

A design-based approach to support and nurture open educational practices

A designed
based
approach to
OEP

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Abstract

Purpose – A critical attribute of open educational practices (OEP) is the pursuit of open scholarship which comprises the release of educational resources under an open licence scheme that permits no-cost access, use, reuse, adaptation, retention and redistribution to others. The degree of openness in relation to this attribute will depend on the context and culture of the place and the people in it. When left to chance, the adoption and practice of open scholarship by educators is at best sketchy. For optimum impact, a design-based approach is essential. A central focus of such an approach will need to target educators' belief systems and practices about their scholarship. Any such work will involve researchers collaborating with practitioners in real-life settings to improve educational practices through iterative analysis, design, development and implementation. The purpose of this paper is to report on how the development and use of such a design-based approach, implemented by the Open University of Sri Lanka, impacted the adoption and uptake of open scholarship among teachers in the Sri Lankan school system in terms of changes in their use of instructional resources, pedagogical thinking and pedagogical practices.

Design/methodology/approach – The study adopted a design-based research (DBR) approach (Reeves, 2006), which involved researchers collaboratively working with practitioners in real-life settings to improve their educational practices along three aspects – instructional resource use, pedagogical perspectives and pedagogical practices. Based on the four stages of the DBR approach – analysis, solution, testing and refinement, and reflection, a professional development intervention programme was designed and implemented to support teachers on the integration of open educational resources (OER) and adoption of OEP in their teaching-learning process. Data collected throughout the process using multiple strategies such as questionnaire surveys, concept mapping, lesson plans, focus group interviews, self-reflections and "stories", were analyzed using both qualitative and quantitative methods.

Findings – By the end of the intervention, significant changes were observed in teachers' use of instructional resources, their pedagogical thinking and pedagogical practices. While resource usage has shifted from no or low usage of OER to reuse, revise, remix and creation of OER, the pedagogical thinking and practices of teachers moved from a content-centric and individualized patterns to more constructivist, context centric and collaborative ways. The diffusion of OEP was prominent along two dimensions – enhancements in the individual practices in innovative OER use as well as collaborative practices of sharing of resources, knowledge and good practices.

Practical implications – The systematic and flexible methodology adopted based on the DBR approach via a framework designed as a contextualized, process oriented and a self-reflective enquiry has been very useful to support changes in OEP among practitioners over time.

Originality/value – This iterative process allowed the researchers to function as "designers", while investigating real-life issues in collaboration with the practitioners through reflective enquiry to further refine

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innovative practices towards OEP. This provides valuable insights for improved design solutions for future interventions in similar contexts.

Keywords Teacher professional development, Open educational resources, Design-based research approach, Open educational practices, Open scholarship

Paper type Research paper

Introduction

The imperative for open educational practices (OEP) has been on the rise for some time now. Foremost, this comprises; open access to educational opportunities; open learning, at the heart of which is time, place and pace flexibility; and open scholarship which means free and open access to educational resources for use, reuse, adaptation, retention and redistribution to others. The concept of openness is not new. Open access to educational opportunities and flexible approaches to learning and teaching have been always a core defining characteristic of open, flexible and distance learning which sees openness and flexibility in relation to time, place and pace of learning as a value principle, much like we see diversity, equity or equality in education and society more broadly. Openness and flexibility are at the heart of what distance educators do and promote. And in the contemporary world, both in the developed and developing contexts, technological infrastructure is a key component of it.

The notion of open scholarship is a more recent phenomenon and an addition to the broader concept of openness. Its value principle is that education in general, and knowledge more specifically, is a public good which should be available to all. A key component of this is the release of educational resources under an open licensing scheme (e.g. Creative Commons Licensing Framework) as open educational resources (OER) for it to be able to be used, reused and shared freely and openly at no cost to either party. The imperatives for adopting this path to open scholarship are enormous. For teachers and learners, both in developed and developing educational contexts, this means access to valuable and adequate educational resources for better teaching and learning. And it includes the opportunity to adopt and adapt these essential educational resources in ways to suit local contexts and its requirements. These affordances are critical and crucial for the achievement of our sustainable development goals towards education for all and promoting equity, and equality of educational opportunity more broadly but especially in developing social and economic contexts.

While the educational imperatives for open scholarship are clear and convincing, its adoption and implementation more widely are till fraught with challenges. Some of these challenges have to do with the economics of open scholarship. Someone, and at some point, must pay for the production of educational resources so that these can be distributed widely and openly among the community, and at no cost to its users. Issues around this kind affordability are still being worked out by authors, developers and publishers of any such content.

The more serious challenge has to do with the adoption and integration of OER in teaching. Foremost this requires an understanding of the concept of open scholarship and what it involves. This includes an understanding of what is an OER, where is it found, and how to find it? How is it distinguishable from any other kind of educational resource? And also, how to develop an OER? What, if anything, is qualitatively different about it? And once found or developed, how best to make use of it in supporting teaching and learning? What are its pedagogical affordances? And how these affordances differ from those that are possible for proprietary educational resources?

A lot of this has to do with developing new perceptions, and perspectives about pedagogy, about what it means to teach and to learn. And this involves, not just developing new and technical skills but it is about shifting mindsets. It requires practitioners to move beyond a focus on access to OER, to a more comprehensive view about creation and integration of OER in order to make a difference in the teaching-learning process. This requires engagement of teachers and learners in open practices

which are participatory, collaborative and innovative, the extent of which will vary, depending on the context and culture of places and people.

