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RESEARCH ARTICLE

Enabling transdisciplinary research: Suggestions for avoiding `road-blocks' based on a case study

[version 1; peer review: 1 approved with reservations, 1 not approved]

Martin Coath[1,2], Ilona Mettiäinen[1], Roxana Contreras[1], Jusu Toivonen[3], John Moore[1,4]

[1]Arctic Centre, University of Lapland, Rovaniemi, Finland
[2]External Consultant, Danish Meteorological Institute, Copenhagen, Denmark
[3]Rukakeskus, Rukatunturintie 9, FI 93830, Finland
[4]College of Global Change and Earth System Science, Beijing Normal University, Beijing, 100875, China

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Abstract

In this brief plain language report we introduce a novel diagrammatic way of thinking about interactions in transdisciplinary teams. This representation is designed to provoke debate about how teams which do not share a common world view can make progress, but not necessarily direct progress, towards common goals. We further identify a range of possible problems -- which we refer to as road-blocks -- which can limit progress and reduce the effectiveness of such projects. Finally we make short suggestions about how road-blocks might be lifted.

The diagrammatic representation was developed as part of the plain language notes which were kept to document the progress of a work package -- part of the Blue-Action project -- dealing with Arctic Tourism. But the report draws on wider experience of transdisciplinary working in the team and attempts an easily readable summary of some aspects of how such projects do, and do not, work. We propose that interactions between members of a team that have little in common, with respect to experience and expertise, will rarely lead to outputs that meet the goals of the project unless supplementary activities first 'recast' their views towards a common frame of reference.

Keywords

Transdisciplinary, Co-Design, recasting, silos, climate services

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2. **Berry Billingsley**, Canterbury Christ Church University, Canterbury, UK
Joshua Heyes, Canterbury Christ Church University, Canterbury, UK

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Corresponding author: Martin Coath (mcoath@gmail.com)

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Introduction

Working in a team where the members have diverse and largely non-overlapping areas of expertise can be a challenging experience. The first aim of this report is to suggest ways of thinking about the process and to throw light on some of the issues that might arise.

The report contains some specific references to our work on the EU H2020 Blue-Action project[1] (a five-year project running from December 2016 to September 2021), but the intention is to make entirely general points wherever possible that are applicable to a wide range of projects. The Blue-Action workpackage which prompted this work was concerned with Arctic Tourism and included managers and decision makers from the tourist industry, academics with interests in modelling, climate predictions, policy-making, data scientists, and programmers.

A secondary aim was to write the text in plain language. As it is difficult to be concise and precise without using specialist vocabulary, one or both of these aims will certainly be compromised at various points. But accessibility and readability are paramount and the section 'Identifying and lifting road-blocks' contains a short explanation of why we have taken this approach.

To further aid readability we adopt a strict order of placement for figures and captions. The captions are written to be part of the main text and should be read in sequence with everything else. Informal surveys of non-specialist readers (canvassed during the development of this report) have suggested that this approach, which has something of the nature of a comic-strip or graphic novel about it, is friendlier than having to move from text to figures and then back again in order to extract meaning. We describe our project as transdisciplinary but have deliberately avoided devoting a great deal of space to exploring exactly what this, or any other closely related term, means. The precise meaning is not important for the current purpose and there is plenty of informed discussion available elsewhere[2]. The terms transdisciplinary and co-designed will be used throughout, occasionally abbreviated to TD and CD respectively where appropriate; these and other terms are briefly dealt with in the Glossary.

Co-design viewed simply

Diagrammatic representation

In this first section we introduce a diagrammatic representation intended to support discussion about problems encountered in transdisciplinary co-designed (TD-CD) projects. The representation is kept deliberately simple, and we are not claiming that it captures all aspects of the many complex issues that arise. We believe that having a simple model is valuable because people will profoundly disagree with it; discussions about why it is incomplete and how it might be improved inevitably follow and are valuable in themselves. Developing this simple representation is a recasting activity, a concept that is introduced in what follows.

An earlier version of this representation, developed over the course of the Blue-Action project, was first introduced by one of us (MC) as part of an on-line event 'Understanding climate complexity - Science through art' in November 2020[3,4]. We can find no similar treatment in the literature and sincerely hope that this will act as a spur to discussion and help many people to develop their own more sophisticated visualisations of the processes.

As mentioned in the introduction, this section contains figures with captions that are to be read as a sequence with the main text.

