

Sustainable agricultural online course development framework for community-based transformative learning

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ABSTRACT

This paper examines the change drivers and challenges involved in the transitioning of the Water Research Commission's Amanzi for Food training of agricultural educators and farmers' face-to-face co-engaged course to an online course aligned with Education for Sustainable Development (ESD) (www.amanziforfood.co.za). The study drew on system thinking to analyse components within the course development activity system. Insights from stakeholder engagement and expansive learning processes fed into key emergent themes which informed the e-learning processes. The research highlights how the development and implementation of a sustainable training programme using Information and Communication Technology (ICT) tools bring together learning processes occurring within different interconnected dimensions and in complex and unpredictable ways. It became clear that to utilise e-learning as a mediating artifact capable of facilitating social transformation towards suitability expansively, certain conditions needed to be in place. The drivers that impacted the development of e-learning as a mediating tool included the need to find an alternative learning platform for broader dissemination of Rain Water Harvesting & Conservation (RWH&C) knowledge and alignment with the United Nations Sustainable Development Goals (SDGs). This study concludes that this transition requires specific tools, adequate time, an understanding of e-learning pedagogical processes and learning platform functionalities (requiring upskilling of the digital literacy of the development team and other actors), and workable data-efficient or data-free, smartphone-friendly training and communication platforms.

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Keywords: Agricultural training, E-learning, Sustainable course development

1. INTRODUCTION

In the field of education, Covid-19 has forced us to look more closely at e-learning from a systemic point of view. Our educational systems are changing. The South African view of education has also changed, with lifelong learning seen as a key competency and opportunity. This paper explores the types of innovation and significant learning processes associated with the migration of an intensive face-to-face community co-engaged learning programme to an e-learning platform as an online course. The Water Research Commission (WRC) funded the Amanzi for Food Project which supports agricultural trainers to strengthen the resilience of smallholder agriculture to climate change-induced water insecurity through a course-activated social learning network approach focused on knowledge dissemination and uptake in the agricultural learning system (Lotz-Sisitka, Pesanayi, Weaver, Lupele, Sisitka, Denison & van Staden, 2016). The learning materials and education practices for this learning programme emerged through a course-mediated social learning framework focused on Rainwater Harvesting and Conservation (RWH&C) knowledge dissemination and the building of learning networks. The project provides training for agricultural educators and farmers through a course-based training programme where participants study whilst working on a change project in their local setting (www.amanziforfood.co.za).

In 2019 the project was expanded in the form of an online course on a WordPress-based e-learning platform. The Trainer of Trainers Online Course aims to increase the access to and use of a range of WRC research materials, additional information, and other support resources. The online course was developed to engage participants (users) and support them in applying the course information practically. This paper provides an iterative description of the experiences of the e-learning team over 12 months extending beyond the full cycle of course development, maintenance, running and evaluation aligned with expansive learning processes. The research shows how the development and implementation of a sustainable training programme using information and communication technology (ICT) tools can bring together learning processes within different interconnected dimensions in complex and unpredictable ways. These complexities are better understood through a system thinking approach, where the focus is on the existing relationships between the different components within the learning system (Aguayo, 2014). This paper discusses these learning processes and the challenges experienced during the course development. Continuous system analysis was

applied. Tools were developed to assist in the transitioning process and expansion into the new social-spatial dimension represented by the internet. The transition was greatly enabled by the establishment of a supportive online learning community. It is also important to recognise that this process was built on deep understandings, developed over the years of the face-to-face course, of participants' life and work contexts and their information, pedagogic, and support needs.

The paper concludes with a discussion on the development of a theoretical model for the design, development, and implementation of online sustainable learning systems within systems thinking, in particular, informed by the Cultural Historical Activity Theory (CHAT). We analyse the model of design and implementation of the e-learning platform for transformative community education for sustainability using CHAT and expansive learning as analytical tools. The main research questions include:

- Can an e-learning platform be a mediating tool capable of facilitating social transformation toward sustainability in an expansive way?
- What measures need to be taken to ensure that the e-learning platform is culturally responsive, meaningful, relevant, functional, and achieves its learning objectives?
- What are the key factors driving the expansion and continuous development of the platform?

