Bridging the Gap

Methods and Teaching of F-A-S-T - Framing-Art-Science-Technology

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Abstract. *Bridging The Gap* discusses necessities and methods of a transdisciplinary approach at the intersection of art, science and technology, including human computer interaction (HCI) and its various subjects. Research work that combines artistic and scientific approaches benefits substantially from artistic perception and the sensibility to questions beyond their regular environment beyond the work's associated environment. The transfer of knowledge, methods and communication strategies foster a transdisciplinary debate, discussing impacts of existing and emerging technology driven phenomenons. The paper provides a depiction of methods and communication of each discipline to carve out the coherence of transdisciplinarity in praxis. F-A-S-T is introduced as a cooperative project of scientific and artistic institutions where a student's existing profession is amplified by complementary knowledge, methods and collaborative project oriented work. It explores new roles and formats within the interaction between art, science and technology. The aim of the paper is to encourage further research regarding transdisciplinarity and the establishment of corresponding educational programs.

Keywords: design philosophy and duxu, education.

1 Foreword

Funded by the European Social Fund (ESF), by the federal state of Saxony via the Sächsische Aufbaubank and the Saxony Ministry for Science and Art (SMWK), F-A-S-T is a pilot project developing and evaluating a new postgraduate program at the intersection of art, science and technology. Supervised by the project lead of Prof. Christian Sery (Professor for Interdisciplinary and Experimental Fine Art), Prof. Markus Wacker (Professor for Computer Graphics) and Prof. Rainer Groh (Professor for Media Design). The following paper is based on the collaborative work of the

A. Marcus (Ed.): DUXU 2014, Part I, LNCS 8517, pp. 589–600, 2014.
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authors together with Jonas Loh[1], Claudia Schötz[1], Svenja Wichmann[1], Axel Berndt[2] and Erik Zimmermann[3].

2 Introduction

In the last decades, computer-based interfaces have changed from technoid machines In the last decades, computer-based interfaces have changed from concrete devices with limited operational functions to fully integrated sensoric components of the human living environment. Interlinked in data-driven networks these technologies increasingly propagate into every-day life. Their research is no longer limited to commercial and academic interests. A vast growing 'Do-It-Yourself' culture is creating unexpected experimental tools and innovative projects outside of industrial mass production, contributing to the research into existing and emerging technologies. According to Ramocki, such a unique process of creativity is synonymous to artistic practice [Ramocki]. He suggests that, for example, the discipline of interaction design can benefit from a methodical dialogue with the arts. Through technological empowerment an approximation of epistemological methods and materializations is able to bridge the disciplines, leading to new forms of research and artistic practice which often form a sketch of possible futures. Prejudices against highly specialized disciplines must be overcome to achieve this goal. Art and science both expand the field of knowledge, though addressing distinct aspects of research. Typically scientific research includes working with documentation material, the construction of hypotheses, and often evaluative, empirical and applied works. In the context of transdisciplinary work, artistic research may also use the same procedures, but is not necessarily committed to scientific research standards. According to Klein, "art is the act of playing with frames – or a framed aesthetic experience" [Klein, 2010]. Scientific research in this context should be able to review itself within multiple framings. Reflexivity of process is already a part of scientific research, but usually limited to the specific disciplinary background. Seen from this angle, debates on the principles of scientific research methods should gain depth.

The remainder of the paper is organized as follows. We will describe examples of existing transdisciplinary projects and show their different ambitions in reference to scientific and artistic research. We encourage reflection and subsequent enrichment of HCI with unusual perspectives from the margins of interpretation. Furthermore, we will characterize conceptions of art and science, focusing on their methodical approaches and communication strategies. We discuss integrated approaches to combine the disciplines on different levels of strategy. Regarding future research challenges, we state that transdisciplinary education is of mutual interest. Within this transdisciplinary framework, we introduce the concept of a postgraduate curriculum called F-A-S-T Framing-Art-Science-Technology that conveys methods, independent of discipline, to students. The curriculum is demarcated from the accepted idea of art as an illustration of science and science as an inspirational tool for art. It focuses on project-oriented collaborations in-between art, science and technology. The program has already been evaluated in test runs. Primary experiences in breaking up the rigidity of traditional interdisciplinary prejudices and then solidifying constructive collaborative transdisciplinary working-relationships and possible future institutions of interaction will be exemplified. Finally we set our work in relation to scientific demands. Our current efforts in enhanced communication tools as well as prospects arising out of the current test periods with students are described. We conclude by encouraging scientific and artistic educational institutes to create inter-institutional structures. This paper aims to brace awareness for the advantages of transdisciplinary work in art, science and technology.

