and discussed in the literature - both peer reviewed published research as well as policy papers).
- Identification and discussion of examples of good practice of new learning opportunities supported / driven by ICTs in developing (and developed) countries.
- Locating and describing research projects that are being carried out in developing countries that appear to be successful and/or are verging on success and/or in developed countries that have the potential to be successful in the developing world.
- Determining how projects or parts thereof may be applicable in other situations / areas and where this is not the case, determining the constraints that are inhibiting application.

The topic of Information and Communication Technologies (ICTs) and development is studied from a variety of disciplines, including sociology, economics and educational sciences (Brown & Grant, 2010). The academic interest in this topic is still growing. Nevertheless, the critique on the current state of this research field is also growing. Issues related to the relevance and efficacy of the research body are mentioned as well as issues concerning the ontological, epistemological and methodological positions adopted by the research community (Brown & Grant, 2010). In general, critics denounce the fragmented nature of the research body. Brown and Grant argue that the research body is not as fragmented as it may seem and identify two distinct lines of research that should be taken into account when looking at the literature. Firstly, they distinguish the problem domain *ICTs for development* that incorporates studies that focus on understanding the link between ICTs and development or how to use technology to empower marginalized populations. Secondly, they distinguish the problem domain *ICTs in developing countries* that focuses on the cultural implications and local adaptations of ICTs. The study presented here looks at this latter research strand from an educational perspective. It aims to distil the most important themes from the literature base on *Educational ICTs in developing countries* to further defragment this research domain to define fruitful directions for future research.

In what follows we first outline some theoretical frameworks that can help to conceptualize the findings from the literature review. Then we describe our desk research approach and present developing region-specific outcomes.

Theoretical frameworks

This section briefly describes some theoretical positions, ordered from more general to more concrete, which could help in conceptualizing issues, challenges and trends related to the use of ICT in education in developing countries.

ICT Policies in Developing Countries

Although large regional differences exist in basic infrastructure, Internet connectivity, etc. (UNESCO, 2012), the majority of developing countries have ICT policies. The policies are incorporated in a country's political vision and are initiated via programs and resources (Kozma & Vota, 2014). The decision whether or not to invest in ICTs, for example, to provide access to and / or to improve the quality of education and teaching, may be influenced by various arguments. Leach (2008) discusses six common views used to critique the relevance of ICTs for developing countries which may influence current and / or future policy decisions and implementations. These six views are briefly summarized, along with Leach's response to each.

The first, *technological view*, regarding ICT for educational purposes, states that planning for ICT use in teaching, in poor rural contexts, is unrealistic due to the fact that ICT access and infrastructure are too undeveloped in these areas. In response to this, Leach points at evidence that suggests it is only a matter of time before widespread connectivity will be possible, even in these areas. This can and should be anticipated. The developmental perspective she proposes in response to the technological view, does not take hardware and software into account as an inevitable starting point but rather "inquires: What forms of ICT? For what purposes? Who will use it? In what contexts will it be used?" (Leach, 2008, p. 790).

The second, *donor view*, argues that ICT is an unaffordable luxury. This view is challenged by a democratic response, which argues "most especially in remote, resource-challenged environments" people should be able "to make their own informed choices about the relevance and appropriateness of such new technologies, in their specific contexts and experiences." (Leach, 2008, p. 791).

The *anthropological view*, which recommends a gradual, linear experience of communication technologies in rural areas ("first books, then radio and television, and only then computers"), is countered by evidence from educational projects, which demonstrate unexpectedly wide use of a range of digital devices in various settings. These projects provide a cultural response to the anthropological view by demonstrating that technologies develop meaning through authentic use, determined by the users in a way that honors their needs and culture (for a recent example refer to Czerniewicz & Brown, 2013).

According to the *standard view* on ICT for educational purposes, state-of-the-art technology is too expensive. Thus, introducing standard equipment (possibly donated by throwaway economies) is the way to go. To this, Leach responds by providing evidence that what can be achieved with a powerful mobile computer differs hugely from what can be achieved with a refurbished desktop computer.

The fifth, *individual view*, which holds that technology will be lost, stolen or broken, is countered by a community response; evidence suggesting that ownership of a project by the school and local community will lead to a practice where each community works out solutions to keep valuable equipment in good working order.

Finally, the *transmissional view* - "There is no learning that cannot be achieved by other, less high-tech means" - is addressed by arguing that ICT has the potential to change the nature and processes of pedagogy, for example, supporting the preparation of resources and lessons, administrative processes, group work, and enhancing learner motivation.

It is important to consider the above views because they influence policy directions and might explain failure / success of ICT implementations.

ICT policies

Kozma (2008) provides a framework with which to compare national ICT policies in developing countries. He distinguishes between strategic policies and operational policies. Strategic policies can be divided into policies that promote the use of ICT to support the *economic growth* or stimulate *social development* or policies that focus on the impact of ICT to advance *educational reform* or support *educational management*. Operational policies are policies regarding: infrastructure development, teacher training, technical support, pedagogical and curricular change or content development.

In general, these educational ICT policies might work best if they are properly aligned on a national level, explicitly articulated by the Education Ministry, translated to educational practice and effectively communicated to teachers, co-financed by private partners, aiming at specific goals and measurable outcomes and finally, formulated and implemented based on "good practices" (Kozma, 2008).

Strategic Policies

Strategic ICT policies aimed at the support of *economic growth* focus on the role of educational ICT in preparing a future workforce. The idea behind this policy is that getting young people acquainted with ICT in schools will help them to develop the ICT skills necessary to solve complex problems related to productivity because productivity is seen as a major contributor to economic growth.

The focus of ICT policies aimed at *social development* is directed at knowledge sharing, participating, enhancing social cohesion, involving minorities and making government services widely available. These policies promote digital literacy and prepare students to participate and thrive in a knowledge economy.

Yet another spearhead of strategic ICT policies is *educational reform*. Educational reform, such as curriculum redesign, pedagogical shifts or assessment changes, is believed to be necessary to educate students in so-called "twenty-first century skills", such as creativity, collaboration, communication, self-directed learning / working and information management.

Strategic policies directed at *educational management* stimulate the use of ICT to increase the productivity, efficiency and effectiveness of education management in the hope that this will have a positive effect on student performance and / or attendance (e.g., Carrasco & Torrecillain, 2012).

There are a number of factors that might hinder the implementation of these policies (Winthrop & Smith, 2012). First of all and regardless of ICT, there are a number of barriers to education. Numerous children in developing countries do not have access to education. Moreover, the children who manage to go to school receive education of poor quality. As a result, these children are not properly equipped to be successful in secondary education or even higher education. Secondly, there are a number of barriers to "learning for all". In primary and secondary education, distance and costs for attending school, shortage of teachers, lack of proper materials and insufficient management form important barriers (Hinostroza, 2011). An important issue in this respect is the lack of good teacher training on the use of ICT and the integration of ICT in the curriculum (Agbatogun, 2013; Agyei, 2012; Nihuka, 2011; Howie, 2010; Kafyulilo, 2013; Salinas & Sanchez, 2009). In higher education, distance and cost, quality of faculty, and access to materials and resources are the most important barriers (Williams, Pitchforth, & O'Callaghan, 2010). In addition, primary and secondary education leaves students academically unprepared for higher education. Thirdly, technology use is also hindered by several barriers: no access to electricity, no connectivity, no human resource capacity for maintenance, lack of political will and management, lack of financial resources, and finally, no alignment between infrastructure availability and ability to integrate. Operational policies aim to level these barriers.

Operational Policies

In order to implement the strategic policies, operational policies are necessary to remove the barriers that stand in the way of strategic ambitions. Operational policies are characterized by (combinations of) different components. Firstly, in the early phases of ICTs in education, operational policies focus on infrastructure development to enable the use of ICTs. Secondly, when the infrastructure has been established, operational policies are directed at teacher training to support teachers in using ICTs in the classroom. Thirdly, once the ICTs are used in the schools, operational policies aim to ensure the technical support of teachers who use the ICTs. Fourthly, in order to support the strategic policies concerning educational reform, ICT-related curriculum redesign, pedagogical shifts or assessment changes need to be explicitly articulated in operational policies. Finally, operational policies can be directed at developing educational content that is adjusted to the culture and language of the target group (Kozma, 2008).

Despite the strategic and operational policies, successful implementation of ICTs in a developing context remains difficult. Brunello (2010) sketches the challenges for educational development projects ("foreign aid") to succeed. Firstly, educational development projects must comply with complex bureaucratic and administrative mechanisms which put heavy constraints on the decisiveness within the projects. This hinders an effective introduction of ICTs in schools. Secondly, the division of roles within development projects still involves allochthonous development agents (agents of change and development not originating in the country itself) in the role of developer and autochthonous development agents in the role of developee. This stands in the way of a true participatory approach to implementing ICTs in the developing world (cf. Leach's democratic and cultural responses mentioned above). Thirdly, the transaction costs are very high for the import of technology to the developing countries. Moreover, the interests of the exporting country are different from those of the importing country. For the exporting country, for example, it is more profitable to export a comprehensive bulk shipment, while for the importing country a comprehensive bulk shipment is hard to "digest". Fourthly, development projects tend to have a bias towards "the set-up of a physical technological infrastructure over the educational use of it" (Brunello, 2010; p. 234). As a result, the objectives of development projects do not include educational use of technology but instead include availability of technology (e.g., Carasco & Torrecillo, 2012; Howie, 2010; Czerniewicz & Brown, 2013). Fifthly, allochthonous development agents and autochthonous development agents (agents of change and development from the country itself)have different perspectives on sustainability. From an autochthonous point of view, sustainability of the development project is that the successes of the project have a permanent effect and do not cease to exist after the funding has stopped. From an allochthonous perspective it is important to stay funded. This might result in a priority swap, that is, the autochthonous development agents' needs might become instrumental to fulfilling the allochthonous development agents' sustainability needs. Finally, and related to the fifth point, the prevalent mindset behind development projects seems to be "forcing the situation to fit into the plan rather than adapting the plan to fit the situation" (Brunello, 2010; p. 235).

An interesting study in this respect is one examining the challenges of ICT practices within the field of higher education in South Africa. The study points at the fact that cell phones are used extensively by students as a core ICT resource yet are underacknowledged as a medium of learning by universities (Czerniewicz & Brown, 2013). At the national level cooperation between different government ministries, research centers and private enterprises could be quite fruitful (Sanchez and Salinas, 2010; Howie, 2010). Government programs and NGOs that offer tailored programs in ICT to low-income people should be encouraged and supported (Gutierrez & Gamboa, 2010). It goes without saying that private enterprises also have their own interests in developing ICT tools for developing countries, and many private initiatives are waiting for educational specialists to cooperate (Kima, 2008).

ICT innovations in developing countries

Avgerou (2010) proposes a general theoretical framework for conceptualizing ICT innovation in developing countries, which could be adapted for the purpose of the current study - Innovative use of ICT for education in developing countries. Firstly, she distinguishes between universalistic and situated research perspectives. While acknowledging the existence of contextual factors, the universalistic view assumes the value of solutions developed elsewhere and tries to introduce "the best practices" of using ICT in education. In comparison, the point of departure for the situated perspective is to consider the local social practice and experiences of stakeholders, before proceeding to develop solutions to the identified issues. The author also introduces two ways of considering context in research on ICT in developing countries – transfer and diffusion from the one side, and social embeddedness, from the other. Transfer and diffusion assumes that knowledge and skills related to ICT are independent from the research culture within which they were developed, hence they could be transferred to any other research culture but should be adapted appropriately if one is to expect any impact on local practices. If the universalistic perspective focuses on "best practices" established elsewhere initially, the transfer and diffusion view emphasizes "appropriate, context-specific practices". Social embeddedness relies most on social context and local actors. "It traces the cognitive, emotional, and political capacities that individuals who are nurtured in their local social institutions bring to bear on the unfolding of innovation efforts. Through this approach, the socially embedded innovation discourse sheds light on what is locally meaningful, desirable, or controversial, and therefore, on how technology innovation and organizational change emerge (or are stunted) amid the local social dynamics" (Avgerou, 2010, p. 4). In a way, social embeddedness is comparable with the democratic and cultural positions, as argued by Leach (2008). Finally Avgerou formulates and discusses four discourses based on type of ICT innovation (transfer and diffusion vs social embeddedness) and type of transformation (progressive vs disruptive). The way ICT innovation is brought about could either have a positive or negative impact on social practices. Our interpretation of the ICT innovations framework identifies four propositions that need to be considered when discussing ICT for education in developing countries. Firstly, the role of context is obvious in how innovation occurs and develops. The universalistic, diffusion and transfer, and socially embedded approaches could be positioned on a continuum depending on how much of the context is taken into account in carrying out research on educational use of ICT in developing countries. Even the universalistic approach does not ignore context entirely. It seems, however, that the approach is negatively connoted and discouraged. Within the framework of this project, the principles of human learning and evidence-based practices of teaching could represent the universalistic approach and this is something that needs to be kept in mind when conducting research on innovative use of ICT for education in developing countries. Secondly, this is the claim that ICT innovation could be transformative, stimulating and could have a positive impact on education in developing countries, but could also be disruptive, which intensifies the problems (e.g., further marginalizing some part of the population). Thirdly, the definition of the socially embedded approach is abstract and difficult to operationalize immediately in concrete actions. This is not necessarily a bad thing, as it opens the door for broader interpretations and pushes to find concrete implementations of the approach. A possible solution would be to first consult experts from different developing regions on issues, challenges or opportunities concerning ICT-enabled pedagogical innovations (for more details refer to Chapter 3). The research themes identified need to be further elaborated in research proposals.

Technology Hype Cycle

The Technology Hype Cycle of the Gartner group (2015) is a popular reference model representing the maturity, adoption and application of specific technologies, including learning technologies. The Hype Cycle consists of five phases: technology trigger, peak of inflated expectations, disillusionment, slope of

enlightenment, and plateau of productivity (refer to Figure 1). Most, if not all of the technologies applied for educational purposes go through these stages. The fact is that up till now, only a few learning technologies reached the two final stages (Van Merriënboer & Stoyanov, 2008). Apart from the fact that the Hype Cycle is a useful reference framework, there are two additional reasons for including it in this report. Firstly, the model is used by research reports on trends in learning technologies (refer to the Horizon report for Europe: Johnson, Adams Becker, Estrada, Freeman, Kampylis, Vuorikari, & Punie, 2014c; Kennisnet trends in education 2014-2015). Secondly, it suggests what could happen in developing countries based on the experience and lessons learned in developed countries. Learning technologies, which are already considered mainstream in developed countries, could be a subject of experimentation in developing countries.

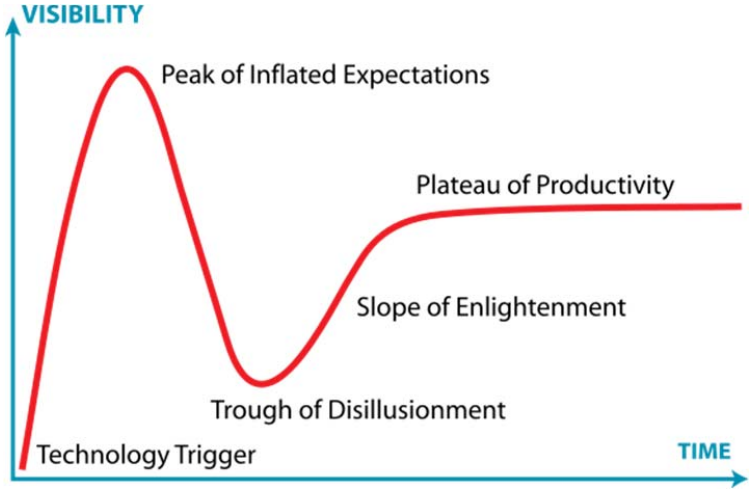


Figure 1. The Hype Cycle

Reviews on trends in learning technologies

The Gartner group Technology Hype Cycle had not been specifically devised for the purpose of education and is mainly a reference model for technology development in general. More concrete reference models are periodic reviews of the learning technology trends (for more details refer to the Horizon reports: Johnson, Adams Becker, Estrada, & Freeman, 2014a, 2014b; Johnson, Adams Becker, Estrada, Freeman, Kampylis, Vuorikari, & Punie, 2014c; Innovating pedagogies: Sharples, McAndrew, Weller, Ferguson, Fitzgerald, Hirst, & Gaved, 2013; Kennisnet trends in education 2014-2015; Mapping and analyzing prospective technologies: Aceto, Borotis, Devine, & Fischer, 2014). These reports are not only frameworks but also provide findings on issues, challenges and trends in using technologies for educational and training purposes, as well as innovative learning and teaching methods associated with them. It might be an idea to carry out similar studies for different developing regions.

No significant difference phenomenon

The no significant difference phenomenon might not be a framework, but is a useful reference point that sparked an ongoing debate on the impact of new technologies on learning. (Clark, 1994; Kozma, 1994; Russell, 2001). Russell (2001) conducted a meta-analytic study including 355 sources of information on the effect of different technologies on learners' outcomes and found that not a single significant difference was reported. Too often, researchers study the effect of technology on learning without taking instructional methods into account. A better approach might be to study the conditions under which a particular technology-method combination has an effect on learning.

Findings from the quantitative and qualitative analyses

A combined search in databases such as Academic search elite®, Psychology and Behavioral Sciences Collection®, ERIC®, PsycINFO® and PsycARTICLES® was conducted, applying the Boolean / Phrase "ICT and developing countries And education And research" to select the articles. The search was expanded to allow for related words and required a search within the full text of the articles, but was limited to the period from 2010 to 2014, available full text and peer-reviewed articles. The search returned 680 hits (Academic Search Elite: 574, Psychology and Behavioral Sciences: 90, ERIC: 8, PsycINFO: 4 and PsycARTICLES: 4). The abstracts, and when necessary, the full text of all articles, were screened to identify those that were most relevant to the projects and the research questions. Forty articles were selected then divided into 4 categories (Africa: 10, Latin America: 3, Asia: 13 and General: 14) and given to four researchers for further examination of the full text. The "General" category included papers that refer to the use of ICT in education in all developing countries not restricted to a particular region. During this stage, some more articles were added by cross-referencing but a few were also discarded because they were not relevant. The final list comprised 43 articles: Africa: 10, Asia: 13, Latin America: 10 and General: 10. A template for a uniform description of the paper was created consisting of the following categories: title, year, author(s), country / institution, perspective, short description, research methodology, research method, types of data, analysis, participants, general appraisal, and lessons learned.

The quantitative analysis was performed using Leximancer® software (Leximancer 4, 2014; also refer to Smith & Humphreys, 2006) . Leximancer automatically extracts concepts from the text and shows their relationships. The software makes several iterations to find evidence that a particular concept is well-represented by the terms that are associated with that concept. In addition, the concepts are clustered into themes. The themes and concepts are visualized as a conceptual map. The themes are heat-mapped, which implies that hot colors (red, orange) indicate the most important themes, and cool colors (blue, green) signify those of less importance. The text browser helps to interpret the results.

Leximancer applies language technologies and machine learning to identify the most important concepts and their relationships. A concept according to Leximancer is a combination of words that co-occur frequently in the text. The software assigns weights to words based on how often a word occurs in the context where a concept is discussed and rarely where this is not the case. Leximancer re-reads the corpus until it finds sufficient evidence for a concept (the sum of the weighted terms which exceeds a threshold). Leximancer thus creates a specific thesaurus of terms for that corpus, which defines each concept. The software visualizes concepts as a two-dimensional conceptual map. A theme is a combination of concepts that appear closely in the text and are shown on the map in close proximity. The name of a theme is the name of the most prominent concept in the cluster. Apart from the conceptual map, Leximancer provides a text browser to explore the text and find what the concepts refer to and their relationships with other concepts.

In the next section we present the results from the quantitative analysis of the literature to outline the 'landscape' of the most important concepts and themes concerning innovative uses of ICT for education in developing regions. This is then complemented with outcomes from the qualitative analysis.

Quantitative analysis of the text

ICT in education in Africa

The most important themes in the literature on the use of ICT for educational purposes in Africa are *Technology, Use and Education* (refer to Figure 2).

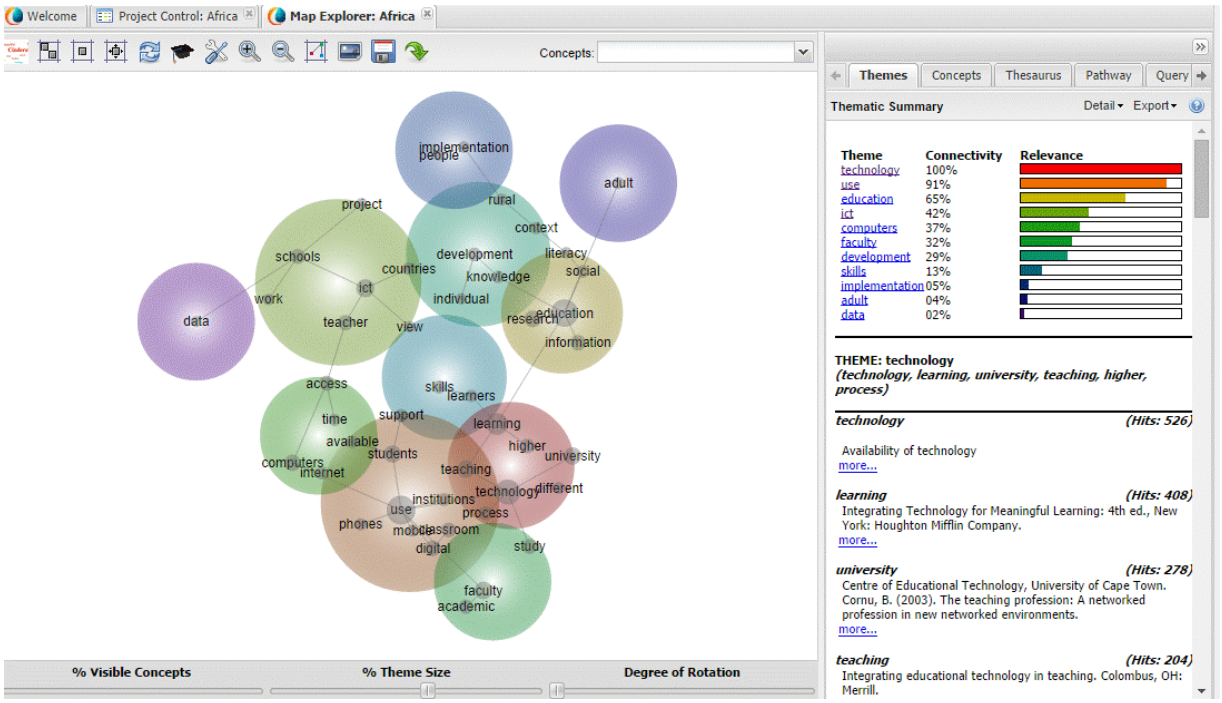


Figure 2. Africa themes

Technology is closely related to concepts such as *Process of Learning and Teaching, High education and University*. The text suggests that most academics in higher institutions struggle to shift from traditional teaching and learning strategies to technology-enhanced pedagogy. At the same time, university students are quick to adopt emerging interactive technologies for personal purposes in and outside of campus. The theme *Use*, apart from the concept with the same name, includes *Students, Digital, Classrooms, Support and Institutions*. Although not so important, *Mobile Phones* are also part of this cluster. The theme emphasizes questions that need to be addressed before planning any change in regard to using technology for educational purposes. The main questions here as the text browser indicates are *"What are purposes for using technology", "Who is going to use it", "Where are they going to use it" and "How are they going to use it".* The themes *Technology*, *Use*, *Computers* and *Faculty* partly overlap, which suggests that technology mostly supports the process of learning and teaching of students in higher education institutions. A specific topic identified is the use of *mobile phones* in classrooms. *Access* and *time* available for using computers and Internet are two other issues shown. It is interesting to see that *Technology*, *ICT* and *Computers* are identified as three separate clusters. Technology can improve learning and teaching, but it doesn't necessarily have to be ICT. Drilling into the text browser indicates that there is a need to consider alternatives to ICT, which entail balancing investment in computers with investment in other technologies which might be less expensive and equally effective. The traditional non-interactive technologies, such as slides and overhead projectors, PowerPoint presentations, and whiteboards no longer meet the needs in terms of supporting effective and efficient learning. However, university instructors are sometimes discouraged to integrate modern

interactive ICT technology into an instructional process, due to their low level of ICT skills, maintenance problems, and lack of encouragement from the institution's management.

The *Computers* cluster is mostly associated with access to the Internet and time available for using it. The *ICT* cluster is related to projects in other countries, describing good practices for the use of ICT for teaching in schools and implementing it in work settings.

The *Education* cluster is not closely related to *Technology* and *Use*, although it is one of the three most important themes. The emphasis here is on the need to conduct research to collect information on the effective use of ICT.

The most frequently used single concepts are Education (744 hits), followed by Use (661), Technology (526) and Learning (408). Refer to Figure 3.

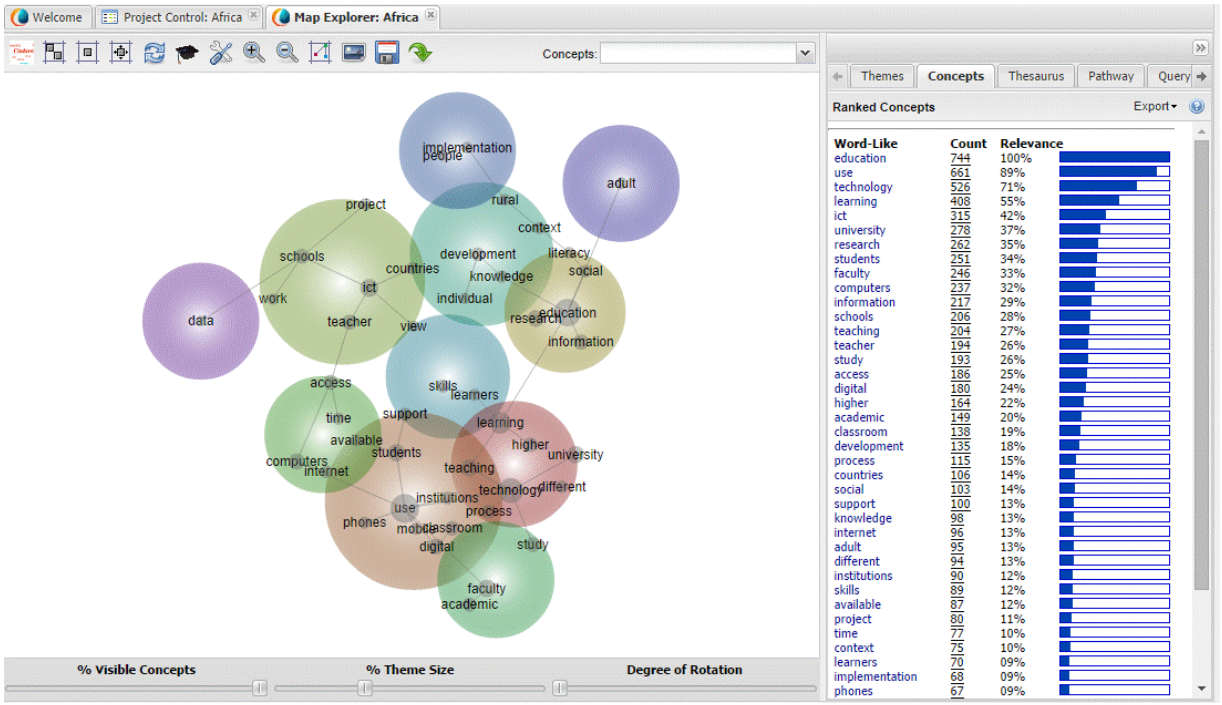


Figure 3. Africa concepts

While indicating that there is little information on the implementation of ICT in education in Africa and that most of the information seems to focus on the policy and intentions of the government, the *qualitative* analysis identified some useful ideas. They are: focus on the teachers and the teacher training and not on the technology; use pilot studies to test theories and strategies before going to scale; use the existing telecommunications infrastructure where possible before investing substantial resources into new infrastructure; gradually introduce computers into schools and integrate them into teaching and learning; decentralize the technical assistance and training; use robust processes for assessment, monitoring and evaluation (Howie, 2010).

