6th International Symposium Knowledge and Capacity Development for Water Management
IHE Delft, May 27-29, 2020

Current knowledge status on capacity building for climate services: an empirical study using C3S blended trainings

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Introduction

Capacity building is essential to ensure that key stakeholders appropriately use climate services. WMO, (2010) stated that capacity building is a critical component for improving data information by supporting the climate services pillars. In the guidelines on Frameworks for Climate Services, WMO (2016) distinguishes between capacity building for climate service *developers* and (*end)-users*. Capacity building for users focuses on the understanding of climate variability and change; and interpretation and use of climate services provided. Capacity building for climate service developers aims to deliver accurate and reliable information and communication to the user (World Meteorological Organization, 2012). Thus, the differentiation between climate service providers and end-users on capacity building, connecting them on one-way collaboration is considered the current status of knowledge of capacity building for climate services.

The need for capacity building to understand, use and deliver actionable information is increasing, because more climate data is available and accessible in several web portals. One of these portals is developed by the European Union Copernicus program, which aims at developing information services based on satellite Earth Observation and in-situ (non-space) data. This program has developed the Copernicus Climate Change Service (C3S). C3S is considered a climate service and a source of data for the development of potential climate services. The C3S provides authoritative information about the past, present, and future climate, along with tools in a web portal called the Climate Data Store (CDS). C3S aims to enable climate change mitigation and adaptation strategies by policymakers and businesses (ECMWF, no date).

C3S includes a User Learning Services (ULS) component. This online learning platform contains modules embedded in individual or team learning paths and blended trainings. The ULS aims to spread knowledge and skills around 30 different European countries. Blended training was designed building on the current state of knowledge regarding capacity building, focusing on improving understanding and use of climate data. After one year of blended training experience, trainers observed that trainees had difficulties in designing case studies delivering actionable knowledge. The literature argues that focusing on understanding and using climate data is not enough to provide actionable information and decision tailored climate services (Dilling and Lemos, 2011; Kirchhoff, Carmen Lemos and Dessai, 2013). Here, we present the results of a study on the C3S blended training as an example of the gap in the current status of knowledge in capacity building. We assessed educational design principles used in current climate service training programs and their intended learning outcomes as well as how they relate to climate services for actionable knowledge. Grasping this current state and the identified gaps allow for a future redesign of the training to more optimally foster climate services for actionable knowledge.

Methods

The first-year C3S blended trainings are assessed using the constructive alignment model of Biggs (1996). Constructive alignment is a pedagogical principle in which what students should be learning, and how they are actually learning, is clearly defined and aligned (see figure 1). Constructive alignment thus allows identifying the consistencies and inconsistencies among the learning goals, activities and assessment. Therefore, if a learning outcome aims to develop a specific skill, activities need to align with practice and assessment methods to demonstrate they have met the intended result.

A learning goal is a clear statement of what a learner is expected to do or know after following the educational entity (e.g. module, training, etc.). Teaching is designed to engage students in educational activities that enhance their abilities for attaining those learning outcomes. Assessment tasks are designed to allow criteria as to how well learning goals have been attained. The assessment includes not only the traditional exams but also presentations, assignments or group work where the skill to

be evaluated is not assumed but explicitly taught (Biggs, 1996). A second framework used to study the C3S trainings is the curriculum perspectives (Van Den Akker *et al.*, 2013): intended, implemented and attained. For each view, the alignment between goals, activities and assessment were analysed.