2. THEORETICAL FRAMEWORK

This study draws upon a systems thinking approach from an education perspective on both socio-ecological sustainability issues and the design, implementation, and use of ICT for community engagement innovation. A holistic systems thinking approach was adopted to analyse the learning within complex systems (Capra, 2005). By adopting this approach, the design and implementation of ICT-based online e-learning systems could respond to the dynamic complexity that unfolds in multidimensional learning contexts. For this paper, the complex ICT and course-activated learning systems are examined through a systems thinking lens, but the learning processes are approached from an activity systems theory perspective.

The research draws upon CHAT to support system analysis and expansive learning innovation processes. Engeström (1999) suggested that activity theory is a useful tool to analyse systems and may be simplified using the following five principles: seeing the object-oriented activity system as the prime unit of analysis; keeping in mind the multi-voicedness and historicity of the system; seeing

contradictions as sources of change and development; and lastly, recognising the possibility of expansive transformations. CHAT is based on Vygotsky's theory of learning and development (Vygotsky, 1978). CHAT provided a perspective for examining and discussing opposing ideas to find a solution while studying the relationships between cause and effect within the system (Engeström, 1987). The first generation of CHAT is based on Vygotsky's concept of mediated action as the unit of analysis and focused on individual or singular activity systems (Zinchenkon, 1985 cited in Engeström, 2016).

By drawing on the CHAT framework, the development of the online course and e-learning platform stimulated the processes of innovation within the e-learning system. This allowed innovation and learning-led change to be defined and supported through the associated expansive learning processes. The expansive learning design enabled the e-learning team to identify the contradictions and tensions within the activity system by drawing upon collaborative analysis and expansive learning cycles (Engeström, 2005). The key indicator of expansive learning is the expansion of the object within the activity system, in this case, the online course and e-learning platform is the object (Engeström, 2016). There are three dimensions in which the object of the activity can expand (Engeström, 2000, cited in Engeström, 2016). The object can expand in the socio-spatial dimension, where the system expands by the increase in subjects or contextual expansion, e.g. more lecturers join the learning process or a learning network is established. Another indicator of expansive learning is the extension of the time perspective known as the temporal dimension expansion. As expansive learning evolves, different contradictions can emerge which require the activity system to expand back in time to understand the newly emerged contradictions. Or, in another scenario, the expansive learning needs to expand, or extend the timeframe to address the impact of the newly emerged contradictions. The third dimension of expansion is political-ethical and deals with human and societal consequences of the activity and accepting responsibility for those consequences (Engeström, 2016). Expansive learning is a process wherein learning and transformation are achieved through specific learning actions that form an expansive cycle. The sequence of this cycle typically follows the steps outlined in Figure 1.

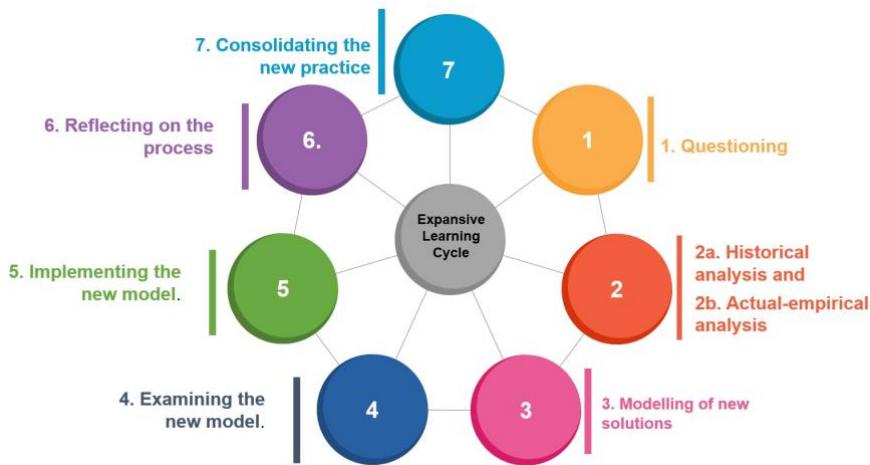


Figure 1: Expansive learning cycle (Engeström, 1999)

This conceptual framework offers common ground for inquiry about the use of e-learning platforms as a tool to enable co-engaged expansive learning. Within this system, the learning process is regarded as an integral outcome of the whole learning system, as properties of systems can only be found as part of the 'whole' and not within individual 'parts' or components. In this case, the objective of the online learning system is to act as a facilitator of the learning process by actively promoting meaningful and culturally responsive interaction with agricultural educators and farming community members that can lead to co-engagement towards transformative learning for socio-ecological sustainability.