Far too many attempts at the integration of OER have failed to impress upon teachers and learners the pedagogical affordances of use, reuse and adaptation of OER. Many have failed to make clear to teachers and learners that not all educational resources, no matter how good, are fixed or static entities. Surely, some of this content is declarative and does not change, but others do change and need to be seen differently in different contexts. As such focussing on the learning of content cannot be the end game for learners. A focus on learning to solve real-life challenges and problems should be the focus of all learning. The subject matter content for this can and should be sourced from anywhere. And it helps if these are OER so that they can be used, reused and manipulated in ways that are not possible with proprietary material. Such an approach requires a shift in the mindsets of educators and teachers from thinking about teaching to the content to designing rich and relevant learning experiences in which students are engaged in solving real-world challenges and problems with the help of OER.

The design of such learning experiences requires a close working relationship and partnership between researchers and practitioners in the field. In our case, these practitioners are the teachers in the Sri Lankan school system. A core component of this partnership is the joint development of learning experience designs by researchers and practicing teachers, such that both parties can claim a sense of ownership of what is being developed, and it is not something that is being imposed upon them. Such a working relationship is at the heart of a design-based approach. It involves researchers and practitioners in the field working closely to design artefacts that can be implemented and data collected on its effectiveness through iterative analysis, design, development and implementation *in situ*.

This paper describes a programme of work along these lines that has been carried out in Sri Lanka over the period 2015-2016. This project was led by researchers from the Open University of Sri Lanka (OUSL), with funding from the International Development Research Centre, Canada, and administered by Wawasan Open University, Malaysia and the University of Cape Town, South Africa. The goal of this work has been to study the impacts of the adoption of OER and OEP by school teachers in Sri Lanka. This paper reports on the use of design-based research (DBR) in supporting and nurturing the adoption of OEP by teachers in the Sri Lankan school system in terms of changes in their use of educational resources, their pedagogical perspectives and pedagogical practices.

Review of literature

Opening up education through OEP

“Opening up education” is a concept that has been given a great deal of attention during the recent past, as witnessed by a continuum of “open” concepts and practices in relation to teaching and learning that have been evolving over time. Under a larger agenda of open education which emphasizes that knowledge should be shared for the greater good of the community, there are various dimensions of open concepts such as open learning, open teaching, open access, open scholarship, OER and OEP, supporting this agenda. All these concepts focus on enhancing “openness” in education by removing barriers to learning and addressing student needs, providing opportunities for lifelong learning and flexibility over when, where, how and at what pace to engage in study, improving access to knowledge, enabling efficient and affordable sharing of educational resources and offering alternative ways of teaching and learning (Butcher, 2011; COL, 2000; Naidu, 2016; Wiley and Green, 2012).

Openness in teaching and learning practices is based on the value principle that knowledge should be shared – freely, openly and equitably. It signifies that knowledge, as a common good, should be accessible and usable by all human beings. Opening up access to educational resources, and opening up practices in the use of such resources are

two focal areas of openness in education. The release of teaching, learning and research materials under an open licensing framework (Creative Commons, n.d.) as OER has increased no-cost access to and sharing of knowledge in an efficient and affordable manner (UNESCO-COL, 2012; Wiley and Green, 2012). This has enhanced emergence and adoption of various scholarly practices of openness, promoting open scholarship, which is a critical attribute of OEP.

The “spectrum of rights” provided by the open licensing framework to users giving access to resources through “most open” to “least open” licence types, allows an opportunity to adopt varying degrees of openness in the use of educational resources via the 5R framework of OER – retain, reuse, revise, remix and redistribution (Wiley, 2014). The ability to adapt and use educational resources in this manner, which they were unable to do with the proprietary materials, has empowered educators to become more creative and innovative in their educational practices. In other words, the OER movement has stimulated innovations in teaching and learning practices. This shift of focus from access to resources, to innovative practices in the use of resources promotes the concept of OEP (Ehlers, 2011; Open Educational Quality Initiative Report, 2009).

The various definitions of OEP fundamentally focus on how “openness” can be practiced in teaching and learning. For instance, OEP are explained as, a set of activities and support around the creation, use and re-purposing of OER (Conole, 2010); a combination of open resource use and open learning architectures to transform learning (Camilleri and Ehlers, 2011); use and production of OER in such a manner to improve the quality of education and innovate educational environments (Ehlers and Conole, 2010); and practices that support the (re)use and production of OER through institutional policies, promote innovative pedagogical models, and respect and empower learners as co-producers on their lifelong learning path (Ehlers, 2011). The emphasis on practices instead of resources and on enhancing innovations and quality in education are common features stressed in all these definitions.

These practices are further described in relation to the use of educational content through “open pedagogies” and “open technologies” (Beetham *et al.*, 2012). While the adoption of pedagogical models based on more constructivist and participatory approaches will allow educators to become more open in their teaching practices, increased availability of free and open technological applications and services let educators select appropriate technology to support innovative practices. OEP will thus require engagement of teachers and learners in innovative practices which are participatory and collaborative, harnessing the potential of both technology and pedagogy (Cape Town Declaration, 2008). However, such changes in practices would essentially require changes in practitioners’ belief systems and mindsets. Hence, promoting adoption of open scholarship and OEP becomes very challenging.

Facing challenges in implementing OEP

The degree of openness in educational practices, and hence open scholarship will vary, depending on the context and culture of places and people. While the degree of openness in actual content will differ based on their licence type, the degree of openness in practices will change depending on the pedagogical models practitioners adopt in the use of the educational resources. In order to make an impact, implementation of OEP would essentially require practitioners to change from a simple focus on access to a broader view about integration of OER in the teaching-learning process and creation of OER, which is a challenging process (Ehlers and Conole, 2010). Even though adoption of OER enhances access to resources, OER by themselves would not have any impact unless those are used in particular ways for a change in practices to occur (Smith, 2016). This will require practitioners using innovative methods in the integration of OER. Research studies conducted on OER integration in teaching and learning reveal that adoption of OEP demands a culture of sharing and use of novel pedagogical models (Beetham *et al.*, 2012;

Carey *et al.*, 2015; Coughlan and Perryman, 2015; Karunanayaka and Naidu, 2013; Karunanayaka *et al.*, 2014, 2015; Lane and van Dorp, 2011; Petrides and James, 2008).