Findings from the qualitative analysis point to a contradiction between students' practices and the field of higher education, in that cell phones are widely used as a core ICT resource yet under-acknowledged as a medium of learning by universities. The adoption rate of mobile technologies in Africa is among the highest rates globally. This has implications for curricula, courses and resource designers in terms of designing learning interventions which utilize mobile technology affordances. On a more general level it

provides a way to focus on existing literacy (which is preferable), rather than on the deficit model, which currently prevails (Czerniewicz & Brown, 2013).

Despite government investments in ICT, the integration of ICT in educational practice is poor. A possible solution could be collaborative course design workshops which help teachers integrate ICT in their teaching for the short and long term (Agyei, 2012; Kafyulilo, 2013; Nihuka, 2011).

Information on new educational models that take advantage of the opportunities created by modern technologies can be found in periodic reports on that subject. The eLearning Africa 2012 Report (Isaacs & Hollow, 2012) points out that much of what is happening in many classrooms across Africa is not producing the expected impact. The conclusion is that business as usual is not working and a prediction is made that ICTs might catalyze and enable "business unusual", to help in finding new approaches to meet some of the most pressing educational challenges. Most educational technology programs across the continent have focused largely on the technology itself and put very little emphasis on the practical implications of the use of ICTs to meet broad educational objectives. Engaging narrowly and tackling issues related to basic "ICT literacy" is not helpful. There is a belief that mobile learning can provide "an inclusive, safe and unbiased way to access information that was previously out of reach; this is not purely about traditional and formal education, but also about a connection to opportunity and social and economic reform" (p. 31). The study outlined the landscape of eLearning Africa in the next 5 years, which contains the following themes: Universal Access to ICT (Devices, Internet Connectivity and Content), Increased Mobility in Education Delivery, Learning & Training, Improved Learning and New Pedagogies, Reap Economic Benefit from ICT Investment in Education, and Improved Political Will. The study indicates that little reference was made to the potential of Open Education Resources (OER) in Africa for significantly expanding access to learning content. At the same time the authors of the report call most of the proposals that were made unrealistic and claim that less attention was paid to the social and cultural context of implementing technologies in the learning process and teaching activities.

The eLearning Africa 2014 Report (Elletson & MacKinnon, 2014) describes Africa as one of the most dynamic eLearning markets in the world. The authors cite three major catalysts for the boom in the African eLearning market: the wide-scale digitization of academic content in almost all countries on the continent; the explosion of online enrolment in higher education; and the hike in the adoption of eLearning in corporations working in booming economies.

The eLearning Africa 2014 Survey provides some interesting facts. 99% of the teachers surveyed believed that ICT should play a greater role in developing cross-border learning and in a global classroom. Of them, 63% would prefer to communicate with people outside of Africa, 30% with people from other African countries, and only 7% with people from their own country. 80% of the people in Africa use social media for professional networking, 78 % for sharing information, 74% for private communication and 66% for educational purposes. When asked "If your school is in need of improvement, and what is its greatest need?", the teachers responded as follows: 31% said internet connection, 21% said ICT hardware, 16% said better teacher training, 10% said more relevant teaching content, 7% said electricity, 5 % said ICT software, and 10 % said "other".

According to the participants, laptops have the greatest potential for education and training (29%) followed by tablets (18%), smartphones (17%) and basic mobiles (16%). The findings suggest that mobile learning will tend to become the norm.

The consulting company Accenture provides some useful recommendations in a brief report on eLearning in Africa (Abell & Trey, 2010).

1. *Make sure to focus on teachers and communities*. The eLearning model should be built on the capabilities of teachers. To be successful, eLearning solutions must engage teachers and communities at an early stage, and must include teacher training and community involvement. This is most easily achieved if they are involved in the actual design of the solutions and in the content selection.
2. *Be flexible with hardware choices*. It is important for countries to make their choices pursuant to technological innovations.
3. *Design the solutions for multiple learning environments*. eLearning solutions should be designed in such a way as to accommodate all available types of infrastructure, including enabling education beyond the classroom into homes and Internet cafes.
4. *Do not just teach computers*. *Focus on the core curriculum and relevant skills*. As computers become much easier to use, the goal of teaching basic computer skills will become relatively unimportant over time.
5. *Take advantage of the inherent flexibility of eLearning to allow for customized content and expanded usage*. eLearning makes the content usable and shareable across borders, providing opportunities for countries to collaborate in developing eLearning materials that are tailored to the needs of local communities.
6. *Leverage cloud computing to extend learning beyond the classroom*. This will utilize the advantage already available to students outside the formal classroom, i.e., students who have computers at home, use computers in cafés, or have mobile phones with internet access.
7. Focus on the actual learning experience, including educational content and learning styles. eLearning enables different modes of learning and provides different types of content, structured in a different way.

ICT in education in Asia

For Asia the most important themes are *Technology*, *Use*, *Educational* and *Students* (refer to Figure 4).

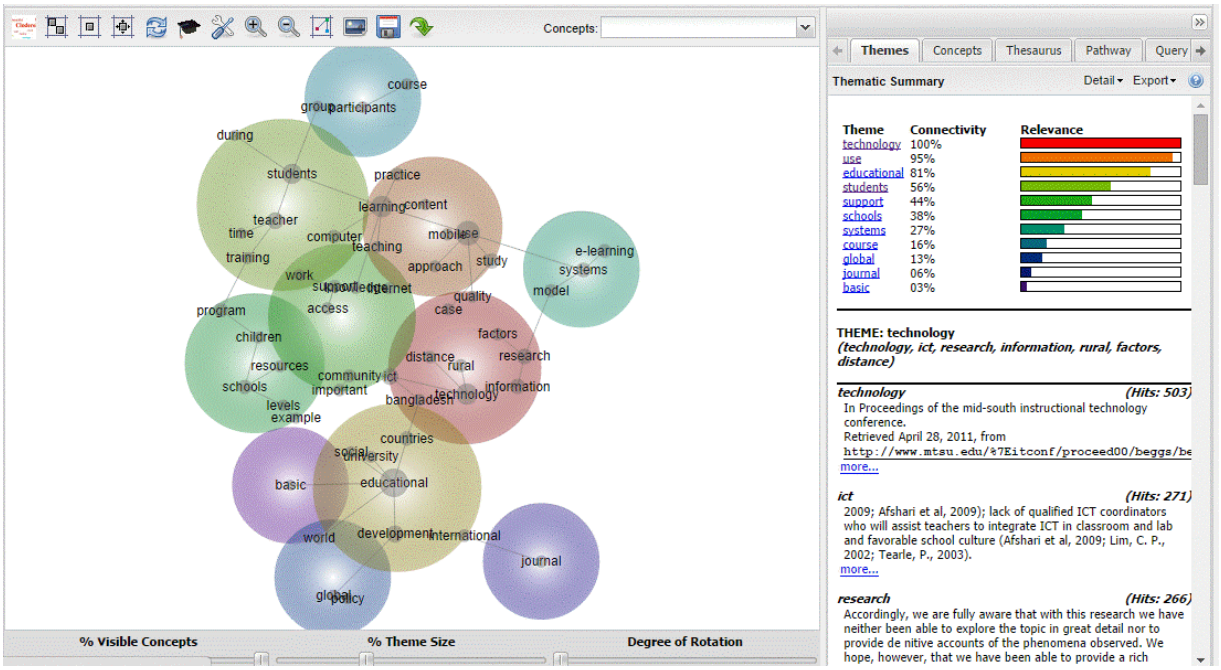


Figure 4. Asia themes

Technology here includes different concepts compared to the technology theme in the Africa context. The theme comprises the following concepts: *ICT, Research, Information, Rural, Factors, and Distance*. What it may suggest is that ICT creates learning opportunities for people in rural areas. It does, however, require investments for supporting distance education and conducting research on how to bring these learning opportunities to people living in remote areas. Another specific focus area is the role of community factors for acceptance and use of technologies.

The theme of *Use* includes the following concepts: *Learning, Teaching, Content, Study, Practice and Mobile*. All of them define the pedagogical use of technology: effective studying of content and improving learning and teaching. The effects of technologies cannot be measured in a snap-shot manner. There is a need to follow the practices as they emerged. Practical perspective is very important when recommending technologies that support effective studying. Special attention was paid to *mobile* technologies.

The "educational" theme consists of concepts such as *Development, Countries and International*. It reflects issues on a macro level, in other words, national and international policies for supporting ICT in education. The supporting text suggests that the allocation of sufficient funds for the educational sector and ICT does not seem to be very attractive to the governments in these countries. These nations are heavily dependent on external donors. While the numbers of donors have increased exponentially over the past decade, the average size of development projects in the same period has declined dramatically. This goes against the idea of donor harmonization. Tensions have also been reported in the education sector between different donors, as well as between donors and governments. The three most prominent themes, however, are not significantly related.

The highly ranked concepts for the Asia context are Educational (845 hits), followed by Use (583 hits), Students (510), Learning (503) and Technology (503). Refer to Figure 5.

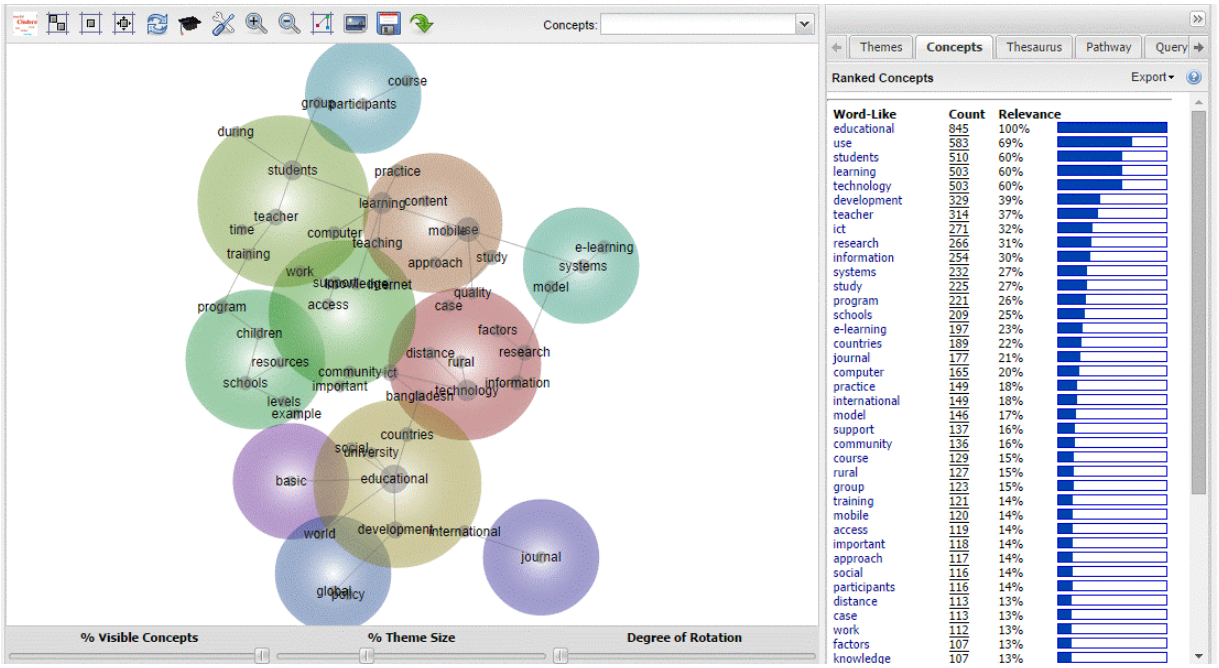


Figure 5. Asia concepts

According to the qualitative analysis of the literature, research on the use of ICT in education in developing countries in this region needs to be based on local educational cultures and should take into account socio-cultural and psychological factors that can create barriers to the establishment of new learning opportunities. The fact that socio-cultural issues are involved suggests that research might have to take a more longitudinal approach (Khan, Hasan, & Clement, 2012).

Open Educational Resources hold great promise, but there are still several important issues to address (e.g., the reuse of OER). eLearning service quality, course quality, perceived usefulness, perceived ease of use, and self-efficacy of users had direct effects on the behavioral intention to reuse among users (Li, Duan, Fu, & Alford, 2012).

Although large parts of the population in remote areas of most developing countries in Asia do not have access to computers, their ownership of mobile phones is often extensive. The development of OER for mobile learning applications may be an appropriate strategy to make OER widely available to these students (Gronlund & Islam, 2010; Valk, Rashid, & Elder, 2010).

The use of social networks also seems promising. A study among medical students in Nepal showed that they consider the use of Facebook from their mobiles as a daily and highly popular practice (Primmer, Linxen, & Gröhbiel, 2012). The authors identified explicit forms of educational content such as quizzes and case presentations, which were embedded in Facebook and associated with deliberate eLearning practices in informal learning contexts. These authors do however state that research on these forms of learning is scarce and needs to increase in terms of depth and scale.

ICT in education in Latin America

In the case of Latin America, the most important themes are *Use, ICT and Countries* (refer to Figure 6).

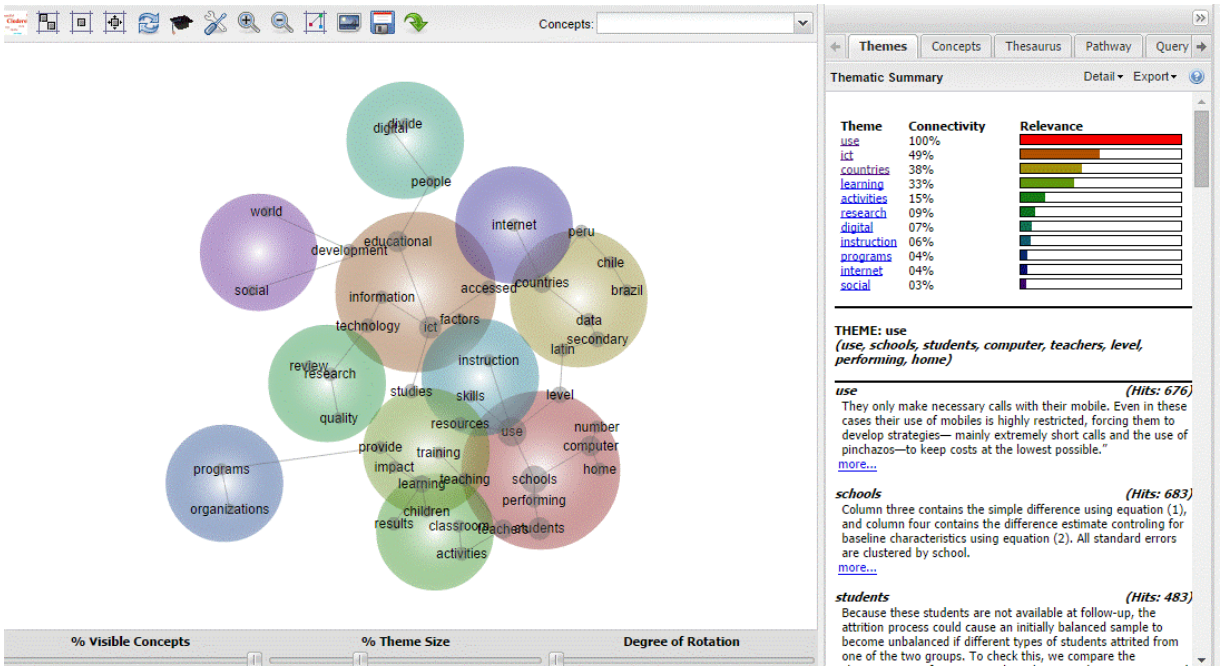


Figure 6. Latin America themes

The *Use* theme takes the name of the most prominent concept in it and also contains *schools, students, teachers, level, performing, home, numbers and computers.* This combination of concepts seems to suggest two aspects of using technology: (a) in school to improve performance of learners and teachers and (b) in home, but depends on the availability of computers. The theme overlaps with some other themes, although these are not as important: (a) *learning*, which is about the impact of technology on learning, teaching and training; (b) *instruction*, which emphasizes the development of skills and (c) *activities*, which involves supporting activities for children in classrooms. Looking at the text browser, it seems as though the theme is affected by some experimental research that reports a significant improvement in the performance of students when educational technology is introduced in schools. It also emphasizes the benefits of using technology at home.

Apart from *ICT*, the other concepts in this theme are *Educational, Technology, Information and Access*.

The analysis of the text reflecting these concepts suggests that comprehensive measures which mix standard ICTs with very advanced ones can be misleading. Also when controlling is introduced for direct access to ICTs, the effect of most of the variables, including age, is reinforced. Motivational or mental stage of the process of ICT appropriation is easier for more educated people, regardless of whether they are from a low-income or wealthy setting. Television-assisted instruction (TAI) is a more advanced form of ICT which can help students understand and learn about abstract concepts through visual imagery and representation, including animation, simulation and dramatization. TAI can include television broadcasts as well as offline video-assisted technologies. Different factors may come between having access to a technology and making good use of it (affordability is such a factor).

Simply equipping schools with technological resources does not ensure better learning or make an impact on the level of performance. Along with ensuring access to these technologies, the greatest

challenge for systems and schools is transforming practices and processes - improving learning, lesson plans and curricula which address the new skills of the twenty-first century.

Countries also include the concepts of *Secondary, Data and Latin.*

The analysis depicts some commonalities and differences between different countries in the region. Most of the developing countries in Latin America reported that the curriculum includes recommendations for ICT-assisted instruction at all grades for all subjects in primary, lower secondary and upper secondary education. However, in countries where schools do not have full access to electricity, the secondary schools are the ones that are more likely to have access.

Latin America has prioritized the integration of Computer-Assisted Instruction (CAI) into secondary education institutions. In Brazil, CAI is available in 78% of secondary institutions, compared to 40% of primary institutions.

On the top of the ranked concepts is School (683 hits), followed by Use (676), Educational (555), ICT (493), Students (483), Computer (394), Countries (360), Teachers (344) and Learning (257) (refer to Figure 7).

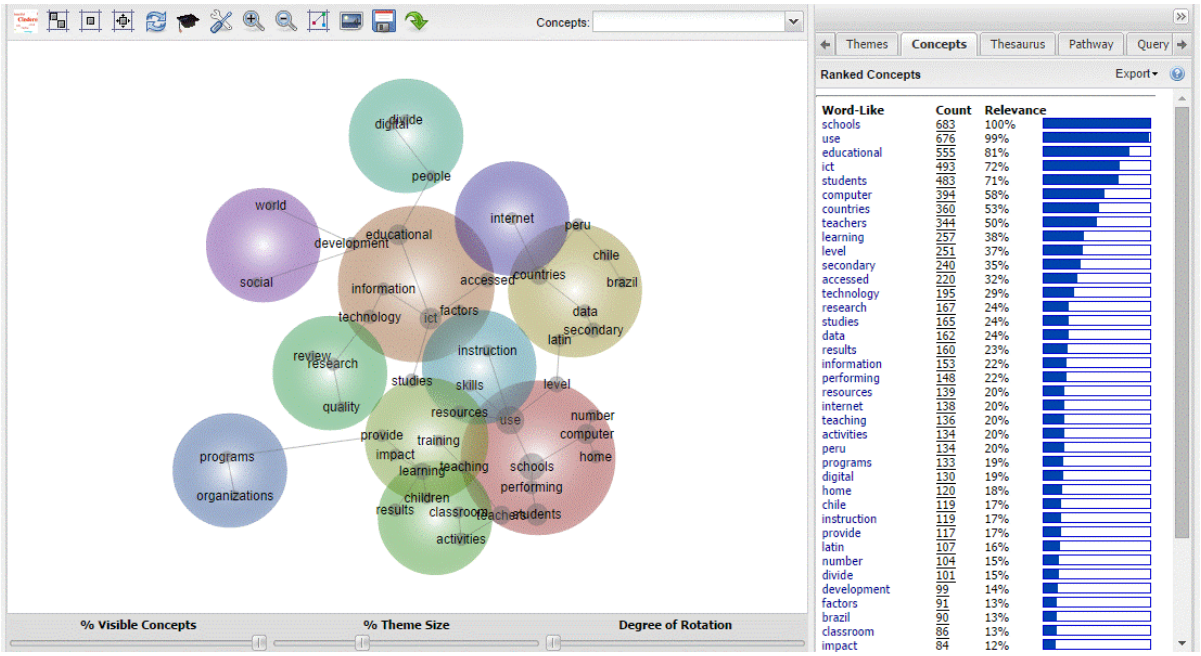


Figure 7. Latin America concepts

The qualitative analysis of the texts identified some technologies and factors that could improve students' performance on some subject matter. Although a formal theory on mobile language learning has not been developed to date, the emerging mobile technologies increasingly suggest potential language learning solutions and learning environments that are highly interactive, ubiquitous and convenient (Kim, Mirandab, & Olacireguic, 2008).

Reading and math performance increases significantly among those students who have a computer in their home, and the increase is greater among those students who have computers at their disposal at school. The use of computers at schools, both by students and teachers, improves school performance in both disciplines after controlling for socio-economic level, family culture, gender, mother tongue and number of pre-school years. However, more studies are needed that explore not only the frequency of use but also the purpose of use by students and teachers. Also pending is an analysis that looks at this

problem in regard to other factors associated with learning, such as the coordination of ICTs in classroom dynamics and their use combined with traditional didactic resources and teacher training (Carrasco & Torrecilla, 2012).

The role of ICT in teaching activities in high-performing schools requires further analysis and represents an opportunity to focus policy design on the quality of ICT usage, by characterizing teachers' "good ICT-based teaching practices" (Hinostroza, Labbé, Brun, & Matamala, 2012).

It would be a false assumption to believe that once equipped and trained, teachers would voluntarily incorporate the provided technology into their classrooms (Barrera-Osorio, & Linden, 2009).

Conclusions

There are at least five trans-region themes that appeared from the analysis of the literature, namely:

- It is not only access that determines the effect of technologies on learning and teaching. Some of the factors that contribute to it and need to be controlled for are methods for teaching and learning, self-efficacy, educational background, age, gender and ease of use of technologies.
- Using ICT for improving learning and teaching on different subject-matter is more important than studying the computer or computer programming as a subject.
- Local context and educational cultures should be taken into account when creating new learning opportunities.
- Successful solutions of implementing ICT in education require engaging teachers and communities, and must include teacher training and community involvement. This is most effectively achieved if teachers and communities are involved in the actual design of these solutions.
- Mobile phones and OER are the technologies that are believed to have the highest potential impact on education in developing countries.

Neither the qualitative nor the quantitative analysis of the literature provided the expected information on the role of modern learning technologies in education in developing countries. To enrich the knowledge base, we asked a number of highly regarded experts in the use of advanced technologies for educational purposes, to reflect on *how these technologies could impact education in developing countries*. The next section compiles these expert opinions.

2. Reflection on modern learning technologies and their role in education in developing countries (expert views)

Open Education and MOOCs in the development context

Marco Kalz

The use of Open Educational Resources (OER) has already enjoyed a longer tradition in the development context. The discussion on how MOOCs can help learners in developing countries and other disadvantaged members of the population has just recently started in the scholarly literature. One of the repeatedly mentioned arguments about MOOCS is that they primarily attract participants with existing degrees in a very good socio-economic position. Liyanagunawardena, Williams, & Adams (2013) discuss the low participation rates of participants from Africa in MOOCs reported in scientific literature until 2013. The authors mainly list infrastructure problems and issues of language and culture as reasons for low participation. Escher, Noukakis, & Aebischer (2014) argue that "their [MOOCs] potential for education in developing countries is real, in our view, but must be carefully monitored".

The authors see the biggest potential in the reutilization of learning resources by organizations in Africa, to overcome the financial and technological barriers hindering systematic updates to educational technology. The authors list several ongoing MOOC initiatives in Africa:

- In 2008 the World Bank launched the "New Economy Skills for Africa Program - Information and Communication Technologies" (**NESAP-ICT,** http://www.worldbank.org/nesap-ict). In this program existing courses and MOOCS are integrated to strengthen the demand for high-quality education.
- The **Kepler project** (http://kepler.org) combines high-quality online content and MOOCs from top universities with in-person seminars and education-to-employment support.
- The "**MOOCs for Africa and future emerging countries**" by EPFL (Ecole Polytechnique Federale de Lausanne) aims to set up an alliance around common MOOC programs with partners from the North and the South.

Altbach (2014) takes a rather critical stance and he discusses the question of whether MOOCs can be regarded as a new form of neocolonialism. Based on the question "Who controls the knowledge?" the author claims that most MOOCs are stemming from universities in the US or western countries which are technologically advanced. This approach holds the implication that "online courses threaten to exacerbate the worldwide influence of Western academy, bolstering its higher education hegemony" (Altbach, 2014, p. 6). The authors especially criticize the embedded western methodology in current MOOC models that might be very different from what a target group from a developing country might expect. He argues that this effect is even amplified through the high amount of research coming from a western tradition which also dominates the academic discourse on MOOCs. Problems of a simple transfer model are, for example, the inhibition of establishing a local academic culture and course development tailored to a national audience (c.f. Avgerou's social embeddedness, 2010 and Leach's democratic and cultural view, 2008). In a similar way Czerniewicz, Deacon, Small, & Walji (2014) argue to overcome the danger that "the current hegemony of western knowledge systems is further entrenched across the world". The authors claim that the deviation from Open Educational Resources (OER) to open courses, which can be consumed and not adapted, is a very dangerous step from a development perspective.

Social Networking in the development context

Marten van de Laat, Fleur Prinsen

Social interaction is a basic human need (Ryan & Deci, 2000). People strive for contact and therefore build and maintain relationships, whether it is to find a place to live, get a new job, share interests and hobbies, etc. People develop interconnected relationships that provide support, shared risks, trust, access to information and knowledge (De Laat, 2012). These relationships result in an open and engaging social "*web*" that facilitates learning, development of professional capital, and how things get done (Christakis & Fowler, 2009; Cross, Parker, & Sasson, 2003; Cross & Parker, 2004; Hargreaves & Fullan, 2012; Thomas & Seely Brown, 2011; Villegas & Reimers, 2003).

In other words, social networks are configurations of connectivity that exist when people interact with each other by communicating, sharing resources, and working, learning or playing together, supported through face-to-face interactions and through the use of information and communication technology (Haythornthwaite & De Laat, 2011). The implications of these social relations for learning are the object of networked learning research (Goodyear, Banks, Hodgson, & McConnell, 2004; Haythornthwaite & De Laat, 2011; Lieberman & Wood, 2002). Networked learning is often defined as "learning in which information and communication technology (ICT) is used to promote connections: between one learner and other learners; between learners and tutors; between a learning community and its learning resources" (Goodyear, Banks, Hodgson, & McConnell, 2004, p. 1).

Research on social networking attempts to better understand how people develop the ability to gain access to shared resources, ask for help and develop collaborations; how people develop the ability to create or participate in social spaces that contribute to working and learning. Much of this research takes place in contexts where informal learning happens. Informal learning happens from the bottom up. It covers learning that happens in a more or less unplanned fashion, fuelled by spontaneous interactions and incidents that require learning to solve them. This type of learning is relational rather than isolational (Lave, 2012), and it is inherently a social activity (Lave & Wenger, 1991; Wenger, 1998) driven by networking and participation in communities.

An argument which is mentioned repeatedly concerning the introduction of innovations (like mobile learning and Open Educational Resources) in developing contexts, is that innovations need to take existing (local) social learning practices and local learning needs into account (e.g., Sey, 2011); leveraging and supporting them but also specifically involving local communities in the educational design process (Czerniewicz & Carr, 2005; Luijendijk & Meija-Velez, 2005; c.f. Avgerou, 2010; Leach, 2008). More than merely ensuring that useful and relevant learning resources exist, are advertised and are accessible, research should also address the open practices around its use. Appropriate approaches to studying social networking include, for instance, user-centered, participatory or action-oriented research approaches (Steeples, 2004), because these approaches can bring distributed people together around common needs and problems; they present the knowledge and experiences of all involved as resources, and validate their experiences.