3 Related Works

This chapter reviews different aspects of transdisciplinary work. First, an artwork reflecting a technology-based interaction process is introduced. Next, research projects combining artistic and scientific methods are shown. Finally, a brief view on the scientific publications about research at the intersections of art, science and technology is given.

Artists regularly cross paths with HCI while creating interactive installations or dealing with perceptive aspects of media-based works. Technologically based processes may be reversed in their purpose to exaggerate a new status of perspective within an artistic moment. A performative work by Cohen and van Balen called “75 Watt” stages an assembly-line machinery, which produces a ‘futile’ object [Cohen & van Balen]. Its only purpose is to demonstrate the motions the workers are bound to perform, when assembling the object. The work was based in China. It addressed inter alia the engineering term ‘black box’ as an “abstraction [that] allows for the design of ever more complex products in ever more complex processes, resulting in a belief that there is very little we can not engineer”, but that also “creates multiple layers of disconnection [..] between the designer and maker, [..] between technology and people, [..] between head and pin” [Cohen & Van Balen].

While the use of computer based technology is evolving in the context of art, current research strategies of both scientists and artists often remain exclusive. The following projects are successful counter-examples, though motivated by different objectives.

The performance-installation „Brain Study“ staged by Klein presented an assembly of simplified functional parts of the brain controlled by one actor respectively [Klein, 2004]. The brain activities were perceived through sonification of the actor’s neuroscan. The actors were trained to intentionally create certain brainwaves as a response. The resulting sound composition of all brain parts showed patterns of cognition, retention and emotion while remaining an artistic musical piece. The group was later asked to present their findings on EEG sonification at medical conferences, because it could be processed faster by test persons than the conventional visualization of EEG. Klein also worked together with musicians and biologists in a research group at the Cluster of Excellence Languages of Emotion at Free University Berlin. In a project called “Do birds tango?” the group analyzed the relevance of rhythm in songbird communication by pairing newborn birds with trained musicians who adopted the role of the birds language teacher [Scharff & Klein, 2010]. In summary, it can be stated that artistic methods are used to elaborate on research issues that science cannot yet answer conventionally.

The Future Lab of the Ars Electronica based in Linz, Austria is a place where international artists and scientists collaborate on research and orders from economy. They can also take residence and work individually while still being an influence to the transdisciplinary assemblage of the Lab. Within the Lab, processes are envisioned “as sketches of possible future scenarios in art-based, experimental forms” [Ars Elektronica]. While being profitable through collaborations with industry partners and developing patentable technology, they contribute to scientific education through workshops and the Ars Electronica Center and are highly innovative in current research fields of aesthetics, design, computer based interaction, robotics and virtual environments.

The fact that artistic and scientific researchers should approach a subject from different perspectives is also thematized by Amowitz et al. who considered that new challenges in interactive scenarios may not be solvable by scientifically established paradigms [Arnowitz, et al.]. The authors broke interaction issues down to communication problems between the interface and the user. Their statement is that „if you identify an artist who has addressed a problem that you are confronted with, then that artist is presenting a proven method of communication“ [Arnowitz, et al, p. 14). The relevance of collaborative and transdisciplinary research is slowly heading toward scientific debates, e.g. through the Digital Arts and Interaction Community that has been part of the CHI conference since 2012 [England, et al.].