3. METHODOLOGY

This paper analyses the generative expansive learning process and identifies the steps required to ensure that the newly developed e-learning system supports sustainable, transformative education and the development of ESD institutional change projects. The research was conducted in two phases. Phase one consisted of establishing the e-learning platform. Phase two focused on the use, monitoring, and improving processes of the e-learning platform. The research methodology followed in this study included conducting a collaborative self-ethnography of the e-learning course developing team, followed by a system analysis of the development and implementation processes through team discussions. Self-ethnography is a form of qualitative research that uses self-reflection and writing to explore anecdotal and personal experience and we connected this to analyse the course development and implementation process. The research analysis was based on a CHAT activity systems approach. The team outlined the context and the processes experienced during the development of the online course. This enabled them to identify matters of concern and contradictions. Construction, technical,

and monitoring data was derived from the Course Learning Management System (LMS) and the data-free version of the online learning platform. This data allowed better insight into the course processes. All the data was captured in the course reports for the WRC. An additional tool for evaluating the course process was a questionnaire completed by participants and tutors, to gain insight into which aspects of the course were valuable for course participants and to explore potentially transformative aspects of the course for individuals and institutions.

Expansive learning was used as the design methodology focused on developing research that provided a method to analyse learning during the development (Phase One) and implementation process (Phase Two). The analysis helped make the necessary adjustments to the online course and e-learning platform and thus initiated change through expansive learning processes. The team then analysed the contradictions further to find solutions by viewing the course development process as an activity within an activity system. For this paper, the activity system refers to a collection of separate activity units. Figure 2 illustrates the work actions of the e-learning team as the subject to produce the online course as products and outcomes. We were then able to examine how our initiative triggered innovative and sustainable expansive learning processes within the e-learning system. The analysis provided a perspective for examining and discussing opposing ideas to find solutions while studying the relationships between cause and effect within the system (Engeström, 1987). Through an expansive learning process, the e-learning team was able to create new models for the design, development, and implementation of online learning systems. The following section provides a step-by-step discussion of the course development processes and what we learned during this time.

4. RESULTS

To analyse the process with a systems thinking approach, we looked at the course development as interlinked with various activity systems. There are many actors and components involved in the development, maintenance, running, and evaluation of an online course, based on our experience during the development of the Amanzi for Food online course. During the development of this course, the three main team members coordinated many of these tasks and also played multiple roles. These roles included pedagogic development, course design, administration, e-learning coordination, custom building and maintenance of the website, development, and management of the Learner Management System and e-learning platform, tutoring, and webinar hosting. In addition, the team leader also managed and led the project. This study drew on an expansive learning methodology as this offers a framework for analysing the interaction of the object under transformation, the mediating

artefacts, and the different perspectives of the subjects (here, the e-learning team) in a progression of jointly achievable actions as described by Engeström (2008, cited by Engeström, 2016).

4.1 Expansive Learning Process

During the transformation of the Amanzi for Food face-to-face course to an online e-learning platform, an iterative process of supported expansive learning was centred on learning innovation and uncovering some of the challenges. The development, implementation, and facilitation phases of an expansive learning cycle (Figure 1) are discussed below.

Questioning phase

During the questioning phase, we realised that for innovation to occur we needed to make some changes to our teaching and learning strategies, expand our learning network, capacitate more agricultural trainers and farmers and make our resources available to a larger audience on different platforms. The question here was how to go about innovating our learning processes and network to achieve this.

Needs analysis phase

Research conducted during face-to-face Amanzi for Food courses indicated that course participants faced specific constraints and barriers. Time was identified as one of the most central elements in determining the success of curriculum innovation, learning led-change, and network development (Van Staden, 2020). Agricultural lecturers stated they did not have time to attend face-to-face courses due to other responsibilities. Another key and repeated issue raised was that agricultural trainers struggled to complete the practical side of the course with their students due to insufficient time for practical activities in their overloaded timetables (Van Staden, 2018). This is also reported in other agricultural education contexts (ASSAF, 2017; Lotz-Sisitka *et al.*, 2016; DAFF, 2010; DAF, 2008). Another challenge hindering the successful implementation of institutional change projects appeared to be the constant changes in the management and academic staff in institutions (Van Staden, 2020).