Luijendijk and Meija-Velez (2005) similarly argue that innovations must be approached as processes of interplay among actors employing relevant social practices. They suggest that considerable investments should be made in improving networking and learning among relevant development actors, also across developing regions, so they can play a strong role in shaping the ideas and knowledge that determine their future.

Learning Analytics for Developing Countries

Hendrik Draschler

Learning Analytics involves the use of data to inform decision-making entities in education and training. In that sense it is not a new field, but the new quantity of data that is available in machine-readable formats makes Learning Analytics an instrument to monitor and steer modern educational systems that are based on electronic systems to an increasing extent.

Those electronic systems make it possible to automatically follow educational stakeholders (students and teachers) and harvest learning data at previously unimagined levels of granularity and variety. The analysis of the data has the potential to provide insights into the actual learning process and patterns of behavior, which allows for on-demand reflection and feedback for individuals but also for educational institutes.

A good introduction into Learning Analytics has been provided by Greller & Drachsler in 2012. They created a Learning Analytics framework that is well received on a global scale to start Learning Analytics activities. The framework presents technological and educational aspects of Learning Analytics in the following six dimensions: 1. *Stakeholders*: the contributors and beneficiaries of Learning Analytics, 2. *Objectives*: set goals that Learning Analytics wants to achieve. 3. *Data*: the educational datasets and the environment in which they occur, 4. *Methods*: technologies, algorithms, and theories that carry Learning Analytics, 5. *Constraints*: restrictions or potential limitations for anticipated benefits. 6. *Competences*: user requirements to exploit the benefits (refer to Figure 8).

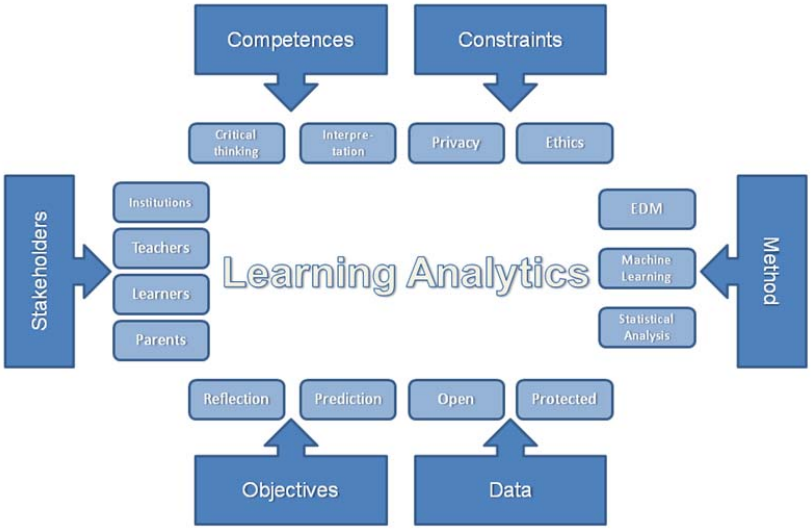


Figure 8. Learning Analytics Framework by Greller and Drachsler (2012).

Most of the initial activities in Learning Analytics were based in North America, while the expertise in Europe was mostly limited to a small number of groups. Europe is addressing this issue by funding dedicated Learning Analytics projects for various target groups. One of those projects is LACE, a community support action initiative, which focuses on collecting evidence around the use of Learning Analytics in Europe (http://laceproject.eu). One of the outcomes of LACE is an Evidence Hub (http://evidence.laceproject.eu/). It gathers evidence related to advantages and disadvantages of Learning Analytics and relates these to a set of propositions. The Evidence Hub is designed to create different insights into positive and negative effects of Learning Analytics by gathering and grouping the

evidence. Interested adopters from developing countries can explore the evidence base and benefit from the vast collection of lessons learned from research conducted in European countries. They can also contribute new insights about their own Learning Analytics research that starts to emerge (Protonotarios et al., 2013).

Among research outcomes published in the evidence hub, developing countries can take advantage of tangible tools such as various open source software solutions that are available. The list that follows provides some examples of Learning Analytics tools that are available as open source solutions:

LEMO[1]

The LeMo project (monitoring of learning processes on personalizing and non-personalizing learning management systems) aims to develop a prototype of a web-based Learning Analytics application, which provides detailed information on user navigational patterns within learning management systems and identifies needs for enhancement and revision of the learning offer. With some minor adjustments, the LeMo application can be used in different learning management systems. A special feature is that data analysis can be done independently of the respective platforms and can hence be done across different platforms that can then be compared.

SNAPP[2]

SNAPP is a software tool that allows users to visualize the network of interactions resulting from discussion forum posts and replies. The network visualizations of forum interactions provide an opportunity for teachers to rapidly identify patterns of user behavior - at any stage of course progression. SNAPP has been developed to extract all user interactions from various commercial and open source learning management systems such as BlackBoard® (including the former WebCT®), Moodle® and now Sakai®.

Metadata specification for Learning Analytics

Learning Analytics increased the need to collect data from different learning systems into analytics systems. Two competing metadata standards have been specified in order to facilitate this process: the xAPI from Advanced Distributed Learning (ADL)[3] and the Caliper framework[4] from the IMS Global Learning Consortium. Both specifications make it possible to collect data on the wide range of learning systems (desktop and mobile systems). They capture data in a consistent format by following an activity stream format of Actor-Verb-Object and by using a simple vocabulary.

As developing countries are widely penetrated by mobile devices with a fast-growing market around it (Deloitte, 2012), a successful uptake of Learning Analytics within those countries might need to address this particular characteristic. The above-mentioned metadata specifications might be key to this development as they enable the combination of desktop systems with mobile devices. New mobile technologies based on those standards could contribute to building a competitive and sustainable ICT industry for specific requirements of developing countries. It could also promote innovation and new solutions that are of interest beyond the developing country markets and attract customers worldwide.

[1] http://www.lemo-projekt.de/lemo-projekt/?lang=en

[2] https://confluence.sakaiproject.org/pages/viewpage.action?pageId=84902193

[3] http://www.adlnet.gov/tla/experience-api/

[4] http://imsglobal.org/caliper/index.html

Open Linked Data

Slavi Stoyanov

This section outlines the possibilities of using Open Linked Data, a recent technological development, for improving the education in developing countries. The information is taken from LinkedUp, an EC funded project (http://linkedup-project.eu/). The project organizes competitions, called Veni, Vidi and Vici, to stimulate development of applications that use open linked data for educational purposes. Open Linked Data tries to connect educational data that is not connected yet, or if connected, the interface is not yet user-friendly in order to invite teachers and students to apply it. As the Veni competition asked for early prototypes, the examples referred to here are selected from the Vidi and Vici completions. The Vici challenge, in addition to the open track, included two focused tracks on developing countries, namely: (a) focus track "Supporting Education in Developing Countries" and (b) targeted content track "Water Resources and Ecology". The targeted content track was indirectly and loosely related to education. It was seeking "enhancing journal article content along with related research statistics and datasets to assist in discovery, learning and interpretation of disparate content and data". The "Supporting Education in Developing Countries" track needed to address challenges that were identified at the Making it Matter Workshop, such as:

- Requirements for multilingualism of educational resources;
- Ease of access to contents and materials;
- Localization approaches to resources;
- Quality of OERs and their discoverability;
- Training for teachers;
- Better interaction with commercial education providers;
- Enhancement of local open data ecosystems;
- Use of low-tech and / or low-resource mobile devices.

More details from the Making it Matter Workshop are available at http://linkedup-challenge.org/vici-focused-tracks/

One of the requirements of the focused tracks on developing countries was that the technology can still be used in situations with limited or no Internet access (for example, by using caching) and that low bandwidth suggests the need for server-side solutions and thin clients. Thin clients will most likely be mobile phones. Unfortunately the call attracted little attention among researchers and developers - only two submissions were received compared to 13 for the Open Track and they were not very relevant for the purpose of this report (one for Electronic Repository for Russian Historical Statistics (http://linkedup-challenge.org/vici/#russian) and Visualizing Research Works in the Water Resources Industry (for more details visit: http://linkedup-challenge.org/vici-focused-tracks/).

Some of the applications submitted to the open tracks of the Vidi and Vici challenges could be used for education in developing countries. Some of them are briefly described in the space below.

TuvaLabs (Parikh, Patel, Farahmand, & Pandey; for more details visit: https://www.tuvalabs.com) proposes different domain-specific datasets to support teachers in designing inquiry-based lessons for different grades, promoting data literacy and self-regulated learning among students. It is a learning environment where teachers can create a class registering their students, where they can select learning activities, obtain professional support and participate in a community of practice.

Solvonauts (Pat Lockley: http://solvonauts.org/). The author claims that it is the only open source, open educational resource (OER) search engine which returns only public domain licensed educational materials. Their ambition is that people anywhere can organize and maintain a list of open resources and then share them with the world, allowing different communities and organizations to express how they want to use open learning content.

LODStories or Learning About Art by Building Multimedia Stories (Chen, Liu, Maulik, Xu, Zhang, Knoblock, Szekely, & Van der Sande; http://goo.gl/XIZhbJ) is an application where students can learn about art while constructing multimedia stories about it. LODStories mines the Linked Open Data cloud to discover interesting connections between different art entities - artworks, artists and places. LODStories guides users to construct a storyboard that connects these entities (text, images and videos) and users can arrange them to create and publish a multimedia story.

Rhizi.net (Garbash, Rotbart, Zeng, Fong, Edstrom, Cole, Fong, Ben Dov; http://rhizi.org) is web-based software to facilitate making and visualizing the online connections between learning materials (a paragraph from a blog, research data, a video segment, or people) through a knowledge graph. The connections can be shared with a community, peer-reviewed, visualized and "followed". Rhizi's connections are built collaboratively to stimulate students, teachers, and researchers, to create, share, and explore open learning materials in new ways. Rhizi provides open analytics so both teachers and students can see where and how they interact, and which learning materials were discussed.

FLAX, Flexible Language Acquisition with Linked and Open Data-Driven Learning (Wu, Fitzgerald, & Witten; http://flax.nzdl.org) looks at Open Data, Open Educational Resources (OERs) and Open Access (OA) research publications as sources for language learning. OERs and OA publications provide large corpora of linguistic material (including text, supplementary images (slides), audio and video) relevant to particular subject areas. Such domain-specific corpora can be automatically analyzed and enriched by establishing links to larger open linguistic datasets.

Didactalia net: Building and Taking Advantage of Large Educational Knowledge Graph to Improve and Accelerate the Teaching-Learning Process (Maturana, Moreno, Alvarado, & Lopez; http://www.didactalia.net/en) is a large collection of educational resources (85,000) for all educational levels from pre-school to higher education. This number is even bigger as Didactalia also includes resources from community members of the Didactalia Ecosystem (82,770). The Ecosystem aggregates, structures and links content from different sources that are reused for educational purposes. It provides searches and the results can be visualized as a knowledge graph. It could be particularly useful for Spanish-speaking developing countries as the software was developed initially to serve students, teachers and parents in Spain.

Mobile and Seamless Learning

Marcus Specht

One of the main developments of technology in the past decade is the miniaturization of mobile handheld computers with the capability of real-time data communication, access to massive computing power via cloud-based server capacity, and the integration of sensor technology with modern smartphones and wearable computing devices.

Based on these developments mobile learning supports learning anywhere, anytime, and with any device, to an increasing extent. Mobile learning has a history that has evolved from a techno-centric perspective towards a strong focus on the mobility of the user and connection between his varying learning contexts and formal, non-formal and informal learning activities (Traxler, 2009). Mobile devices are used in different roles for supporting learning either as personal hubs to learning resources (Tabuenca, Drachsler, Ternier, & Specht, 2012), multi-media recorders for documentation of learning processes and authentic data collection (Kravcik, Kaibel, Specht, & Terrenghi, 2004; Mikroyannidis et al., 2013), mobile social media terminals to connect with learning peers (Jong, Specht, & Koper, 2008), or to access filtered information for the current environment of the user (Zimmermann, Lorenz, & Specht, 2005). In 2014, for the first time ever, there were more phones on earth than actual human beings.

The research in mobile learning is based on educational theories like Situated Learning (Brown, Collins, & Duguid, 1989; Lave & Wenger, 1991), Anchored Instruction (Bransford et al.), Distributed Cognition or Seamless Learning. A comprehensive overview of the research field of seamless learning and ongoing research was recently published in Wong, Milrad, & Specht (2015).

Currently the main research questions in mobile and seamless learning develop around the smart and effective use of mobile applications and smartphones in individual and collaborative learning, the orchestration of different digital services and learning support in multi-device scenarios, and the connection of formal and informal learning with personal learning environments or in inquiry-based learning settings.

Serious games for developing countries

Wim Westera

For many decades the engaging properties of games have been used for learning and other serious purposes (Apt, 1970). These so-called serious games cover a wide range of domains, objectives, approaches and styles, as to meet specific educational requirements and address diverse target audiences. Games have demonstrated to provoke active learner involvement through exploration, experimentation, competition and cooperation. They support learning because of increased visualization and challenged creativity. In the past decade the popularity of digital / computer games and game technology worldwide drove renewed interest in applying games for learning purposes (Westera et al., 2008). Also, the potential of games for developing countries is widely recognized (Kolko & Putnam, 2009).

Two influential mechanisms can be distinguished for seizing the opportunities. Firstly, games can be used directly for educational purposes in the developing countries. Secondly, games about developing countries can be used in the developed world for raising awareness, thereby indirectly influencing public opinions, attitudes and knowledge of the developing world.

The direct mechanism: using games for education in developing countries

Kolko and Putnam (2009) consider games a pivotal piece of a developing country's computerization, how its population gains skills related to information and communication technology (ICT), and how ICTs begin to diffuse in developing world contexts. Among very few educational gaming initiatives, the Mindset Network (South Africa) should be mentioned, which uses mobile phone-based games to teach math skills to girls (Mathstermind and Fashion Network). Another example would be literacy and numeracy games for disadvantaged youth, developed by Pratham (www.pratham.org) in India. The impact of using games in education is considerable. Impact evaluations of early childhood development programs using games demonstrated reduced dropout rates among school children and higher test scores (IIIE, 2013). UNESCO offers a wide range of educational games, be it not exclusively targeting developing countries. An educational example in the domain of health and lifestyle would be from Changemakers (changemakers.net), which uses games on mobiles for raising awareness among young people in various Asian and African countries, in connection with positive and negative behavior related to HIV / AIDS. Advanced technologies, such as speech recognition, which become available on modern smart phones, are being used to an increasing extent for educational purposes. Kumar et al. (2012) successfully used speech recognition features for a mobile game to help rural, low-income children in India read words with comprehension. Nevertheless, not all game initiatives in developing countries are driven by the motives of international aid or charity. The world's leading game industries like Nintendo target developing markets for commercial purposes, to an increasing extent, by launching region-specific hardware for players in lower income countries (Kamen, 2014) or even abandon their own console platform and embrace smartphones for game delivery in order to reach out to larger user groups (Byford, 2015). Still, such commercial activities may help establish and amplify the gaming market in developing countries, including educational gaming.

The indirect mechanism: raising awareness in the developed world

Most initiatives in this area are from non-governmental organizations, such as Games for Change and Oxfam. These organizations use games with explicit pro-social goals in mind, e.g., poverty, world peace, hunger, pollution, climate, gender, discrimination, and many more. For example, "Darfur is Dying" (Games for Change) allows players to experience the problems encountered by 2.5 million refugees in the Darfur region of Sudan in the middle of a military conflict. Players are responsible for the functioning

of their refugee camp in the face of possible attack by Janjaweed militias. They learn about the genocide in Darfur and are challenged to stop this human rights and humanitarian crisis. Likewise, Oxfam has developed a Game for Change on the conflict in Darfur (Refugees Realities). Award winning "Third world farmer" is a game about poverty. Players have to manage a small farm and will experience the hardships and dilemmas faced by the poor, such as corruption, trade barriers, armed conflict, and lack of education, sanitation, infrastructure and economic stability. Many of these games target children in the developed world.

3. Group Concept Mapping study

The desk research which was carried out 'indirectly' identified themes about innovative use of ICT in education in developing countries. The integration of those findings was done by researchers representing developed countries. These expert views, although more targeted, were still based on literature and experiences accumulated in the developed world. Both the desk research and the expert opinions delineate the diffusion discourse on using ICT in the education in developing countries (Avgerou, 2010). The Group Concept Mapping (GCM) described in this chapter empirically identifies and prioritizes themes relating to ICT-enabled innovative teaching and learning gleaned from experts from developing countries directly. In this respect the GCM operationalizes the social embedded perspective on innovative uses of ICT in the education of developing countries (Avgerou, 2010).

Definition

Group Concept Mapping (GCM) is a research methodology that facilitates a group of people to arrive at a shared vision regarding a particular issue (e.g., what are issues, challenges and opportunities for innovative uses of ICT for education in developing countries). The participants are involved in activities they are used to: generating ideas, sorting ideas into groups and rating ideas on some values (e.g., importance and feasibility). While the participants generate, sort and rate ideas individually two advanced multivariate statistical techniques - multidimensional scaling (MDS) and hierarchical cluster analysis (HCA) - aggregate the individual input to identify patterns in the data and show a common understanding of the group on the issue under investigation. GCM differs from other methods for collecting and analyzing opinions (interviews, questionnaires, Affinity Diagram, Delphi, collective classical concept mapping) in three substantial ways. Firstly, the participants, not the researchers, generate and structure the ideas. Secondly, the methodology implements some advanced multivariate statistics (e.g., Multidimensional Scaling and Hierarchical Cluster Analysis) that objectively identity emerging patterns in the data. Thirdly, the methodology presents the results in visual formats (conceptual maps, pattern matches and go-zones) that are easy to grasp for further interpretation and implementation into practice.

All activities included in the GCM study were carried out within a web-based environment, created specifically for this project (Scoping Concept System Global Max, 2014).

Participants

Thirty-one experts form developing countries participated in the idea generation. Of them 25 started the sorting, 17 finished it but the data from one of them was unreliable and excluded from the analysis. 20 started the rating on importance, 17 finished it. Of 18 participants who started the rating on feasibility, 16 completed it. The participants in the workshop were 18 experts from different developing regions as follows: 8 from Asia, 5 from Africa and 5 from Latin America. Eight associated themselves with education, 6 with research, 2 with policy and 2 with advocacy.

Procedure

The procedure included the following steps:

1. Online idea generation. The participants were asked to brainstorm as many ideas as possible, completing the following focus prompt: "One specific issue, problem, challenge or opportunity concerning ICT-enabled pedagogical innovations that transforms education in developing countries is…"

1. Idea synthesis. The purpose of the idea synthesis phase is to: obtain a list of unique ideas, with only one idea represented in each statement; ensure that each statement is relevant to the focus of the project; reduce the statements to a manageable number for sorting and rating; ensure that statements are clear and understandable across the entire stakeholder group; not prioritizing, selecting on perceived value, or deleting unpopular ideas. Idea synthesis was conducted by a small group of three researchers.
2. Sorting of the ideas. Grouping ideas on similarity of meaning and giving each group a name.
3. Rating of the Ideas. Rate the ideas on two values: (a) how important it is to research an issue, challenge, or opportunity of using ICT for education in developing countries; and (b) how feasible it is to carry out research on that issue, challenge or opportunity.
4. Analysis of the data applying MDS, HCA, correlation and descriptive statistics (conducted by researchers).
5. Interpretation of the results. The results from the analysis were presented back to the participants at the workshop in Amsterdam. They worked in small groups to further conceptualize the data and refine the scope of the research agenda (refer to Appendices C and D).
6. Utilization of the results. Implementing the findings and their interpretations in defining research agenda and call for research proposals.

Results

Idea generation

The participants produced 131 ideas during the idea generation phase. These ideas were subjected to idea synthesis, which reduced their number to 97. The ideas were then sent back to the participants for sorting and rating.

Data analysis

Figure 9 shows the first output of the MDS - a point map. The points represent the 97 ideas that were generated. Some of the ideas are closely related (e.g., 20 “School teachers and university lecturers struggle to understand the affordances of technology and when to use them for which pedagogic purposes” and 74 “Many teachers, when getting into ICT-based education, replicate what they do in face-to-face learning, in the new digital environment”), which means that the group of participants had put them together more frequently. The closer the ideas are related to one another the closer they are in meaning. In contrast, statement 22 (“A need (and opportunity) to use design-based research / educational design research as the methodology for pedagogical innovation in developing regions, to enable effective, evidence-based practice as well as the building of sound theory”) and statement 25 (“Lack of sustainability of the infrastructure and slowness or inability to upgrade infrastructure in a timely fashion reduces effectiveness of teaching and learning opportunities”) are far away from each other, indicating that they had rarely been grouped together and suggesting different meanings. Statement 70 “A need (and opportunity) to use Amartya Sen’s capability approach as an ethical and conceptual framework for the planning and evaluation of pedagogical innovations in developing regions” is in the middle of the map because it has been grouped together with statements that are in different areas.

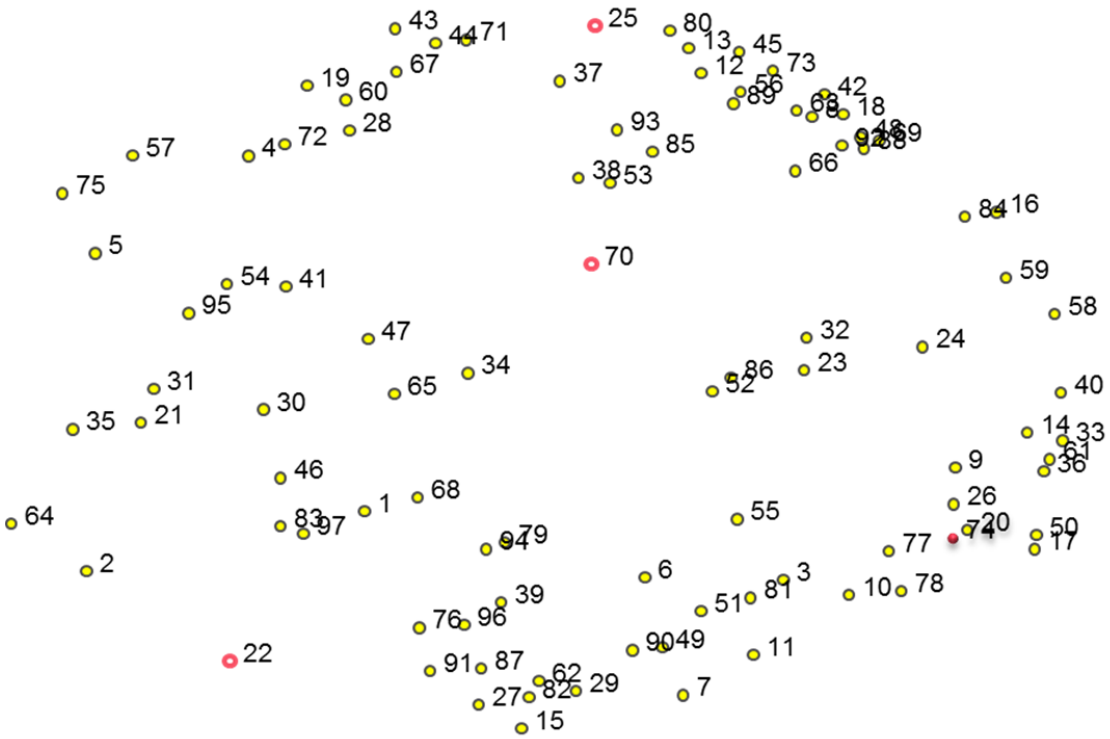


Figure 9. Point map

Identifying themes

The next step of making sense from data is drawing borders around the ideas that are close to each other, thus suggesting a common theme. Hierarchical cluster analysis (HCA) identifies these thematic areas in an objective way on the MDS configuration. The question, however, is how many groups of ideas should there be? In principle, there is no right or wrong number of clusters. The selection depends on the goal and context of the study. Within the analysis section of the GCM web-based environment there is a tool that simulates different numbers of solutions and suggests which clusters could merge at each step (the so called “replay map”). Typically we start with 20 cluster solutions until we reach 5 (a practical heuristic based on research and practice with GCM - Kane and Trochim, 2007). A recent meta-analytical study (Rosas and Kane, 2012) suggested reducing the number of steps from 16 to 5 (refer to Figure 10 and Figure 11).

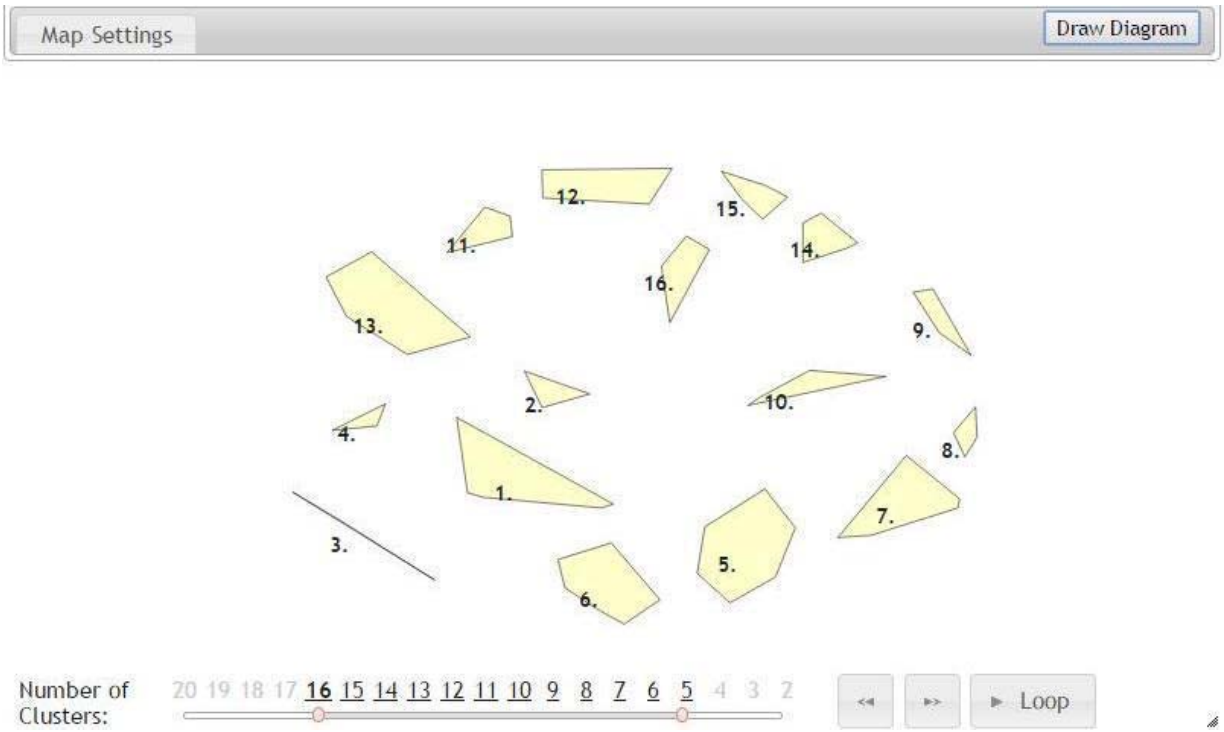


Figure 10. Replay map 16 clusters

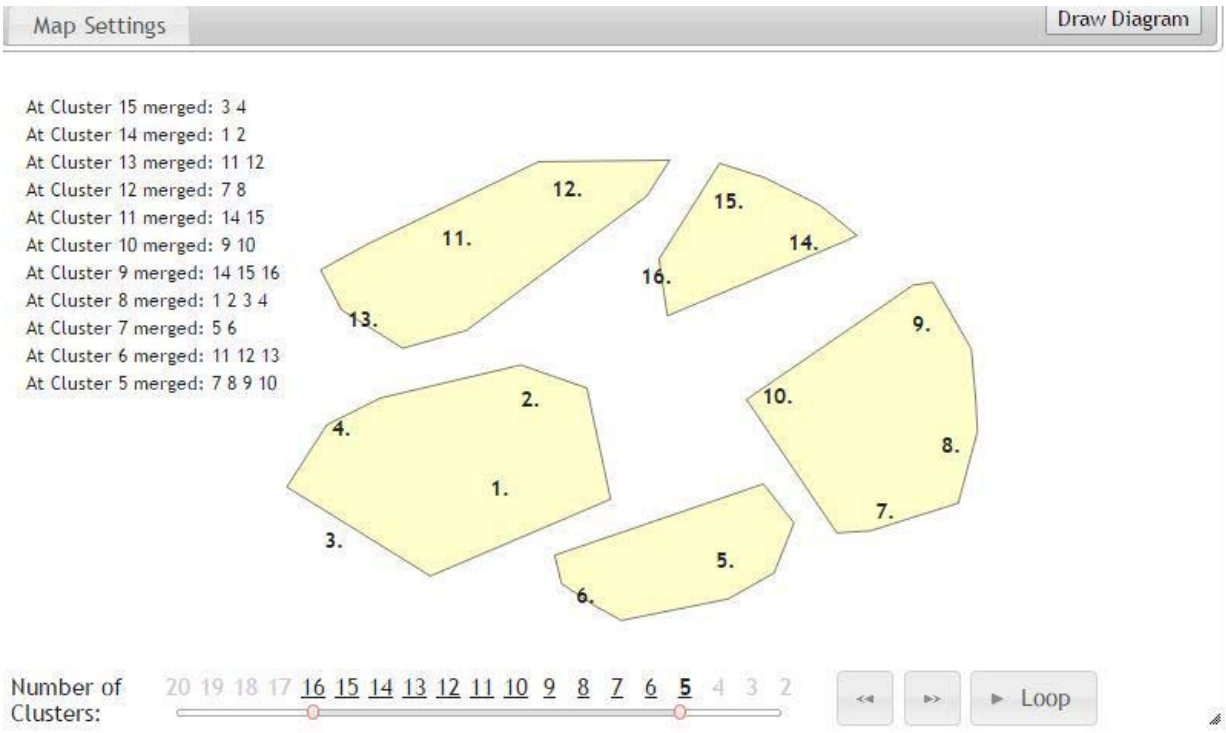


Figure 11. Replay map 5 clusters

A checklist with suggestions for merging clusters was prepared and three researchers were asked to look at them. The options were “Agree”, “Disagree” and “Undecided”. It turned out that the three researchers consensually disagree on the first suggestion to merge clusters. This implied that we needed to keep the detailed 16-cluster solution at the start (refer to Figure 12). The statements in each cluster are presented in Appendix A.

