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# Interactive network visualization on the integration of mindsets and sustainability – creating conditions for emergence through a relational narrative

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Transdisciplinary research processes often involve the integration of knowledge and stakeholders from various backgrounds. Here, we introduce the story of the research project AMA (A Mindset for the Anthropocene) on the role of mindsets in the context of sustainability and present an interactive visualization tool that we developed for stakeholder mapping and research communication. Through this platform, we provide access and navigation to everyone interested in this field of research and we have simultaneously created a channel for all stakeholders to co-create content. Here, we describe the design and functionalities of the platform and the participatory way it was developed as part of our stakeholder engagement. We discuss upon how such a design allows for reflection of potential biases in transdisciplinary research processes and simultaneously catalyzing self-organization in stakeholder networks.

**Keywords:** stakeholder mapping and networking; inner transformation; sustainability; transdisciplinarity; mindsets; co-creation; relational paradigm

# Introduction – setting up a transdisciplinary research project connecting the discourses on sustainability and mindsets

The academic and societal discourse on sustainability and socio-ecological transformation has been receiving widespread attention for decades (Kates et al. 2001; Clark, Crutzen, and Schellnhuber 2005). In the sustainability discourse it has become widespread consensus that the nature of sustainability-related challenges in the Anthropocene needs to be described and addressed from an understanding of complex adaptive systems (Clark and Harley 2020; Waltner-Toews, Kay, and Lister 2008; Ravetz 2006; Liu et al. 2007; Kay et al. 1999; Espinosa and Porter 2011; Steffen et al. 2011). Within academia, the discourse on sustainability science has been connected with the emergence of transdisciplinary research as a way to address complex societal problems more holistically.(Thompson Klein 2004; Lang et al. 2012; Jahn, Bergmann, and Keil 2012; Lawrence et al. 2022; Hirsch Hadorn et al. 2006; Felt 2010) These kinds of approaches require integrating aspects of human subjectivity, such as mental models (Meadows 2001; Meadows 1997) and mindsets for example as deep leverage points for systemic change (Abson et al.

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2017; Manuel-Navarrete 2015; Wamsler and Brink 2018; Kassel and Rimanoczy 2018; Maiteny 2002; Hermes and Rimanoczy 2018). Also in the context of transformative transdisciplinary research, there has been a growing call for reflexive practices as a way to integrate aspects around mindsets and inner transformation (Lang, Wiek, and von Wehrden 2017; Fazey et al. 2018; Popa, Guillermin, and Dedeurwaerdere 2015; Bruhn 2021).

In 2015, the IASS initiated the research project AMA (A Mindset for the Anthropocene) with the intention to create and host a space for strategic dialogs among researchers and stakeholders who were interested in the connection between 'inner' transformation (mindsets) and sustainability. During an informal phase in 2015, we gained the impression that both discourses were largely disjunct as schematically depicted in Figure 1. The term mindset had been used occasionally in various disciplines before (Weick 1998; Urde 1999; Lebow 1993; Delgado 1990). More prominently and comprehensively it had been used particularly in some fields of psychology and neuroscience in the context of personal development and leadership.(Dweck 2006b; Dweck 2006a; Taylor and Gollwitzer 1995; Gollwitzer and Keller 2016) In all cases, it had, however, not been addressed systematically in the context of sustainability. Also, the term 'inner transformation' (Fontana 1999) was only recently adopted in the academic discourse on sustainability more explicitly (Wamsler et al. 2020; Wamsler 2019; Wamsler et al. 2021; Woiwode et al. 2021).