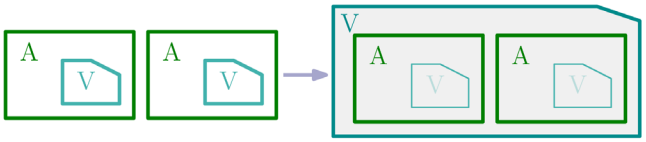


Figure 1. The simplest view of what we are trying to achieve. On the left team members, or **Actors** (A - green rectangles), each have their own internal **View** of the world (V - cyan pentagons). On the right a shared view, or common frame of reference has emerged around the actors.

In Figure 1 the central grey arrow stands for all processes and activities that lead to the emergence of a new view, or frame of reference, common to all actors. (This new frame is, of course, not external to the actors but it is graphically convenient to show it as being shared in this way.) None of the processes that could lead to the emergence of the common frame are possible without members of the team originating activities and interactions of some sort; for this part of the discussion we will call this an output.

The output shown in Figure 2 can be anything: a slide presentation, a plan for a group activity, or a sketch on the back of a beer mat. Creating this output has an impact on the view of its creator. But Figure 2 hides a subtle difficulty. Researchers are well practised at designing a narrow range of outputs for a narrow range of audiences. We will suggest later that this comfortable familiarity

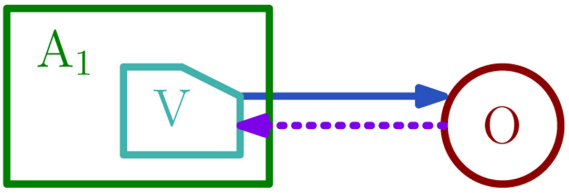


Figure 2. The origin of a simple interaction. An actor A_i initiates an interaction by creating something, an **output**. The process of creation is shown as a solid blue arrow → and the output that has been created is shown as a red circle labelled 'O'. The broken indigo arrow ⇠ represents the **impact** included because the view of the actor is likely to be changed by the process of creating the output.

with a limited range of output types is a road-block in co-design projects; we will come back to this point later in the 'Identifying and lifting road-blocks' section.

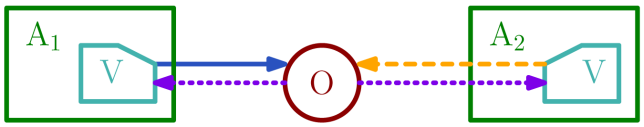


Figure 3. A traditional form of interaction between two actors. The second actor A_2 (right) observes or participates in the output created by A_1. Observation/participation is indicated by a dashed orange line. Both actors hopefully gain something from the interaction, it has impact on both their world views indicated by the dotted indigo lines.

The simplest example of a situation that matches Figure 3 would be where A_1 is the lecturer, the output is the lecture, and A_2 is a student. The impact on the world view of the student would be the principle aim in this case.

It is tempting, but not valid, to suggest that a simple view of co-design would be where observation and creation were somehow integrated; for example if the observer is encouraged to also make suggestions about the content of the output. If the observer modifies the output as part of their participation they become a co-designer, and maybe we have partly achieved what we set out to do. This situation is described in the next figure.

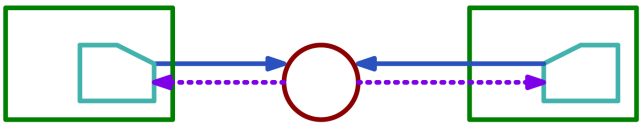


Figure 4. A naive and misleading view of co-design. (Here we have dropped the alphabetical labels.) This figure is simply a restatement of Figure 3 but with the second actor (on the right) now not simply an **observer/participant** but has an interaction that modifies the output in some way.

A situation which could be something like Figure 4 would be two children inventing a game; if they can 'play together nicely' then something that is satisfactory and meaningful containing elements supplied by both can be achieved. Perhaps a better illustration would be two jazz musicians cocreating a performance by improvising and 'riffing off' one another's contributions.

It is clear that the situation represented in Figure 4 can result in an output that is co-designed in some very limited sense. But experience has shown that this approach is hard to initiate and difficult to sustain with actors who, unlike our two jazz musicians, do not share a common background. There are a number of road-blocks that emerge in this situation.

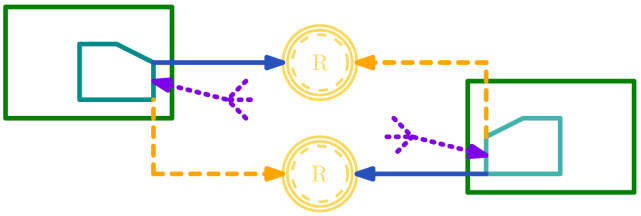


Figure 5. Clearing the road-blocks. Our proposal is a set of intermediate interactions, that we will call **recasting activities**, indicated by gold circles and labelled 'R' in this figure. These are shown with thinner double or triple rings because it is important that a wide range of such activities is explored. It is also critical that each of them is not overly complex; these are not the goals of the collaboration but merely its support.