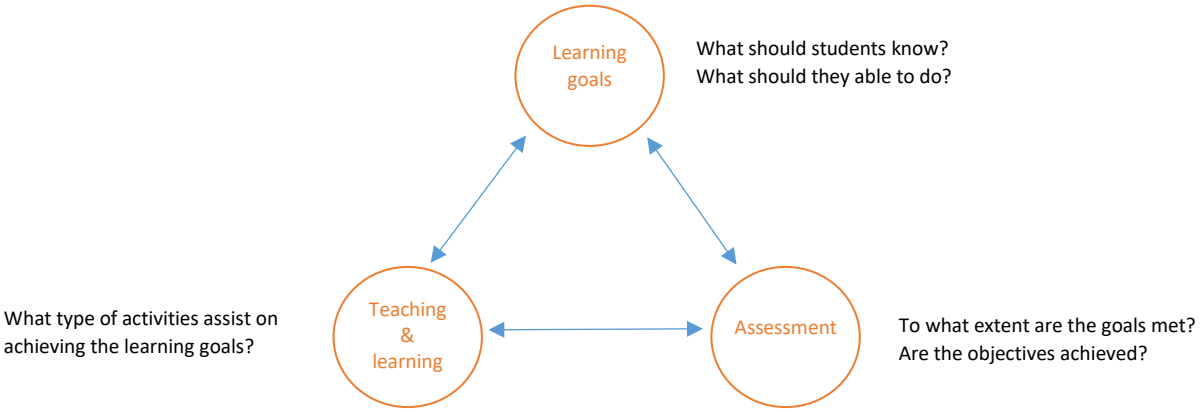

Figure 1. Adaptation constructive alignment from Biggs (2003)

Different data sources were used to assess the intended, implemented and attained goals, activities and assessment from the first-year blended trainings (table 1). The *intended* goals, activities and assessment were evaluated by comparing document analysis from service and call proposal, and interviews with the four proposal developers from Wageningen University and Research. The *implemented* goals, activities and assessment are extracted from local training documents and interviews with trainers. The trainers performed seven trainings around Europe: Italy, Spain, Serbia, Latvia, Portugal and Croatia. The trainings were designed with the same goals, activities and assessments. Thus, we do not aim to analyse the individual training alignment but instead to identify commonalities of the implemented design. We interviewed thirteen local trainers and five master trainers from Wageningen University and related project partners. The interviews with Wageningen University and Research are done by an external researcher to ensure objectivity. The *attained* goals, activities and assessment are perceived by trainers and compared with what trainees learned by analysing the twenty-seven adaptation case study presented in the blended training.
The documents, interviews and case studies were analysed using both the framework of constructive alignment as well as the three curriculum perspectives of intended, implemented and achieved (Van den Akker et al., 2013). The collected data was analysed using codes on goals, activities and assessment to typify the intended, implemented and attained curriculum. We aim to study the misalignments within the curriculum perspectives and the significant inconsistencies between the intended, implemented and attained curriculum. The results are represented in a matrix to evaluate possible inconsistencies and then compare them with those objectives related to the learning outcomes associated with decision tailored and actionable climate services.

Results

While completing this extended abstract, the data collection is still in process. The results presented in this chapter are in preliminary results. These results are based on the proposal, call and twenty-seven case studies document analysis; and the four proposal developers and eight local trainers interview analysis. Table 1 summarizes the preliminary results in a matrix comparing misalignments within the curriculum perspectives and the significant inconsistencies between the intended, implemented and attained curriculum.

Intended goals, activities and outcomes

The mission of the C3S User Learning services is to enable users to use data from the Climate Data Store (CDS) to support decision-making. The interviews point to a change in the training learning goals definition. Initially, the learning objective intended to focus on the use of the CDS. However, the CDS

status did not allow the achievement of this objective (yet). Therefore, intended learning goals shifted to train users on the use of climate data and in climate data used for assisting decision making.

Table 1. Matrix of constructive alignment on goal, activities and assessment

	Goal	Activities	Assessment	Misalignments
Intended	Training users in the use of the CDS and in use of climate data for assisting decision making.	Online modules on use of climate data and CDS, communication and user engagement. Individual adaptation case study to apply climate data and tools according to context and needs.	Quizzes and questions after the online lessons	The connection between the adaptation case study and the goal is not directly linked. Lack of intended assessment needed to use data and CDS
Implemented	Increase awareness on climate change and its potential impacts, introduction to climate data and the CDS	Online modules on climate data, use of CDS . Expert lecture on local climate change. Group Adaptation case study.	Quizzes and questions after the online lessons. Feedback, assignments and presentation of the adaptation case study	The connection between the adaptation case study and the goal is not directly linked. Lack of explicit activities related to collaboration, user needs, ambiguously included in discussions
Attained	Flexible application of implemented objectives depending oo trainees background.	Online lessons on climate data, use of CDS and uncertainty Group Adaptation case study Group interdisciplinary discussions and collaborations	Improvement at different levels on climate data dependent on background Limit link between data selection and decisions Increase of collaborations	Identification of usability gap due to the lack of explicit knowledge on climate services and adaptation
Inconsistencies	Major shift due to overambitious and abstract objectives for the diversity of participants.	Major shift towards group discussion and collaboration. Intended modules on the communication and user engagement disappeared, Content not explicitly included during activities	The intended assessment did not aim to assess knowledge and skills. The case study became an assessment tool to detect a gap.	