During a scoping phase until mid-2017, we invited in total 14 guests ('fellows') to explore if and how it would be viable to set up a transdisciplinary research project and co-design the process with us. These fellows represented a mixture of scholars and stake-holders, coming from backgrounds as diverse as philosophy, sociology, theology, psychology, economics, geography, business consulting, activism, policy advice and the arts. Demographically, their age varied between 25 and 70 years, 7 were men, 7 women, 7 originating from Europe 3 from Asia, 3 from Northern America, 1 from Southern America. Our activities attracted a lot of interest among our peers in the field of sustainability who shared our perception of the need of such kind of project and actively engaged in various research and dialogue activities. The joint activities during the scoping phase brought about three key realizations:

(1) 'There is no proper language for the link between inner transformation and sustainability' – Individuals from our sustainability-related peers from academia, civil society, or policy (advice) expressed interest in the topic of mindsets or inner transformation. They raised concerns, however, that they had no proper



Figure 1. Schematic illustration of the role of the AMA project as a dialogic space of exchange and research connecting the largely distinct communities (and research fields) 'sustainability' and 'mindsets' ('inner change').

language to address this topic and might be considered 'unscientific' or lose their credibility if they engaged openly in such 'vague' or 'fluffy' topic.

- (2) 'Nobody else is interested in this' Conversation partners expressed the perception to be alone with their interest, believing that other stakeholders in the context of sustainability would not see the relevance of linking these two fields. We started connecting people from our dialogs informally and received positive feedback about a slowly growing sense of a community.
- (3) 'How can it help me with my work for sustainability?' As the interest in mindsets often emerged out of a personal, private interest many of our peers expressed the wish to learn how the two topics would practically synergise and create opportunities for strengthening efforts towards sustainability.

The supportive feedback from our peers and the quality of first academic results were convincing to the leadership of the IASS and resulted in the establishment of a 4-year project funded from the IASS' core budget. Responding to the three key realizations from the scoping phase, the project was launched in 2017 pursuing three complementary purposes:

- (1) Develop a scientifically robust language: Provide a platform for (academic) discourse and research about potential synergies between the two concepts.
- (2) Offer spaces for community building: Develop a stakeholder-mapping and connect people who can work together synergistically.
- (3) Develop practices for integration: Both as part of the action-research and as service to its stakeholders the project aimed at developing formats and practices that allow for integrating aspects of inner transformation in specific efforts for sustainability.

In the following, we will describe how the project facilitated a participatory process to develop a digital platform that supports all three of these purposes.

# Methods – participatory design of a database for research content and stakeholders

Based on the experiences of the scoping phase it was decided to create a database<sup>1</sup> that can: (a) be an infrastructure for the project (e.g. for managing research results and contacts), (b) provide access to the research results of the project, and (c) allow peers of the project to contribute content to the database, become visible and connect with each other. Therefore, a key task was to create a vocabulary that allowed for locating all content meaningfully in the database. For this purpose, it was decided to tag all entries in the database in relation to the questions:

- (1) For which question(s) of the project storyline is an entry relevant?
- (2) Which specific (conceptual) aspect(s) does an entry relate with?
- (3) Which perspective(s) does it represent?

For all three questions we wanted to create a vocabulary that was scientifically accurate enough while simultaneously being open and inclusive enough for our peers from diverse (academic and non-academic) backgrounds to feel invited to engage in dialogue and mutual learning. We invited 60 of our peers to share with us the terms they used in

relation to 'sustainability' and 'inner change/mindsets'. We clustered and aggregated the feedback together with a few academic and non-academic partners (particularly former fellows from the scoping phase). In parallel, we conducted literature research on relevant academic fields to explore which kinds of conceptual frameworks already existed for the two fields.

For the field 'sustainability', most of our peers were using the SDGs as their preferred reference framework. Additionally, we chose to include a few terms that were widely mentioned in the feedback to our questionnaire. Similarly, we developed the vocabulary for 'inner change' from a combination of the clustering of the survey and our research. It turned out that the framework of positive psychology introduced by Peterson and Seligman (Peterson and Seligman 2004) showed highest overlap with the terms mentioned by our peers and at the same time provided the most robust reference in this field.