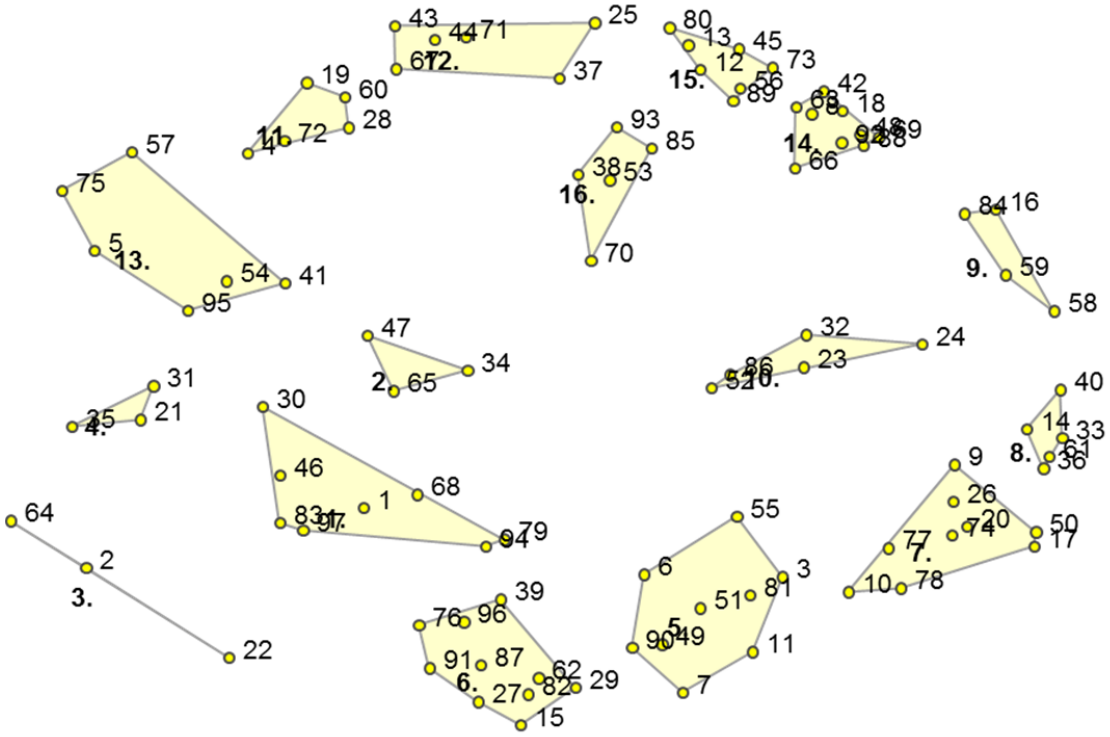


Figure 12. 16-cluster solution

As we also asked the participants to not only sort the ideas but also to name the groups they made; labels were attached to the clusters. In principle, there are three ways of labelling the clusters: (a) by looking at the content of a cluster (ideas in it); (b) by looking at the bridging value of the statements in a particular cluster[5]; (c) by looking at the suggestions given by the software[6]. We used the last option for presentation purposes (refer to Figure 13).

[5] MDS assigns a bridging value to each statement, which is between 0 and 1. A low bridging value means that a statement has been group together with statements around it. A high bridging value means that the statement has been grouped with statements further apart. Statements with a low bridging value are a better representation of a particular cluster.

[6] The software provides the 10 most representative titles for a cluster as given by the participants. How this is achieved technically is not included in the scope of this report.

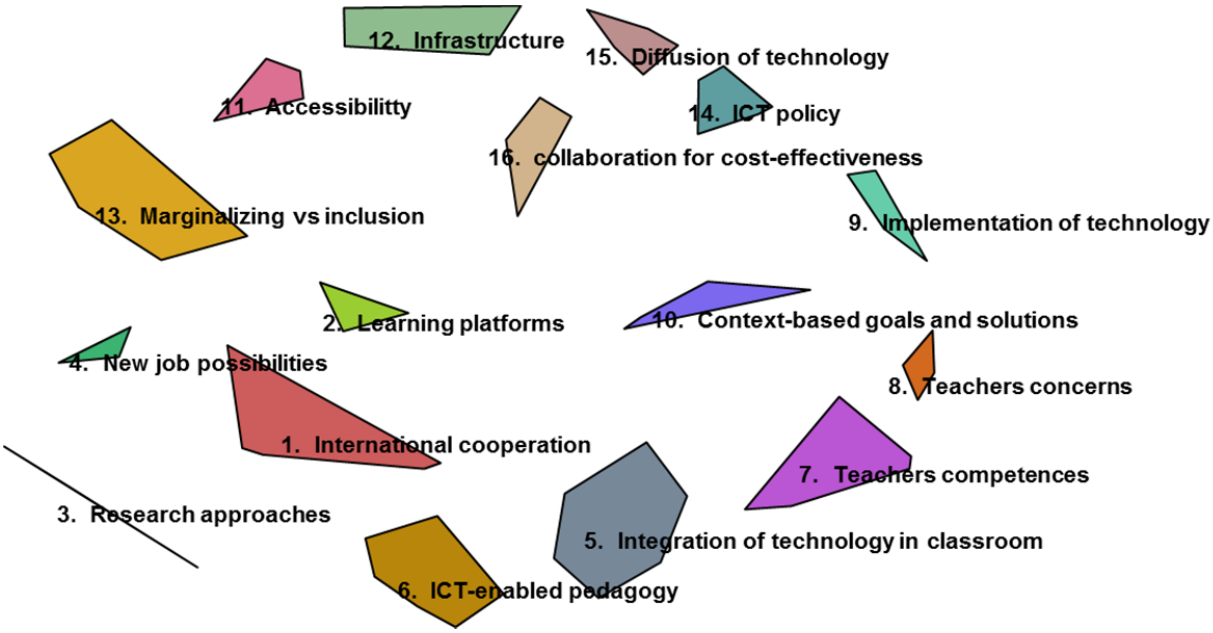


Figure 13. Clusters labelled

Although HCA suggested a 16-cluster solution, clusters could further be grouped into more general categories during the interpretation of the results. For example, clusters 5 and 6 could go together. They are about technology-enhanced learning and teaching strategies. Clusters 7 and 8 are about teacher training in the use of ICT. Clusters 14, 15 and 16 contain statements on ICT policy for education. Clusters 11 and 13 refer to different aspects of the digital divide issue. It is perhaps useful to mention that according to this group of participants, pedagogical issues (e.g., clusters 5, 6, 7 and 8) are not related to policy (e.g., clusters 14, 15 and 16), digital divide (e.g., clusters 11 and 13) and infrastructure (cluster 12) issues. These groups of clusters are far away from each other. In the GCM methodology, distances matter - in terms of individual statements and clusters.

Although the analysis of the rating data is considered secondary for the GCM methodology, it could provide some additional insights. As Figure 14 shows, some clusters score the highest on importance, with 5 layers each (e.g., clusters 3, 4, 5, 6 and 7), while others (e.g., 9, 10, 11, 14, 15 and 16) have only one layer. Also refer to Appendix B for ratings of the statements and clusters. The visualization shows the relative importance of one cluster to the other but does not indicate whether a significant difference between the clusters' means exists. T-tests were performed and a significant difference between the means on importance of the following clusters was found: 'Integration of technology in classroom' ($M = 3.96$; $SD = 0.26$) and 'ICT policy'($M = 3.52$; $SD = 0.42$); $t(16) = 2.63$, $p < .02$); 'ICT-enabled pedagogy' ($M = 4.26$; $SD = 0.15$) and 'Accessibility' ($M = 3.55$), $t(13) = 3.59$, $p < .05$; 'ICT enabled pedagogy' ($M = 4.26$; $SD = 0.26$) and 'Infrastructure' ($M = 3.98$; $SD = 0.29$); $t(14) = 2.26$, $p < .05$; 'ICT-enabled pedagogy' ($M = 4.26$; $SD = 0.15$) and 'ICT policy' ($M = 3.52$; $SD = 0.42$), $t(17) = 4.93$, $p < .001$; 'ICT-enabled pedagogy' ($M = 4.26$; $SD = 0.26$) and 'Diffusion of technology' ($M = 3.61$; $SD = 0.39$), $t(15) = 4.22$, $p < .001$; 'Teachers competences' ($M = 4.18$; $SD = 0.09$) and 'ICT policy' ($M = 3.52$; $SD = 0.42$), $t(16) = 4.52$, $p < .001$; and 'Teachers competences'($M = 4.18$; $SD = 0.09$) and 'Diffusion of technology' ($M = 3.61$; $SD = 0.39$), $t(14) = 3.8$, $p < .002$. The pedagogical clusters such as 'ICT-enabled pedagogy' and 'Teacher competences', are not only unrelated to but they are rated significantly higher on important than the clusters about policy and infrastructure.

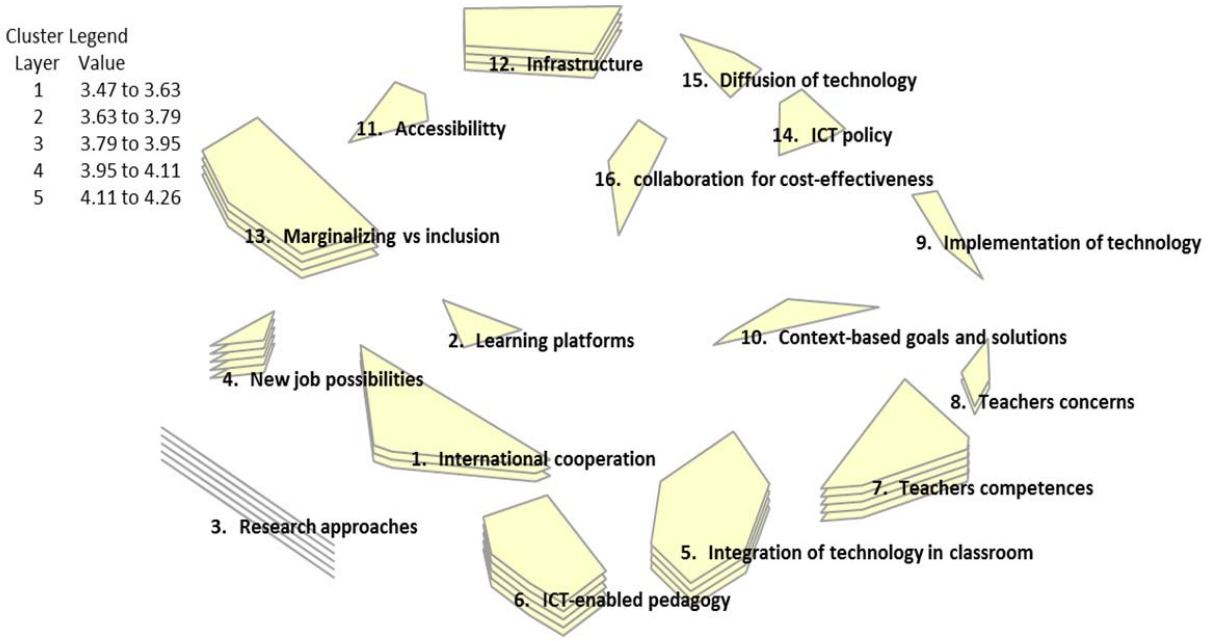


Figure 14. Cluster rating map on importance

In general, the clusters score lower on feasibility than on importance. Cluster 7 'Teacher competences' again displays 5 layers. Cluster 8 'Teacher concerns', which scored relatively low on importance (2 layers), gets a 5 on feasibility (refer to Figure 15). There is a significant differences between some clusters on feasibility: 'Teachers competences' (M = 3.67; SD = 0.17) and ' Infrastructure' (M = 3.42; SD = 0.19), $t(13) = 2.73$, $p < .02$; 'Teachers competences'(M = 3.67; SD = 0.17) and 'ICT policy' (M = 3.23; SD = 0.43), $t(16) = 3.73$, $p < .002$; 'Teachers competences' (M = 3.67; SD = 0.17) and 'Diffusion of technology' (M = 3.35; SD = 0.25), $t(14) = 2.97$, $p < 0.02$; 'Teachers concerns' (M = 3.36; SD = 0.33) and 'Diffusion of technologies' (M = 3.35; SD = 0.25), $t(14) = 2.68$, $p < .05$; 'Teachers concerns' and 'ICT policy' (M = 3.23; SD = 0.32), $t (12) = 3.32$, $p < .01$. This suggests that the issues depicted through the statements in the clusters about teachers, that scored high on feasibility, should much easier be dealt in contrast to clusters that score lowest on feasibility such as 'Infrastructure, 'ICT policy' and 'Diffusion of technology' . Similar conclusions should be made in regard to other clusters that score low on feasibility, although no significant differences was found.

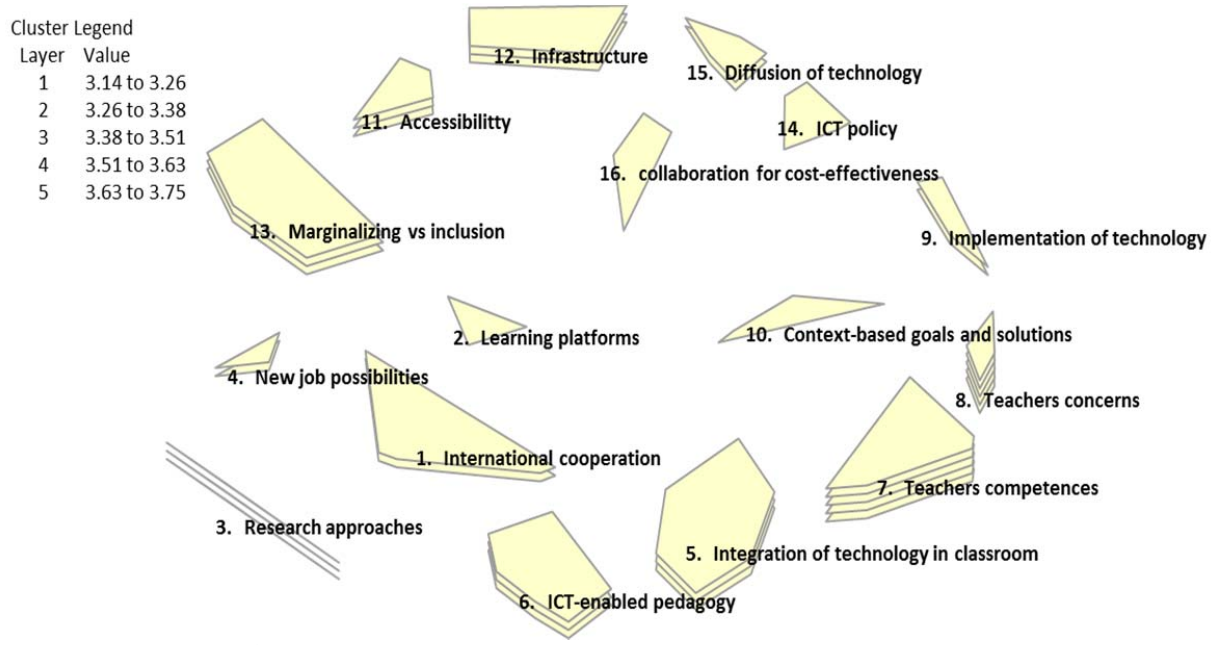


Figure 15. Cluster map on feasibility

The ratings of the clusters on importance and feasibility can be compared on a ladder graph called pattern match (refer to Figure 16). As is evident, the 'ICT-enabled pedagogy' cluster is on top in terms of importance but gets a relatively low rating for feasibility. In contrast, the 'Teacher concerns' cluster is at the top of the feasibility ranking, but relatively low on importance.

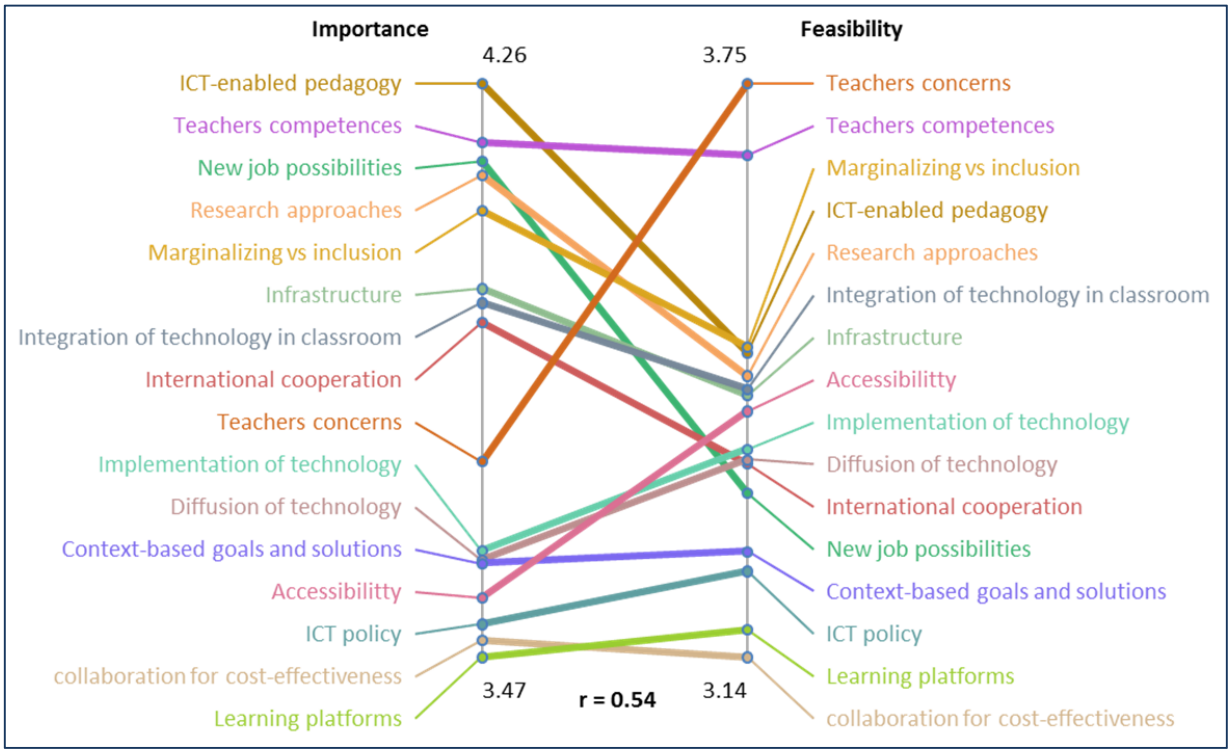


Figure 16. Pattern match Importance vs Feasibility

A significant differences was detected between the scores on importance and feasibility of some of the clusters: 'ICT-enabled pedagogy' (M_{imp} = 4.26; SD = 0.15; M_{feas} = 3.46; SD = 0.2), t(18) = 10, p < .002; 'Integration of technology in classroom' (M_{imp} = 3.96; SD = 0.26; M_{feas} = 3.42; SD = 0.31), t(16) = 3.92, p < .002; 'Teachers competences' (M_{imp} = 4.18, SD = 0.09; M_{feas} = 3.67; SD = 0.17), t(16) = 8.01, p < .001; 'New job possibilities' (M_{imp} = 4.16, SD = 0.25; M_{feas} = 3.31; SD = 0.1); t(4) = 5.48, p < .01.

Pattern match can also show how different developing regions differ in terms of cluster ratings (refer to Figure 17, Figure 18, Figure 19, Figure 20, Figure 21 and Figure 22). These regional pattern matches were not used during the workshop; they are presented here for illustration purposes only.