The intended training design aimed to reach the learning goal through blended learning. The intended design proposed a combination of online modules embedded in a learning path and an adaptation case study. Individual learning included twenty-eight online modules. The intended topics aimed at understanding of climate data (e.g. re-analysis, projections, seasonal forecasting, etc.), communication and user engagement, and using the CDS. The interviewees argued that the online lessons aimed to bring the trainees in the same understanding level on climate data. The proposed individual adaptation case study was based on an adult learning theory. The case study aimed to enable trainees to capitalise on their own experience. It also intended to connect context with relevant climate data.

The intended assessment was described in the proposal as a set of quizzes and questions in the online modules. The proposal also mentioned monitoring and evaluation for training's quality rather than knowledge and skills achieved. However, the interviewees also argued for the difficulty to assess learners without taking their prior knowledge into account.

The adaptation case study and the intended goal are not directly linked, and there is no aligned assessment matching the case study activity. The intended goal aims to support decision making but developing adaptation requires also understanding of knowledge needs (UNCC, 2018) that are not explicit as a learning goal.

Implemented goals, activities and outcomes

The implemented learning goals reflected in the training documents aimed to increase awareness on climate change and impacts, introduction to climate data and the CDS. Local trainers claimed that the goals shifted to a general introduction due to the time restrictions only to one face-to-face day. Local trainers also pointed to possible trainee's expectations misunderstandings: "participants could interpret that after the training they could use climate data without data coding skills".

The online lessons and activities main content during the training focused on climate data and the potentials of the CDS. The learning path implemented distinguishes between two categories of lessons. First lessons on climate data including content on data resources and discovery, uncertainty projections and re-analysis. The second category focused on CDS usage, introducing the main characteristics and components. A local expert was also introduced in a learning activity to bring local knowledge by explaining contextualized climate change and impacts. Local trainers implemented adaptation case studies in groups. A first proposal case study was submitted individually by all participants. From all of them, local trainers select between 4-5 cases depending on the number of trainees participating in the session. Trainers set case studies based on sectorial diversity, representation of local interests and data availability. The activities to develop the group case study included group discussion to define the climate issue, users, data needs and tools available for the adaptation case study. Local trainers set the final presentation as an assessment tool to evaluate knowledge and skills achieved. However, trainers did not include other methods of formal assessment. Trainers gave feedback on the adaptation case study at two moments during the training and also during group discussions.

Two significant inconsistencies have been identified among the implemented goal, activities and outcomes. There is not a direct connection between the adaptation case study and the learning goal. This inconsistency recurred through the intended and implemented goals and activities. There is no content explicitly delivered during the activities related to adaptation. The adaptation case study includes ambiguous knowledge through discussions to define the information's users. However, climate change adaptation is difficult and a complex human process, framed by uncertainties and constraints (Holman *et al.*, 2019). The knowledge and skills required for developing an adaptation case study should not be assumed but explicitly taught.

Attained goals, activities and outcomes

Local trainers perceived that different target groups participating in the training activities achieved different learning goals. For example, the local Spanish trainer pointed out trainees with management positions in the private sectors aimed to understand climate data to potentially include it in their business. Similarly, a Portuguese trainer pointed out that non-climatic related researchers aimed to include climate data in their own research. Trainers observed that where participants could manage complex data and had coding skills, they lacked the basics of understanding climate data.

Interdisciplinary group discussions allowed for case studies with a clearer objective. Local trainers highlighted the advantage of using the different backgrounds of the trainees as key to knowledge creation during the case studies. Local trainers perceived that groups that had different backgrounds were better able to connect climate data with the context compared to groups with a more homogeneous background. The Portuguese trainer gave a specific example from a particular case study on agriculture. He argued that as the group also contained business background participants, the case study was addressing more user-driven compared with other case studies.

