Bridging Critical Constructivism and Postphenomenology at Techno-Anthropology

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Bridging Critical Constructivism and Postphenomenology at Techno-Anthropology

Tom Børsen

Abstract: Both postphenomenology and critical constructivism are central paradigms used as philosophies and theoretical resources at the Master's program in Techno-Anthropology at Aalborg University. In the fall of 2018 a didactical experiment was set up as Techno-Anthropology Master's students were introduced to postphenomenology and critical constructivism and asked to compare these two theoretical positions. This comparative assignment and following class discussions between students, a guest lecturer and teachers is the point of departure for this paper. First, the paper introduces Techno-Anthropology with a special focus on the roles of postphenomenology and critical constructivism in the Master's program. The next part of the paper zooms in on how these two philosophical positions were presented to the students. The third part analyzes students' comparisons of postphenomenology and critical constructivism. On that basis, the author identifies similarities and differences between the two positions and discusses how the two positions can complement each other in a unified Techno-Anthropological research strategy.

Key words: critical constructivism, postphenomenology, comparison of theories, techno-anthropology, university education

1. Introduction

Techno-Anthropology is both a research area and a Master's program at Aalborg University in Denmark that might be familiar to readers of *Techné* as a special issue analyzing this new research area and study program became available in 2015 (Wellner, Botin, and Otrel-Cass). This paper presents a didactical experiment conducted within the Master's program in which students and teachers provided a comparison of critical constructivism and postphenomenology on the basis of

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different teaching elements (e.g., introductory lectures, a written exercise requiring students to compare postphenomenology and critical constructivism, a guest lecture by Peter-Paul Verbeek and open class discussions between students and teachers).

In the first part of the paper Techno-Anthropology will be introduced as two of its models will serve as criteria for comparing postphenomenology and critical constructivism. Then the didactical experiment and its context are introduced. This presentation is followed by an analysis where postphenomenology and critical constructivism are compared using the mentioned Techno-Anthropological models.

A central model of Techno-Anthropology is present in the book "What is Techno-Anthropology?" issued by Aalborg University Press (Børsen and Botin 2013). The purpose of the book is to define and discuss Techno-Anthropology as a new research area and study program. It includes 18 papers and an introduction that are collected in three parts: part one concerns the philosophy and ethics of technology, part two includes contributions on ethnographic studies of science and technology practices, and the third part includes scholarly discussions and analyses of technological design and innovation. Each part includes six chapters.

This division of the book indicates that Techno-Anthropology is a hybrid research area that combines different theoretical positions, empirical studies of use of technologies, and transformational interventions aimed at reconfiguring technological practices, situations and designs. The book includes philosophical and theoretical discussions and empirical analyses of both descriptive and normative nature. It introduces a number of different theoretical positions. These positions cluster in two groups: paradigmatic theoretical positions (e.g., postphenomenology and critical constructivism) presenting basic assumptions potentially underpinning a vast number of Techno-Anthropological case studies and theories that associate with a specific model, tool or function (e.g., participatory design and responsible innovation). Postphenomenology and critical constructivism are not the only theoretical resources in Techno-Anthropology, though they are among the central ones.

Tom Børsen's (2013) contribution to "What is Techno-Anthropology?" states that the focus of Techno-Anthropology is "Technology." He situates "technology" in the middle of a triangle surrounded by the concepts "experts," "users" and "artifacts" in the triangle's corners (Figure 1). Techno-Anthropology studies not only focus on the corners of the triangle, but also investigate the relationships between the corners: The interfaces between "experts and users." "experts and artifacts," and "users and artifacts." The user-artifact interface is for example concerned with

how users experience technical artifacts, and with generating input from users on how an artifact can be improved (user experience, participatory design, technological interventions). The expert-user interface deals with how experts and users perceive technologies differently, and how one can overcome these controversies (trading zones, interactional expertise, transdisciplinary work). The expert-artifact interface has to do with how technical experts develop, innovate and design technological systems. Such processes should respect ethical requirements, avoid undesirable side effects and address societal challenges (responsible innovation). Postphenomenology and critical constructivism can be compared by liaising them to the Techno-Anthropological triangle. Such an analysis will be conducted later in this paper.