It became clear that our peers were working with a diversity of frameworks and terminologies, and we decided to accept the fact that no vocabulary would be scientifically coherent and simultaneously workable for us and our transdisciplinary and trans-sectoral peers. In an admittedly messy and far from straight-forward process, we created a first draft of the vocabulary that we iterated over three times with internal colleagues and external peers. At the same time, we created the database such that the vocabulary could be subject to further amendments in the future if we were to realize that some terms were missing or not workable. A first version of the database was setup in spring 2018. For a phase of almost two years, we developed and used the database only internally and iterated over the vocabulary further to meet our practical needs. Only after this test phase did we launch the database to the public in March 2020, containing four *types* of entries:

- (1) Publication (Journal article, book, blog entry etc.)
- (2) Institution (Organization, initiative, website, etc.)
- (3) Project (research project, event etc.)
- (4) Person (incl. role in the project)

In its current form the taxonomy contains four *dimensions* of tagging with *sub-head-ings* (e.g. for the dimension 'inner change' the sub-headings 'qualities', 'practices' and 'framings & discourses') to cluster the keywords and allow for better overview and easier navigation.

- (1) Journey stations (relation with the guiding questions of the learning journey)
  - (a) Motivation Why is 'inner' change needed in the context of sustainability?
  - (b) Definition Which definitions are relevant for our research?
  - (c) Inspiration Which examples and stories show how 'inner' change can be conducive to a change in practice in the context of sustainability?
  - (d) Process What makes for inner change? / How is it possible to personally practice and collectively cultivate specific qualities?
  - (e) Potential What is the concrete contribution to sustainability?
  - (f) Vision How do we envision sustainable futures and how can this inform transformative action towards sustainability?
  - (g) Next steps Which conclusions do we derive for the future?
- (2) Sustainability
  - (a) Objectives (SDGs and others)
  - (b) 'Layers' of change (individual, social, technological, etc.)
- (3) Inner change

- (a) Qualities (mindfulness, reflexivity, compassion, etc.)
- (b) Practices (contemplation, psychotherapy, yoga, etc.)
- (c) Framings and discourses (deep ecology, integral theory, systems thinking, etc.)
- (4) Perspective
  - (a) Academia (psychology, anthropology, neurosciences, etc.)
  - (b) Arts (music, visual art, etc.)
  - (c) Business (industry, entrepreneurship, etc.)
  - (d) Civil Society (NGO, activism, etc.)
  - (e) Public Sector (Administration, Politics, etc.)
  - (f) Spirituality (Buddhist, Christian, etc.)

The taxonomies did not only serve as means of structuring the content in the database, but also helped us derive connections between items. Traditionally when creating a network dataset, one needs to create explicit connections between nodes in the network, for instance, which person is connected to which institution, or which person was involved in which project or publication. We did this, and furthermore, through those direct links we also created (weaker) secondary links, e.g. people who worked on the same project or at the same institution also share a link. But beyond those explicit links, we were more interested in links that are not explicitly made so far, the invisible connections, particularly across the domains of 'sustainability' and 'inner change'. To unravel those connections, we used the taxonomies as shared interests. If two items have the same taxonomy, they are linked. The more taxonomies they share, the stronger they are linked. While creating direct, explicit links is very time consuming, by using the taxonomy as a basis for our network we could quickly refine the taxonomies and visualize the resulting connections spanning across the domains.

### Results – interactive visualizations as tools to provide access to and navigate in an emerging research field

All content collected in the database was meant to be made accessible to visitors of the website in a form that allowed users to (a) find content matching their own needs and interests and (b) recognize and explore patterns and relationships or thematic clusters within the database. An implicit ambition was to not only juxtapose the two fields 'sustainability' and 'inner change,' but also to integrate them. This ambition was pursued both in terms of the research work and in the way the results were communicated. At the same time, the website was meant to allow users to start from the notion of 'two separate fields' that had marked the beginning of the research project. Here, we would like to present the different visualizations that were developed to present and navigate with the database content. Four visualizations were developed for the entire database. Two visualizations were developed for depicting a single entry in its database context.