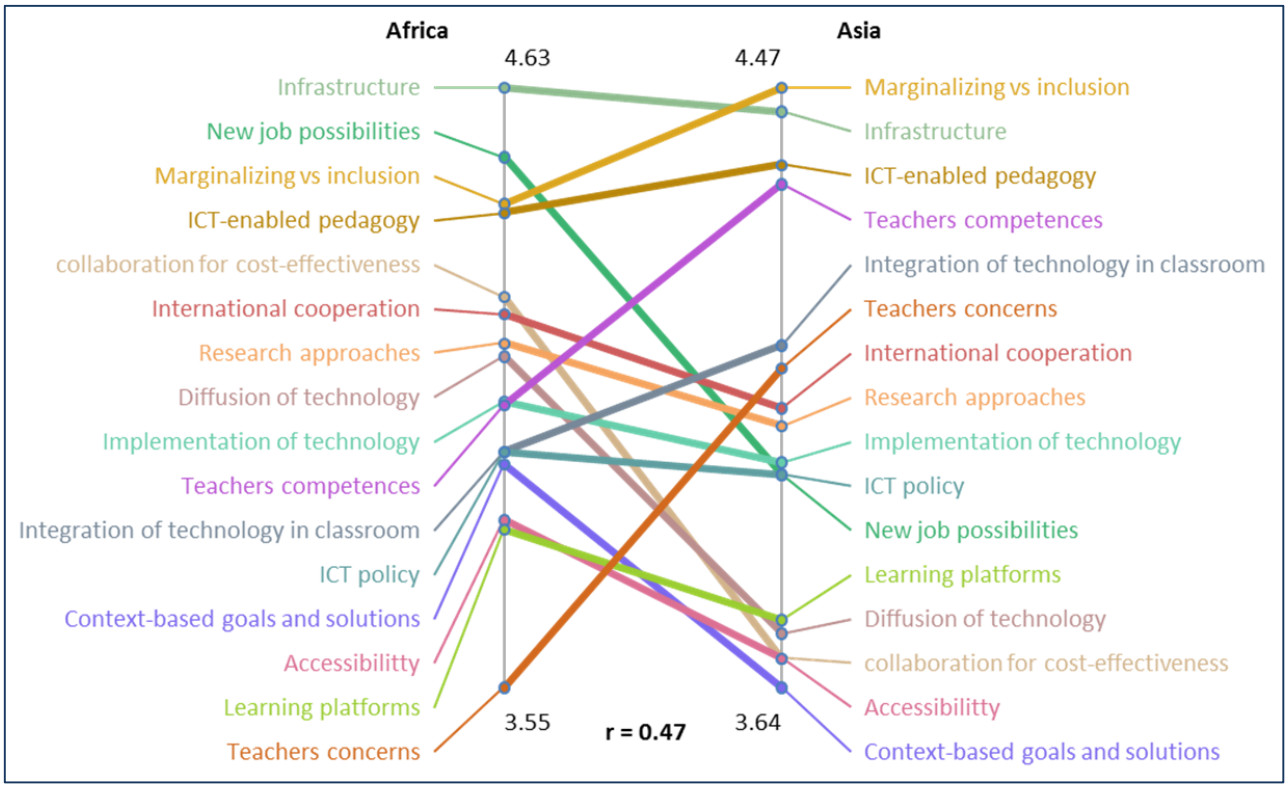


Figure 17. Pattern match Africa vs Asia on importance

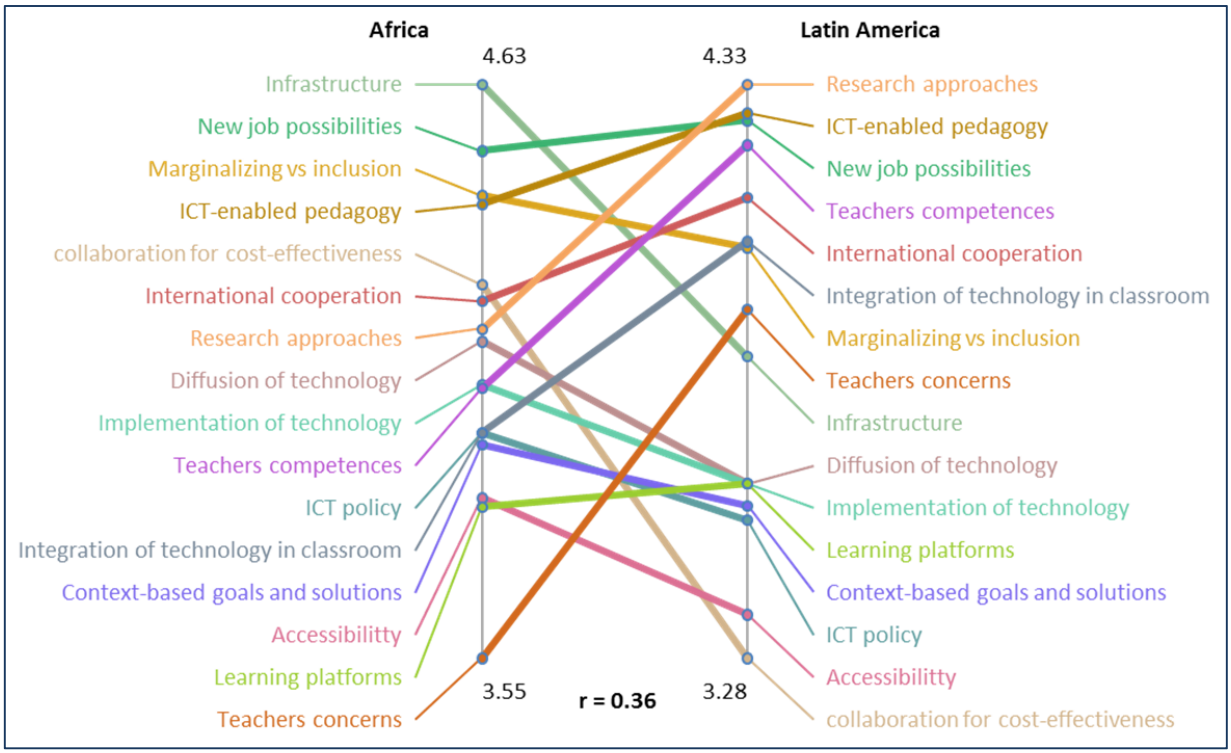


Figure 18. Pattern match Africa vs Latin America on importance

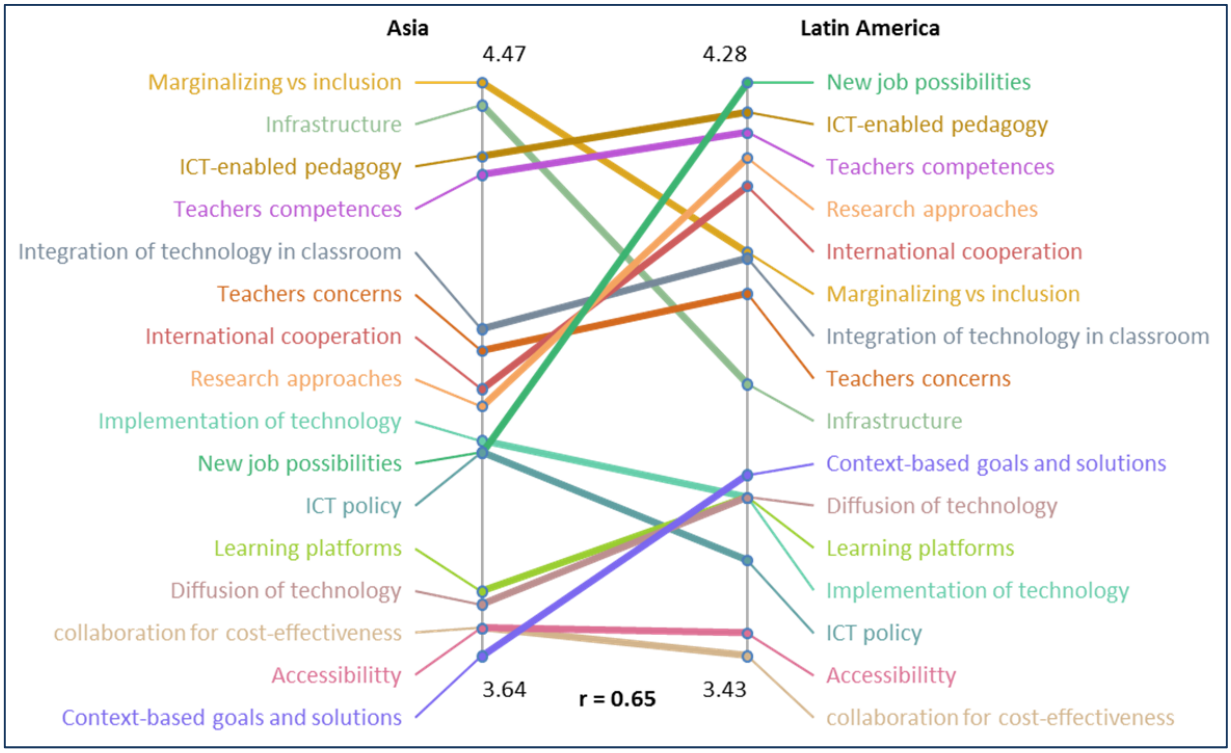


Figure 19. Pattern match Asia vs Latin America on importance

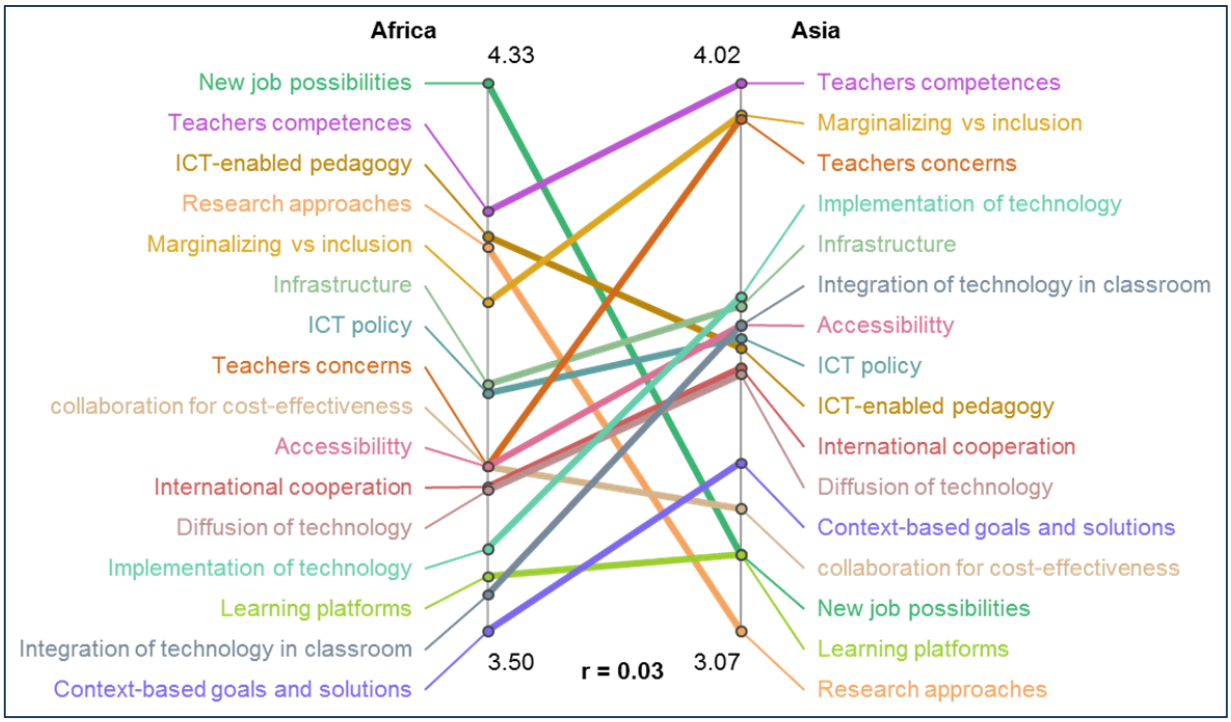


Figure 20. Pattern match Africa vs Asia on feasibility

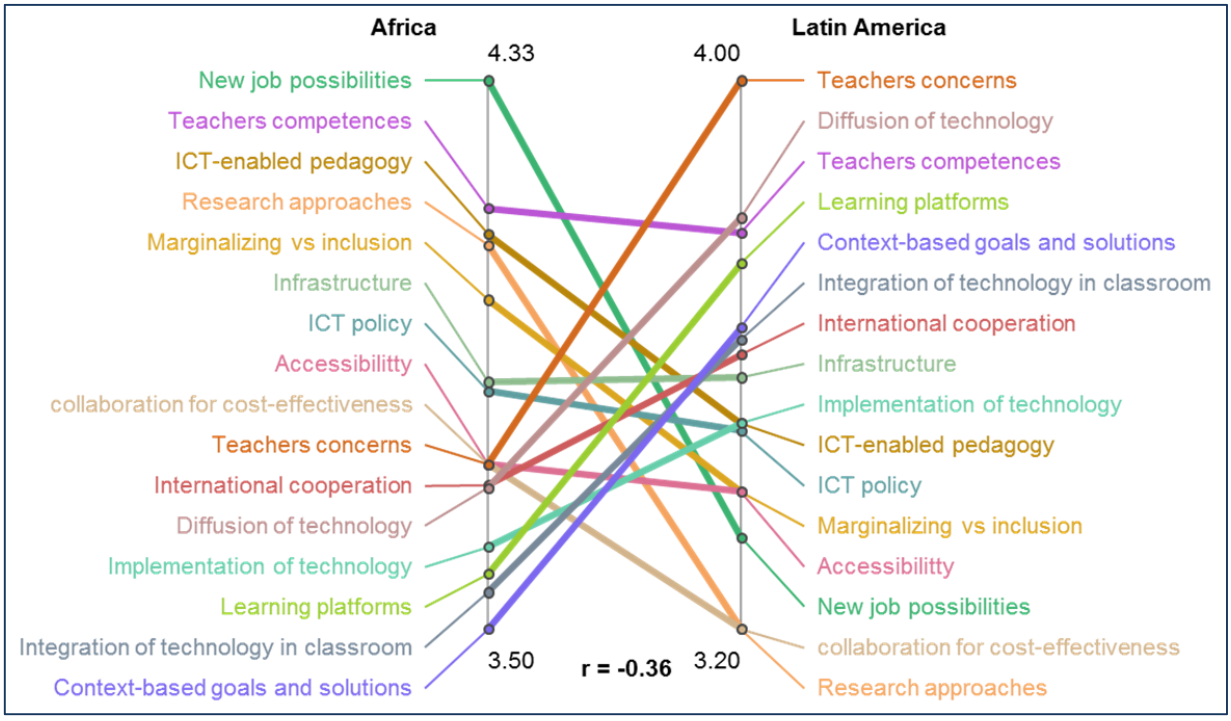


Figure 21. Pattern match Africa vs Latin America on feasibility

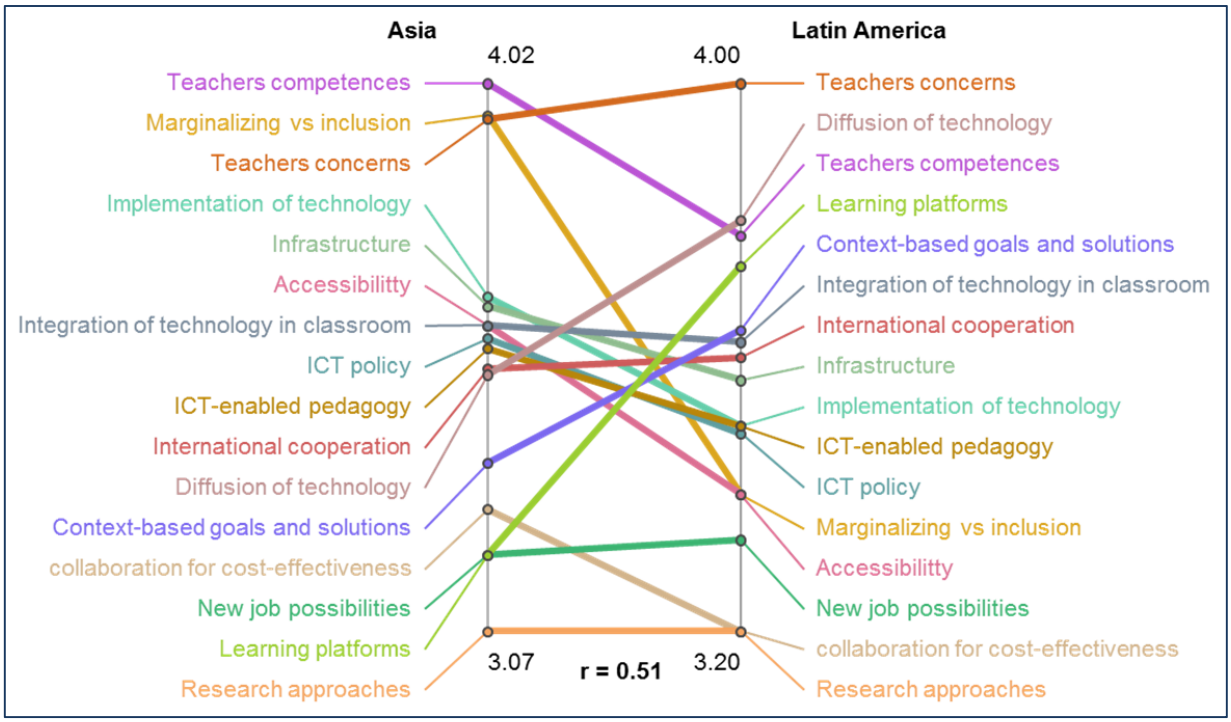


Figure 22. Pattern match Asia vs Latin America on feasibility

The GCM analysis allows for exploration of ratings for the individual ideas within a cluster on importance and feasibility through a visualization called “go-zone”. A go-zone is a bivariate graph dividing a cluster in 4 quadrants based on the mean values of importance and feasibility. The ideas that score high on both values (e.g., statement 1 “The complexity of working in ICT-enabled learning environments requires building of capacity in new types of skills (learning design, digital literacy) as well as acceptance of new modes of working (collaborative and team approaches to course design)”; and 30 “Open Access to high-quality educational resources and research, for both learners and faculty”) call for actions in the short term. The ideas that score high on importance but relatively low on feasibility suggest longer term actions (e.g., 79 “To strengthen the role of ICT in non-formal learning”; and 97 “The opportunity of repurposing, adapting, reusing and sharing open educational content”). Go-zones were not a subject of discussion during the workshop and are presented here for illustration purposes only (refer to Figure 23 to Figure 34).