Figure 5 is a critical point in the establishment of a shared view because there is no project output. Nobody is explicitly working on the output while they are building the common frame of understanding. This has a profound effect on the nature of the impacts, as indicated by the indigo arrows with multiple tails. A range of carefully chosen recasting activities leads to a multitude of small impacts that, acting together, encourage **insight** across team members and disciplines, something that has been called **leakage** which leads to transgressive knowledge[5].

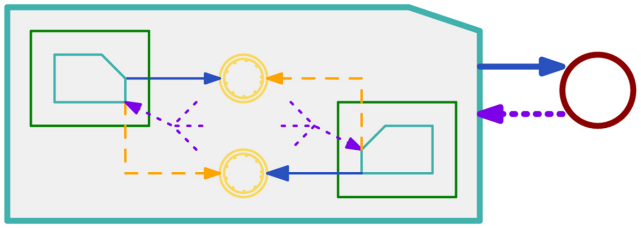


Figure 6. The ideal co-design. Here we illustrate the idealised outcome of the continuing recasting of views (as shown in Figure 5). It leads to a new common frame and the output is now co-designed based on this new frame of reference.

Figure 6 illustrates a purely hypothetical situation. The combined impacts of all the recasting activities on the internal views of the team results in a common frame of reference. The common frame of reference can now be used to give form to co-designed goals of the project.

An example which approaches Figure 6 would be a group of actors performing 'improv', a form of live theatre in which the plot, characters, and dialogue of a scene are made up in the moment. The actors share a world view because they have similar training and experience. This is further reinforced if the troupe have worked regularly together forging a stable shared frame of reference. With just a few prompts from the audience they are able to dynamically interact to co-create a cogent and amusing narrative.

However much we would like to achieve this result, it is unrealistic to suggest that Figure 6 represents a stable position for teams of disparate researchers assembled for a single project. The incompleteness and lack of stability in the emergent common frame leads directly to our last figure.

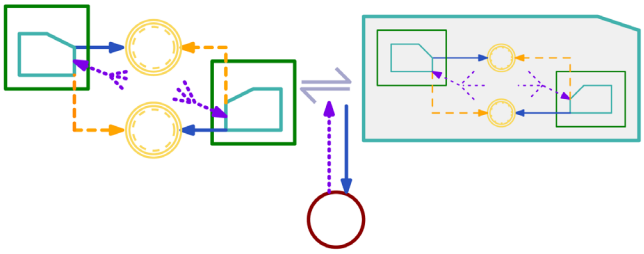


Figure 7. A more realistic view. The idealised representation (right) where there is a common frame of reference, is in a dynamic equilibrium with continuing recasting activities (left). The project goals or outputs (centre) are achieved by harnessing, and managing, this equilibrium.

Figure 7 contains perhaps the most difficult and controversial assertion in this report. It is too much to expect the common frame of reference to be as well formed or as stable as each individual internal view. As a result it is necessary to manage the equilibrium and tension between the recasting activities and the emergent common frame.

In the overview of the project represented by Figure 7 the output arises not from the recasting activities (which are not designed to meet project goals directly) or as a direct result of the common frame of reference (which is incomplete and unstable), but as a result of harnessing the mutual insights and momentum generated by the processes themselves.

Discussion

The diagrammatic representation of transdisciplinary co-design processes proposed here is not complete and will not appeal to everybody. Its simplicity and the fact that we have tried to describe it in non-technical language will ensure that many readers are already suspicious of its usefulness. However, several colleagues have already turned their misgivings into suggestions as to how it can be improved; this is entirely positive.

As previously remarked, developing the representation and publishing it in this form is itself a recasting activity. It is not to be expected that all readers will have a common world-view as a result of reading this report, but perhaps the impact will be enough to start an interaction somewhere where the resulting insights can be exploited.

Finally in this section a summary can be attempted, without any reference to the diagrammatic representation, in a few bullet points:

- Teams that contain individuals with no common frame of reference should plan for recasting interactions that are not directed towards the goals of the project.
- The aim of these interactions is to modify each individual world view (or at least create the ethos in which views can be modified) in pursuit of insights that move the team towards a shared frame of reference.
- Neither the recasting activities (not being designed to contribute directly) or the possible common frame of reference (not usually being well developed or stable enough) give rise directly to the project outputs or goals.
- Co-design is the harnessing and management of the process of building the desired common frame, a process which is characterised by a tension and equilibrium between many intermediate stages.
- The impacts on world views, resulting from recasting activities, lead to mutual insights and, if management is successful, the mutual insights contribute to the goals of the project.