It was noted that participants who were engaged in the process of innovation did not necessarily focus on broader institutional change, but more on how they could innovate their curriculum and learning practices (Van Staden, 2020). It was agreed that the development of an online course could help address some of these challenges experienced by agricultural trainers. An online version would enable participants to complete the course in their own time (within certain constraints), integrate the course

as part of their practical component within the agricultural curriculum, and also mitigate the impact of institutional instability on the success of an individual participant. An online course would also enable the Amanzi for Food team to reach a greater and more geographically dispersed audience including remote rural agricultural communities, both across South Africa and in neighbouring countries.

Following the analysis, the online course was developed as an innovative mediating tool with the following aims:

- Enhance the access to and use of valuable information on RWH&C in a range of WRC's research outputs and other related resources;
- Enhance the practice of and training in RWH&C to improve food production and nutrition;
- Provide learning resources and mediation methods for teaching and learning about RWH&C;
- Explore and use opportunities for curriculum and course development and innovation; and
- Connect people and organisations in their intersecting workspaces to share their knowledge, and experiences on RWH&C practices.

Modelling of the online course

The modelling of the new version of the Amanzi for Food course on an e-learning platform was an iterative process comprising several steps. These steps were informed by an ESD online course framework involving: the identification of an appropriate e-learning platform and other ways of enhancing learning; course design; development of online course content; skills development for the e-learning team; and setting up structures for the learning, assessment, and evaluation processes.

Framework for ESD online course

An ESD framework supports the accessibility of resources and knowledge for everyone, connecting people, increasing food security, and decreasing poverty. The course was built on an ESD framework and is aligned with UNESCO's Sustainable Development Goals. The e-learning team identified key concepts within the ESD e-learning framework such as:

- Online course content and the e-learning platform is accessible to everyone;
- Course functioning as a knowledge dissemination resource hub;
- E-learning platform promoting the building of learning networks;
- E-learning platform catering, where possible, for individuals with limited data;

- E-learning platform and content accessible on a range of devices including desktop computers, laptops, tablets, and phones;
- The E-learning platform is simple, user-friendly, works with older phones with less sophisticated technology and requires low data costs;
- Providing free education and qualifications for everyone; and
- Creating online opportunities for discussion, the sharing of experiences, and the development of support networks.

Design and collaboration with a web designer

The e-learning team deliberated on how best to present the course outline and modality and over what period. The course structure and functionality were then discussed with a website developer who developed the shell of the online course. It was decided that the e-learning team would populate the online course in terms of content, and manage the back end of the course, as this would enable the team to manage the course and website themselves instead of depending on a third party. Training of the course team by the website developers and mutual training within the team was a continuous component of the course development process. A timeline was set from 8 July to 31 November 2019. The timeline included: training of e-learning staff; meetings with the website developers; development of online learning resources such as presentations in the form of pdf documents; development of online course content; compiling support resources for the course; uploading content and resources to the e-learning platform; and developing and testing of the modules. All teaching resources, including the module texts, presentations, and support resources were made available for easy downloading to reduce the online time for course participants. Additional activities included: progress report meetings with the team and website developers; development of assessment, registration, and login procedures; assessments and rubrics; editing and revision of content; final proofreading and test runs. This process took 8 months longer than the proposed timeline, due to various emerging contradictions within the system and further challenges.

Building of Learning Management System

The e-learning platform used for the course was LearnDash, the LMS of WordPress. Establishing the basic functionality of the platform took more time than expected. After the course content, resources and assignments were uploaded, and the system had been tested, we continued with the next phase of the development process. Forums for each module were created. The forums created a space where participants could discuss the module with tutors or ask questions. The e-learning team set up several

notification systems to notify participants, tutors, or administrators regarding various activities occurring on the LMS system, such as a participant submitting an assignment or an assignment being approved. A login system was introduced for participants to upload their assignments and needed to function as an open-access platform for both course participants and casual visitors to the website. The LearnDash LMS system functions best in the ‘focus mode’ style, but as the course was built on the dual imperatives of simplicity and low data requirements, it was challenging to get the right look and feel for the course. Ultimately, a contradiction emerged between the technological logic informing the platform construction and the pedagogical logic on which the teaching and learning were based.

During the development stage a good relationship was built between the e-learning team and the web designers, and over time the e-learning team was able to manage more of the online course and website themselves. The training by the web designers and self-driven skills development was an essential part of the success of the online course development.