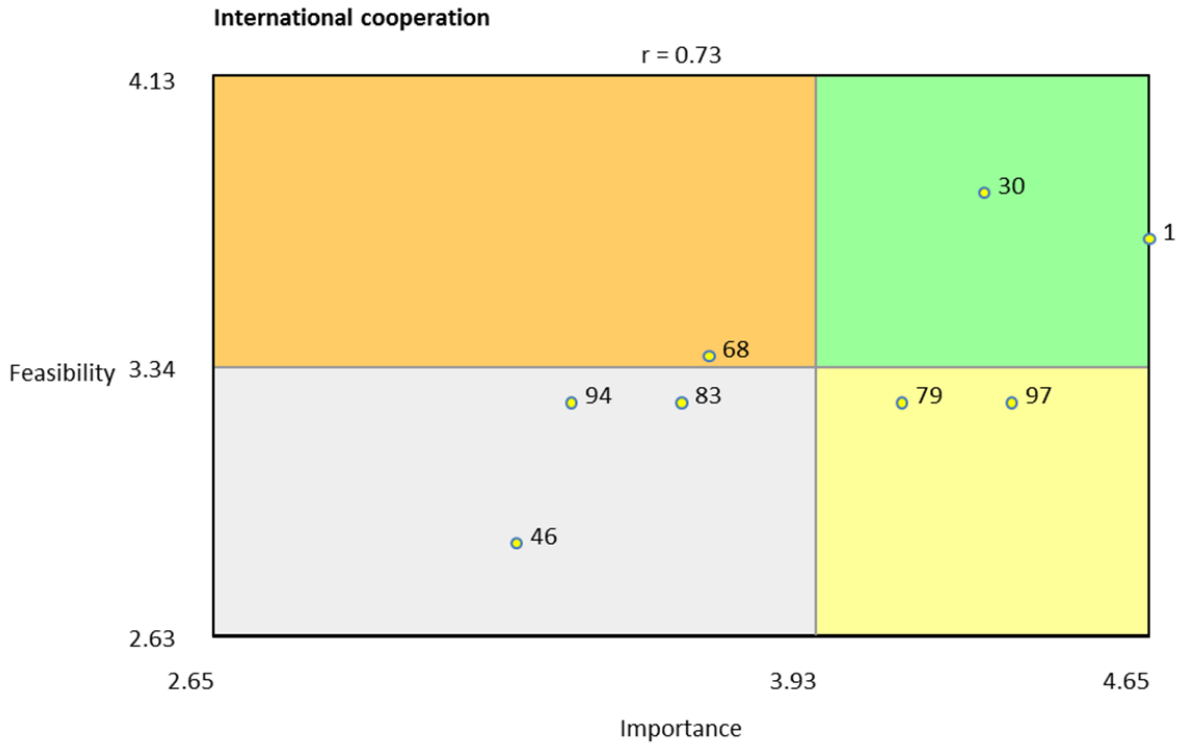


Figure 23. Go-zone cluster International cooperation

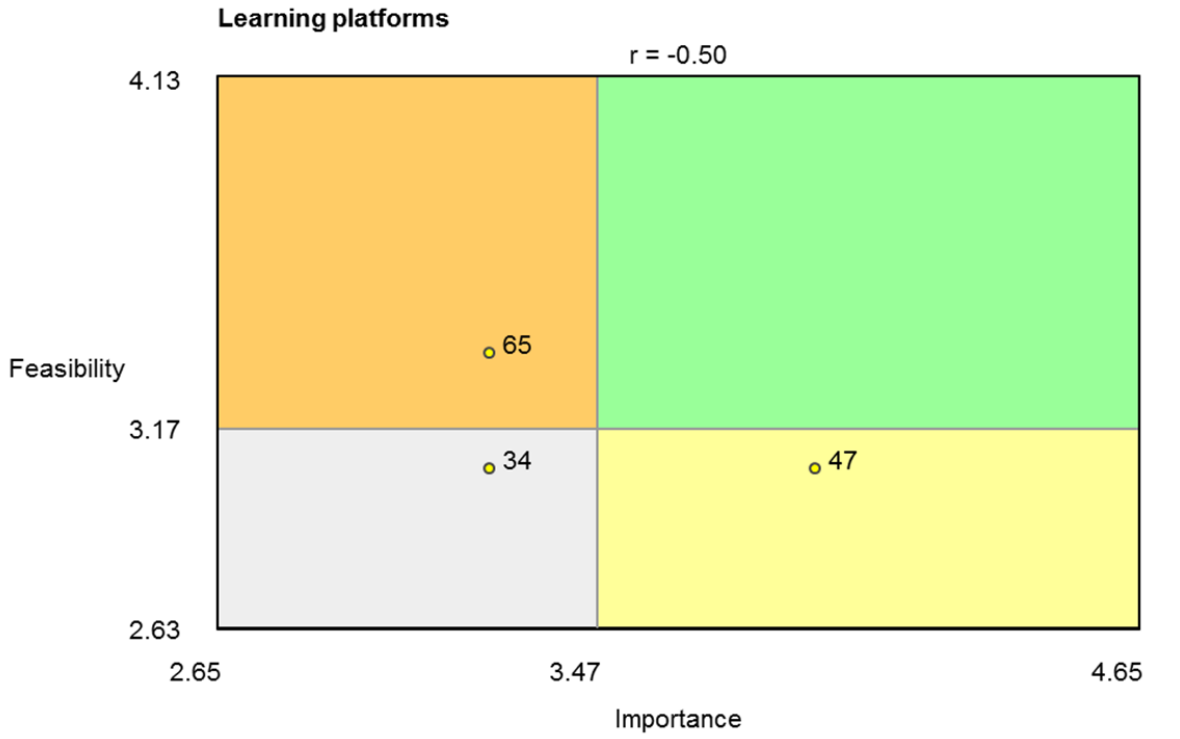


Figure 24. Go zone cluster Learning platform

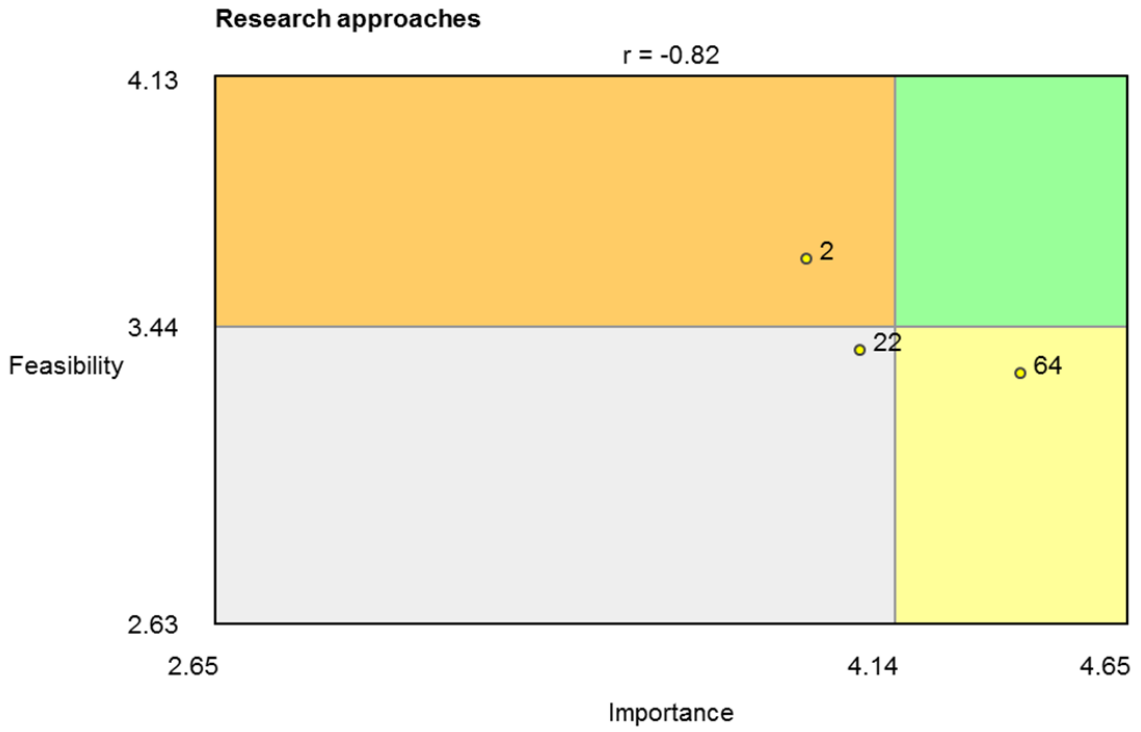


Figure 25. Go zone cluster Research approaches

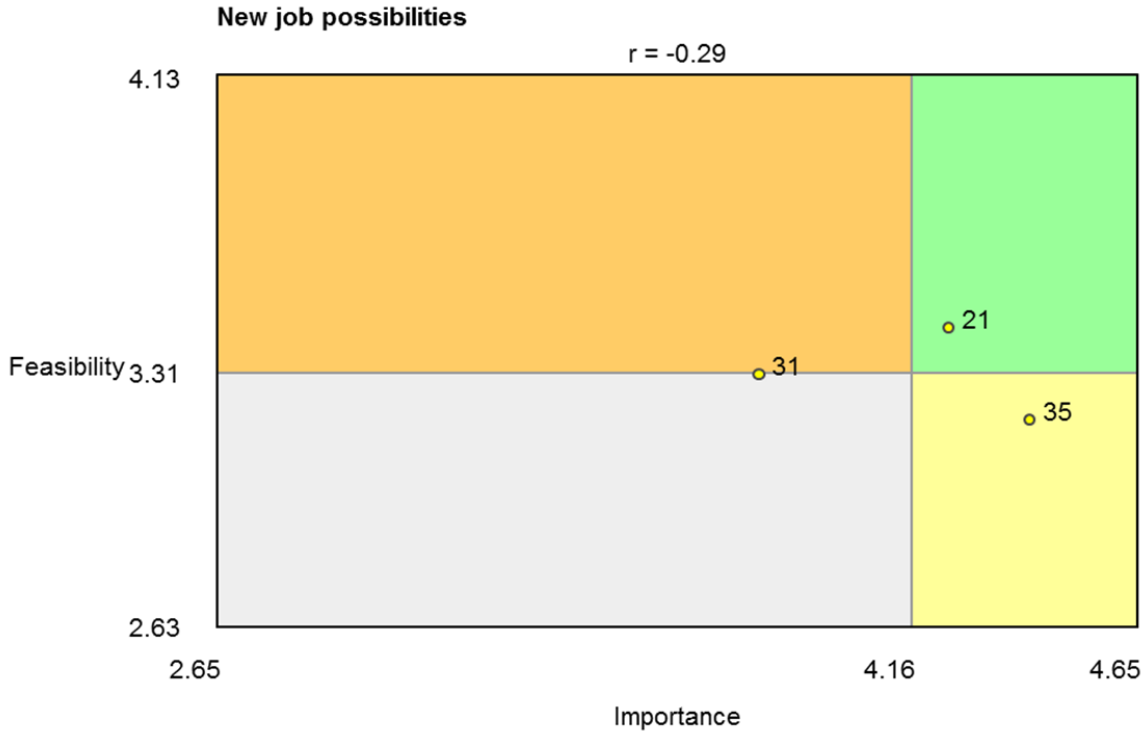


Figure 26. Go zone cluster New Job possibilities

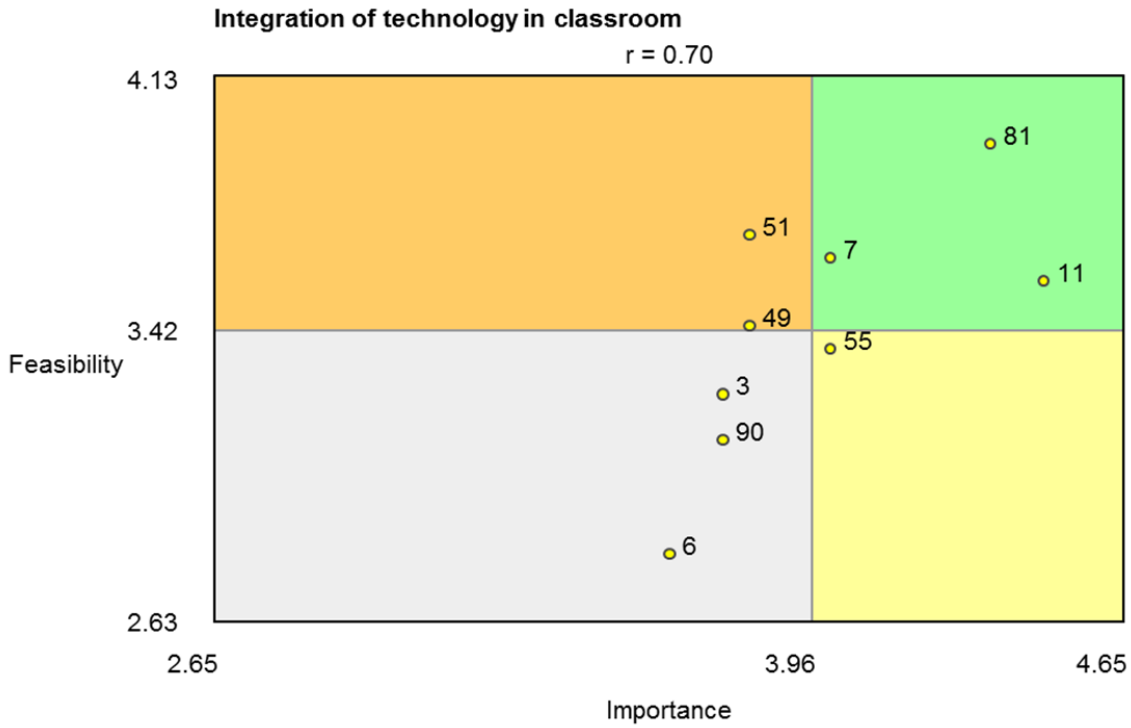


Figure 27. Go zone cluster Integration of technology in classroom

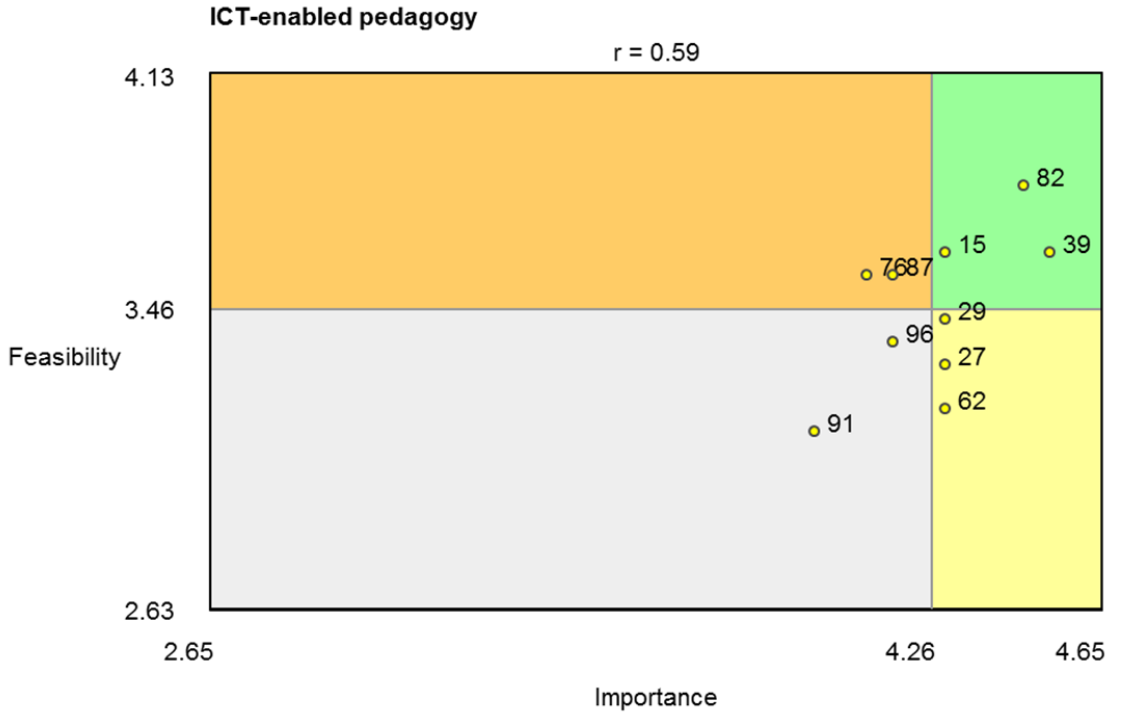


Figure 28. Go zone cluster ICT-enabled pedagogy

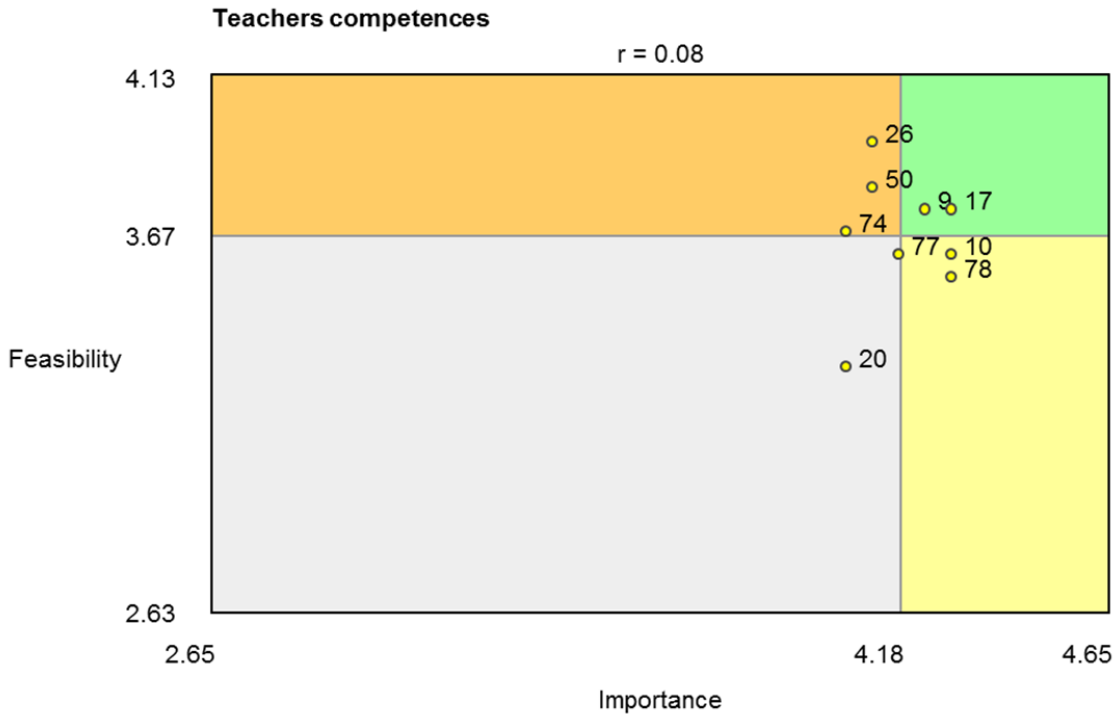


Figure 29. Go zone cluster Teacher competences

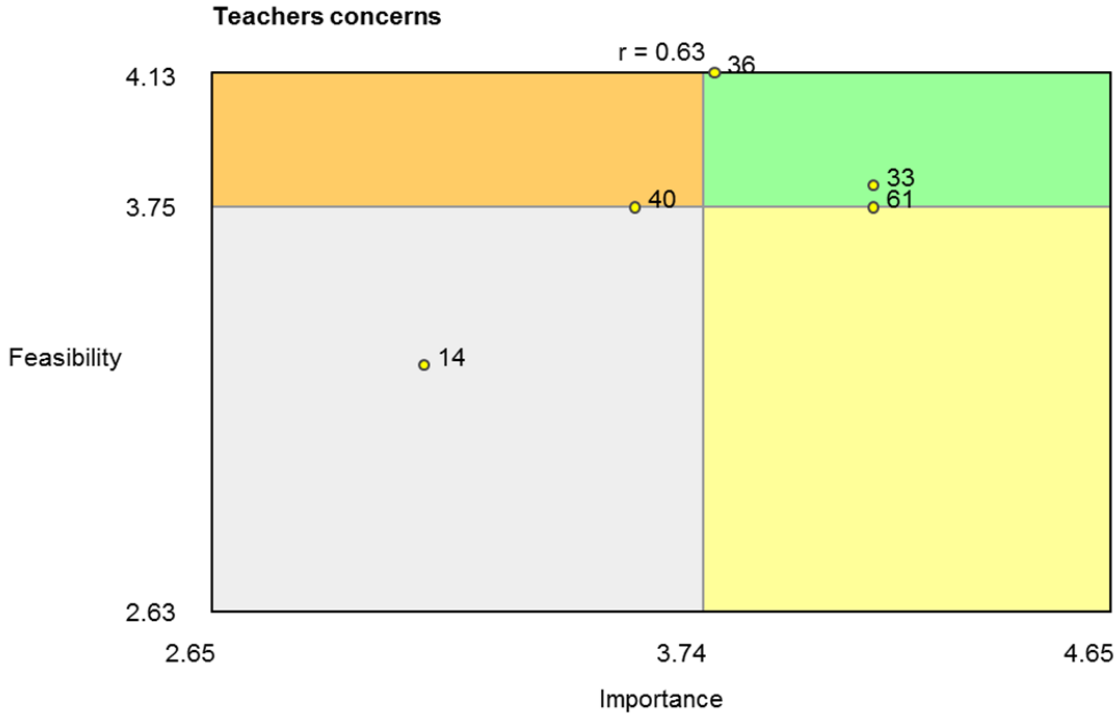


Figure 30. Go zone cluster Teacher concerns

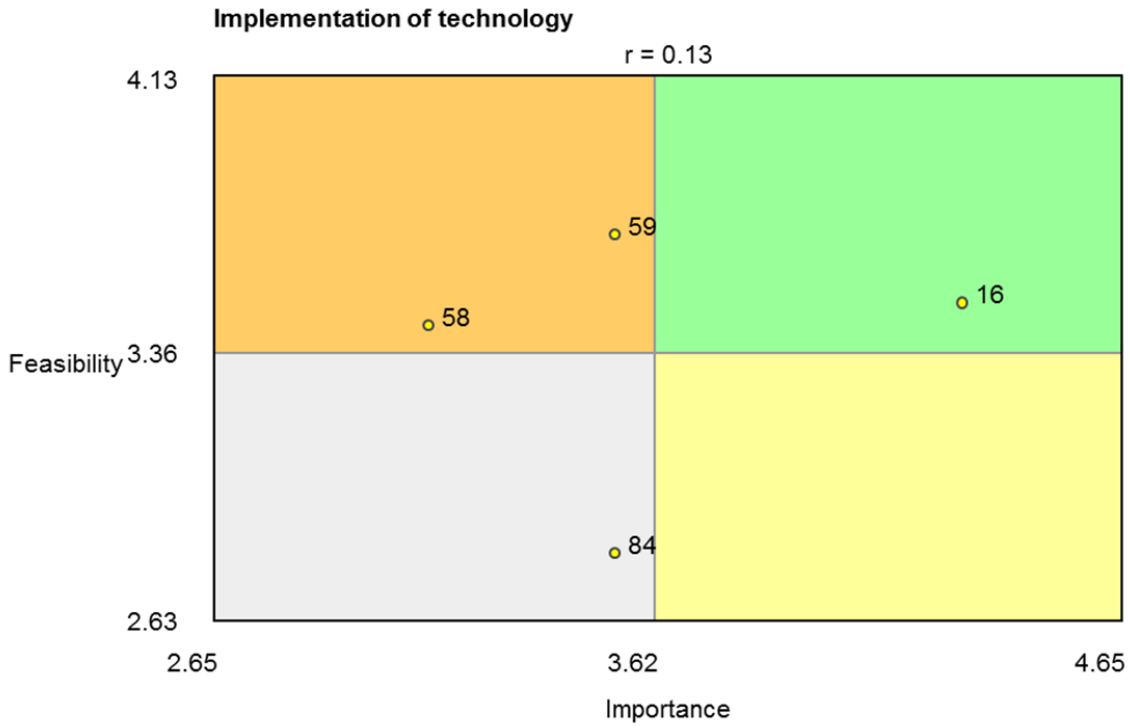


Figure 31. Go zone cluster Implementation of technology

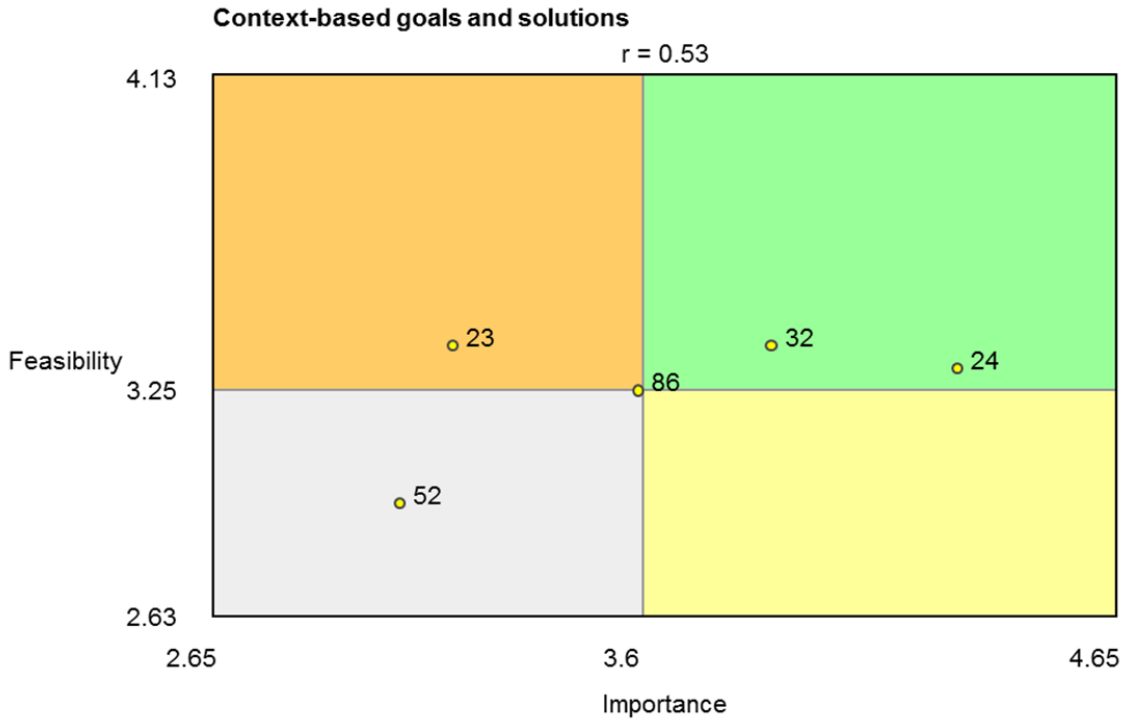


Figure 32. Go zone cluster Context-based goals and solutions

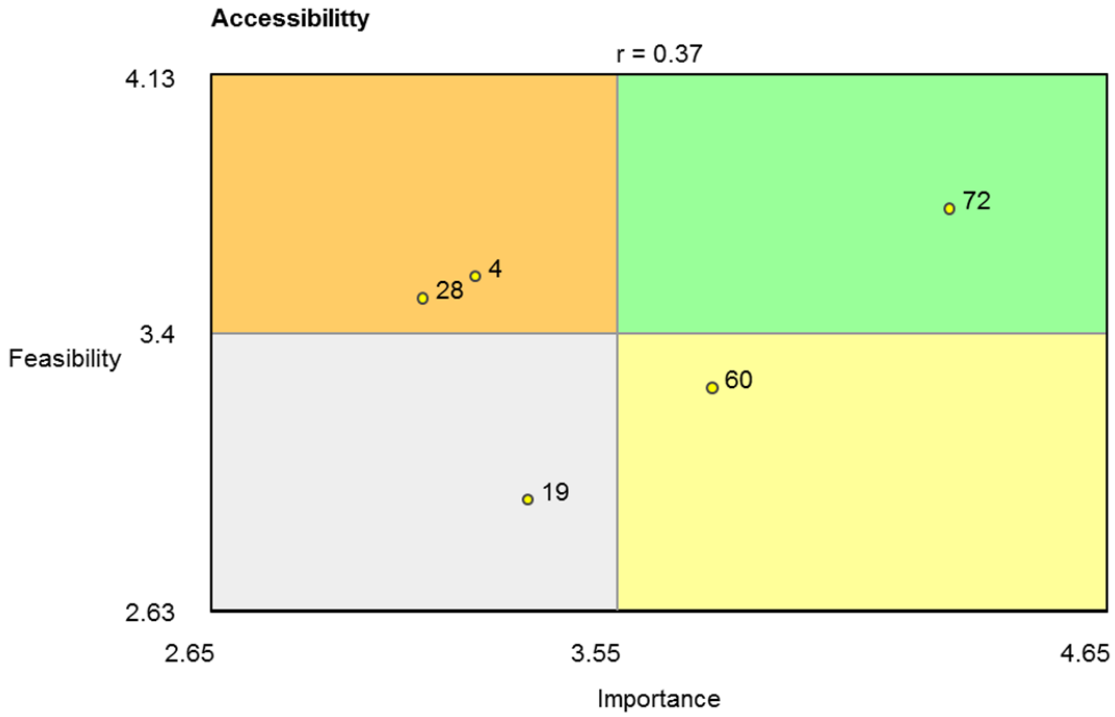


Figure 33. Go zone cluster Accessibility

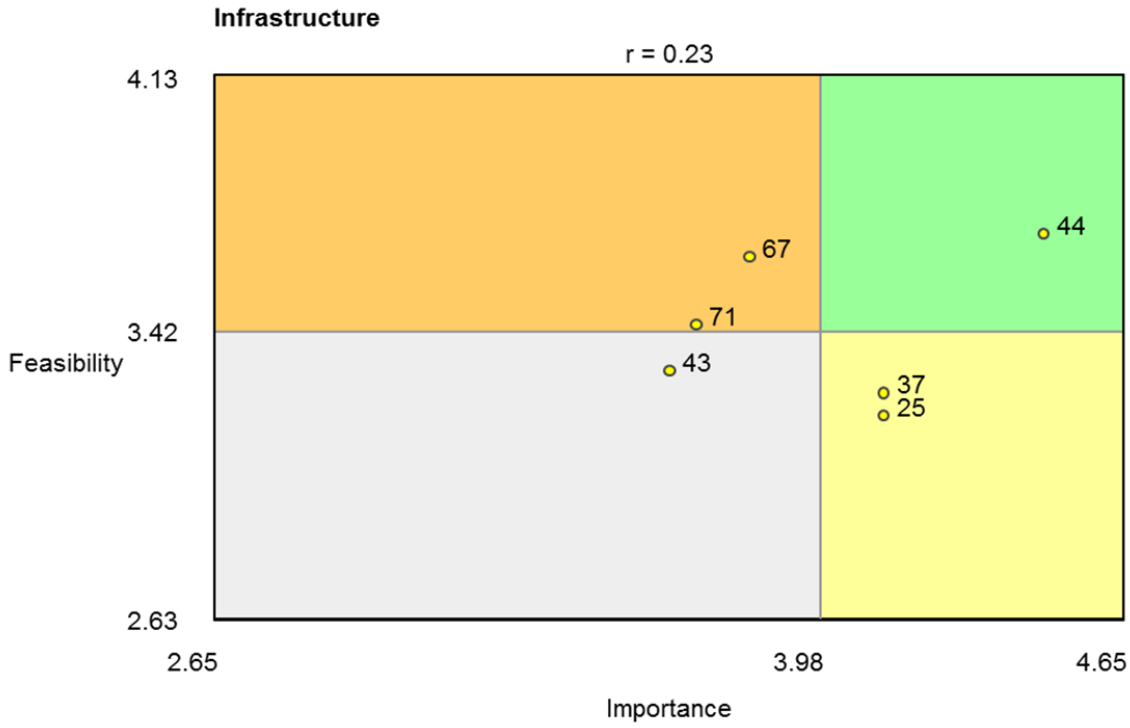


Figure 34. Go zone cluster Infrastructure

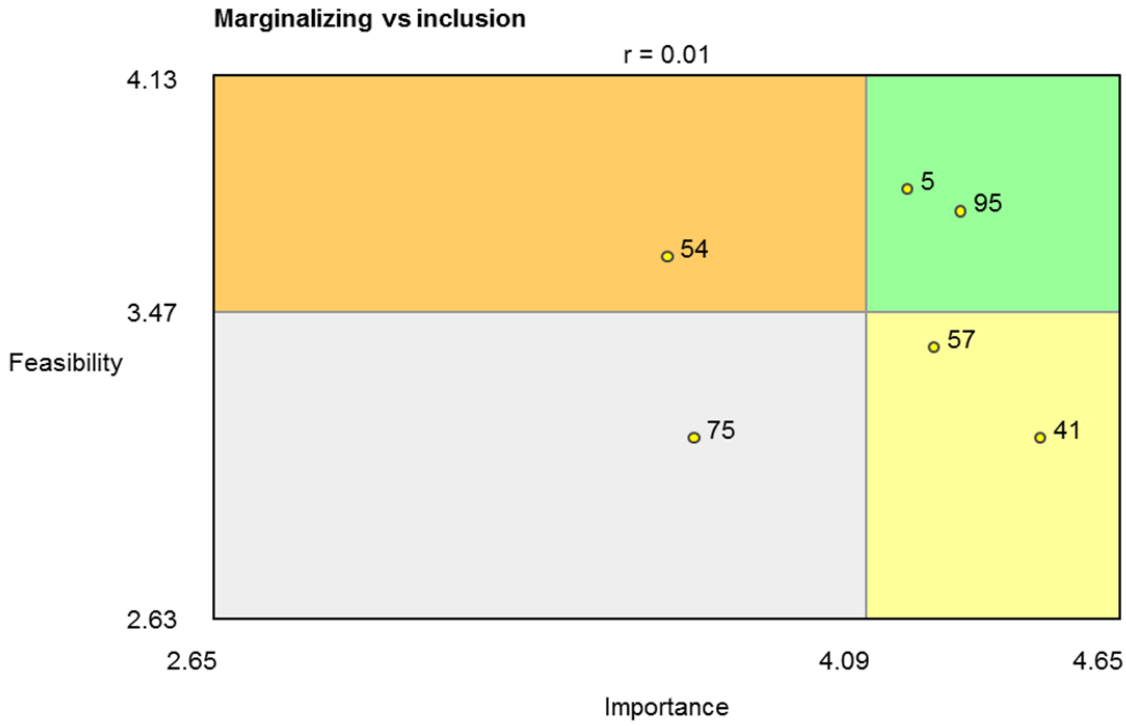


Figure 35. Go zone cluster Marginalizing vs inclusion

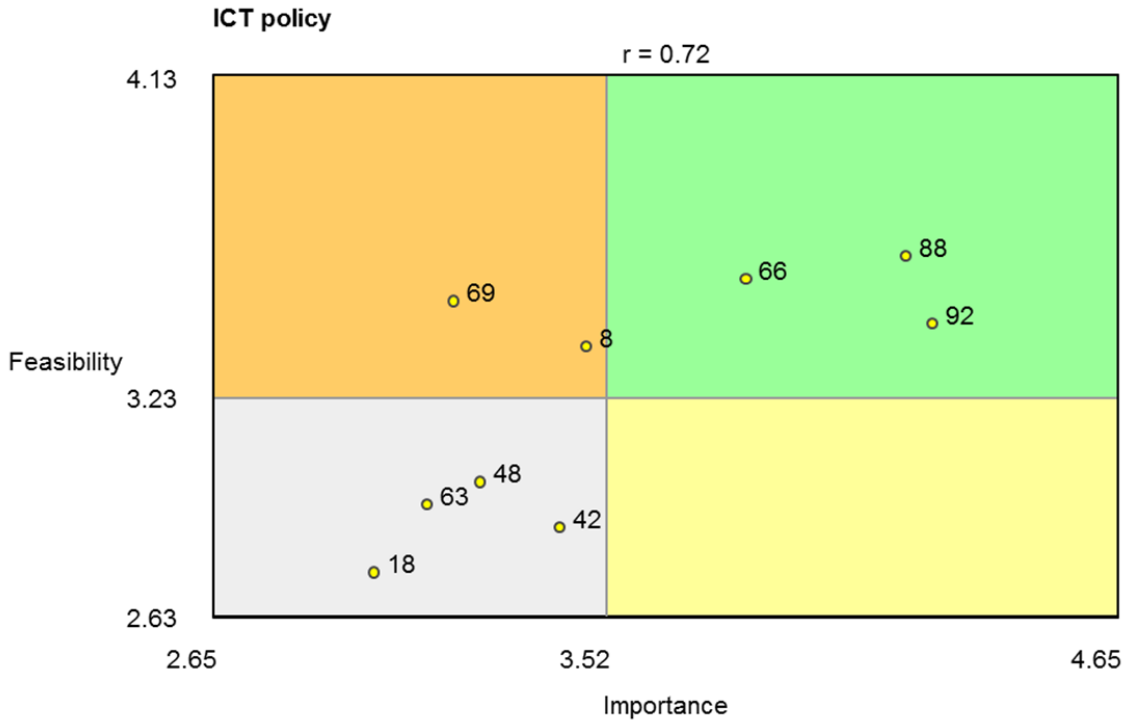


Figure 36. Go zone cluster ICT policy

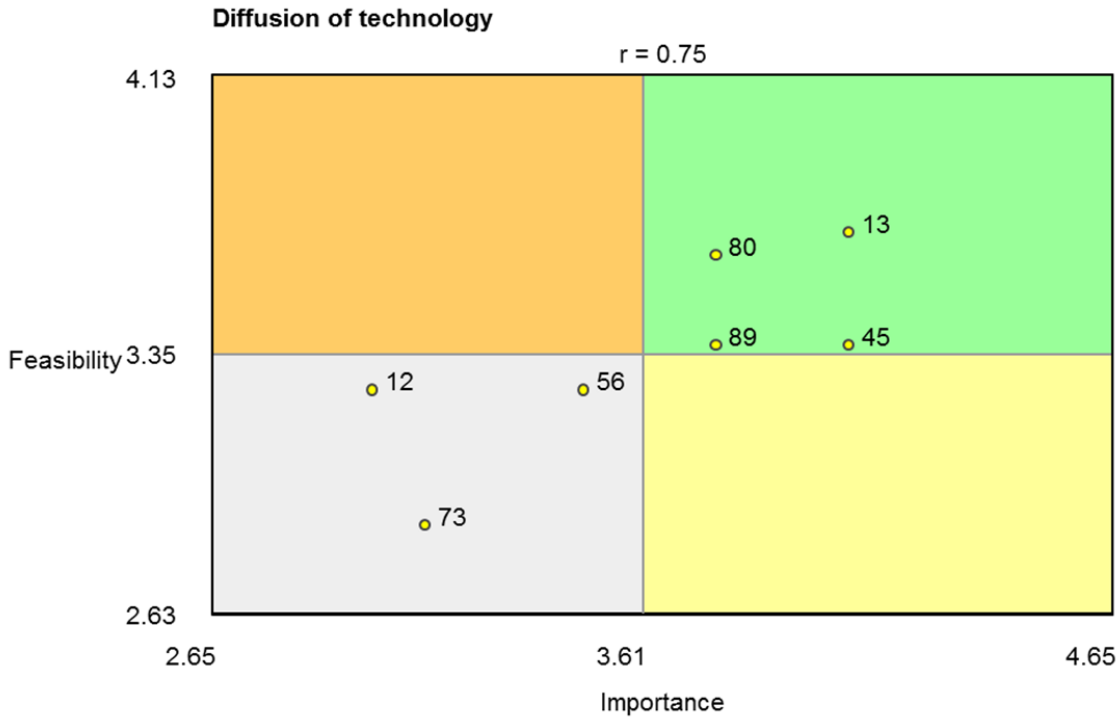


Figure 37. Go zone cluster Diffusion of technology

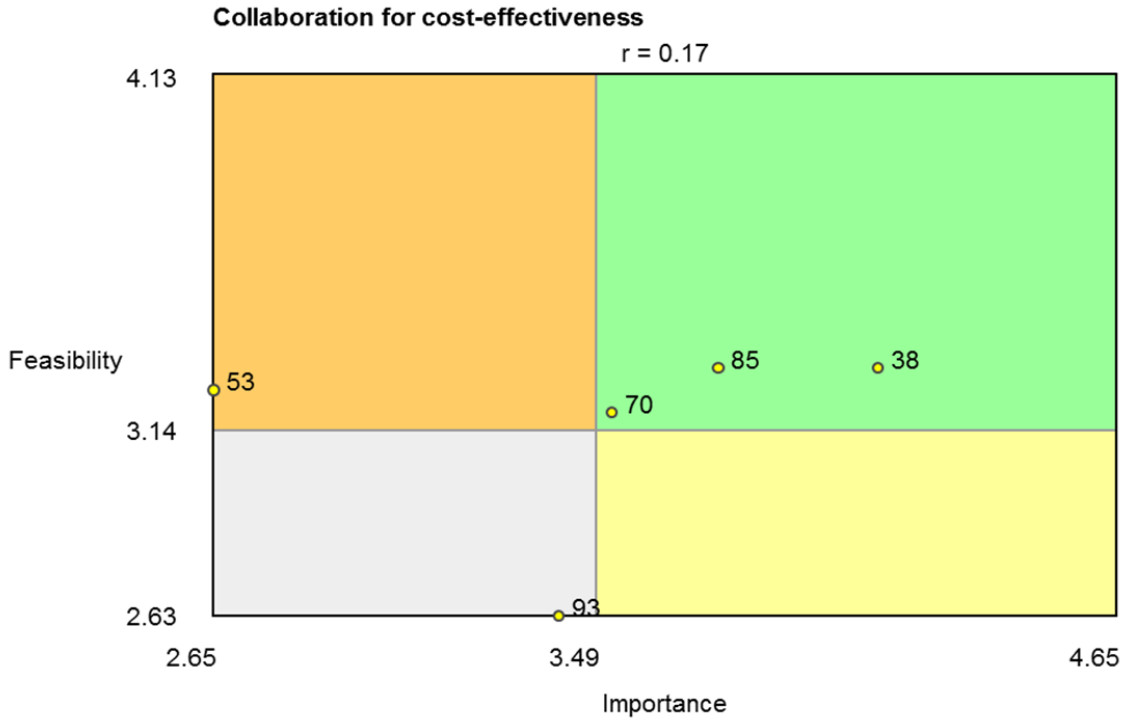


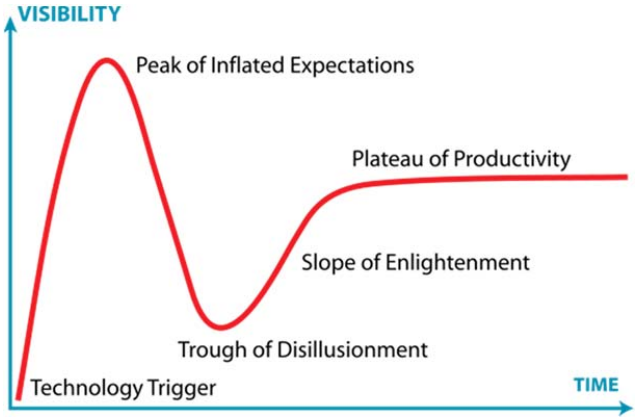
Figure 38. Go zone cluster Collaboration for cost-effectiveness

Discussion

Based on the assumption that the education in Africa, Asia, and Latin America is considerably different than the education in Europe and North America it is surprising see how much conceptual overlap exists between the reports on trends in learning technologies and innovating ICT pedagogies, (Horizon reports: Johnson, Adams Becker, Estrada, & Freeman, 2014a, 2014b; Johnson, Adams Becker, Estrada, Freeman, Kampylis, Vuorikari, & Punie, 2014c; Innovating pedagogies: Sharples, McAndrew, Weller, Ferguson, FitzGerald, Hirst & Gaved, 2013; Kennisnet trends in education 2014-2015; Mapping and analyzing prospective technologies: Aceto, Borotis, Devine, & Fischer, 2014), and the findings of the current GCM study on ICT-enabled pedagogical innovations for education in developing countries. First, in the trends reports and GCM study pedagogy and technology are closely related to each other. However, the integration of technology and pedagogy in the GCM study findings is much more apparent than the reports referred to above. This is evident at the cluster and statements level. Technology without appropriate pedagogy would not have a positive impact on education in developing countries - this is what the data suggests. The 'Integration of technology in classroom' and 'ICT-enabled pedagogy' clusters score high on importance. Advanced learning technologies such as Open Educational Resources (OER), Massive Open Online Courses (MOOC), mobile learning, learning analytics and networked learning have not been identified in a separate technology-dedicated cluster, but rather they have been seen integrated in different contexts (i.e., clusters).