#### Overview of the database

Visitors can choose among four kinds of visualizations each of which allows to filter the database with respect to one specific aspect. The first visualization focuses on juxtaposing the two reference concepts sustainability and inner change in so-called 'polar' depiction. The second one shows all items as one integrated network ('network' depiction). Third, a matrix visualization allows the user to self-select which keyword dimensions should be shown in relation to each other. And finally, a geographical map shows the locations of

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institutions or people within the database. In all visualizations, dropdown menus (see Figure 2) allow the user to select keywords from multiple taxonomies (dimensions, entry types and AMA roles). According to this cumulative selection all respective entries are filtered and highlighted in the current visualization, as well as shown in an easy-to-browse list below the visualization, thereby, always offering two ways of exploring the results.

#### Polar depiction

The polar depiction (Figure 2) allows for analyzing the relation between specific keywords from the field of 'sustainability' and keywords from 'inner change'. From the dropdown menus the user can select the keywords on either side he or she may be interested in. The width of the connection illustrates how many entries are connected to the respective keywords. Upon selecting a keyword on either side (see Figure 3), the hierarchical structure of the taxonomy is revealed, allowing the user to select from more detailed sub-keywords of the current selection. For example, Figure 2 shows linkages between 'objectives' and 'qualities'. Upon selecting both terms, the user can now see more detailed connections, e.g. between the various individual SDGs ('objectives') and specific sub-keywords under the umbrella-term 'qualities' (Figure 3, left). This allows for much more specific search of resources and analysis of data. Selecting one of the keywords (e.g. SDG#4) allows for further specification of the results (Figure 3, right).

#### Network

This visualization (Figure 4) depicts all entries integrated in one network. Each entry is represented by one symbol (projects as squares, institutions as crosses, persons as rhombus, publications as triangles) connected by lines to the keywords that are used in their tagging. Keywords from the field of inner change are shown in green, sustainability keywords are shown in red, and the size of a keyword circle indicates the number of entries that relate to this keyword. An algorithm<sup>2</sup> arranges the items such that the distance between the keywords correlates with the content that connects <u>both</u> keywords. For instance, the fact that the two keywords 'compassion' and 'SDG #4 – quality education'



Figure 2. Polar depiction with no sub-headings or keywords selected.



Figure 3. Polar depiction with one sub-heading selected on either dimension (left) and one keyword selected (right).

appear close to each other indicates that many entries in the database connect these two keywords (see Figure 4). This visualization reflects the results of the research work of the project in which we developed an understanding that moves beyond a dualistic understanding dichotomizing inner change and sustainability ('outer change') towards an integrated, relational understanding of the two frameworks (Walsh, Böhme, and Wamsler 2021). These developments represent the emergence of a general trend in sustainability research that integrates human subjectivity (inner change) in a relational, systemic understanding of sustainability and transformation (West et al. 2020; Manuel-Navarrete 2015).

#### Matrix

In the matrix depiction shown in Figure 5, the user can choose to set keywords from the dimensions as x- and y-axis of a matrix. The size of the gray field indicates how many entries of the database are tagged to the respective keywords in the x- and y-axis. This depiction allows various insights and analyses that are not possible in the other visualizations, like e.g. identifying biases or marginalized perspectives in the database. For



Figure 4. The 'network' visualization illustrates proximity between specific keywords from the fields inner change and sustainability.



Figure 5. Matrix depiction with self-selected dimensions for the x- and y-axis of the matrix. In this example, 'perspective' and 'journey station' are selected revealing how strongly the different perspectives are represented in the database and to which guiding questions (journey stations) they are contributing respectively.

example, Figure 5 shows the dimension 'perspective' depicted against the dimension 'journey stations'. The visualization reveals that more entries represent the perspective from academia or civil society while there are relatively few entries from the arts or business perspective. Also, it is visible that the database contains more entries from the civil society perspective about 'next steps', only very few about 'definitions'. The significance and value of these biases is reflected upon in the discussion section.