The realization of successful OEP will thus depend on having opportunities for pedagogical innovation, yet innovative thinking and practices may occur if and when more flexibility and choices are available for practitioners (Educause, 2010; Weller, 2014). Five principles of openness necessary for implementing OEP have been identified, comprising open tools and processes that will promote: collaboration and sharing of information; connected communication about learning and teaching; collectivity to grow knowledge and resources; critique for the promotion of scholarship; and serendipitous innovation (Conole, 2013). Digital technologies will play a key role in achieving such requirements effectively and efficiently and hence digital competencies also becomes a crucial requirement in supporting OEP (Beetham *et al.*, 2012; European Commission, 2013).

Various initiatives on OER integrations have presented frameworks for implementing OEP in different contexts. For instance, the “OPAL framework” (Andrade *et al.*, 2011), provides strategies to consider when designing, developing, implementing and evaluating OER initiatives. Capturing the link between resources and practices, OEP is explained in two dimensions in this framework: openness in resource usage and creation versus openness in pedagogical models, suggesting different degrees of openness in both aspects from low to high levels (Ehlers, 2011). Similarly, the 7C learning design framework (Conole, 2014) presents seven elements: conceptualize; capture; communicate; consider; combine and consolidate, integrating the trend for openness by using OER and collaborative practices. A model of “open pedagogy” discusses eight interconnected attributes – participatory technologies; people, openness, trust; innovation and creativity; sharing ideas and resources, connected community; learner generated; reflective practice and peer review (Hegarty, 2015). Such models exemplify how OEP can be facilitated by creating structured enabling environments.

It is apparent that adoption of OER and OEP by practitioners can be truly effective only if it reflects a change in their thinking and actions. Educational change is a complex process, and to deal with such complexity, the best way is not to control change but to guide it, by individuals taking action as “change agents” (Fullan, 1993). Enacting change towards OEP is best achievable through a strategic approach via systematic design of appropriate learning experiences (Naidu and Karunanayaka, 2014). OER integration endeavours in the Sri Lankan context, have revealed significant influences in supporting changes in thinking and practices of educators towards OEP through design and implementation of effective, efficient and engaging learning experiences based on innovative pedagogical models (Karunanayaka and Naidu, 2014, 2015; Karunanayaka *et al.*, 2015). Experiences which are designed to create more intense and close interactions with the practitioners in context, while engaging them as co-participants in the process would be more desirable in promoting changes towards OEP.

Affordances of a DBR approach to support adoption of OEP

A DBR approach that involves researchers collaborating with practitioners in real-life settings to improve educational practices (Reeves, 2006), offers a feasible solution to ensure a sustainable and lasting impact on the adoption of OEP. DBR is a systematic but flexible methodology aimed at improving educational practices through iterative analysis, design, development and implementation in real-world settings (Wang and Hannafin, 2005). It comprises four phases: analysis of existing levels of expertise and practices by researchers and practitioners; designing, developing and implementing solutions as appropriate; testing and refinement of solutions in practice; and reflection by researchers and practitioners on authentic problems produce design principles and enhance solution implementation (Reeves, 2006). Being grounded in real-life context and conducted in collaboration with the practitioners, a DBR approach would have more potential in enacting desired changes of authentic educational practices.

DBR resembles action research (AR) in that it identifies real-world problems accompanied by subsequent actions to improve the status quo, and practitioners are highly involved in the research process. However, DBR is distinct from AR in two respects. Its major goal is to generate theory to solve authentic problems; and in it the roles of researchers and teachers as partners in the research process are central. In DBR, researchers take the initiative as both researchers and designers (Wang and Hannafin, 2005), whereas in AR, the practitioners initiate the research. Hence, when aiming at designing an approach to support changes in practices such as OEP among practitioners, DBR would be a more desirable approach.

“Design” is the key element of DBR. Yet, it extends beyond mere designing of interventions and testing them. Within a DBR framework, complex problems are addressed in real contexts in collaboration with practitioners; integrates known and hypothetical design principles with technological advances to render possible solutions to these problems; conducts rigorous and reflective enquiry to test and refine innovative learning environments as well as to define new design principles (Reeves, 2006) (see Figure 1).

The basic characteristics of DBR are defined as: pragmatic; grounded; interactive; iterative and flexible; integrative and contextual (Wang and Hannafin, 2005). With its ultimate goal of solving current real-world problems by designing and implementing interventions, while extending theories and refining design principles, rather than testing theory (The Design-Based Research (DBR) Collective, 2003), DBR emphasizes on an iterative cyclic process of designing-testing-refining solutions leading to a better understanding of the process. Being grounded in real-world context and conducted in collaboration with the practitioners, it has more potential in enacting desired changes of authentic educational practices. Further, given their joint role as designers and researchers, “[...] DBR researchers are not simply observing interactions, but are actually “causing” the very same interactions they are making the claims about [...]” (Barab and Squire, 2004, p. 9). Such an iterative process can guide similar research and development endeavours (DBR Collective, 2003).

DBR is useful in designing solutions/strategies by researchers functioning as designers through an intervention, collaboratively with practitioners, to improve their educational practices. This provided the conceptual framework in guiding the design of an intervention in our study.

Key research question

The key research question of this study was as follows:

RQ1. How and to what extent a DBR approach impacted the adoption of OEP among teachers in terms of changes in their use of instructional resources, pedagogical thinking and pedagogical practices?