Second, the same technologies are identified in GCM study, the Trend Reports and the experts' written reflections on advanced educational technologies. OER and mobile learning were the technologies most often mentioned in the desk research report.

Third, in line with the Trend Reports and desk research, GCM detected signs of technology leapfrogging (i.e., adoption of advanced or state-of-the-art technology in an application area where immediate prior technology has not been adopted) in terms of both technology and pedagogy. It seems that for OERs, MOOCs and mobile learning the stages of technology trigger, peak of inflated expectations, and even disillusionment have already passed (refer to Figure 1 the Hype Cycle; Gartner, 2002; see below).



Research can start at the stage of slope of enlightenment but will require some time before arriving at the plateau of productivity. Relatively little was said in the GCM study with respect to serious gaming and networked learning, but the literature review and the experts' reflection on the issues indicate that these research topics could also be positioned at the starting line of slope of enlightenment.

An overarching theme that emerged from the GCM study is open education: OER, MOOCs, networked learning and mobile technologies as a hub for access to other techno-pedagogical innovations. In addition, cloud technologies make it possible to attain open-up education ICT-based pedagogical

innovation (e.g., vendors' educational apps, professional social networks, open linked data applications, OER, MOOC and open instructional design tools).

The workshop participants were aware that reuse of open education resources, methods and tools (e.g., OER, MOOCs, tools supporting learning design) did not mean reuse exactly as is (the Reusability Paradox where the pedagogical effectiveness of a learning object and its potential for reuse are at odds with one another; Wiley, 2015), but they knew that it was also about revise, remix and redistribute (the Remix Hypothesis – Wiley, 2015). To effectively adapt OER to local contexts, educators from developing countries could benefit from the availability of open instructional design tools (e.g., Compendiu®, Learning Designer and Cloudworks® – see for more information Conole & Wils, 2013).

Revising, remixing and redistributing open education needs skilled and motivated teachers. The two clusters on teachers ('Teachers concerns' and 'Teachers competences') were rated high on both importance and feasibility, which may suggest encouraging research initiatives on teacher training in the short term. This corresponds with research as discussed in the desk research report (Agbatogun, 2013; Agyei, 2012; Nihuka, 2011; Howie, 2010; Kafyulilo, 2013; Salinas & Sanchez, 2009) and Horizon-Europe report (Johnson, Adams Becker, Estrada, Freeman, Kampylis, Vuorikari, & Punie, 2014c). Teachers could join professional social network groups or become members of international communities of practice like Schoolnet eTwinning (http://www.etwinning.net/en/pub/index.htm).

Context is essential for dealing with the Reusability Paradox and exploring effectively the Remix Hypothesis. Context can be identified either explicitly (there is a cluster about the role of context – 'Context-based goals and solutions') or inferred implicitly across all clusters identified in the GCM study. Context has been defined as one of the most important themes in the desk research report as well.

The participants in the GCM study see the potential of ICT-enabled pedagogical innovation, not only for primary, secondary and higher education, but also for lifelong learning, professional development (both formal and informal), and new job possibilities.

As can be expected, the landscape of ICT for education in developing countries contains themes such as infrastructure, accessibility and ICT policy, which define various issues for adopting ICT-enabled pedagogical innovations. Most are considered threats (marginalizing) but some of them are perceived as opportunities (inclusion). The participants seem to have found technical solutions to issues related to infrastructure and accessibility -cloud computing. It also creates better opportunities for open education.

As shown by the desk research and GCM study, and In the to-be-developed Research Agenda with Call for Research Proposals, the requested proposals should include a combination of advanced technologies and evidence-based learning and teaching methods (the clusters 'Integration of technology in classroom' and 'ICT-enabled pedagogy'), apply a range of research approaches (i.e., from design-based research to longitudinal studies (the cluster 'Research methods' and desk research findings), targeting different educational levels but also life-long learning and professional development (both formal and informal) (the clusters 'Integration of technology in classroom' , 'ICT-enabled pedagogy', 'New job possibilities', 'International cooperation', 'Teacher competences' 'Teachers' concerns', and 'ICT policy'; see also the desk research and learning technologies experts' consultation) and take into account the local context (the clusters 'Context-based goals and solutions', 'New job possibilities', 'Integration of technology in classroom', 'Marginalizing vs inclusion', 'ICT policy', and 'Diffusion of technology'. In addition, the participants in the GCM study emphasized the need for international cooperation in this respect (the cluster 'International cooperation'). The two clusters about teachers and teacher-training ('Teachers competences' and 'Teachers concerns') and the high score on both importance and feasibility they received, suggest conducting research on improving teachers' skills, motivation and attitudes in using ICT in their professional practice. Periodic surveys on trends in learning technologies and approaches, similar

to Horizon and innovating pedagogies studies (refer to Horizon reports: Johnson, Adams Becker, Estrada, & Freeman, 2014a, 2014b; Johnson, Adams Becker, Estrada, Freeman, Kampylis, Vuorikari, & Punie, 2014c; Innovating pedagogies: Sharples, McAndrew, Weller, Ferguson, FitzGerald, Hirst, & Gaved, 2013; Kennisnet trends in education 2014-2015; Mapping and analyzing prospective technologies: Aceto, Borotis, Devine, & Fischer, 2014) could be carried out for different developing regions as well (like elearning Africa reports).

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Appendix A. Statements clustered

	Statement	Bridging
	Cluster 1. International cooperation	0.45
94	(Interactive) Television broadcasts of subjects needing specialized teachers can be integrated into school schedules.	0.22
79	To strengthen the role of ICT in non-formal learning.	0.24
68	Experiences of some countries have shown how women have used “low-tech” devices in creative combinations with traditional media such as folk songs, dance and theatre to develop content materials that are relevant to their educational needs.	0.32
97	The opportunity of repurposing, adapting, reusing and sharing open educational content.	0.38
30	Open Access to high-quality educational resources and research, for both learners and faculty.	0.47
46	Participation in social network professional communities across national boundaries permits the announcement and negotiation of occupational status and professional identities.	0.58
1	The complexity of working in ICT-enabled learning environments requires building of capacity in new types of skills (learning design, digital literacy) as well as acceptance of new modes of working (collaborative and team approaches to course design).	0.61
83	To promote empathy and collaborative process among teachers who want to introduce ICT in an innovative way.	0.79

Count	Std. Dev.	Variance	Min	Max	Average	Median
8	0.19	0.04	0.22	0.79	0.45	0.43

	Statement	Bridging
	Cluster 2. Learning platforms	0.37
34	Open educational movement creates opportunities for new knowledge on copyright.	0.33
47	Cloud-based course learning platforms could allow some institutions and organizations in developing countries to leapfrog current institutional constraints to experiment with ICT-enabled learning.	0.37
65	Lack of creative virtual environment platforms that are easy to use.	0.4

Count	Std. Dev.	Variance	Min	Max	Average	Median
3	0.03	0	0.33	0.4	0.37	0.37

	Statement	Bridging
	Cluster 3. Research approaches	0.82
22	A need (and opportunity) to use design-based research / educational design research as the methodology for pedagogical innovation in developing regions, to enable effective, evidence-based practice as well as the building of sound theory.	0.63
2	A research approach in which implementations of ICT-supported pedagogical innovations are reported in an isolated case study manner without seeking to ground them in, and contribute to the development of broader ICT4D theory.	0.84
64	Interventions should be undertaken within the context of longitudinal field	1

	experimentation using well-designed measures and mixed methods of data collection (e.g., standardized measures, school exams, surveys, interviews, observations and trace data).	

Count	Std. Dev.	Variance	Min	Max	Average	Median
3	0.15	0.02	0.63	1	0.82	0.84

	Statement	Bridging
	Cluster 4. New job possibilities	0.75
21	The growth in open educational practices in developing countries provides the opportunity for much more local content to go online.	0.69
31	New job possibilities (such as online learning design, digital curation, etc.) arise from changing ICT-enabled pedagogical innovations in developing countries.	0.75
35	ICT applications enable lifelong learning opportunities for working adults and professionals seeking to constantly re-equip themselves to the changing demands of their work.	0.82

Count	Std. Dev.	Variance	Min	Max	Average	Median
3	0.05	0	0.69	0.82	0.75	0.75

	Statement	Bridging
	Cluster 5. Integration of technology in classroom	0.21
90	To look beyond pedagogy and focus on the role of ICT in andragogy and heutagogy.	0.14
49	ICT innovations must be based on the human sciences first, and then only on the computer sciences.	0.17
51	Technology should complement the existing curriculum.	0.17
81	Authentic educational improvement using technology must be integrated into classroom practice by teachers in core subject areas and not by IT experts teaching ICT skills as a separate subject matter.	0.19
6	A serious challenge with ICT-enabled pedagogical innovations is that they add layers of complexity to critical literacies by adding the multifaceted dimensions of digital literacies to teaching and learning.	0.2
3	Under government pressure, faculties are often instructed to “Use ICT” - but issues related to pedagogy are not discussed anywhere.	0.21
11	A belief that existing digital resources (including Open Educational Resources) can simply be “plugged in” to new contexts, without the need to support educators in understanding the pedagogical beliefs and practices that underpin their teaching.	0.25
55	Teachers have very large classrooms (many students) with a diversity of student skills and levels of understanding, including special needs learners, who are often neglected in overall class instruction.	0.27
7	MOOCs as a way to make content available is not enough to promote construction of knowledge. It is necessary to have interaction among learners, and between teacher and learner.	0.31

Count	Std. Dev.	Variance	Min	Max	Average	Median
9	0.05	0	0.14	0.31	0.21	0.2

	Statement	Bridging

	Cluster 6. ICT-enabled pedagogy	0.19
29	The effectiveness of ICT-enabled pedagogical innovation seems to depend more on innovation of pedagogy than innovation of ICT.	0.1
82	The focus needs to be on the use of evidence-based pedagogical strategies rather than novel technology strategies.	0.12
76	Open online learning, MOOCs and emerging models from MOOCs can make online learning pedagogy visible and acceptable and help foster discussions around ICTs in education.	0.17
96	Offline tablets and mobile phones should be used to make learning more flexible and more learner-centered.	0.18
62	Technology solutions should focus on essential educational competences (e.g., reading, writing, numeracy, scientific reasoning, self-regulation, inquiry skills) with a special emphasis on younger learners.	0.18
27	Use of learning analytics to enable a greater understanding of how learners learn, their preferred media, attention spans, difficulties faced, search and knowledge acquisition behavior.	0.21
91	Designing suitable moderation and assessment strategies in a MOOC environment in order to improve its learning potential and lower non-completion rates.	0.23
15	Digital content must be interactive to foster learner understanding and engagement and should always be used with scaffolding and support from peers and teachers (i.e., not as a stand-alone or substitute for teaching).	0.23
87	Development of appropriate pedagogical designs for integrating Open Educational Resources in online learning.	0.24
39	Possibility of getting the learners to become more engaged in learning as ICTs offer vast possibilities for interactivity and connectedness.	0.26

Count	Std. Dev.	Variance	Min	Max	Average	Median
10	0.05	0	0.1	0.26	0.19	0.2

	Statement	Bridging
	Cluster 7. Teacher competences	0.26
50	The most important thing is for teachers to know how they can manage the ICT aspect inside the classroom to improve learning, but most of them don't know.	0.2
77	Educators have not necessarily had good models at their disposal for how pedagogy can be successfully enhanced by technology, compared to learners themselves, and so they struggle to create this experience for their learners.	0.21
20	School teachers and university lecturers struggle to understand the affordances of technology and when to use them for which pedagogic purpose.	0.22
10	Even among faculties that do use ICT in teaching, such use is often restricted to making presentations, or showing some videos. True integration of ICT into teaching has not happened in most traditional educational institutions.	0.22
78	Integrating technology into the classroom changes the educator's role from that of a dispenser of knowledge to that of a co-learner, facilitator, moderator and coordinator of learning activities.	0.25
74	Many teachers, when getting into ICT-based education, replicate what they do in face-to-face learning on the new digital environment.	0.28
26	Since traditional "Chalk and talk" teaching meant each teacher developed their own	0.32

	teaching materials based on diverse resources, when they adapt ICT in teaching, they believe they have to prepare their own materials - very few teachers are aware of OER.	
17	Teachers follow the traditions of direct, oral instruction and need professional development to learn other pedagogical strategies.	0.33
9	Educators don't always have the technical skills to be able to revise, remix or redistribute Open Educational Resources, and therefore end up merely re-using them "as-is".	0.33

Count	Std. Dev.	Variance	Min	Max	Average	Median
9	0.05	0	0.2	0.33	0.26	0.25

	Statement	Bridging
	Cluster 8. Teacher concerns	0.39
61	Fears among teachers to use ICT such as: computers, tablets, iPads and OERs, in class, because they don't know how to use them appropriately.	0.29
33	Teachers fear that the use of ICTs for the purposes of teaching and learning involves an added workload and avoid getting involved in it.	0.38
36	Lack of motivation to use ICT among teachers.	0.4
14	The tendency among staff to want to "ring-fence" the classroom and teaching activities.	0.43
40	Many students know more about ICT technology than their teachers in schools and lecturers in universities, which makes teachers and lecturers feel vulnerable and defensive about their capabilities.	0.46

Count	Std. Dev.	Variance	Min	Max	Average	Median
5	0.06	0	0.29	0.46	0.39	0.4

	Statement	Bridging
	Cluster 9. Implementation of technology	0.46
58	In several institutions while the faculty may be IT savvy, the educational administrators are not. The reverse is also true in some cases.	0.43
16	A problem that is occurring in developing countries is that governments are taking tablets and laptops to basic education without training teachers, without foreseeing the technological capabilities of the devices and without implementing a monitoring plan.	0.44
84	The initial focus on in-service professional development should give way to pre-service professional development.	0.45
59	Lack of awareness regarding free software and content.	0.53

Count	Std. Dev.	Variance	Min	Max	Average	Median
4	0.04	0	0.43	0.53	0.46	0.45

	Statement	Bridging
	Cluster 10. Context-based goals and solutions	0.36
86	University students and teachers say it takes a long time to adapt a resource from another educational practice so it becomes their own.	0.31
52	The types of power relations that invest in traditional face-to-face classrooms are	0.31

	more easily threatened by many innovative online designs.	
23	ICTs should not simply replace former distance education technology, such as radio and television.	0.34
32	The specific goals for the use of ICT in education are often not clear, which makes them less effective.	0.4
24	One of the persisting problems related to the use of technology in education is that educational planners and technology advocates think of the technology first and only explore the educational applications of that technology later.	0.44

Count	Std. Dev.	Variance	Min	Max	Average	Median
5	0.05	0	0.31	0.44	0.36	0.34

	Statement	Bridging
	Cluster 11. Accessibility	0.51
60	The implementation of tablets is transforming education strategies but is limited to privileged environments.	0.39
19	Even in countries where initial efforts to bridge the digital divide were successful, such successes were short-lived.	0.46
28	Gender bias in accessibility is a reality. The laptop / PC is generally owned by men in the family.	0.5
72	According to a recent OECD report, a second digital divide is emerging, separating those with computer skills and competences from those without.	0.57
4	ICT is an unknown concept in rural school areas.	0.64

Count	Std. Dev.	Variance	Min	Max	Average	Median
5	0.09	0.01	0.39	0.64	0.51	0.5

	Statement	Bridging
	Cluster 12. Infrastructure	0.31
44	Lack of financial resources, poor access to the Internet, limited trained personnel, and lack of suitable policy are the challenges faced by developing countries that make the "digital divide" continue, not only between countries but also within countries.	0.23
25	Lack of sustainability of the infrastructure and slowness or inability to upgrade infrastructure in a timely fashion reduces effectiveness of teaching and learning opportunities.	0.27
37	The true costs of building ICT-enabled pedagogical innovations (such as MOOCs, e-books, apps) are a challenge to resource-constrained environments, which may lack capacity and skills as well as resources.	0.31
71	In most developing countries, priority in use of ICTs is in school education. Likewise, to produce a "knowledge-based" economy, more investments are made in university education. Use of ICTs for education of marginalized groups is likely to be side-lined.	0.31
43	Access to good quality ICT is still inconsistent across developing countries.	0.33
67	Poor access to computers and Internet facilities hinders use of ICT for teaching-learning.	0.39

Count	Std. Dev.	Variance	Min	Max	Average	Median
6	0.05	0	0.23	0.39	0.31	0.31

	Statement	Bridging
	Cluster 13. Marginalizing vs inclusion	0.67
54	Increased bandwidth and connectivity provide the foundation for participation in knowledge creation and collaboration between educators and scholars.	0.6
57	While the introduction of ICTs raises important equity issues, with real danger that ICT use can further marginalize already excluded groups from educational systems, they also hold the promise and opportunity for facilitating greater inclusion of such groups.	0.61
95	ICTs can play an important role in stimulating interest and engaging learners and can be a useful tool in education of marginalized groups, particularly rural women, by developing materials that are culturally and linguistically appropriate.	0.61
75	ICT solutions should focus on equality between genders, races, religions, familial incomes, etc.	0.64
41	To meet the challenges of "digital divide", developing countries have tended to focus narrowly on "ICT Literacy". They need to take a holistic approach to include reforms of the curriculum, student assessment systems, pedagogical approaches and teacher training.	0.68
5	The potential and effectiveness of reaching out to large numbers of learners through the use of mobile devices in remote areas of the developing world.	0.9

Count	Std. Dev.	Variance	Min	Max	Average	Median
6	0.1	0.01	0.6	0.9	0.67	0.63

	Statement	Bridging
	Cluster 14. ICT policy	0.07
63	Pressure from industry might distort ICT policy for education in their favor.	0
42	Public policies in developing countries do not have a business continuity plan for the integration of technologies (begin and end when each government period ends).	0
18	Technology per se is seen as a magic bullet by policymakers and administrators.	0.02
8	There are still many barriers on the side of policymakers for the social recognition of online learning.	0.05
69	Universities lack policy related to the development of ICT-driven learning.	0.06
88	Institutional support and structure are critical for effective integration of ICT in education and management of education institutions.	0.09
92	Lack of institutional policies to support the creation, use and reutilization of Open Educational Resources.	0.11
66	Barriers for using Open Educational Resources (OER) include lack of regional and national policies to support the creation and use of OER.	0.14
48	A challenge with ICT-enabled pedagogical innovations is that policymakers hope for one-size-fits-all generic solutions.	0.16

Count	Std. Dev.	Variance	Min	Max	Average	Median
9	0.06	0	0	0.16	0.07	0.06

	Statement	Bridging
	Cluster 15. Diffusion of technology	0.14
73	A conception of "development" that is predominantly western / dominated by the	0.07

	global north.	
56	There is a low importance to improving education in developing countries, for example, the current call for research to solve national problems does not integrate education as an option.	0.07
89	Education in developing countries is in danger of being transformed by innovations created in developed countries which are not context appropriate.	0.1
12	Proprietary software is prohibitive: it is costly and promoted / pushed / packaged when buying laptops / PCs.	0.11
13	Technology-based solutions need to consider the state of technology in schools and should be designed to be scalable and sustainable at minimal cost.	0.14
80	Active and engaging partnerships with local stakeholders are key to scalability and sustainability.	0.19
45	An international consensus holds that insufficient attention is paid to monitoring and evaluation of issues and feedback loops during the program design process of most ICT in education initiatives.	0.29

Count	Std. Dev.	Variance	Min	Max	Average	Median
7	0.07	0.01	0.07	0.29	0.14	0.11

	Statement	Bridging
	Cluster 16. Collaboration for cost-effectiveness	0.26
53	On school level, theft of ICT is preventing wide-scale implementation of ICT-enabled pedagogical innovations.	0.22
85	ICT interventions should be based on minimal cost for maximum benefit to learners and not on profit margins.	0.22
93	Collaboration is a key word in development of OER, but in developing countries, competition is the key word.	0.23
38	ICT-enabled collaborative program development and sharing between institutions so that cost efficiencies and quality can be enhanced.	0.27
70	A need (and opportunity) to use Amartya Sen's capability approach as an ethical and conceptual framework for the planning and evaluation of pedagogical innovations in developing regions.	0.36

Count	Std. Dev.	Variance	Min	Max	Average	Median
5	0.05	0	0.22	0.36	0.26	0.23

Appendix B. Clusters with statements rated on importance and feasibility

	Statement	IMP	FEAS
	Cluster 1. International cooperation	3.93	3.34
1	The complexity of working in ICT-enabled learning environments requires building of capacity in new types of skills (learning design, digital literacy) as well as acceptance of new modes of working (collaborative and team approaches to course design).	4.65	3.69
97	The opportunity of repurposing, adapting, reusing and sharing open educational content.	4.35	3.25
30	Open Access to high-quality educational resources and research, for both learners and faculty.	4.29	3.81
79	To strengthen the role of ICT in non-formal learning.	4.12	3.25
68	Experiences of some countries have shown how women have used “low-tech” devices in creative combinations with traditional media such as folk songs, dance and theatre to develop content materials that are relevant to their educational needs.	3.71	3.38
83	To promote empathy and collaborative process among teachers who want to introduce ICT in an innovative way.	3.65	3.25
94	(Interactive) Television broadcasts of subjects needing specialized teachers can be integrated into school schedules.	3.41	3.25
46	Participation in social network professional communities across national boundaries permits the announcement and negotiation of occupational status and professional identities.	3.29	2.88

	Count	Std. Dev.	Variance	Min	Max	Average	Median
IMP	8	0.46	0.21	3.29	4.65	3.93	3.91
FEAS	8	0.27	0.07	2.88	3.81	3.34	3.25

	Statement	IMP	FEAS
	Cluster 2. Learning platforms	3.47	3.17
47	Cloud-based course learning platforms could allow some institutions and organizations in developing countries to leapfrog current institutional constraints to experiment with ICT-enabled learning.	3.94	3.06
65	Lack of creative virtual environment platforms that are easy to use.	3.24	3.06
34	Open educational movement creates opportunities for new knowledge on copyright.	3.24	3.38

	Count	Std. Dev.	Variance	Min	Max	Average	Median
IMP	3	0.33	0.11	3.24	3.94	3.47	3.24
FEAS	3	0.15	0.02	3.06	3.38	3.17	3.06

	Statement	IMP	FEAS
	Cluster 3. Research approaches	4.14	3.44
64	Interventions should be undertaken within the context of longitudinal field	4.41	3.31

	experimentation using well-designed measures and mixed methods of data collection (e.g., standardized measures, school exams, surveys, interviews, observations and trace data).		
22	A need (and opportunity) to use design-based research / educational design research as the methodology for pedagogical innovation in developing regions, to enable effective, evidence-based practice as well as the building of sound theory.	4.06	3.38
2	A research approach in which implementations of ICT-supported pedagogical innovations are reported in an isolated case study manner without seeking to ground them in, and contribute to the development of broader ICT4D theory.	3.94	3.63

	Count	Std. Dev.	Variance	Min	Max	Average	Median
IMP	3	0.2	0.04	3.94	4.41	4.14	4.06
FEAS	3	0.14	0.02	3.31	3.63	3.44	3.38

	Statement	IMP	FEAS
	Cluster 4. New job possibilities	4.16	3.31
35	ICT applications enable lifelong learning opportunities for working adults and professionals seeking to constantly re-equip themselves to the changing demands of their work.	4.41	3.19
21	The growth in open educational practices in developing countries provides the opportunity for much more local content to go online.	4.24	3.44
31	New job possibilities (such as online learning design, digital curation etc.) arise from changing ICT-enabled pedagogical innovations in developing countries.	3.82	3.31

	Count	Std. Dev.	Variance	Min	Max	Average	Median
IMP	3	0.25	0.06	3.82	4.41	4.16	4.24
FEAS	3	0.1	0.01	3.19	3.44	3.31	3.31

	Statement	IMP	FEAS
	Cluster 5. Integration of technology in classroom	3.96	3.42
11	A belief that existing digital resources (including Open Educational Resources) can simply be “plugged in” to new contexts, without the need to support educators in understanding the pedagogical beliefs and practices that underpin their teaching.	4.47	3.56
81	Authentic educational improvement using technology must be integrated into classroom practice by teachers in core subject areas and not by IT experts teaching ICT skills as a separate subject matter.	4.35	3.94
55	Teachers have very large classrooms (many students) with a diversity of student skills and levels of understanding, including special needs learners, who are often neglected in overall class instruction.	4	3.63
7	MOOCs as a way to make content available is not enough to promote construction of knowledge. It is necessary to have interaction among learners, and between teacher and learner.	4	3.38
49	ICT innovations must be based on the human sciences first, and then only on the computer sciences.	3.82	3.44
51	Technology should complement the existing curriculum.	3.82	3.69
90	To look beyond pedagogy and focus on the role of ICT in andragogy and	3.76	3.25

	heutagogy.		
3	Under government pressure, faculties are often instructed to “Use ICT” - but issues related to pedagogy are not discussed anywhere.	3.76	3.13
6	A serious challenge with ICT-enabled pedagogical innovations is that they add layers of complexity to critical literacies by adding the multifaceted dimensions of digital literacies to teaching and learning.	3.65	2.81

	Count	Std. Dev.	Variance	Min	Max	Average	Median
IMP	9	0.26	0.07	3.65	4.47	3.96	3.82
FEAS	9	0.31	0.1	2.81	3.94	3.42	3.44

	Statement	IMP	FEAS
	Cluster 6. ICT-enabled pedagogy	4.26	3.46
39	Possibility of getting the learners to become more engaged in learning as ICTs offer vast possibilities for interactivity and connectedness.	4.53	3.63
82	The focus needs to be on the use of evidence-based pedagogical strategies rather than novel technology strategies.	4.47	3.81
29	The effectiveness of ICT-enabled pedagogical innovation seems to depend more on innovation of pedagogy than innovation of ICT.	4.29	3.63
27	Use of learning analytics to enable a greater understanding of how learners learn, their preferred media, attention spans, difficulties faced, search and knowledge acquisition behavior.	4.29	3.31
15	Digital content must be interactive to foster learner understanding and engagement and should always be used with scaffolding and support from peers and teachers (i.e., not as a stand-alone or substitute for teaching).	4.29	3.44
62	Technology solutions should focus on essential educational competences (e.g., reading, writing, numeracy, scientific reasoning, self-regulation, inquiry skills) with a special emphasis on younger learners.	4.29	3.19
96	Offline tablets and mobile phones should be used to make learning more flexible and more learner-centered.	4.18	3.56
87	Development of appropriate pedagogical designs for integrating Open Educational Resources in online learning.	4.18	3.38
76	Open online learning, MOOCs and emerging models from MOOCs can make online learning pedagogy visible and acceptable and help foster discussions around ICTs in education.	4.12	3.56
91	Designing suitable moderation and assessment strategies in a MOOC environment in order to improve its learning potential and lower non-completion rates.	4	3.13