#### Geographical map

The most intuitive visualization (not depicted here) is a map that indicates the geographical places where an institution or person is located. This allows both for identifying biases and for searching specifically for entries from a certain regional or cultural background, or e.g. searching for a stakeholder 'nearby'. The current map shows that the database exhibits a certain bias towards Northern American and European entries, stemming from the inception of the project at a German research institute in close collaboration with partners in the U.S. As the project matures, we aim at inviting and integrating perspectives from all continents and cultures more evenly.

#### Contextualization of a single entry

In addition to the visualizations that help to navigate the entire database, there are also two visualizations that help to contextualize a specific entry.

#### Network of 'similar' entries

When one entry is selected from the database, all available information about this entry is shown. Additionally, as shown in Figure 6, a small version of the network visualization depicts those entries that are connected to the selected entry through its taxonomy. The larger the symbol of an entry is shown, the more keywords overlap with the keywords of the selected entry. This visualization allows users to find entries that are similar to the ones they were interested in. It is important to note that, unlike in many commercial platforms (e.g. YouTube, etc.), these entries are not automatically suggested to users because of earlier activities in the platform (collaborative or content-based filtering). Rather the user



Figure 6. Network context of a selected entry. Here, for instance, the NGO 'mindfulness for social change' has been selected and the network shows entries that are tagged with similar keywords.

has full transparency about how individual entries are tagged and can self-select whether and which of these suggested entries are interesting to him/her.

#### 'Rings' depiction of similar entries

Similar to the network context, also the ring depiction shows entries that are tagged with the same keywords as the selected entry. The selected entry is displayed in the center of



Figure 7. Context of an individual entry with respect to inner change and sustainability. Here, 'similar' entries are shown in the vicinity of the various keywords that were used for tagging this item.

two rings, 'inner change' as an inner green circle, and 'sustainability' as a larger outer ring in red. Around the keyword in the respective ring, all other entries are shown that are tagged with this keyword. In the space between the two rings, entries are shown that share keywords both from 'sustainability' and 'inner change' with the selected entry. This visualization allows more detailed options for selecting 'similar' entries than the network context depiction. The visualization does not classify other entries as more or less similar due to the number of keywords they share. Rather it shows all entries that share at least one keyword with the selected entry. For the user this means that she can explore specifically those items that share one particular keyword with the formerly selected item. Also, this visualization may reveal if there is <u>no</u> other entry in the database that shares a particular keyword (Figure 7).

#### Discussion

The different kinds of visualizations present options for users to engage with the results of our research and the community of people and stakeholders we have identified (and/or are collaborating with). We consider these a visual compass to the research field of our project. Purposefully, we do not want to prescribe to the visitors and users of the platform *how* they want to engage. We offer different possibilities that allow for different intensity of engagement. For some, the platform may simply serve as a pre-structured library, for others it may provide an overview over the research field as a whole and again for others it may serve as a match-making tool to get in touch with other people and organizations. We do not pursue a clear *plan* with the platform. Rather, we see it as a catalyst for our research field creating conditions for further emergence.

Simultaneously, these visualizations offer us continuous reflections about our own field as it is emerging. We started creating the platform at a stage when we had no overview of the research field and stakeholder landscape. Now the platform allows stakeholders to participate, and we witness the field taking on developments of its own, beyond any plans we might have had in the beginning of the project. The structure reflects the research process (e.g. through the guiding questions of the learning journey) and the relational understanding that has been part of the research results (e.g. by showing every entry always in its relationality to the various concepts, keywords, etc.). In its current form, the database contains certain biases. For example, different geographic regions are represented unevenly in the database. Also, we have a certain bias towards academia and civil society and comparably little representation from the arts or business perspectives. We see these observations not as indicators that these perspectives (regions) are not active in this field of research (and action) per se. Rather, the reflection of biases helps us to identify which perspectives have already become involved, and which others we would particularly like to try to engage in the future. Also, by opening the platform to the public and offering accessible ways of contributing to the database, we invite others to contribute their perspectives and develop a more balanced overview of the field. Our approach to transformative research starts from the acknowledgement that we are not able to provide an 'objective' analysis of our field of research, regardless how carefully we try to ensure fair representation and participation. The database presented in this article is designed as a communication infrastructure that allows us to remain continuously reflexive about our own biases as transformative researchers as demanded e.g. by Fazey et al. (2018) and the biases brought into the process through the presence or absence of certain perspectives and stakeholder groups.