A second collection of formative and defining Techno-Anthropological papers is a book edited by Lars Botin, Pernille Bertelsen and Christian Nøhr (2015b) that presents Techno-Anthropology research in the domain of Health Informatics.

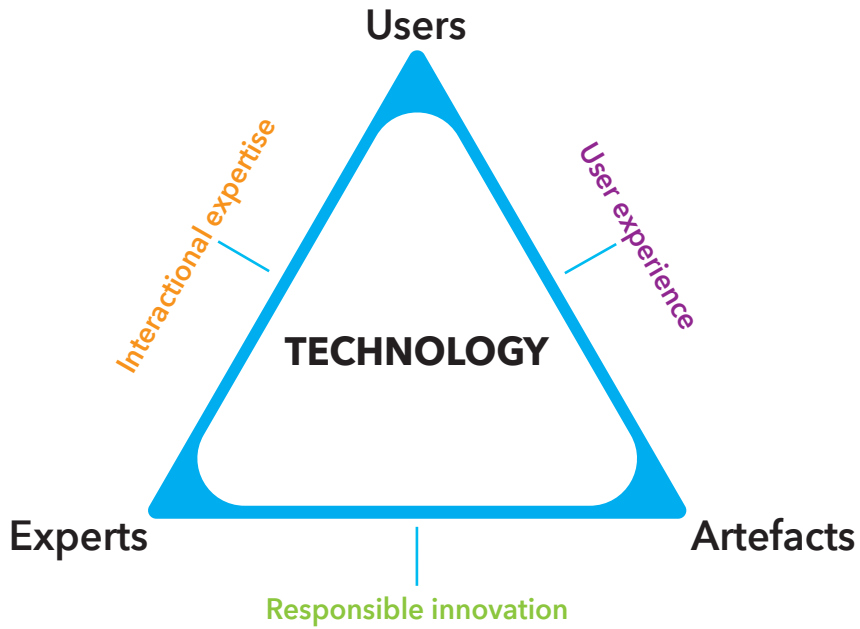

Figure 1: The Techno-Anthropological Triangle. The figure shows the various components in the Techno-Anthropological research domain: technical experts—technical artifacts—technology users. It also shows the interfaces between these components: interactional expertise—user experience—responsible innovation (Børsen 2013).

It encompasses twenty chapters including many case studies (e.g., smart floors at care facilities [Brodersen and Lindegaard 2015], wet beds at a nursing house [Kanstrup and Bygholm 2015], clinical simulations [Jensen 2015], and preventive surgery based on health information [Børsen and Danborg 2015]).

The first chapter of "Techno-Anthropology in Health Informatics" argues that it is not sufficient to study the individual technology user (Botin, Bertelsen, and Nøhr 2015a). Two additional layers of scholarly attention of Techno-Anthropology are suggested: the institutional and the societal layers. It is argued that new technology design for health care must be developed to simultaneously pursue all three dimensions. The idea is that the "expert-artifact-user" relations can be analyzed and understood on the micro level, the institutional level and on the societal level, and that there are relations between the layers. Hence, new technology design for e.g., health care must be developed to simultaneously pursue all three dimensions:

> [In an individual perspective] health care professionals and patients, as well as relatives, need support to acquire new competences to make use of new health informatics in order to obtain empowerment, emancipation and enhancement. . . . From an institutional perspective the challenges are mainly concerned with reduction of unintended consequences [i.e., technology assessment], change in the organization to meet health care challenges, and transfer of roles between providers and patients. (Botin, Bertelsen, and Nøhr 2015a, 5)

On the societal level issues like public health, cost per capita and issues of legislation are on the agenda.

Figure 2 illustrates this argument by situating the Techno-Anthropological triangle in three spheres representing the three layers: the micro layer, the institutional layer and the macro layer ("the macro layer" is in the figure and elsewhere called "the societal level"). A question to be discussed later is how postphenomenology and critical constructivism relates to this embedded Techno-Anthropological triangle. Do the two theories locate themselves in two different locations in the model? The remaining parts of this paper discuss how postphenomenology and critical constructivism compare, relate the two positions to the Techno-Anthropological triangle, and finally argue that the two theoretical positions in conjunction can complement each other in Techno-Anthropological research.