Identifying and lifting road-blocks

In the previous section we repeatedly made reference to road-blocks meaning the things that prevent TD-CD teams from being successful. Here we will try to identify six of the most troublesome blocks, give some examples, and make some short suggestions how they might be lifted.

Drift

Projects can drift if there is a lack of process management and a failure to initiate recasting activities. This happens even if everyone is apparently busy doing something; one of the most common types of drift is the drift towards everyone pursuing their own unconnected part of the project that they feel comfortable with. In this case there is plenty of activity but no impact and hence no insight. To avoid drift it might not be enough to recruit researchers who are open to the possibilities of working in a TD team, or even those that have a track record.

We believe there is a strong argument for the role of transdisciplinary **facilitators** and we find that this conclusion has been anticipated by others, including EU funded working groups on TD research[6].

In the context of this report the role of the facilitator would include encouraging the origination of recasting activities, originating their own activities if appropriate, modelling active participation in activities, and ensuring that the resulting insights are successfully converted in to goals of the project.

Facilitators might be found among experienced members of the team. Equally, they could, and should where possible, be drawn from a wider range of backgrounds not limited to subject specialists and researchers. These would include communicators, coaches, counsellors, and educators; there is value in making a deliberate attempt to widen the range of viewpoints and approaches withinteams.

We were lucky in our small work-package to have team members with experience of, and commitment to, guiding TD-CD projects; not every project is going to be so fortunate.

Lack of plain language

It is certainly true, and it has been noted by many authors, that:

> 'A transdisciplinary process requires that all participants contribute in a mutual learning process on equal footing. Transdisciplinary processes thus demand certain constraints and a discourse culture'[7].

The phrase **discourse culture** here is shorthand for 'a commitment to communicating freely among the team, and with the wider community of stakeholders, in ways that can be understood'; and among the many **constraints** that this requires is the use of language that is accessible to all parties inside and outside the project. Too often however, far from encouraging a discourse culture, discussions about transdisciplinary projects, and about transdisciplinarity itself, are presented in arcane, frankly byzantine, language. Even researchers who are working in this area are unintentionally limiting their appeal to a very narrow readership.

It takes courage and goodwill within a TD-CD team for the members to abandon the carefully cultivated vocabulary of their own specialist areas. Inability to do this is clearly a road-block to shared insight. The unwillingness to speak plainly is perfectly understandable, the vocabulary we use is part of the armour that we wear. But the metaphor of 'armour' is telling; if we all wear it then we cannot properly see, hear, or sense each other's presence.

There is no easy way to lift the plain language road-block. The team as a whole, but in particular whoever has the role of facilitator, needs to be ready to encourage plain language discourse and to model this in their own outputs. Activities that allow people safe spaces to express themselves without using jargon must be devised, and training could also be made available. However, grant-awarding bodies need to make plain language reporting part of the contract.

One member of our team was prepared to take the lead in internally documenting the project in this way. The resulting notes were shared with the rest of the team, and these form an important source for this report. This limited approach is not ideal, but in a small team we believe that it had considerable positive effect.

Impatience with recasting

It is natural to want to 'get on with the job' from the beginning, and an activity that makes no immediate contribution to stated aims of the project might be viewed as unnecessary. Under pressure from project deadlines there is always an early temptation to come up with a step-by-step plan leading to the project goals, and to stick to it. This approach has the feel of an instruction sheet supplied with self-assembly furniture. Such a plan is a road-block, and this road-block could alternatively be called 'insisting on a plan when what is needed is a strategy'.

Although the step-by-step plan can appear like a guarantee of success, constructive TD interactions will always generate a great deal that **cannot** be planned. If a plan eventually emerges in the later stages of a project, it must emerge as a result of an agile, creative, strategy for encouraging team interaction and exchange of insight. A truly useful plan is, in fact, not a way of getting to the goals of the project, it is itself an output of the project, and the strategy is the way of getting to the plan.

Life in the silo

A common metaphor for academics, and others who have spent years absorbing the knowledge and culture within narrow subject boundaries, is that they operate in a silo. This is not an expression we would choose but it is in common use. The silo is a place of safety where expertise is recognised and valued, and where anything new is likely to be framed in familiar terms by others who share the same view. Silos are not without value, they can produce highly skilled researchers with a subtle grasp of some very important, but obscure arguments; in short people you would want in your team. Transdisciplinary projects do not require researchers to abandon their silos. One of the aims of recasting activities should be simply to open windows[1] in each disciplinary or professional silo. The windows must be open not just to see beyond (although that is useful) but to let the richness of experience, the alternative views, of other silos and the outside world circulate freely.