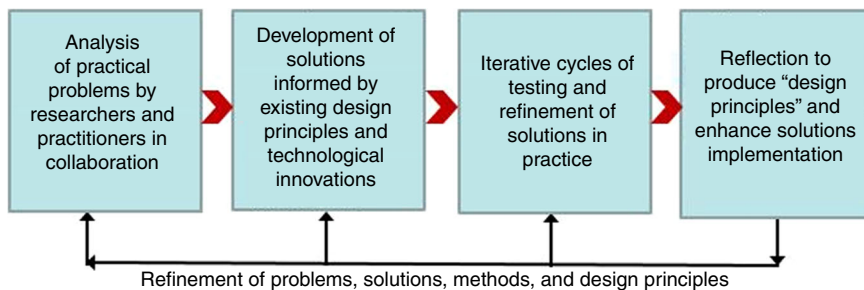


Figure 1.
Four phases of
design-based research

Source: Adapted from Reeves (2006)

Methodology

The project implemented by OUSL involved the integration of OER and adoption of OEP by student teachers of the Faculty of Education, and ascertaining its impact on the use of instructional materials by teachers, and changes in pedagogical perspectives and practices of teachers. The focus of the current study was to explore how a DBR approach impacted on supporting OEP among the teachers.

Research design

The DBR (Reeves, 2006; Wang and Hannafin, 2005) approach adopted in this study involved researchers collaboratively working with practitioners in real-life settings to improve their practices along three aspects – instructional resource use; pedagogical perspectives; pedagogical practices.

The full programme of activities comprised the design and implementation of a professional development intervention programme for teachers on the integration of OER in teaching and learning, and ascertaining the impact of integrating OER and adoption of OEP in their teaching-learning process. This intervention programme was implemented in several stages, at nine OUSL centres representing nine provinces of the country.

Participants

Participants in the study comprised 230 student teachers during Stage 1, and 85 student teachers in 21 teams in Stage 2, representing the nine provinces of the country. A summary of the participant profile at Stage 1 is presented in Table I.

The participants constituted more females (66 per cent) than males (34 per cent), and all (100 per cent) were graduate teachers with more than half (57.8 per cent) being science graduates, and some (17.4 per cent) were with post graduate qualifications. A majority of the participants (75.7 per cent) were newcomers to the teaching profession with less than five years of teaching experience, and only very small percentage (1.7 per cent) with experience above 15 years. The distribution of participants at Stage 1 in the nine OUSL centres – Anuradhapura (A), Badulla (B), Batticaloa (Ba), Colombo (C), Jaffna (J), Kandy (Ka), Kurunegala (Ku), Matara (M) and Ratnapura (R) is presented in Figure 2.

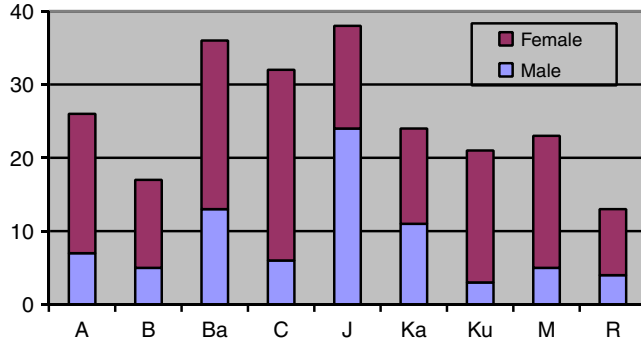
The intervention framework

The intervention framework was designed as a contextualized, process oriented and a self-reflective enquiry following the four stages of the DBR approach – analysis, solution, testing and refinement and reflection (Reeves, 2006). This allowed examining the impact on the three aspects in focus – instructional resource use, pedagogical perspectives and pedagogical practices, through the provision of a carefully structured intervention process with specific strategies at each stage.

Aspect	Category	Number	%
Gender	Female	152	66.1
	Male	78	33.9
Academic qualifications	BSc	133	57.8
	BA/BCom	77	33.5
	Others	20	8.7
	Post graduate	40	17.4
Professional experience	< 5 years	174	75.7
	6-15 years	52	22.6
	> 15 years	04	1.7

Table I.
Participant profile

Figure 2.
Distribution of participants in the nine OUSL centres



A diagrammatic representation of the framework developed to design and implement the intervention using the DBR approach is presented in Figure 3.

The design of the intervention involved designing and developing a set of strategies based on existing theories and frameworks, tested design principles and prior research.

Strategies were developed to monitor and support teachers to gradually move from “no” or “low” usage of OER to “high” degrees of usage and creation of OER enhancing openness

Aim – To support “Open Educational Practices” (OEP) among practitioners				DBR approach	Strategies/ experiences
Level	Instructional resource use (5R)	Pedagogical perspectives (5C)	Pedagogical practices (5C)	Four stages in iterative cycles	F2F; online; P2P
Complex ↑ OEP	Redistribute	Collaborative	Collaborative	Reflection Produce design principles	Finding solutions to authentic problems in teaching and learning by researchers and practitioners together
	Remix	Creative	Creative	Testing and refinement Solution in practice	
	Revise	Critical	Critical	Solution	Providing opportunities for OER integration and OEP adoption in practices
	Reuse	Challenging	Challenging	Design and implement an intervention	
	Retain	Contextual	Contextual	Analysis Analyze existing level	Reflect on current thinking and practices by researchers and practitioners together
Simple/basic					

Figure 3.
A DBR framework to provide experiences in OEP

Source: Karunanayaka and Naidu (2016)

in their use of instructional resources, based on the 5R framework of OER – retain, reuse, revise, remix, and re-distribute (Wiley, 2014), and the OPAL framework to support OEP in two dimensions: openness in resource usage and creation vs openness in pedagogical models (Ehlers, 2011).

To enhance changes in teachers' pedagogical perspectives and practices towards OEP, the experiences in the intervention were designed based on situated learning principles underlying a constructivist approach to learning (Brown *et al.*, 1989; Duffy and Jonassen, 1991). These included specific strategies designed to support teachers moving from low towards high degrees of context centric, challenging, critical-thinking, creative, and collaborative thinking and practices (termed “5Cs”).