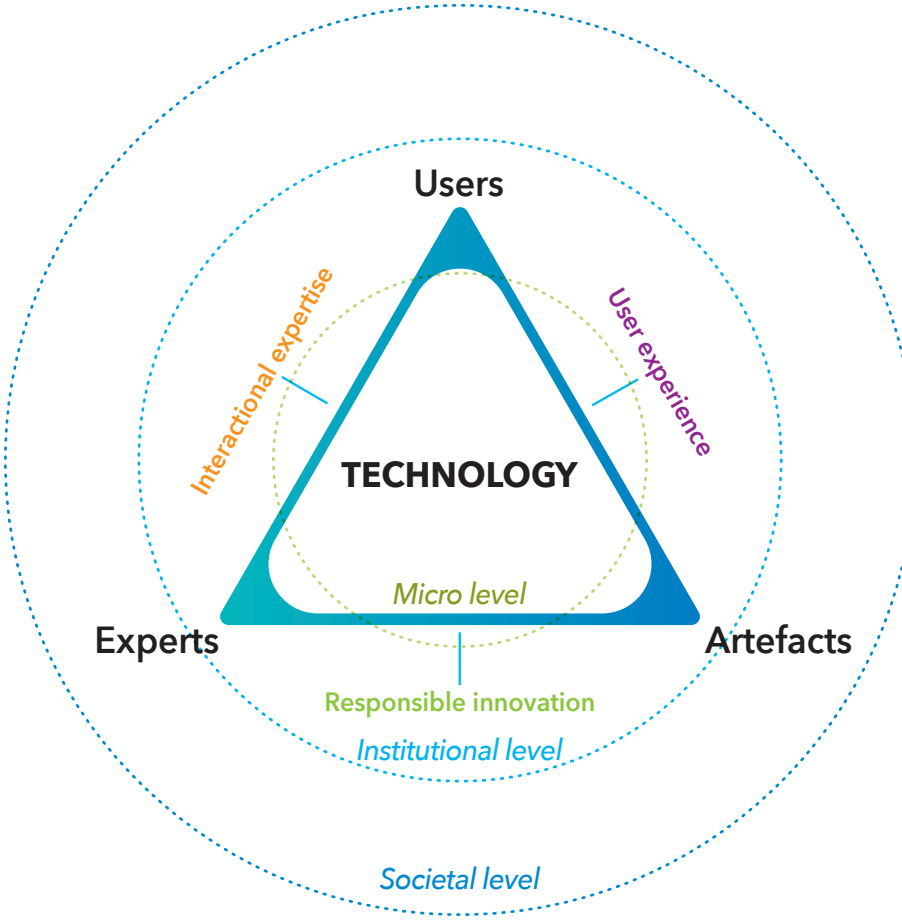

Figure 2: The embedded Techno-Anthropological triangle. This figure shows the three levels that influences a Techno-Anthropological study of technology. The interaction of technical experts, technical artifacts and technology users can be analyzed at the micro level, the institutional level and the societal level. The micro level brings forward concrete interactions between individual persons and entities; the institutional level brings forward codified norms and reified practices; and the societal level highlights ideologies and political processes underpinning both the micro and the institutional levels.

2. Techno-Anthropological Problems and Theories

Techno-Anthropology is not only a research area. It is also a Bachelor and Master's study program at Aalborg University offered in both Copenhagen and Aalborg. It is based on the principles of Problem-Based Learning, PBL (Barge 2010; Karadechev, Petersen, and Børsen forthcoming; Kolmos, Fink, and Krogh 2004),

which means that students each semester both follow courses (15 ECTS) and work in groups on projects addressing a problem the students themselves have identified within a semester topic (15 ECTS).

The first semester of the MSc in Techno-Anthropology aims at generating an overview of the theories and exemplary case studies of special relevance to Techno-Anthropology. During this semester's project work, the students address real-life problems by relating them to Techno-Anthropological theories. They must in the semester project work with one or more Techno-Anthropological theories, including critical constructivism or postphenomenology. The students are also required to follow two courses: A 5 ECTS elective and a course entitled "Techno-Anthropological Problems and Theories" of 10 ECTS.