In our project we had team members who had no experience developing algorithms or implementing them as computer programs. Many discussions about the usefulness, or lack of usefulness, of an algorithmic approach resulted only in minimal impact. The turning point in this discussion was the development of a prototype application (in the first instance little more than a 'toy') that had a few features that were recognisably useful. Near the end of the project this application became a project goal in its own right, but not before interaction with it recast thinking and led to a shower of suggestions from all team members, and from the other representatives of the end-user, as to how it could be improved.

The windows of neighbouring silos were opened, and the aroma of what colleagues could cook was allowed to circulate. The result was that everyone wanted a taste, and everyone had an opinion on how to improve the recipe.

Outputs and activities in the comfort zone

The previous example of a programmer providing the team with a quick prototype application can be regarded as an output squarely in the programmer's comfort zone. This is true even if they had never have done anything like it before. It is much more difficult creating outputs and interacting with activities that look and feel very alien to your usual way of thinking.

An example of non-comfort-zone activities is the excellent annual 'Dance Your PhD' competition organised and sponsored by the AAAS Science journals; although we are not suggesting that dancing interactions should be a pre-requisite for

[1]Technically Silos have 'breather openings' -not windows.

participation in TD-CD projects. But the dismissive reactions of many when they hear that researchers might create outputs through dance is not greatly different from their reaction when asked to make a simple sketch, take part in a discussion with a community group, play a game, write something for a newspaper, or sing a song.

Unfamiliar, or even uncomfortable, activities cause us to recast our focus. Engagement with these activities will promote insight, and interactions with a broad range of stakeholders. This is often talked about in the context of public engagement initiatives, but it is forgotten that this applies just as much **within** a transdisciplinary research group as it does in the wider community.

Our own team was constantly challenged to engage with the constraints of a commercial enterprise; something that only one of us had any experience of. Limitations on time and money (see following section) made it possible to recast internal views only to a limited extent. However, the team had access to outputs generated solely by the industry, in the form of calendars of activities, usage spreadsheets, and diaries kept by long-term employees, and these were continually the focus of discussion. The impact of these discussions was enough to ensure that all members of the team framed their outputs in new ways that were not immediately comfortable. This would not have been possible at the beginning of the project or in the absence of material from outside everyone's silos.

Resources

Writing this in August 2021, as the world is adjusting to SARS-CoV-2 as an endemic problem, many of us have been forced to rely on internet-based interactions during long periods of social isolation. News reports are full of speculation about if, when, and how willingly, workers will return to their offices.

In the context of this report there are some interesting features of the debate about remote *vs* office working. While many staff believe they are more **productive** at home, many companies believe that staff are more **creative** when they have the chance to freely interact[8]. It is not our intention to develop this argument here; but it is entirely possible that freed of the necessity to travel, freed of interruptions by colleagues, and free to organise their own time, employees are getting through their to-do lists and ticking boxes on their plans as well, or better, at home than they could in the office. Companies, it seems, are thinking more strategically (see 'impatience with recasting').

This strategic goal of creativity, through extended interaction and shared insight, requires significant resources of time and, hence, money. Transdisciplinary projects are likely to be relatively expensive because team members need to be brought together and freed of their competing responsibilities. However:

> 'Most European Union research projects in . . . Horizon 2020 include researchers from several disciplines. While many resources are invested in supporting different disciplines, the proportion of resources allocated to create collaboration across knowledge domains is much lower'[6].

There is a particular danger for early career researchers because of pressure to meet other goals. For junior researchers their work within their own silo, promoted by senior academics in their own departments and perceived as being more important to their career development, is likely to take priority.

In our own case travel restrictions due to the pandemic had an impact on our work only at the very end, as remote working had been incorporated from the outset. During the study a major barrier to having time for discussion and recasting activities was accommodation and living costs. Money for working hours was available, and travel is relatively inexpensive; even international travel can be relatively low cost. But for a team of five people, on a four day meeting, the subsistence and accommodation costs soon become an issue. Such meetings need to be regular, not once-a-year weekend 'catch-ups'.

To lift this road-block grant-awarding bodies need to be realistic, and explicit, about how often and how much time the team are expected to spend together, and to fully fund this interaction. This is **not** the same as being explicit about how much working time will be paid for on the project, and then simply adding a fixed amount to cover travel, living expenses, and accommodation for the whole grant period.