4 Motivation

As already mentioned, not only open scientific questions may be superiorly accessible when addressing them from a contrary point of view. The role of people who get addressed by artists and the role someone plays as the user of a sensitive device can be comparatively discussed as a form of communication between a medium of presentation and its target. The increasing adoption of computer-based interaction environments into everyday life thrusts HCI issues further into disciplines like sociology, medicine, philosophy or architecture. Topics evolve with social and emotional stakes. The complexity of HCI processes increases rapidly, leading to less evaluative scenarios [Poppe & Rienks]. Therefore future challenges such as interactive devices in public spaces create a necessity to approach them from various perspectives and to think through the implications of possible scenarios. The outcome of a materialized thinking process is not intended to solve a problem per se but rather to identify a question that is then communicated in a provoking manner fostering a debate. Art as a medium of critical reflection has the ability to discuss technological phenomena, such as ‘rapid prototyping’ or the ‘Big Data' hype, in an intriguing way that communicates possibilities, but also possible risks. We need speculative notions of future challenges to show their context on a scale science may yet not be able to estimate. Overlapping thought processes can lead to a profound gain of knowledge, which is why a combined scientific and artistic education could lead to new ways of research. Positive trends in open-source software and hardware and emerging Do-It-Yourself communities favor such concepts. We will later propose a structure of a program that could provide exactly such an education. Priorly we will present a more general point of view on comparative aspects of scientific and artistic research.

5 Section Thinking, Communication and (re-)Presentation

For a better understanding of the challenges of cooperative thinking and working across the disciplines, one needs to recall the given structure of science and art.

The disciplines of science and their frontiers reflect their historic development: Objects of research, theories, methods, and research purposes define the identities of single subjects and disciplines and their responsibility for certain problems. But they are no given theoretical frontiers or frontiers of objects. Therefore, the complexity of actual problems increasingly does not fit the framework of singular disciplines, e.g. environmental and political challenges or the crafting of a successful future. Mittelstrass speaks of an “asymmetry of problem development and scientific development” [Mittelstraß, p. 3].

Different forms of cooperation can compensate for this difference. That scientific questions are answered through cooperation of scientists with different professional background is usual. ‘Interdisciplinarity’ could be understood as an increased form of cooperation, in a concrete project with undetermined duration.’Transdisciplinarity’ would then mean a permanent cooperation that transgresses the boundaries and changes the structure of scientific disciplines permanently [Mittelstraß, p. 3].

In our context the term ‘transdisciplinarity’ does not only include scientific, but also artistic disciplines. Therefore, not only the subdivision of science is debatable; it is also the separation of art and science as two antithetic categories of thinking and knowledge production itself that is no longer appropriate. Art and science have been progressively disjoined and understood as apparently independent sectors over the last 300 years. Such categorization reached its zenith in modern times with the “functional differentiation between diverse spheres of action” [Reckwitz, p. 32]. In contrast to the classic modern separation of the sciences and the arts, it is the common grounds of artistic and scientific research that have been highlighted by the current discourse. Accordingly, Bippus notes that a clear distinction of disciplines is only possible on the level of (re-)presentation, but not fundamental on the level of research processes [Bippus, p. 15].

To overcome thinking in disciplinary boundaries, communication and exchange of research results has to go beyond the experience of single subjects and the scope of individual projects. Publications are the distributional medium of scientific research. They are a representation of expert communication, characterized by textual and linguistic complexity, differentiation, and comprehensiveness. They (re-)present research processes and results with the help of conventionalized text forms and scientific images. Publishing transdisciplinary results is a tightrope walk between the different disciplines and their conceptual clarification and theoretical framing. Artistic research uses the scientific forms of (re-)presentations in an (for classical scientific research) unconventional manner and questions their mechanisms sceptically. According to Bippus, artistic research is a provocation, simply because it follows a different course and achieves its results differently [Bippus, p. 10].

Transdisciplinary communication is complex since it happens either between dialogue partners of different scientific disciplines or between scientists and nonscientists. Communication difficulties arise because the dialogue partners possess different states of knowledge and diverse methods of knowledge discovery, convey varying interests, morals, concepts and beliefs. The first goal is therefore to establish a common vocabulary as a basis for mutual understanding. The point is not only to inform one another about a certain research question, as seen and understood from different perspectives, but to gain a deeper common understanding as a basis for design- or decision-making processes by. Transdisciplinary thinking requires an education program that reflects, avoids and abolishes methodical prejudices.