Examining the new model

The new model was tested by various members of the Environmental Learning Research Centre, Rhodes University, Agricultural Training Institute lecturers, and members of farming communities. Shortcomings were identified during this testing process and suggestions were discussed on how to address these. Contradictions within the system also came to light during the development and examination of the new course model. (These will be discussed in the next section.) A data-reverse version of the online course was also developed to ensure that the course was accessible to everyone (<https://amanziforfood.sbox.datafree.co/>). When participants within South Africa access the website via their mobile phones, using the data-free version link, they are not charged for any data used. The data costs are transferred to the website owner. On the data-reverse website, participants can access all the pages, download any documents, listen to any podcast and watch any video on the website without incurring any data costs themselves.

Implementing the new model

The online course was initially launched in the public sphere in October 2020, with a few adjustments made after the initial course opening. However, for several reasons the take-up was extremely slow and a relaunch was scheduled for February 2021. This launch was widely advertised with direct mailings to key stakeholders in the agricultural sector and a deadline for registration of 25 February

2021. This changed the dynamic of the course quite considerably with over 170 registrations at the time of writing (and several pending, as the registration process has been put on hold). The re-launch was very successful and the large number of registrations required the recruitment of additional course tutors. However, a considerable number of registered participants withdrew their commitment to the online course and deregistered. It seemed that many had registered without fully understanding the commitment they were making. Only 66 participants ultimately engaged with the course. These course participants included members of agricultural communities, agricultural trainers, and community development project leaders.

Reflecting on the process

Various contradictions were found within the e-learning activity systems and changes to the online course were made accordingly. Capacitating the team ⁴was also essential to address the contradictions. These contradictions are discussed in detail in the next section as part of the activity system analysis.

Consolidating the new practice

The online course is functioning successfully, with many of the first cohort participants graduating in December 2021. The online course and e-learning platform have been successfully utilised as a mediating tool to support course-activated learning and transformation within agricultural learning communities. Of the 66 participants that engaged in the course, 24 graduated at the end of 2021, and there were 16 active enrolled participants at the beginning of 2022.

Analysis of the E-learning activity system

This analysis draws on CHAT as an analytical framework and a tool for identifying the contradictions found within the system. The activity system shows the interactions between the members of the 'Community', and between them and the other elements within the activity system (Figure 2). For this paper, the e-learning team is the 'Subject' of the activity system. The 'Instruments' available for the e-learning team to achieve the 'Object' include e-learning pedagogy, information technology knowledge, software, resources provided by the Water Research Commission and others, content knowledge, and virtual and face-to-face course structures. The 'Object' of the activity system is a completed and functioning online course aligned with Education for Sustainable Development goals.

⁴ The online course implementation process will be discussed in a subsequent article as part of our series of articles on ESD online learning processes.

The ‘Outcome’ includes the learning outcomes of the online course that are specified on the online course webpage.

The ‘Rules’ of this system include the ESD Goals, ESD e-learning pedagogy, Rhodes University course compliance regulations, and the LearnDash Learning Management System on WordPress. The ‘Community’ comprises supporting actors such as the hosting company, the graphic designer, university administration support, and the agricultural training community that commented on and tested the course in different phases. The agricultural trainers for whom this course was primarily developed are also part of the community within the system. The ‘Division of Labour’ includes the responsibilities for a wide range of tasks at different stages of the online course development.

5. CONTRADICTIONS WITHIN THE SYSTEM

5.1 Tools: Pedagogic requirements of the course and the technical functionality of the LearnDash Learning Management System

Essentially the LearnDash LMS system was appropriated as an e-learning mediation tool requiring the development of a range of new skills within the team to develop, manage and support learning on this e-learning platform. One fundamental contradiction which required sensitive management was between the logic driving the shape and structure of the platform and the logic underlying the participatory pedagogy on which the teaching and learning were based. This contradiction was not entirely reconcilable, and the two logics, in some ways, operated more in parallel than in concert. The e-learning team, however, went to great lengths to ensure that this contradiction did not overly compromise the educational effectiveness of the course.