Specific strategies of the intervention in line with the four phases of DBR are presented in Table II.

As indicated in Table II, the four phases in the DBR approach were implemented in iterative cycles during the intervention, using different strategies. These strategies also served as a variety of data gathering methods, both qualitative and quantitative, systematically used at different stages of the intervention.

Initially, the current situation in relation to the three aspects – instructional resource use, pedagogical perspectives and pedagogical practices were analyzed, in collaboration with the practitioners. Next, as a solution, the intervention consisting of two key components – a series of interactive workshops and an enabling online environment in Moodle learning management system (LMS) was designed and implemented. Both these components included specific activities for capacity building, guiding, monitoring and supporting, as well as reviewing and evaluating, in relation to integration of OER by teachers. A variety of hands-on individual and group experiences were provided to engage teachers in the integration of OER in their teaching-learning process, while encouraging collaborative practices and promoting reflective practice.

Iterative cycles of testing and refinement of solutions in practice occurred during the series of pre, mid and post intervention workshops conducted at the nine OUSL centres, as well as constant interactions through the online environment in the LMS. Data gathering via multiple sources continued throughout, and these helped researchers to work together with practitioners in refining design strategies, based on contextual needs and complexities.

Throughout the intervention process, both teachers and researchers were encouraged to maintain reflective journals, writing their self-reflections on the experiences gained at different stages. Based on these reflections, teams of participant teachers and researchers compiled narratives in the form of “stories” at the end of the process. This helped in discussing and finding solutions to authentic problems, and to recommend effective design principles.

Methods of data collection and analysis

In keeping with the DBR process which involves integrative use of multiple data gathering methods over time, data were collected throughout the intervention process using questionnaire surveys, concept mapping, analyzing lesson plans, focus group interviews, records in the LMS, self-reflections and narratives (“stories”) of teachers. These strategies were employed at different stages – pre, mid and post intervention, and analyzed using qualitative and quantitative methods to capture changes in relation to adoption of OER and OEP in terms of changes in instructional resource usage, pedagogical practices and pedagogical perceptions of teachers.

Such methodological triangulation allowed providing a more comprehensive view of the whole, since each source of data gave a different views of the issues being studied (Morse, 1991). This process helped gaining a broader understanding of the effects of the intervention.

Interpretative phenomenological analysis (IPA) was the methodological construct used in the analysis of qualitative data that comprised content analysis and interpretation of

Table II.
Strategies adopted during the intervention to promote adoption of OER and OEP

Phase in DBR	Intervention stages	Purpose	The intervention to promote integrating and adoption of OER and OEP Specific strategies
Analysis of practical problems by researchers and practitioners in collaboration	Pre-Intervention survey Orientation workshop	Reflecting on current thinking and practices in relation to use of instructional methods and materials by teachers	Pre-Intervention questionnaire Individual concept mapping on "Openness in Education" Analyzing teachers' lesson plans Focus group discussions
Development of solutions informed by existing design principles and technological innovations	Designing a series of interactive workshops Capacity building Monitoring/supporting Reviewing/evaluation Designing of a LMS to support OER adoption Capacity building workshops LMS to support OER adoption Monitoring/supporting Workshops Reviewing/evaluation	Capacity building, monitoring and supporting teachers to adopt OER; Use of technology (LMS) to support OER adoption by teachers	Designing a sequence of experiences to enhance 5Rs in OER adoption, and 5Cs in teachers' pedagogical thinking and practices Workshop activities LMS activities Monitoring activities
Iterative cycles of testing and refinement of solutions in practice	Capacity building workshops LMS to support OER adoption Monitoring/supporting Workshops Reviewing/evaluation	Capacity building and guidance to adopt and integrate OER; lesson planning with OER integrations and upload in LMS; sharing OER in LMS; Monitoring, reviewing and supporting; enhance collaboration and cooperation; stimulate healthy competition; sharing of good practices; support extension activities; promote reflective practice; data collection	Hands-on individual and group activities in identifying/ searching/selecting OER and planning lessons with OER integrations; Providing links to OER repositories via LMS; Encouraging teachers to use LMS to share OER found/reused/ revised/remixed/ created; providing constructive feedback; Constant communication via LMS; competition to find most active teacher and most active centre; encourage extension activities at school/centre/zonal levels; Concept mapping; reflective journal writing; questionnaire survey; focus group discussions Compilation of "Stories" – by teachers and researchers, based on their reflections; Creation of a weblog to share the stories of their experiences
Reflection to produce design principles and enhance solution implementation	Teacher reflections researcher reflections	Use teachers and researcher's reflections to find and implement solutions to authentic problems	

concept maps, open-ended questions in surveys, self-reflections, interview transcripts and narratives. The IPA strategy was used to explore in detail how individuals were perceiving the particular situations they faced and making sense of their personal and social world (Smith and Osborn, 2003), that helped discovering the meaning of experiences of participants through their and researchers' interpretations by examining their "lived experiences" (Reid *et al.*, 2005).

Further, such a "realist, process-oriented approach" that relied on understanding the processes by which a situation occurs via direct physical connection in the real world, offered a feasible approach for ascertaining causation, rather than a comparison of situations depending on the existence of the presumed cause (Maxwell, 2004; Mohr, 1999).

Results and discussion

Changes in instructional resources usage

Data obtained from questionnaire surveys revealed that at the pre-intervention stage, teachers' use of OER was minimal, as indicated in Table III. Only 10 per cent have even heard the term "OER" and 3.9 per cent have used some OER materials, while use of online resources was only 20.4 per cent.