6 Research Methods and Didactic Methods

Methods are the way of doing something. In the context of science, methods are investigation procedures targeted on research results. Scientific methods are planned, goal-oriented and systematic. Method books represent methods to ensure their transparency, each discipline defines certain methods for solving certain problems. In consequence scientific methods should be objective and repeatable.

Artistic research also uses various methods, but in contrast to scientific methods, these are not necessarily conventionalized, reproducible and linear (even though they can be). The method, and the question of the method, are inherent subject matters of the artistic process itself. Malterud compiles a list[1] of competences to describe art as a general phenomenon and states: "Methods are individual as well as field-based. Processes are run by single persons in their personal way, or in corporate settings like theater or concert rehearsals. For all contemporary practice, challenging methods and settings will be part of the work." [Malterud, p. 25]. The idea of the uniqueness of the artist is opposed to the idea of transparency and repeatability as known from science. To sum it with Frayling, scientists prefer "words rather than deeds", whereas artists, craftspeople and designers do "deeds not words" [Frayling, p. 1].

Creativity methods provide further methodical indications. They mediate between analytical and intuitive principles: Creativity methods are often experimental and unconventional processes to consequently and systematically induce innovations. With their help, basic creative mechanisms can be described that are known in science

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[1] The list of competences includes technical skills and hands-on expierence, creativity, courage, curiosity, attention, reflection, concentration, patience, knowledge of and insight into the field, knowledge of and ability to make use of relevant theory, notions of context, and notions of quality criteria in the peer community. Abilities to set up methodical experiments relevant to the project are needed, as well as competences of organization: locating and staging, communicating with partners, assistants, sponsors, and producers. [Malterud, p. 24]

on the one hand and design and possibly in art on the other. Due to their historic genesis, creativity methods can be comprehended as techniques of cultural and knowledge engineering, as well as techniques of memory, invention, and design across the disciplines. [Marais, p. 230]. This leads us to the question of transdisciplinary methods.

As specified above, problems of transdisciplinary are complex and individually different. They should offer answers, which a single discipline cannot give. Since they go beyond the scope of a discipline, they require case-by-case methods. Mittelstraß states that transdisciplinarity defies theoretical forms (e.g., the methodical form). [Mittelstraß, p. 1]

Transdisciplinarity uses various methods of different disciplines. Therefore, the knowledge about individual methods, and also about field-based methods, is necessary. This approach is given either by transdisciplinary teams or by transdisciplinary method books as suggested by Bergmann et al. The authors gathered different transdisciplinary (scientific) projects and analyzed their methods. They organized them according to seven integration strategies to guarantee transparency and repeatability. [Bergmann, et al.]:

1. *Integration through conceptual clarification and theoretical framing*
2. *Integration through research questions and hypothesis formulation*
3. *Screening, using refining, and further development effective integration scientific methods*
4. *Integrative assessment procedures*
5. *Integration through the development and application of models*
6. *Integration through the artifacts, services and products as boundary objects*
7. *Integrative procedures and instruments of research organization*

A pursuing question is, to what extend the documentation and classification of transdisciplinary processes in a method book is a useful tool for the extremely diverse interface of art, science and technology.

Our methodical considerations are the basis of the teaching at F-A-S-T. Our main objective is to develop a transdisciplinary platform where art, science and technology meet. Therefore, we introduced project-based work as the central format of our course. Within this form of teaching, students are asked to identify questions on a given relevant topic and to concentrate on possible responses. Project-based work puts a stronger focus on unconventional thinking and the iterative process of e.g. making prototypes, rather than on final objects, products, or solutions.

Project-based work is common didactic method in the fields of Art, Design and Media Computer Science. It is focused on independence, iteration and diversity, rather than on classical forms of teacher-centered education. The lecturer has the role of an initiator who selects topics and regulates process. Ideally, the class is formed by students with diverse backgrounds and prior knowledge in their respective fields to enable an in-depth-discussion. This arrangement of specifically selected topics, the transdisciplinary composition of the group, the processual and project-oriented work and the subsequent critical discourse, distinguish F-A-S-T from other education programs.