#### Conclusion

In its essence, the research project is about understanding and transforming relationship patterns across the anthroposphere through reflexive practice. Consequently, the platform itself is conceived as a channel for engaging in relationships based on the resonance with the research intention and focus. As an interactive infrastructure, it is meant to support people who share the nature of our learning journey and are seeking to engage with like-minded people in transformative practice informed by our research and the work of many others, co-constituting this emerging field of research and action. Therefore, the platform is designed such that it does not need to be controlled by the research project on the long run. In the first years, the content was curated exclusively by the research team. For the future, the vision is to offer space for a community of stakeholders to contribute, curate and engage in the process of this field.

We see this platform as an experimental form of science communication in transformative research processes. It integrates functions to share research results, offer space for engagement and co-creation and simultaneously give us as researchers the opportunity to continuously reflect on the process as it progresses. It does not pretend to provide objective insights into a field of research that includes human subjectivity as a key element. Rather, it reflects the continuously evolving subjective perspective of the project on this research field. Through the visualizations we provide an accessible overview and simultaneously allow for navigation along context specific needs in the self-organized network around the research project. The database presented here, represents a key infrastructure for us to remain reflexive with respect to the biases of our own research perspective and the biases of stakeholder perspectives that we are integrating into our transdisciplinary process. The platform is an example for how to communicate in a way that allows the research process to evolve and still allows related stakeholders and the public to actively participate in the learning journey of a research process. All programming code has been published as open-source code and we have been offering our consultation to others who are interested in learning more from our experiences and developing similar structures for their own field(s). We are convinced that such kinds of visualization-based communication tools may play a crucial role for navigating complex fields of content and relationships around shared intentionality. Continuously reflecting on this hypothesis by the help of the database will be an integral part of the project as it progresses.

#### Summary

We have introduced the platform www.ama-project.org developed by of the AMA project of the IASS. The platform offers visualizations to help ourselves and external users gain an overview of and engage with the research process and community around the topics of sustainability and inner change. We describe the participatory manner in which the narrative and structure of the platform were designed together with key stakeholders and how the visualizations reflect with key insights of the research process regarding a relational paradigm of sustainability. By this, we provide an example of how science communication can be designed around a narrative (learning journey) that is not communicated to receivers of a narrative but instead is co-created by researchers and non-academic stakeholders. We have also provided an outlook to how the platform might develop further towards a self-organized communication space for the specific research focus at the interface between inner transformation (mindsets) and sustainability. Through this function, it serves as a digital infrastructure creating conditions for further emergence in this field,

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and serving as a role model for a possible communication tool for other fields and other transformative research activities.

#### Notes

- 1. Following the agile development idea of quickly creating results to iterate upon, we chose to use a Wordpress setup as our 'database'. Using custom types and taxonomies, as well as Advanced Custom Fields (ACF), we established an easy-to-use system for all participating researchers. Beyond the public frontend, the biggest customization from a standard Wordpress instance, was a custom algorithm, which would derive the network from the taxonomies. The whole code base is available on GitHub under an Open Source license: github.com/sebastian-meier/ama-project.
- 2. The underlying algorithm is a so-called force-directed graph approach. While the algorithm tries to create an optimal layout, it has to adhere to several rules, strength of connection, minimum distance between items, etc.

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**Prof. Mark G. Lawrence** is scientific director at the IASS Potsdam and Honorary Professor at the University of Potsdam. Prof. Lawrence is author or co-author of over 150 peer-reviewed publications. He has led various international projects, and has been serving on the editorial and advisory boards of various international committees, including having been co-chair of the International Global Atmospheric Chemistry program (IGAC) from 2015-2018. He is the deputy chairman of the German Climate Consortium, DKK and Co-Chair of the Wissenschaftsplattform Nachhaltigkeit 2030.

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