	Count	Std. Dev.	Variance	Min	Max	Average	Median
IMP	10	0.15	0.02	4	4.53	4.26	4.29
FEAS	10	0.2	0.04	3.13	3.81	3.46	3.5

	Statement	IMP	FEAS
	Cluster 7. Teacher competences	4.18	3.67
17	Teachers follow the traditions of direct, oral instruction and need professional development to learn other pedagogical strategies.	4.29	3.63

10	Even among faculties that do use ICT in teaching, such use is often restricted to making presentations, or showing some videos. True integration of ICT into teaching has not happened in most traditional educational institutions.	4.29	3.75
78	Integrating technology into the classroom changes the educator's role from that of a dispenser of knowledge to that of a co-learner, facilitator, moderator and coordinator of learning activities.	4.29	3.56
9	Educators don't always have the technical skills to be able to revise, remix or redistribute Open Educational Resources, and therefore end up merely re-using them "as-is".	4.24	3.75
77	Educators have not necessarily had good models at their disposal for how pedagogy can be successfully enhanced by technology, compared to learners themselves, and so they struggle to create this experience for their learners.	4.18	3.63
26	Since traditional "Chalk and talk" teaching meant each teacher developed their own teaching materials based on diverse resources, when they adapt ICT in teaching they believe they have to prepare their own materials - very few teachers are aware of OER.	4.12	3.94
50	The most important thing is for teachers to know how they can manage the ICT aspect inside the classroom to improve learning, but most of them don't know.	4.12	3.81
74	Many teachers, when getting into ICT-based education, replicate what they do in face-to-face learning on the new digital environment.	4.06	3.31
20	School teachers and university lecturers struggle to understand the affordances of technology and when to use them for which pedagogic purpose.	4.06	3.69

	Count	Std. Dev.	Variance	Min	Max	Average	Median
IMP	9	0.09	0.01	4.06	4.29	4.18	4.18
FEAS	9	0.17	0.03	3.31	3.94	3.67	3.69

	Statement	IMP	FEAS
	Cluster 8. Teacher concerns	3.74	3.75
33	Teachers fear that the use of ICTs for the purposes of teaching and learning involves an added workload and avoid getting involved in it.	4.12	3.81
61	Fears among teachers to use ICT such as: computers, tablets, iPads and OERs, in class, because they don't know how to use them appropriately.	4.12	3.75
36	Lack of motivation to use ICT among teachers.	3.76	4.13
40	Many students know more about ICT technology than their teachers in schools and lecturers in universities, which makes teachers and lecturers feel vulnerable and defensive about their capabilities.	3.59	3.75
14	The tendency among staff to want to "ring-fence" the classroom and teaching activities.	3.12	3.31

	Count	Std. Dev.	Variance	Min	Max	Average	Median
IMP	5	0.37	0.14	3.12	4.12	3.74	3.76
FEAS	5	0.26	0.07	3.31	4.13	3.75	3.75

	Statement	IMP	FEAS
	Cluster 9. Implementation of technology	3.62	3.36
16	A problem that is occurring in developing countries is that governments are	4.29	3.69

	taking tablets and laptops to basic education without training teachers, without foreseeing the technological capabilities of the devices and without implementing a monitoring plan.		
59	Lack of awareness regarding free software and content.	3.53	3.5
84	The initial focus on in-service professional development should give way to pre-service professional development.	3.53	3.44
58	In several institutions while the faculty may be IT savvy, the educational administrators are not. The reverse is also true in some cases.	3.12	2.81

	Count	Std. Dev.	Variance	Min	Max	Average	Median
IMP	4	0.43	0.18	3.12	4.29	3.62	3.53
FEAS	4	0.33	0.11	2.81	3.69	3.36	3.47

	Statement	IMP	FEAS
	Cluster 10. Context-based goals and solutions	3.6	3.25
24	One of the persisting problems related to the use of technology in education is that educational planners and technology advocates think of the technology first and only explore the educational applications of that technology later.	4.29	3.31
32	The specific goals for the use of ICT in education are often not clear, which makes them less effective.	3.88	3.38
86	University students and teachers say it takes a long time to adapt a resource from another educational practice so it becomes their own.	3.59	3.25
23	ICTs should not simply replace former distance education technology, such as radio and television.	3.18	3.38
52	The types of power relations that invest in traditional face-to-face classrooms are more easily threatened by many innovative online designs.	3.06	2.94

	Count	Std. Dev.	Variance	Min	Max	Average	Median
IMP	5	0.45	0.21	3.06	4.29	3.6	3.59
FEAS	5	0.16	0.03	2.94	3.38	3.25	3.31

	Statement	IMP	FEAS
	Cluster 11. Accessibility	3.55	3.4
72	According to a recent OECD report, a second digital divide is emerging, separating those with computer skills and competences from those without.	4.29	3.75
60	The implementation of tablets is transforming education strategies but is limited to privileged environments.	3.76	3.25
19	Even in countries where initial efforts to bridge the digital divide were successful, such successes were short-lived.	3.35	2.94
4	ICT is an unknown concept in rural school areas.	3.24	3.56
28	Gender bias in accessibility is a reality. The laptop / PC is generally owned by men in the family.	3.12	3.5

	Count	Std. Dev.	Variance	Min	Max	Average	Median
IMP	5	0.43	0.18	3.12	4.29	3.55	3.35
FEAS	5	0.28	0.08	2.94	3.75	3.4	3.5

	Statement	IMP	FEAS
	Cluster 12. Infrastructure	3.98	3.42
44	Lack of financial resources, poor access to the Internet, limited trained personnel, and lack of suitable policy are the challenges faced by developing countries that make the "digital divide" continue, not only between countries but also within countries.	4.47	3.69
37	The true costs of building ICT-enabled pedagogical innovations (such as MOOCs, e-books, apps) are a challenge to resource-constrained environments, which may lack capacity and skills as well as resources.	4.12	3.19
25	Lack of sustainability of the infrastructure and slowness or inability to upgrade infrastructure in a timely fashion reduces effectiveness of teaching and learning opportunities.	4.12	3.25
67	Poor access to computers and Internet facilities hinders use of ICT for teaching-learning.	3.82	3.63
71	In most developing countries, priority in use of ICTs is in school education. Likewise, to produce a "knowledge-based" economy, more investments are made in university education. Use of ICTs for education of marginalized groups is likely to be side-lined.	3.71	3.44
43	Access to good quality ICT is still inconsistent across developing countries.	3.65	

	Count	Std. Dev.	Variance	Min	Max	Average	Median
IMP	6	0.29	0.08	3.65	4.47	3.98	3.97
FEAS	6	0.19	0.03	3.19	3.69	3.42	3.38

	Statement	IMP	FEAS
	Cluster 13. Marginalizing vs inclusion	4.09	3.47
41	To meet the challenges of "digital divide", developing countries have tended to focus narrowly on "ICT Literacy". They need to take a holistic approach to include reforms of the curriculum, student assessment systems, pedagogical approaches and teacher training.	4.47	3.13
95	ICTs can play an important role in stimulating interest and engaging learners and can be a useful tool in education of marginalized groups, particularly rural women, by developing materials that are culturally and linguistically appropriate.	4.29	3.75
57	While the introduction of ICTs raises important equity issues, with real danger that ICT use can further marginalize already excluded groups from educational systems, they also hold the promise and opportunity for facilitating greater inclusion of such groups.	4.24	3.38
5	The potential and effectiveness of reaching out to large numbers of learners through the use of mobile devices in remote areas of the developing world.	4.18	3.81
75	ICT solutions should focus on equality between genders, races, religions, familial incomes, etc.	3.71	3.13
54	Increased bandwidth and connectivity provide the foundation for participation in knowledge creation and collaboration between educators and scholars.	3.65	3.63

	Count	Std. Dev.	Variance	Min	Max	Average	Median
IMP	6	0.31	0.09	3.65	4.47	4.09	4.21
FEAS	6	0.28	0.08	3.13	3.81	3.47	3.5

	Statement	IMP	FEAS
	Cluster 14. ICT policy	3.52	3.23
92	Lack of institutional policies to support the creation, use and reutilization of Open Educational Resources.	4.24	3.44
88	Institutional support and structure are critical for effective integration of ICT in education and management of education institutions.	4.18	3.63
66	Barriers for using Open Educational Resources (OER) include lack of regional and national policies to support the creation and use of OER.	3.82	3.56
8	There are still many barriers on the side of policymakers for the social recognition of online learning.	3.47	3.38
42	Public policies in developing countries do not have a business continuity plan for the integration of technologies (begin and end when each government period ends).	3.41	2.88
48	A challenge with ICT-enabled pedagogical innovations is that policymakers hope for one-size-fits- all generic solutions.	3.24	3
69	Universities lack policy related to the development of ICT-driven learning.	3.18	3.5
63	Pressure from industry might distort ICT policy for education in their favor.	3.12	2.94
18	Technology per se is seen as a magic bullet by policymakers and administrators.	3	2.75

	Count	Std. Dev.	Variance	Min	Max	Average	Median
IMP	9	0.43	0.19	3	4.24	3.52	3.41
FEAS	9	0.32	0.1	2.75	3.63	3.23	3.38

	Statement	IMP	FEAS
	Cluster 15. Diffusion of technology	3.61	3.35
45	An international consensus holds that insufficient attention is paid to monitoring and evaluation of issues and feedback loops during the program design process of most ICT in education initiatives.	4.06	3.69
13	Technology-based solutions need to consider the state of technology in schools and should be designed to be scalable and sustainable at minimal cost.	4.06	3.38
80	Active and engaging partnerships with local stakeholders are key to scalability and sustainability.	3.76	3.63
89	Education in developing countries is in danger of being transformed by innovations created in developed countries which are not context appropriate.	3.76	3.38
56	There is a low importance to improving education in developing countries, for example, the current call for research to solve national problems does not integrate education as an option.	3.47	3.25
73	A conception of “development” that is predominantly western / dominated by the global north.	3.12	2.88
12	Proprietary software is prohibitive: it is costly and promoted / pushed / packaged when buying laptops / PCs.	3	3.25

	Count	Std. Dev.	Variance	Min	Max	Average	Median
IMP	7	0.39	0.15	3	4.06	3.61	3.76
FEAS	7	0.25	0.06	2.88	3.69	3.35	3.38

	Statement	IMP	FEAS
	Cluster 16. Collaboration for cost-effectiveness	3.49	3.14
38	ICT-enabled collaborative program development and sharing between institutions so that cost efficiencies and quality can be enhanced.	4.12	3.31
85	ICT interventions should be based on minimal cost for maximum benefit to learners and not on profit margins.	3.76	3.31
70	A need (and opportunity) to use Amartya Sen's capability approach as an ethical and conceptual framework for the planning and evaluation of pedagogical innovations in developing regions.	3.53	3.19
93	Collaboration is a key word in development of OER, but in developing countries, competition is the key word.	3.41	2.63
53	On school level, theft of ICT is preventing wide-scale implementation of ICT-enabled pedagogical innovations.	2.65	3.25

	Count	Std. Dev.	Variance	Min	Max	Average	Median
IMP	5	0.49	0.24	2.65	4.12	3.49	3.53
FEAS	5	0.26	0.07	2.63	3.31	3.14	3.25

Appendix C. Day 1. Group work - results

Group A
Cluster Map Labelled

1) International cooperation
2) Learning platforms
3) Research approaches
4) New job possibilities
5) Integration of technology in classroom
6) ICT-enabled pedagogy
7) Teacher competences
8) Teacher concerns
9) Implementation of technology
10) Context-based goals and solutions
11) Accessibility
12) Infrastructure
13) Marginalizing vs inclusion
14) ICT
15) Policy
16) Diffusion of technology

Group Work – Super Clusters
Identify specific issues, problems, challenges or opportunities concerning ICT-enabled pedagogical innovations that transform education in developing countries?

- ❑ Technology affordances - How technology affordances can lead to more effective and efficient learning.
    1) Integration of technology in classroom
    2) ICT-enabled pedagogy
    3) Teacher competences and concerns
    4) Learning platforms
- ❑ Sustainable technology development
    1) ICT Policy
    2) International cooperation
    3) Implementation of technology
    4) Capacity building **** (new)
    5) New job possibilities
    6) Collaboration for cost-effectiveness
- ❑ Broadening access
    1) Accessibility
    2) Connectivity
    3) Diffusion of technology
    4) Infrastructure
    5) Marginalizing vs inclusion
    6) Context-based goals and solutions
- ❑ Research Approaches

Group B

We accept the data that has been processed by Slavi and team. We considered everything with an importance rating above 4.0

Cluster I: Systems

1	The complexity of working in ICT-enabled learning environments requires building of capacity in new types of skills (learning design, digital literacy) as well as acceptance of new modes of working (collaborative and team approaches to course design).	4.65
97	The opportunity of repurposing, adapting, reusing and sharing open educational content.	4.35
30	Open Access to high-quality educational resources and research, for both learners and faculty.	4.29
21	The growth in open educational practices in developing countries provides the opportunity for much more local content to go online.	4.24
13	Technology-based solutions need to consider the state of technology in schools and should be designed to be scalable and sustainable at minimal cost.	4.06
38	ICT-enabled collaborative program development and sharing between institutions so that cost efficiencies and quality can be enhanced.	4.12

Cluster II: Research Methods

64	Interventions should be undertaken within the context of longitudinal field experimentation using well-designed measures and mixed methods of data collection (e.g., standardized measures, school exams, surveys, interviews, observations and trace data).	4.41
22	A need (and opportunity) to use design-based research / educational design research as the methodology for pedagogical innovation in developing regions, to enable effective, evidence-based practice as well as the building of sound theory.	4.06
45	An international consensus holds that insufficient attention is paid to monitoring and evaluation of issues and feedback loops during the program design process of most ICT in education initiatives.	4.06

Cluster III: Pedagogy Issues

11	A belief that existing digital resources (including Open Educational Resources) can simply be “plugged in” to new contexts, without the need to support educators in understanding the pedagogical beliefs and practices that underpin their teaching.	4.47
81	Authentic educational improvement using technology must be integrated into classroom practice by teachers in core subject areas and not by IT experts teaching ICT skills as a separate subject matter.	4.35
55	Teachers have very large classrooms (many students) with a diversity of student skills and levels of understanding, including special needs learners, who are often neglected in overall class instruction.	4
7	MOOCs as a way to make content available is not enough to promote construction of knowledge. It is necessary to have interaction among learners, and between teacher and learner.	4
41 b	They need to take a holistic approach to include reforms of the curriculum, student assessment systems, pedagogical approaches and teacher training.	4.47

Cluster IV: Professional development / Capacity Building (of system, especially teachers)

39	Possibility of getting the learners to become more engaged in learning as ICTs offer vast possibilities for interactivity and connectedness.	4.53
82	The focus needs to be on the use of evidence-based pedagogical strategies rather than novel technology strategies.	4.47
29	The effectiveness of ICT-enabled pedagogical innovation seems to depend more on innovation of pedagogy than innovation of ICT.	4.29
27	Use of learning analytics to enable a greater understanding of how learners learn, their preferred media, attention spans, difficulties faced, and search and knowledge acquisition behavior.	4.29
15	Digital content must be interactive to foster learner understanding and engagement and should always be used with scaffolding and support from peers and teachers (i.e., not as a stand-alone or substitute for teaching).	4.29
62	Technology solutions should focus on essential educational competences (e.g., reading, writing, numeracy, scientific reasoning, self-regulation, inquiry skills) with a special emphasis on younger learners.	4.29
96	Offline tablets and mobile phones should be used to make learning more flexible and more learner-centered.	4.18
87	Development of appropriate pedagogical designs for integrating Open Educational Resources in online learning.	4.18
76	Open online learning, MOOCs and emerging models from MOOCs can make online learning pedagogy visible and acceptable and help foster discussions around ICTs in education.	4.12
91	Designing suitable moderation and assessment strategies in a MOOC environment in order to improve its learning potential and lower non-completion rates.	4

Cluster V: Barriers to adoption

16	A problem that is occurring in developing countries is that governments are taking tablets and laptops to basic education without training teachers, without foreseeing the technological capabilities of the devices and without implementing a monitoring plan.	4.29
33	Teachers fear that the use of ICTs for the purposes of teaching and learning involves an added workload and avoid getting involved in it.	4.12
61	Fears among teachers to use ICT such as: computers, tablets, iPads and OERs, in class, because they don't know how to use them appropriately.	4.12
24	One of the persisting problems related to the use of technology in education is that educational planners and technology advocates think of the technology first and only explore the educational applications of that technology later.	4.29
25	Lack of sustainability of the infrastructure and slowness or inability to upgrade infrastructure in a timely fashion reduces effectiveness of teaching and learning opportunities.	4.12
92	Lack of institutional policies to support the creation, use and reutilization of Open Educational Resources.	4.24
88	Institutional support and structure are critical for effective integration of ICT in education and management of education institutions.	4.18

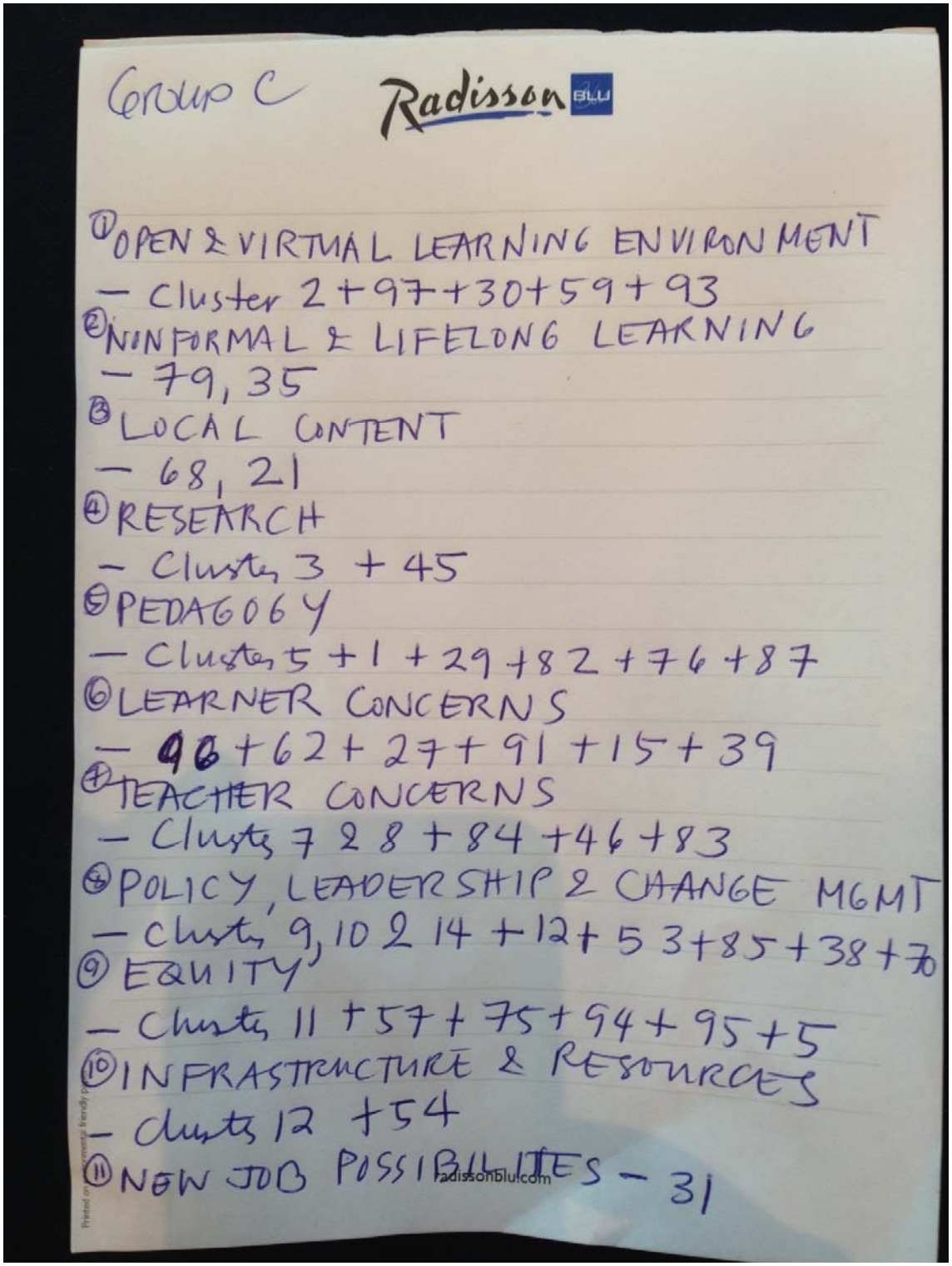
Cluster VI: Access, Equity & Inclusion (for the new Economy)

72	According to a recent OECD report, a second digital divide is emerging, separating those with computer skills and competences from those without.	4.29
44	Lack of financial resources, poor access to the Internet, limited trained personnel, and lack of suitable policy are the challenges faced by developing countries that make the "digital divide" continue, not only between countries but also within countries.	4.47
37	The true costs of building ICT-enabled pedagogical innovations (such as MOOCs, e-books, apps) are a challenge to resource-constrained environments, which may lack capacity and skills as well as resources.	4.12
41b	To meet the challenges of "digital divide", developing countries have tended to focus narrowly on "ICT Literacy".	4.47
95	ICTs can play an important role in stimulating interest and engaging learners and can be a useful tool in education of marginalized groups, particularly rural women, by developing materials that are culturally and linguistically appropriate.	4.29
57	While the introduction of ICTs raises important equity issues, with real danger that ICT use can further marginalize already excluded groups from educational systems, they also hold the promise and opportunity for facilitating greater inclusion of such groups.	4.24
79	To strengthen the role of ICT in non-formal learning.	4.12
35	ICT applications enable lifelong learning opportunities for working adults and professionals seeking to constantly re-equip themselves to the changing demands of their work.	4.41

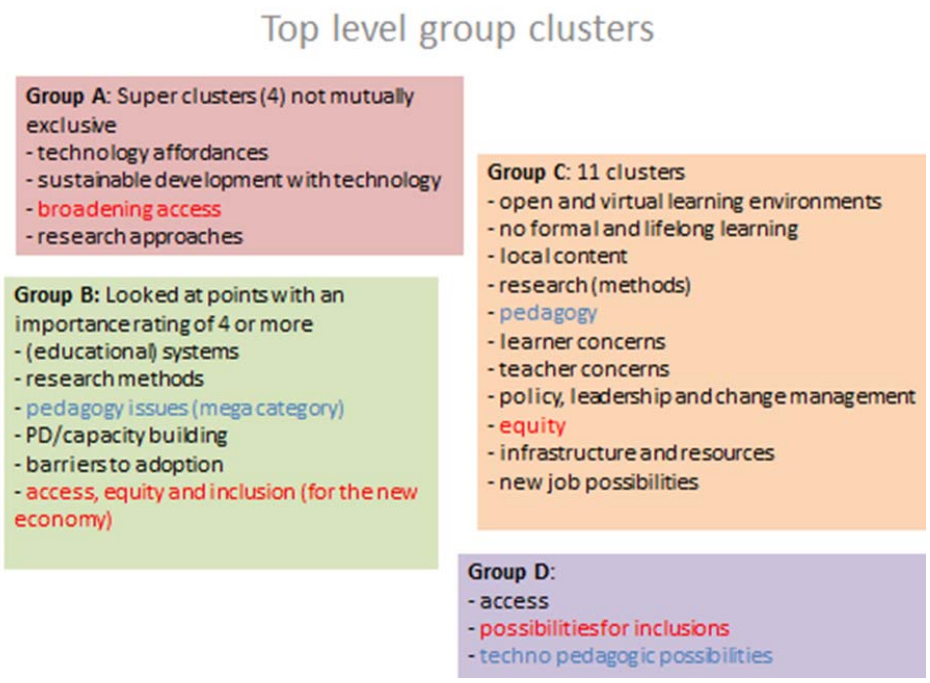
Innovation 4 GLE[6]: i4glee

Generating Learning that is
Effective
Equitable
Engaging
Efficient
Enjoyable
Electronic

Group C



All groups


Top level group clusters
Group A: Super clusters (4) not mutually exclusive
- technology affordances
- sustainable development with technology
- broadening access
- research approaches
Group B: Looked at points with an importance rating of 4 or more
- (educational) systems
- research methods
- pedagogy issues (mega category)
- PD/capacity building
- barriers to adoption
- access, equity and inclusion (for the new economy)
Group C: 11 clusters
- open and virtual learning environments
- no formal and lifelong learning
- local content
- research (methods)
- pedagogy
- learner concerns
- teacher concerns
- policy, leadership and change management
- equity
- infrastructure and resources
- new job possibilities
Group D:
- access
- possibilities for inclusions
- techno pedagogic possibilities

Appendix D. Day 2. Group work - results

Group A

New learning opportunities/directed in a networked world:" Innovative uses" of ICT for Learning and teaching

1. How do communities appropriate (use, integrate and transform) ICT within a learning environment for sustainable development? (*environmental sustainability; social equity; economic viability and financial feasibility*)
2. What role could ICT play in promoting the participation of young women/youth in technical/vocational education to enhance the skills for employment?
   - Formal
   - Non formal
3. How does "innovative" learning and teaching enable the attainment of digitally connected, personalised or differentiated learning?
   - Includes androgogy, heuterogogy open models, life long learning.
   - self directed and self determined

Assumptions

- Change model
- Professional development
- Learning model
- Possible lens of social justice in conceptual framework
- Research takes context into account
- Scalability – own type of research
- Needs leadership
- Not only Use – also integration and transformation

Group B

Empowering Communities through individualized and connected collaborative learning using Techno-pedagogy –

Including: Formal / Informal / Non-formal learning in the context of lifelong learning and leading to improvement of quality of life.

Communities of teachers / learners / support staff / special groups

- regions
- age groups – education levels / Adult learners
- gender
- out-of-school groups
- occupation-based
- socially marginalized groups

Pedagogy (dependent on environment): usage, access, sharing, collaborative, participative pedagogy.

The technology used would be dependent on the nature and access available to the groups.

- Mobile
- Broadband Internet
- Social Media
- Community Radio and TV
- Audio Cassettes etc.

Group C

“Give a Child a computer, and tomorrow he /she needs an IPAD, give him or her knowledge and he /she can develop himself or herself and make his or her own device”.

HOW CAN SOCIAL JUSTICE BE IMPROVED THROUGH RESEARCH INVOLVING INNOVATIVE / NETWORK (THECHNO) PEDAGOGY?

We answered this question taking in account our regions**:**

Similar Characteristics:

Very low-tech classroom.

Lack of teacher training.

Lack of basic infrastructure.

Use of non-licensed software and low rate of use of free software.

Delinquency and many more….

Our definition to social justice: accessibility, diversity, inclusion, equity, human rights respected and same opportunities for all.

Group D

Research on Application of affordable and accessible technologies to create effective and facilitated collaborative and individualized learning opportunities for development to all

Suggested research areas:

1. Enabling professional teacher training
2. Enabling working populations for lifelong learning opportunities
3. Facilitation of teaching-learning processes in a networked technology enabled classroom environment
4. Understanding and developing pedagogies for collaborative and individualized technology enabled learning
5. Preparing the marginalized and excluded populations for sustainable livelihood
6. Analyses of outcomes and impacts of policy frameworks for technology for ICT in learning