7 F-A-S-T - An Educational Vision

Research-based knowledge production is a common practice in any discipline. Still, differences between the disciplines are often identified in the respective general approaches and the used methods. In order to bridge this gap between art, science and technology, transdisciplinary educational approaches are of mutual interest. This particularly includes the teaching of artistic and scientific methods, communication and presentation forms. With this vision in mind, the cross-university project F-A-S-T Framing-Art-Science-Technology aims to develop a postgraduate course at the intersections of art, science and technology. In the course of this cooperative project, test runs were conducted, approaches were evaluated and the development of a curriculum is currently in progress. The working groups primarily consisted of representatives from the fields of design interactions, fine arts, architecture and media computer science and design. The focus of the curriculum has been influenced by this fact, without being limited to it.

One of the first fundamental questions was related to the topics and competencies that must be imparted in order to permit transdisciplinary work and research. In order to get to the point of transdisciplinarity, the students need a common understanding of disciplinary methods and topics. Based on this knowledge, current topics and state-of-the-art technologies can be analysed transdisciplinary. Regarding the forms of teaching, it soon became apparent that the focus should lie on project-based learning in the combination of seminars, workshops, colloquia and presentations. With this combination the students will be provided with target skills, such as reflexivity, communication, documentation, prototyping and scenario development.

In the interest of analysing and evaluating the approaches and questions, three independent test runs of one to 6 months were conducted with different focuses and participants. The topics and conditions varied thematically from rather specific to more general topics. Due to the voluntary, non-committal participation - less regulations and guidelines were imposed than one would commonly define in a running program. Furthermore, an optimal representation of the target group, which should equally consist out of students of art, science and technology, was not possible. Nevertheless, these insights were very valuable for the construction of the curriculum, especially with regard to the conveyed contents, techniques and methods. Moreover, it has been shown that the contents cannot be provided by existing courses, leaving behind the necessary context and transdisciplinarity. It was possible to draw conclusions about the preferable forms of teaching, the liberality of tasks and qualifications of the teachers. Concerning this, a tandem supervision between one mentor specialized in the field of humanities and arts, and another teacher in charge of mentoring the practical project work, such as the design, has been proven to be beneficial. These act as mediators between the disciplines and encourage the reflection of the knowledge areas and project work within colloquia. In the case of more advanced technical topics, contacts within the institutions should exist in order to give an entry point into a particular field of art, science or technology providing in-depth knowledge.

Taking the results of the test runs in consideration, F-A-S-T is currently developing a curriculum. The students will participate in thematically alternating projects and - while working on practical experiments - transfer the theoretical knowledge, research approaches and methods into practice. With every project, the context and the general conditions will change, allowing to evolve the designated target skills. The necessary knowledge support is provided by two additional components of the curriculum - the theoretical and technological influence streams. The theoretical inflow comprises theories and methods of disciplinary topics in order to produce a transdisciplinary context. The modular technological inflow provides the students with a wide practical relevance by imparting newest technology and back-and-forth workflows from analog to digital. The educational offer is completed by a public lecture series with alternating specialized lecturers, presenting their discipline and transdisciplinary ways of working. This already established fluctuating lecture series permits an immediate response to trends and achievements in research areas.