The cases study assessment and trainers perceptions showed increasing trainee's knowledge and skills on understanding climate change, climate data and the CDS for supporting decision making. Case studies showed relevant scenarios and data sets selection from the CDS. Trainers also perceived shift from data-driven initial assignments to user-driven case studies by comparing the first individual case study with the final one. The majority of the first assignments focused on using data. For example, the first assignment adaptation case study submitted in Italy defined as 'Extreme events like heat waves are on the rise in the changing climate scenario'. Compared with this first assignment, the final adaptation case study included the purpose and use of the information produced. However, the majority of cases did not consider which decisions are being supported by the information provided. Trainers refer to this as a 'knowledge gap' between the users and the data selected. This gap might result from inconsistency between the absence of an explicit definition in the goal, on the one hand, and the knowledge and skills provided on climate services and adaptation during the activities, on the other.

Conclusions

The learning goals shift significantly due to overambitious and abstract intended objectives. The learning goals were simplified during implementation and were flexibly applied depending on the trainee's background. Climate data users are depicted differently in the literature. In the provision of climate services, providers and purveyors of climate services are distinguished. Climate providers are directly related to producing raw climate data. A purveyor is also a provider that uses data from other providers and adds value to provide the information required by the end-users (M. Máñez, T. Zölch, 2014). An end-user is the person who ultimately uses the information for assisting on their decisions (Lourenço *et al.*, 2016). Therefore, data users is an ambiguous term that embraces a wide background range with different and distinctive learning goals.

The wide variety of users resulted in a shift towards group learning and collaboration. Although the adaptation case study intended an individual experience, the trainers implemented it as a group activity taking interdisciplinarity as an advantage. The training attained interdisciplinary in group activities. Interdisciplinarity derived in collaboration, communication and engagement. This collaboration process is considered a key component of the development of climate services (Vincent et al., 2018). The attained curriculum suggests that exploiting the heterogeneity of participants improves knowledge creation in the adaptation case.

The use of the adaptation case study as an assessment was not intended but allowed to detect a gap in the case study between the end-users and the climate data selected. Trainers refer to this gap as 'knowledge gap' as the training did not include specific content on climate services and adaptation. Specifically, the implemented training did not explicitly teach in communication and user engagement, as was intended. Literature defines it as 'usability gap' (Dilling and Lemos, 2011). Lourenço et al. (2016) attributed this last gap to the tendency towards science-driven climate services as opposed to demand or user-driven. This gap has resulted in a rise in calls for actionable information and decision tailored climate services (Dilling and Lemos, 2011; Kirchhoff, Carmen Lemos and Dessai, 2013).

Reference List

Van Den Akker, J. *et al.* (2013) *Educational Design Research*.

Biggs, J. (1996) *Enhancing teaching through constructive alignment*. Kluwer Academic Publishers.

Dilling, L. and Lemos, M. C. (2011) 'Creating usable science: Opportunities and constraints for climate knowledge use and their implications for science policy', *Global Environmental Change*, 21(2), pp. 680–689. doi: 10.1016/j.gloenvcha.2010.11.006.

ECMWF (no date) *User Learning Services | Copernicus*. Available at: https://climate.copernicus.eu/user-learning-services (Accessed: 2 December 2019).

Holman, I. P. *et al.* (2019) 'Improving the representation of adaptation in climate change impact models', *Regional Environmental Change*. Springer Verlag, 19(3), pp. 711–721. doi: 10.1007/s10113-018-1328-4.

Kirchhoff, C. J., Carmen Lemos, M. and Dessai, S. (2013) 'Actionable Knowledge for Environmental Decision Making: Broadening the Usability of Climate Science', *Annual Review of Environment and Resources*. Annual Reviews, 38(1), pp. 393–414. doi: 10.1146/annurev-environ-022112-112828.

Lourenço, T. C. *et al.* (2016) 'The rise of demand-driven climate services', *Nature Climate Change*. Nature Publishing Group, pp. 13–14. doi: 10.1038/nclimate2836.

M. Máñez, T. Zölch, J. C. (2014) *Mapping of Climate Service Providers Theoretical Foundation and Empirical Results: A German Case Study*.

UNCC (2018) *Lima Adaptation Knowledge Initiative*. Bonn, Germany. Available at: https://unfccc.int/nwp (Accessed: 30 April 2020).

Vincent, K. *et al.* (2018) 'What can climate services learn from theory and practice of co-production?', *Climate Services*. Elsevier B.V., 12, pp. 48–58. doi: 10.1016/j.cliser.2018.11.001.

World Meteorological Organization (2012) *Guidelines on Frameworks for Climate Services at the National Level World Meteorological Organization, Geneva*.