Summary

This section is not called 'Conclusions' because the conclusions, such as they are, are contained in the individual sections. But a bullet point summary of this report could read as follows:

- Transdiciplinary research and co-design (TD-CD) are important approaches to achieving many complex but desirable outcomes such as, in our case, the provision of climate services which bring together modellers, data scientists, decision makers, and industry practitioners[9].
- There are many people who are keen to associate themselves with TD-CD teams who have little idea, and no experience, of the difficulties involved or the responsibilities it imposes upon them.
- Diagrammatic descriptions, however incomplete, allow inexperienced researchers to gain an impression of 'how something works'[10] and provide more experienced team members with something to disagree with, promoting discussion.
- A collaboration of the willing is not automatically a community of discourse[11], (a complex way of saying 'just because you all signed up for the money doesn't mean you are motivated to talk meaningfully to each other'). It is easy to retreat into a comfortable silo, fall back on narrowing vocabulary, do your own thing, and be suspicious or even dismissive of activities that are designed to shake up your world view.
- Funding bodies should **require** more plain language communication (which has legacy value for other projects), more interaction, and more risk taking.

They should not rely heavily on evidence of **epistemic exchange** or societal impact, even though both are valuable outcomes. The quality of these valuable outcomes, and hence the success of the project, depends critically on the quality of the processes and depth of insights that brought them about.

Glossary

Actor: A participant in the co-design, a team member, an active stakeholder.

Co-designed: Designed (or created) jointly by all stakeholders to ensure the outputs meet every-ones needs and are usable.

Drift: The danger that a project might make no progress towards transdisciplinary insight even if everyone is busy doing something.

Epistemic Exchange: This is used to describe what happens when actors, or stakeholders, learn from each other and is a desirable outcome of TD projects.

Impact: A change in attitude, a shift, a nudge, anything that changes the way people think or feel.

Output: Anything that results from the co-design process or from the initiation of a recasting activity: a presentation, a sketch, a dance etc.

Plain Language: Communication with your non-specialist audience in a way that can be understood the first time they read or hear it (also called plain writing)[12].

Recasting Activity: An interaction designed to alter world views rather than meet project goals directly.

Road-Block: Used in this report to refer specifically to any barrier to interaction and insight within a transdisciplinary team.

Silo: The constraints of traditional or entrenched subject divisions.

Strategy: is used as a contrast to a *plan*. If you are about to assemble a bookcase you will unfold a plan, designed to lead you to a fixed outcome. If you are about to play a game of chess you will have a strategy. Plans are box-ticking exercises, while strategies are agile, creative, and productive in situations where plans are inappropriate.

Transdisciplinary: Research that seeks to value and integrate knowledge from a wide range of stakeholders. This implies a *'processes of mutual learning between science and society, ...which embodies a mission of science with society rather than for society'*[7].

Transgressive Knowledge: *'...knowledge, as well as expertise, is inherently transgressive. Nobody has anywhere succeeded for very long in containing knowledge. Knowledge seeps through institutions and structures like water through the pores of a membrane'*[5].

Data availability

All data underlying the results are available as part of the article and no additional source data are required.

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Open Peer Review

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?

Berry Billingsley
Faculty of Arts, Humanities and Education, Canterbury Christ Church University, Canterbury, UK
Joshua Heyes
Canterbury Christ Church University, Canterbury, UK

The paper identifies the importance of exploring how teams that do not share a common worldview can make progress, but not necessarily direct progress, towards common goals. It offers a tool to assist with creating a dialogue while proposing that interactions between members of a team that have little in common, with respect to experience and expertise, will rarely lead to outputs that meet the goals of the project unless supplementary activities first 'recast' their views towards a common frame of reference.

This is an important and emerging area of work. In our own area of education studies, a growing number of influential global educational policy-making organizations are advocating for a less siloed approach to teaching and learning at all levels of national education systems. This more integrated approach to knowledge building also has significant consequences for all institutions involved in research, innovation, and development. Our work sits alongside the resources being offered here in developing and testing interventions which develop epistemic insight – knowledge about knowledge, including the similarities and differences between different forms of knowledge and how they work together in real-world concepts.

Overall we think this is an interesting and useful contribution to this wider conversation, explicating how transdisciplinary teams might work effectively together. The diagrammatic approach is a particularly valuable original contribution to knowledge in this area. We have three main points of feedback.

The first is that we do not agree with the authors' assertion that no other similar work exists in the literature. There is a significant body of literature that discusses transdisciplinary collaboration. One example of work that attempts something similar to the authors is Christian Pohl's work (https://doi.org/10.1016/j.futures.2005.02.009). While we appreciate the aim of this article is to provide something imminently useable we would like to see a revision that acknowledges similar

work being done by others and draws on insights from this wider literature that are likely to enrich and deepen the authors' explication of the diagrammatic understanding they want to promote.