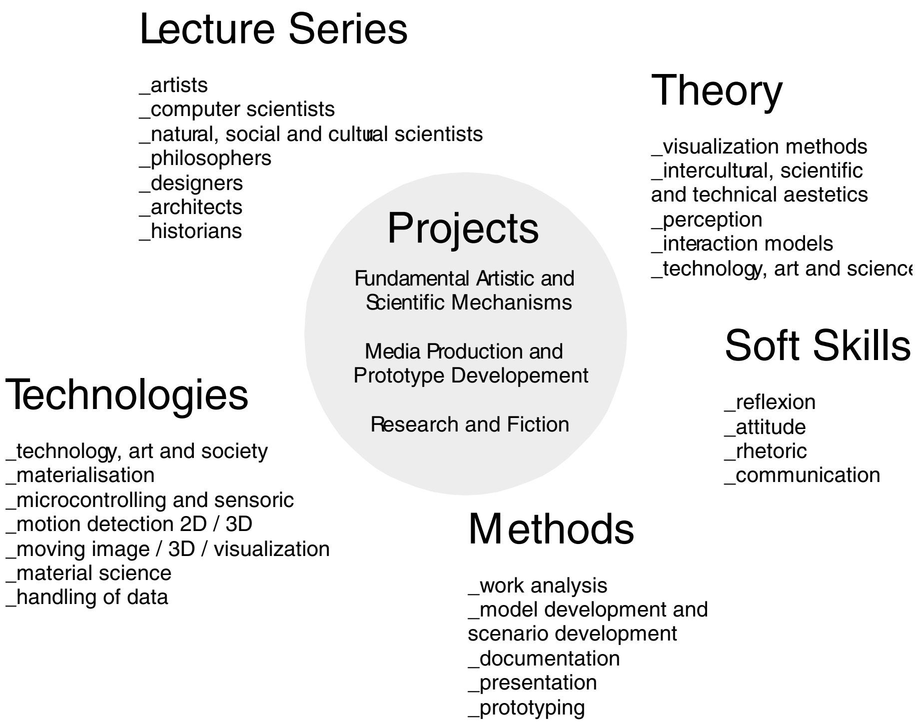

Fig. 1. The project work in the center of the curriculum is supported theoretically and technically

Since transdisciplinarity can not be mapped onto a particular method and thus does not provide a clear result definition, graduates of the educational program will not learn a new pre-defined profession. It is rather the case that the own professional skills will strongly improve and, more importantly, a transdisciplinary competency profile will evolve (see). Due to this perspective change, the work in the respective discipline of the students will become many-faceted. In the field of HCI - as an example - the project work will strongly focus on the analysis, abstraction and materialization of processes, as well as on the conception of prototypes. From a theoretical perspective, the curriculum will be supported by knowledge from media theory, aesthetics perception theory, alternative design and presentation models. Courses on information visualization or the teaching of current interaction technologies serve as a practical inflow.

Running and evaluating the test runs and lecture series showed proof of an increasing acceptance regarding the program and revealed a profound interest in bridging the gaps in-between the topics, approaches and mindsets of art, science and technology. Furthermore, the inter-institutional base of F-A-S-T immensely increased the network of accessible experts and cooperation partners that students can refer to. As a perspective, the capacities of the City of Dresden - in terms of research, creativity and industry - could gain promising intersections.

8 Conclusions

This paper questioned hardened discrepancies in-between the fields of art and science, especially concerning their researching ambitions. We emphasized the relevance of transdisciplinary approaches. A research-based depiction of scientific and artistic studies was given to carve out the coherence of transdisciplinarity. We concluded that teaching transdisciplinarity is not as methodically inflexible as individually considerable and therefore favors project-based working opposed to conventional lecture teaching. We suggest fluctuating and combined methods correlating with the project topic and the brought in professions of the participants. Based on the theoretical findings and empirical knowledge of our team in current teaching strategies of Media Computer Science and Fine Arts, we presented F-A-S-T, a cooperative project of scientific and artistic institutes. F-A-S-T introduces a curriculum that imparts applicable competences in addition to the students original outline of profession.

The last test run of the program with voluntary participants showed a strong correlation between the composition of participants and the outcoming project and knowledge assets. It also emphasized a positive impact of a double supervision by one supervisor skilled in theoretical approaches and one with a more practical background. The overall feedback on the subject matter and the public lectures was encouraging.

These results are primarily empirical. The test runs only lasted maximally half a year and our experiences are hard to generalize. For that reason further scientific investigations regarding this topic should be made. There are art schools with diverse approaches to teach within transdisciplinary aspects like the design interactions program at Royal College of Art [Royal] or the master degree program "Art & Science" at the Angewandte Wien [Art & Science]. Further efforts to establish truly overarching education opportunities between art and science and associated institutions should be made.

9 Outlook

F-A-S-T is an ongoing project. The current test run with participants will be finalized and evaluated. Similar projects may help to establish an appreciation of transdisciplinarity between art, science and technology in education, research, economy and society. Currently we pursue an approach to create a decentral interactive visual term network. This could help to connect detached research or educational projects of different institutes and should also be discussed in the context of HCI. Nevertheless, a new research understanding as a base of teaching is needed to qualitatively discuss moral, ethical, political and aesthetic questions in a technology based context. Interinstitutional structures for transdisciplinary work environments should be established and socially adapted.

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