However, by mid-intervention this has significantly changed as shown by Figure 4, where a majority have claimed developing competencies in searching and identifying OER, identifying CC licence, adopting 5Rs, creating OER and integrating OER in their teaching practices.

Even though the number of participants decreased by the end of the intervention, many participants who remained were actively engaged not only in reusing OER, but also re-purposing them by translating into local languages, adapting to suit their contexts, and even creating OER on their own, as evident by the following excerpts:

When I use OER I modify it to local language. Some OER's are advanced than I expect. Thus I edit it according to my lesson.

We were able to find interesting presentations on photosynthesis. We translated one presentation to Sinhala and used it to teach students. Sometimes we downloaded exercises and tests and made copies. Then we distributed among students.

The provisions of hands-on experience during the workshops and the Moodle LMS have vastly supported their use and adoption of OER:

Workshop activities helped us to identify relevant OER and identify the nature of their licenses [...] it helped us to gain some knowledge and practice of the 4R concept through practical activities organized during the workshop.

We could also access the OER site created for us [...] in the Moodle LMS and search for OER materials relevant to our subject areas. We could identify appropriate OER to integrate in lesson plans.

Hence, it was evident that starting from an initial state of "no or low-usage" of OER, the participants gradually moved towards adopting 5Rs and creating OER. This move from

Aspect	Category	No.	%
Heard of OER before	Yes	23	10.0
	No	207	90.0
Used OER before	Yes	9	3.9
	No	221	96.1
Types of resources being used	Print	230	100.0
	Audio/video/multimedia	162	70.5
	Online resources	47	20.4

Table III.
Teachers use of
instructional materials
at pre-intervention

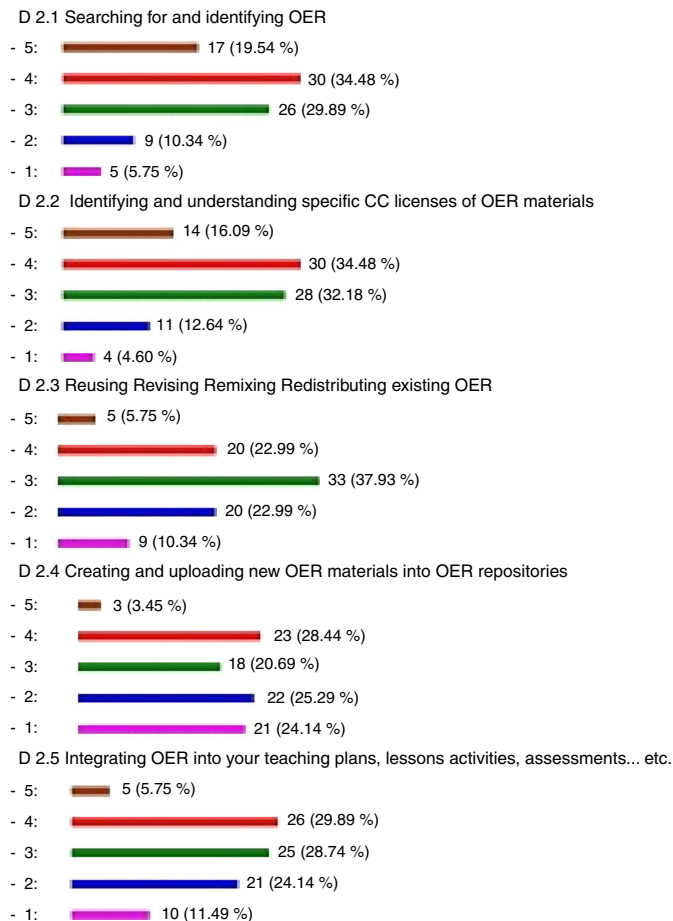


Figure 4.
Types of engagement
with OER by teachers
by mid-intervention

“low” to “high” degrees of openness in two aspects – use, sharing and creation of OER, and innovative use of instructional resources, signifies enhanced diffusion of OER (Ehlers, 2011). The specific strategies of the intervention – availability and accessibility of a variety of OER through the LMS that allowed 5Rs, and provision of hands-on activities to search, select and integrate OER in lesson plans have facilitated enhancing creativity and innovation in their use of resources.

Changes in pedagogical perspectives

The structural and content analysis of the concept maps created by participant teachers at different stages of the intervention revealed the developments in teachers’ understandings and changing perspectives over time. The comparison of different versions of concept maps illustrated incremental changes in teachers’ perspectives, moving towards more “open” thinking, as depicted by Figures 5(a) and (b).

At the end of the process group concept maps were created by teams of participant teachers, elaborating their collective understandings and perceptions, as illustrated by Figure 6.