The second is that we found the article to lack illustrative examples. Given the importance of 'recasting exercises' to the methodology proposed we were surprised to see no concrete examples given – We would expect at least two to give readers adequate understanding of this. Similarly with 'road blocks'. In general, we were curious to know more about the authors' own experiences of working together on the Arctic Tourism project – a novel and intrinsically interesting area of research that we are sure would not alienate the range of disciplinary perspectives authors may bring to this work. We believe that adding more exemplar detail and narratives from the author's own experiences would add to rather than detract from the accessibility and usability of the diagrammatic tool.

The third point is how the article frames the process by which this diagrammatic tool was arrived at. It is implied that this tool was developed through a process of use and refinement. It would be useful to know, therefore, whether this tool has been in any way rigorously or intentionally tested and what were the outcomes of the test. Even if it has not been tested, it would be useful to know whether this is in the authors' future intentions and what this testing might look like.

References

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Is the work clearly and accurately presented and does it engage with the current literature?
Partly

Is the study design appropriate and is the work technically sound?
Partly

Are sufficient details of methods and analysis provided to allow replication by others?
Not applicable

Are all the source data and materials underlying the results available?
Yes

If applicable, is the statistical analysis and its interpretation appropriate?
Yes

Are the conclusions drawn adequately supported by the results?
Yes

Competing Interests: No competing interests were disclosed.

We confirm that we have read this submission and believe that we have an appropriate level of expertise to confirm that it is of an acceptable scientific standard, however we have significant reservations, as outlined above.

Author Response 01 Jun 2022

Martin Coath

Thank you for reading this report and providing considered, constructive feedback. It was not my original intention to submit this work to a peer reviewed journal - I was encouraged to do so by colleagues mostly on the grounds that it would increase its visibility. I thought, and still think, that the ideas have merit and the approach could be useful to many. Visibility is hence a key issue. Other researchers, including reviewers, have been positive about the ideas and approaches contained in the report - in an area that is often short of new approaches. However it is clear that the work does not meet the agreed criteria for 'research' and all criticisms based on this assessment are valid. Also valid are the criticisms that I have not adequately discussed the ideas in the context of the broader literature. To do so would have made the text very dense and readable only to specialists in the field, the aim being to use the plainest language possible. In addition the exposition even in its submitted form was already well over the word limit. One further point; the claim of originality made in the introduction was meant to apply, of course, principally to the graphical representation, but also to an exposition designed to be read by non-specialists; this being a necessary requirement in a transdisciplinary team. I am still missing something if comparable treatments exist in the literature. I would certainly consider revising if I was wrong about this. Apart from this possibility I will not be revising the paper but I am, of course, happy to participate in any further discussions with reviewers or readers.

Competing Interests: No competing interests were disclosed.

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John Damm Scheuer
Roskilde University, Roskilde, Denmark

Review of " Enabling transdisciplinary research: Suggestions for avoiding "road-blocks" based on a case study

Is the work clearly and accurately presented and does it cite the current literature?
The authors introduce a novel diagrammatic way of thinking about interactions in transdisciplinary teams which – according to the authors- "is designed to provoke debate about how teams which do not share a common world view can make progress, but not necessarily direct progress, towards common goals. Based on the diagrammatic description of social interactions in such teams some problems labelled "roadblocks" are identified that limit progress and reduce the effectiveness of transdisciplinary teams in such transdisciplinary projects. The

diagrammic description was developed as an approach to report the progress of a work package of the “Blue-Action project” that focused on Arctic Tourism. The basic assumption of the authors and the text is “that interactions between members of a team that have little in common, with respect to experience and expertise, will rarely lead to outputs that meet the goals of the project unless supplementary activities first recast their views toward a common frame of reference”. The work is clearly written. The intentions and key messages of the authors are clear too. The text is however submitted as a research article. At the same time the authors present the text as a “plain language report” and seem to be summing up the authors experiences with having been “working in a team where the members have diverse and largely non-overlapping areas of expertise” and where “certain issues might arise”.

As a consequence what the research question is, and what the reasons for asking it are, are not explained. Is the text about the use of diagrams and “plain language” to communicate research-based theoretical insights? Is the text focusing upon developing some diagrams that may help transdisciplinary teams to collaborate better? Or is the text about reporting some empirical and normative insights of the authors to an audience using plain language and diagrammatic descriptions of interactions between transdisciplinary team members? In my view, the current text is using diagrams of the interaction between group members to sum up the authors experiences and normative insights from having worked in a transdisciplinary team in the “Blue-Action” Arctic Tourism project and is -as a consequence -not formatted as a research article.