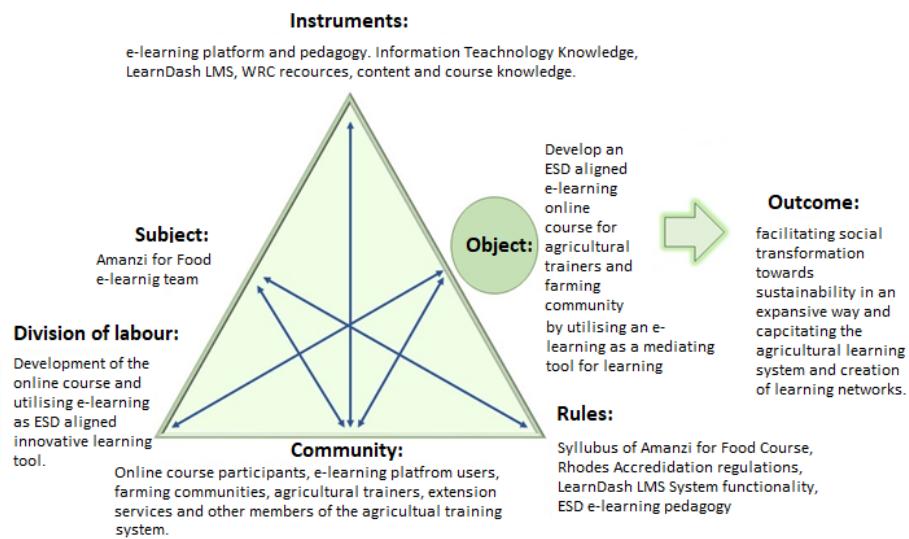


Figure 2: e-Learning as an activity system (adapted from Engeström, 1987)

For example, this showed in the limitations of LearnDash LMS in supporting the e-learning team's vision of an ESD-aligned e-learning platform. Some functionalities of the LearnDash LMS system did not sit easily with the course specifications. An extension of this was how the online course functionality required considerable adaptation of the original face-to-face course structure and functionality. The whole course had to be reimagined. Not only was the course content rewritten, but additional activities and resources had to be created within the online course, processes of engagement with the online course participants needed to be clarified, and assessment and moderation for e-learning had to be put in place. The main learning from this is that it should be possible to collaborate with the platform developers to see how the platform logic can be adapted to better correlate with the pedagogic logic of such a learner-centered educational process.

5.2 E-learning development needs versus technical support

There were also some contradictions with the division of labour as evidenced in the communications between the web developers and the e-learning team. The web developers were not used to collaborating in ESD education development and e-learning pedagogy and struggled to understand the initial specifications of the online course and e-learning platform. The e-learning team initially lacked the necessary internet platform tools and knowledge of the LearnDash system to express their vision or outline the specifics of the online course clearly. Through the patient building of relationships and the e-learning team's self-training to understand the functionality of the LearnDash system better, these contradictions were overcome to some degree.

5.3 Subject skills versus the LMS skills requirements

The varied computer and digital literacy levels of both tutors and course participants were challenging. Course developers and tutors not only had to have a good grasp of the content of the course but also had to understand online pedagogy. Almost everyone had some degree of computer literacy, but the e-learning team, tutors, and course participants required training and mentoring to be able to manage and use the online e-learning platform. Most of the platform's facilities were not utilised by most of the tutors. However, the core e-learning team had undergone intensive training and self-training in LearnDash WordPress skills and e-learning pedagogy to enable them to develop and manage the online course.

5.4 Digital divide versus participants' needs

One key principle underlying the online course was that it should, in alignment with SDGs, be free for everyone. However, the website, the modules, and the supporting resources could only be accessed by using data. All course materials were developed as downloadable pdf documents so that course participants could work with them offline, reducing their data needs. This did not entirely overcome the need for data, so a data-free site was created for the course. A data-free website operates via a different URL link that the course participants can access from their phones. However, people need to understand how to use the data-free version of the website and therefore this component needs to be worked on further

5.5 Roles of the tutor vs an online learning facilitator

All tutors who tutored in the course had previous course experience with the face-to-face version of the Amanzi for Food course, either as participants or as tutors. However, only three of them had online course platform experience. The way the tutors tutor and teach the course face-to-face is completely different from being an online learning facilitator. New skills and new e-learning pedagogy were required. The most important roles outlined to the tutors before the beginning of the course included assignment assessment; responding to questions from students; responding to issues in the café forum, and engaging with participants. When a participant was allocated a tutor, they were provided with only the tutor's email address. At the same time, the tutor received an email with the participant's contact details. It was suggested that the tutors should contact each of their participants by email to introduce themselves and establish contact with them. They could then agree with each participant on which medium would be most appropriate for their subsequent communications.