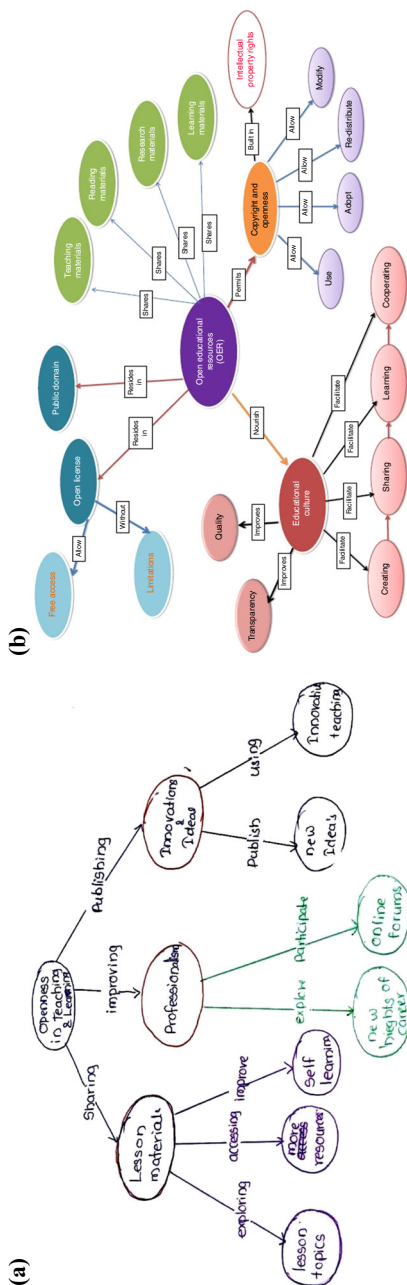
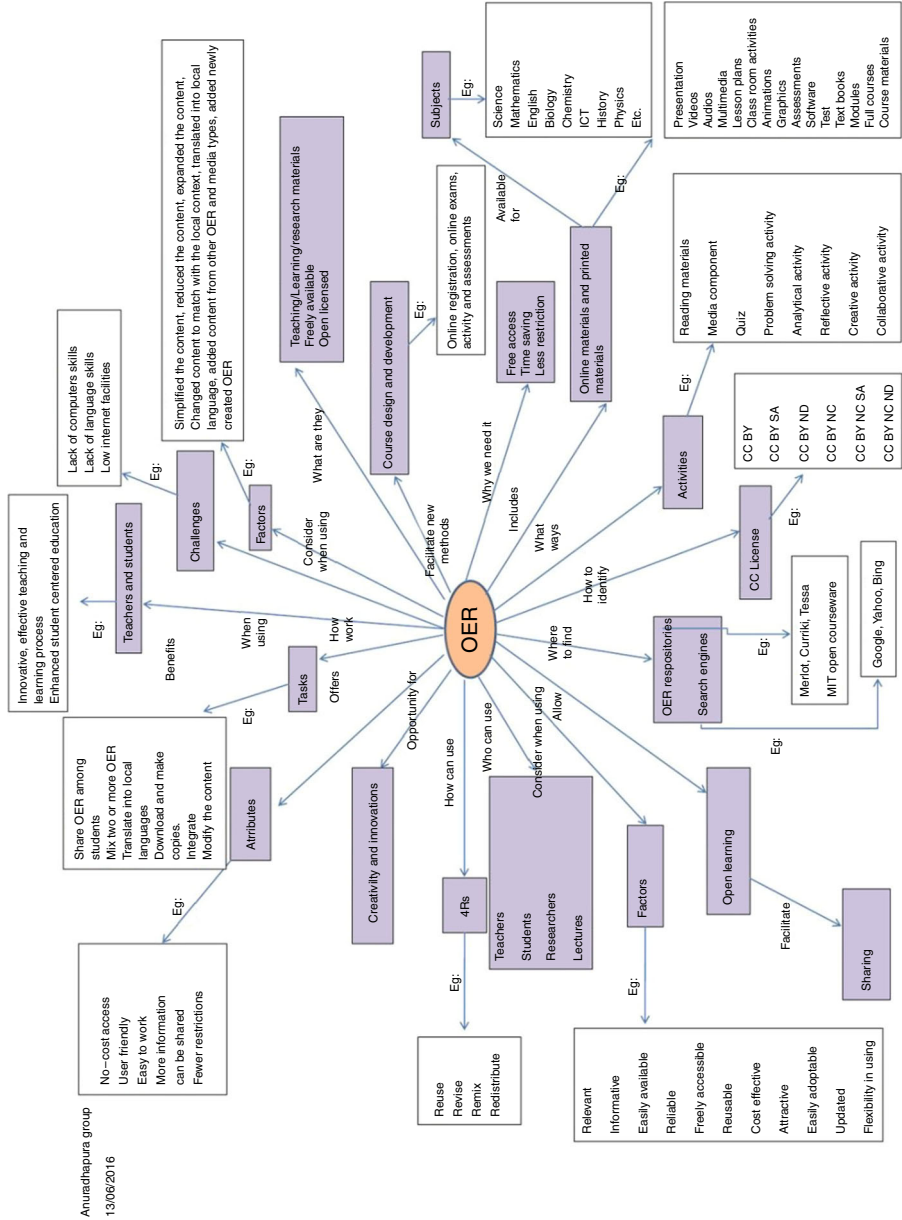


Figure 5. Two versions of concept maps: pre intervention and mid intervention



Anuradhapurna group
13/06/2016

Figure 6.
A group concept map
– post-intervention

The final group concept maps constructed by teams of teachers demonstrated their enriched perspectives towards adoption of OER and OEP.

The concept mapping exercise has also supported teachers to reflect on changes in their own pedagogical thinking during the intervention process as claimed below:

The concept maps was a new experience [...] which provided an easy way to summarize our findings throughout our activities and that new knowledge had made us special.

Even though teachers' awareness on OER was minimal at the beginning, their perceptions on sharing resources was quite positive. However they were not very much concerned about copyrights when using resources. This view has changed during the process and teachers have started thinking more about using online resources legally and sharing resources, as indicated by the their reflections:

I have already used teaching materials which are available in the internet without checking the license agreement. But today I could get a real idea about the license agreement of the resources.

I can understand the meaning OER [...]. Now I can use useful data and information legally. Before that I mostly use copyright data and information without permission [...] now I use free usable data source with permission.

Further, it was evident that the participants' pedagogical thinking has become more context centric, challenging, critical, and creative as well as collaborative, as following excerpts specify:

Through the integration of OER [...] we have got the opportunity to "think out of the box" and release ourselves from the traditional teachers' role. The creation of our own OER enhanced our thinking capabilities and contributed to the development of our personalities as well.

OERs helped us to plan and implement very attractive lessons. Here the teachers as well as students were encouraged to look for new knowledge. This created an opportunity for us to share subject related resources such as activities, assessments, video clips etc.