As a research article different types of theories and research may be relevant in relation to the above mentioned text depending on what the main focus of the authors are. If the text is about how artifacts like diagrams and plain language can be used to communicate theoretical, empirical or normative insights from research projects to practitioners research about how artifacts and especially diagrams have been used to achieve such communicative aims in other projects need to be looked into. If the text is about helping transdisciplinary project teams to become better at collaborating by referring to a number of diagrams that gives a better understanding of the collaborative process, the authors need to look into research literature that focus on the kind of “work” that such artifacts or “boundary objects” (Star & Griesemer, 1989) do in such contexts.

A way forward may also be to look into the translation literature and especially research related to knowledge translation. Knowledge may easily be transferred between groups (or representatives of groups) that are similar in language and culture. But if they are different (or distant) in language and culture knowledge need also to be translated and negotiated (Carlile, 2002,2004). And perhaps that is exactly what happens during the “recast” activities mentioned by the authors; that participants “get to know” the language and cultures of the other team members who are different from themselves. The concept of “boundary objects” may also be relevant here. A “boundary object” is “plastic enough to adapt to local needs and the constraints of the several parties employing it, yet robust enough to maintain a common identity across sites” (Star & Griesemer, 1989, p.393). The project or the diagrams may thus both (potentially) be theorized as boundary objects that has to “make sense” across participants/team-members sites (in different ways) and helps achieve collaboration and coordination even though full agreement about things may not be achieved ?

The relevant references are here:
Carlile, P.R. (2004). Transferring, Translating, and Transforming: An Integrative Framework for Managing Knowledge Across Boundaries, *Organization Science,* Vol. 15, no.5, Sept.-Oct, pp.555-

568.

Carlile, P.R. (2002). A pragmatic view of knowledge and boundaries: Boundary objects in new product development. *Organization Science,* 13, pp.442-455.

Star, S.L., Griesemer, J. (1989) Institutional ecology, `Translations´, and Boundary objects: Amateurs and professionals on Berkeley´s museum of vertebrate zoology. *Social Studies of Science,* 19, pp.387-420.

Is the study design appropriate and does the work have academic merits?
Since the text is not formatted as a research article the study design is not described. And it is thus not possible to decide whether the text has academic merit.

Are sufficient details on methods and analysis provided to allow replication to others
Since the text is not formatted as a research article no methods or approach to the analysis are described. It may therefore not be decided whether it may be possible to replicate the study on which the text is based.

If applicable, is the statistical analysis and its interpretation appropriate?
The text report the empirical experiences and insights of the authors from having participated in an interdisciplinary work group related to a work package in the “Blue-Action project” that focused on Arctic Tourism. These insights are communicated in schematic form and explained in “plain language” in the text. The “data” were thus qualitative not quantitative.

All the source data underlying the results are available to ensure full reproducibility
No source data are provided.

Are the conclusions drawn adequately supported by the results?
Since the text reports the authors experiences from working in a transdisciplinary team summed up in diagrams and explained in “plain language” it is not possible to decide to what degree the authors perceptions, interpretations and diagrams are supported by the research done in relation to the Blue-Action tourism project.

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Is the work clearly and accurately presented and does it engage with the current literature?
Partly

Is the study design appropriate and is the work technically sound?
No

Are sufficient details of methods and analysis provided to allow replication by others?
No

Are all the source data and materials underlying the results available?
No

If applicable, is the statistical analysis and its interpretation appropriate?
No

Are the conclusions drawn adequately supported by the results?
No

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Organization studies, translation studies

I confirm that I have read this submission and believe that I have an appropriate level of expertise to state that I do not consider it to be of an acceptable scientific standard, for reasons outlined above.

Author Response 01 Jun 2022

Martin Coath

Thank you for reading this report and providing considered, constructive feedback. (In particular for the Star & Griesemer (1989) reference which was interesting reading and entirely new to me.) It was not my original intention to submit this work to a peer reviewed journal - I was encouraged to do so by colleagues mostly on the grounds that it would increase its visibility. I thought, and still think, that the ideas have merit and the approach could be useful to many. Visibility is hence a key issue. Other researchers, including reviewers, have been positive about the ideas and approaches contained in the report - in an area that is often short of new approaches. However it is clear that the work does not meet the agreed criteria for 'research' and all criticisms based on this assessment are valid. Also valid are the criticisms that I have not adequately discussed the ideas in the context of the broader literature. To do so would have made the text very dense and readable only to specialists in the field, the aim being to use the plainest language possible. In addition the exposition even in its submitted form was already well over the word limit. I will not be revising the paper but I am, of course, happy to participate in any further discussions with reviewers or readers.

Competing Interests: No competing interests were disclosed.