Further challenges included: the initial lack of tools to guide the e-learning team in the development of the online course; the unexpected length of time taken to facilitate the course; and many extra and unforeseen aspects, functionalities, and roles that needed to be fulfilled. To address these additional requirements, the e-learning team trained themselves in all WordPress features to ensure optimum functionality of the online course and e-learning processes. From this experience, the team developed a checklist for future ESD e-learning course development highlighting all the roles that are required.⁵

⁵ Available at: <https://amanziforfood.co.za/wp-content/uploads/2022/02/checklist-2.jpg>

6. DISCUSSION

Ultimately, after working carefully to address the challenges and contradictions, the transition from a face-to-face learning programme to an e-learning programme was successful. This provided clear evidence that e-learning can be utilised as a mediating tool capable of facilitating social transformation towards suitability in an expansive way. However, for this to happen, certain conditions needed to be in place. Specific roles, as shown in Figure 2, are required when developing and implementing an e-learning programme, and specific steps need to be taken to ensure that an ESD e-learning platform is culturally responsive, meaningful, relevant, and functional, and can achieve its learning objectives. These steps include the identification of an appropriate e-learning platform with the functionality to support and enhance participatory learning; the creation of an appropriate course design; the development of online course content in appropriate forms; developing the necessary skills for the e-learning team; setting up structures for the learning, assessment and evaluation processes; reflecting on the development process; and finally, consolidation of the learnings and reflections in the implementation of the course.

The drivers that impacted the development of e-learning as a mediating tool included the need to find an alternative learning platform, for wider dissemination of RWH&C knowledge, and alignment with the Sustainable Development Goals. Even though the system is functioning, there remain some contradictions within the activity system. In particular the contradiction between the logic of participatory pedagogy and that of a web-based learning platform. However, most contradictions were addressed during the expansive learning process. The digital literacy levels of the subject, the Amanzi for Food team including the tutors were upgraded to ensure that the course was successfully developed and well managed. The participants were also provided with training in how to navigate the course, upload assignments, and download course materials. By developing the data-reverse version of the website, the contradiction between the tools and the object of the course was reduced considerably. Through the data-reverse website, access was free within South Africa for users on mobile phones. This meant the course was well aligned with the UN Sustainable Development Goals and the aims of the Amanzi for Food project, at least for the South African participants. Through an analysis of the activity system, two different means of learning and learning platforms, face-to-face and online, were compared. There are advantages and disadvantages to both means of delivery. As previously noted, finding sufficient time was seen as a problem for some of the course participants, but the inherent flexibility of the course largely overcame that challenge. The online course, as an open and free course, in which participants can enrol at any time makes it less institutionally bound.

Thus, an individual can enrol in the course, without support from their employer or other colleagues, which both enables micro-innovation at an individual level to take place and reduces the disruptions caused by management and institutional instability.

The challenges faced by the Amanzi for Food team during the development and implementation of the course included:

- Skills development for a better understanding of web-based systems was required to ensure effective communication with the web designer and the ultimate success of the course.
- The development process took longer than expected for several reasons, identified as challenges and contradictions in the discussions above.
- Limited tutor and participant engagement with the platform and the lack of familiarity of tutors with such platforms were unexpected challenges. The team's initial assumptions concerning the internet/digital literacy of both participants and tutors were brought into question.
- Of the 170 participants who initially enrolled, 66 engaged with the course and 24 worked through to completion, despite being supported by engagement with the tutors. The reason for this higher-than-desired drop-out rate was to be probed through an evaluation process involving many of the participants who did not complete.

Despite the challenges and the higher-than-expected drop-out rate, the course was considered by the e-learning team and the tutors, to have been successful. This success was driven to a large degree by the uptake by team members of the various roles within the course development process and the effective collaboration between the different components and actors within the system. To share the experiences of what made the development and implementation of the course successful the team developed an online course checklist for an ESD-aligned course (Figure 1). This is intended for use by the team members with future courses and others working on e-learning both within the Environmental Learning Research Centre and in the broader educational context. Figure 1 assists in understanding the crucial steps required during the development of the online course and the processes involved. These processes are summarised as follows.

Questioning: Questions such as how to ensure that the participants obtain the necessary sustainable development competencies and knowledge at the end of the course, and questions related to the best pedagogical approaches to achieve this are essential.