As evident by these quotes, engagement with OER has stimulated critical reflection among the teachers about their current practices and offered inspiration to attempt new practices with OER, and leading towards OEP (Beetham *et al.*, 2012). The provision of specific "reflective" experiences in the intervention such as concept mapping, reflective journal writing and peer discussions, together with the individual and group activities on OER integration, and the enabling environment of the LMS to share OER, have significantly supported this. The compilation of "stories" based on their experiences with OER adoption process also promoted critical reflection and collaborative thinking leading to further enhancements in teachers' pedagogical perspectives towards OEP.

Changes in pedagogical practices

Analysis of the lesson plans of teachers at the pre-intervention stage revealed that even though a majority (> 60-70 per cent) demonstrated use of a learner-centred pedagogic approach with learning activities in their overall approach to teaching, only a small percentage (> 10-20 per cent) demonstrated innovative learning designs, use of a variety of media types as learning resources, use of technology, providing opportunities for learner creativity, promoting self-regulated learning, linking with real-life situations and creating an enjoyable learning experience.

Yet, during the intervention, their pedagogical practices have notably changed, as revealed by the OER-integrated lesson plans, and also supported by their responses and reflections:

OER supported us to prepare a quality lesson plans for our lessons in all subjects. Then we were able to incorporate new techniques in our teaching-learning process.

Our lesson evaluators and colleagues highly appreciated OER incorporated lessons [...] It was very easy to get students' attention and it supported to create a better learning environment.

Further, it was encouraging to observe many examples of sharing OER and disseminating the OER concept among others by the teachers via creation of OER and sharing them, conducting awareness raising workshops, publishing booklets etc:

I shared my OER knowledge with my school teachers by organizing a workshop. I created more than 30 OERs and uploaded to LMS and also searched more than 50 lessons to different subjects.

One member wrote a booklet in Sinhala about OER for teachers and any others who are interested in this concept.

We felt proud to publish a magazine on OER titled "Integrating OER in Learning Teaching Process.

Strategies such as motivating teachers to engage in lesson planning with OER integration and share them in the LMS, organizing a competition to identify the most active centre and the most active student teacher in each centre, have certainly impacted on promoting OER adoption among teachers. The design of such challenging activities related to their own contexts has stimulated teachers adopting critical, creative and collaborative approaches in their teaching practices. The shift from low to a high degree of OER use, and change of practices in the creative use of OER clearly suggests a move towards OEP. The diffusion of OEP was prominent along two dimensions – enhancements in the individual practices in innovative OER use as well as collaborative practices of sharing of resources, knowledge and practices (Ehlers, 2011), that has resulted due to the intervention.

Impact of the DBR approach in supporting OEP

The basic features of the DBR approach has been very supportive in enacting changes in educational practices of teachers towards OEP. In order to address a meaningful current problem faced by practitioners in relation to effective implementation of OEP, an educational intervention grounded in a robust theoretical framework was designed, developed and implemented in real-world settings, in collaboration with the practitioners (Reeves, 2006).

Situating the research work in naturalistic contexts enabled close interactions among researchers and practitioners, in their pursuit to find solutions to face the challenges in the adoption of OEP. The co-partnership link with the practitioners (teachers) was useful for researchers to test and refine design strategies in collaboration (Wang and Hannafin, 2005), according to the contextual and emerging needs during the process.

The iterative and flexible nature of the process allowed recognizing the complexities and dynamics of the real-world interactions and contextual limitations in the designs (Collins *et al.*, 2004), and refining them as appropriate during the series of testing cycles, in the form of workshops and online activities via LMS.

The integrative use of multiple methods and a variety of data gathering strategies – both qualitative and quantitative, as required by the DBR approach enhanced the credibility of findings (Wang and Hannafin, 2005). It also generated a large amount of "thick" descriptive data sets (DBR Collective, 2003) which required systematic analysis and consensus building around interpretation of data to provide a comprehensive view of the process.

The armoury of tools and strategies created during the iterative process generates evidence-based claims about new design solutions, guidelines and frameworks to address the contemporary issues in integration of OER and OEP by practitioners, based on theoretical relationships. Thus, DBR approach, through its coherent methodology has enabled bridging theoretical research and educational practice (DBR Collective, 2003), and refining both theory and practice (Collins *et al.*, 2004) through their synergy.

Conclusions and implications

It was evident that OEP among practitioners can be supported and “promoted” through a DBR approach using iterative analysis, design, development and implementation of carefully planned intervention strategies at different stages. Significant changes were observed in teachers’ use of instructional resources, their pedagogical thinking and pedagogical practices, due to this DBR intervention. The specific strategies designed and implemented in an intensive sequence of activities in the intervention during a series of workshops and provision of an enabling online environment supported both practitioners and researchers to gradually move through the four phases of DBR, analyzing issues, developing solutions, testing and refining solutions and reflecting on the experiences in their collaborative journey towards OEP.

The careful selection and design of activities to develop teachers’ competencies in identifying, using and creating OER has facilitated a shift in resource use from no or low usage of OER to reuse, revise and creation of OER. The opportunities provided to engage in sharing resources and challenging and innovative use of OER have enacted a change in the pedagogical perspectives and practices of teachers shifting from a content-centric and individualized pattern to more constructivist, context centric and collaborative ways. The process of capturing teachers’ and researchers’ real-life experiences through a collection of “stories” around their experiences, enabled sharing as well as transfer of “good practices” in relation to adoption of OEP by practitioners.

The systematic and flexible methodology adopted via DBR by designing a framework aiming at improving educational practices was very useful to support changes in OEP among practitioners over time. This iterative process allowed the researchers to function as “designers”, while investigating real-life issues in collaboration with the practitioners through reflective enquiry to further refine innovative practices towards OEP. This provides valuable insights for improved design solutions for future interventions in similar contexts.

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