Needs identification: The needs of the course participants in relation to the use of the e-learning platform must be identified before the development of the course, as these have considerable implications for the design of the course. These include participants' data needs, their device preferences, their digital literacy including computer literacy levels, and their time availability. All this is in addition to their information and educational needs. Also, regarding the provision of data: if participants will require data, who will be providing the data for them and how is it best to provide this? Once the needs of the participants are understood then the focus can shift to the course designer and developer.

Modelling and framework development: The designer and developers must understand the pedagogical processes and ESD aspects of online learning and teaching. Course designers must have a clear and sound understanding of how to design an online course, add the content, and maintain the course on the e-learning platform. They will also have to work closely with the company that develops and hosts the site. This study indicated clearly that the course developers must provide a clear and structured layout of the course to be communicated to the website designer, otherwise, considerable delays in the site development are likely to occur. Where possible, the course developers can work with the platform designer to ensure a better fit between the pedagogic and technical logic.

Design and collaboration: Clear communication and collaboration between the course developer and the site designers, graphic designers and, if necessary, the #DataFree site developers are essential. The course designer must understand the interactive learner-led community-based approach required for an ESD-aligned course. Online learning needs to promote participation in various ways such as through online forums, webinars, easily accessible and downloadable core content and supporting resources such as videos, PowerPoints, and PDFs, tasks to be completed and feedback provided, and assignments to be uploaded and assessed, again with feedback. It is also very important for the course developer to understand the purpose and value of feedback and the use of the course data for research purposes. The use of the wrong format for an embedded task may make it impossible to retrieve the data for future use.

Building, examining, and consolidation: It is crucial to provide friendly and empathetic support to participants from their registration and throughout their journey through the course processes. This helps ensure they derive maximum benefit from their participation, even if it cannot guarantee successful completion. Online course participants often engage with the course outside normal

working hours, and facilitators/tutors and even the course developers will sometimes need to provide support at unexpected times. Training and support are also essential for the course facilitators/tutors. They need to be able to work in the ‘back-end’ of whichever platform is being used (in this case WordPress) and have sufficient levels of computer literacy to manage student forums, access and respond to uploaded assignments, and support the participants generally. They may also have to manage webinars or other interactive web-based platforms. An online course facilitator/tutor’s role is in some ways quite different from that of a face-to-face educator. An online facilitator requires sound online pedagogical knowledge and must be able to facilitate active learning, and coordinate social interaction in the virtual space while ensuring effective support of individual participants. Another critical component of an online course is course administration. An online course administrator will be responsible for the general administration and financial management of the project, but might also take responsibility for data management/distribution and maintaining participant records. Four main recommendations from this study are:

- Good communication between all actors in the activity system is essential at all times.
- All members of the online course development team are trained in the chosen LMS platform and online pedagogy.
- All facilitators/tutors are provided with training and support in the use of the digital platform.
- The participants have support throughout the learning process.

7. CONCLUSION

This paper has examined the change drivers and challenges involved in the transition from a face-to-face co-engaged course to an ESD-aligned online course. The study drew upon system thinking to analyse the different components within the course development activity system. As Figure 2 illustrates, there are various interlinked components and roles within a functioning e-learning system. Specific roles are required and specific steps need to be taken to ensure that an ESD e-learning platform is culturally responsive, meaningful, relevant, and functional, and can achieve its learning objectives. Insights from the stakeholder engagement and expansive learning processes were utilised and key emergent themes which informed the e-learning processes were identified. The expansive learning processes were crucial steps required during the development of the online course and the learning processes. These include questioning, needs identification, modelling and framework development, design and collaboration, building, examining, and consolidation.

The key drivers which led to the development of an e-learning platform as a mediating tool included the need to find an alternative learning platform for wider dissemination of Rain Water Harvesting & Conservation knowledge, and the need for alignment with the Sustainable Development Goals. The main conclusion of the study is that this transition requires specific tools, adequate time, an understanding of the e-learning pedagogical processes and the learning platform functionalities (requiring upskilling of the digital literacy of the development team and other actors), a workable data-efficient or data-reverse option, smartphone friendly training, and communication platforms. Underlying all these, such transitioning requires a deep understanding of the course participants' life and work contexts and their information, pedagogic, and support needs. In this way, any effective transition to an e-learning context should be built on a foundation of strong relational understandings, developed through more conventional face-to-face interactions.

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