The overall idea of the latter course is to stimulate discussions about the relations between empirical case studies and more fundamental theoretical positions. By becoming familiar with a huge set of Techno-Anthropological case studies and by analyzing them with different theoretical tools, including postphenomenology and critical constructivism, the course participants are expected to become able to recognize and analyze Techno-Anthropological problems.

Students are asked to read three different types of texts respectively about Techno-Anthropological case studies, thematic theories, and foundational theoretical frameworks. It is during this module that postphenomenology and critical constructivism are introduced to the students, and where an exercise asking the students to compare postphenomenology and critical constructivism is distributed and discussed in class.

In 2018, eight groups handed in the written exercise. The exercise was partly made to decide to what extent the existing teaching formats facilitate learning postphenomenology and critical constructivism's central concepts, important authors, and illustrative examples, but also—and more importantly—to scaffold scholarly discussions of the relations between the two theories.

This study analyzes the class introduction to postphenomenology and critical constructivism, students' answers to the comparison exercise, and follow-up discussions between students and teachers to answer two questions:

1) What are the central elements (central authors, illustrative case studies, theoretical concepts and applied methods) of postphenomenology and critical constructivism?

2) How do postphenomenology and critical constructivism relate to each other and to Techno-Anthropology?

3. Postphenomenology

In one of the introductory teaching sessions Robert Rosenberger's book *Callous Objects: Designs against the Homeless* (2017) was discussed. Later, Verbeek's case study on obstetric ultrasound (2008) and Don Ihde's study of Galileo's telescope (2011) were analyzed in theme-related sessions. During the course, the students were asked to read texts by Lars Botin (2015) and Mithun Bantwal Rao, Joost Jongerden, Pieter Lemmens and Guido Ruivenkamp (2015). They got links to two video resources on You Tube: Peter-Paul Verbeek's 2017 Inaugural Lecture as Honorary Professor in Techno-Anthropology at Aalborg University: "Our Technological Condition: Techno-Anthropology and the Politics of Technology" and a video lecture by Don Ihde and Peter-Paul Verbeek entitled "How Technology Changes Us." Peter-Paul Verbeek gave a guest lecture during the course entitled "Postphenomenology: Thinking technology and reinventing phenomenology," and discussed with the students how postphenomenology and critical constructivism relate to one another.

The students identified a few additional theoretical resources on postphenomenology to support their work on the paper assignment (Bats, Valkenburg, and Verbeek 2013; Ihde 1986; Kudina and Verbeek 2019; Rosenberger and Verbeek 2015; Van Den Eede 2011; Verbeek 2006) and two case studies on respectively ICTs (Bats, Valkenburg, and Verbeek 2013) and Google Glass (Kudina and Verbeek 2019). All groups recognized in their comparison exercises Don Ihde and Peter-Paul Verbeek as central figures in postphenomenology, and six groups added Robert Rosenberger as a central postphenomenological figure. One group listed Lars Botin as a postphenomenologist.

3.1 Origins

Postphenomenology originates from phenomenology, which is a philosophical program theorizing on how humans "are" in the world (i.e., how they perceive and operate in it). Postphenomenology differs from phenomenology by delegating a central role to technology in the human-world relation. Postphenomenology suggests that technology mediates how humans are in the world.

Martin Heidegger is a central representative of phenomenology, and the one who delegates most attention to technology among phenomenologists (Heidegger 1962, 1977). In the book *Heidegger's Technologies: Postphenomenological Perspectives* (2010), Don Ihde criticizes Heidegger's perception of technology. According to Heidegger, modern technology enframes or scaffolds humans' being

in the world, but the framing or scaffolding is—according to Ihde's reading of Heidegger—reducing our being to one thing, making it a one-dimensional instrumental approach to reality. Ihde and other postphenomenologists have a more elaborated understanding of technology as mediating our relations with the world in many ways—sometimes reducing, while at other times enriching our being in the world.

Two group essays provided a genealogy of postphenomenology, and made reference to Martin Heidegger. One of these groups also referred to Maurice Merleau-Ponty and Hubert Dreyfus. Peter-Paul Verbeek's authorship is also inspired by Michel Foucault and Bruno Latour. This was not noticed in any group essays.

3.2 Mediation

The course presents postphenomenology as focusing on how technology mediates between humans and the world in which they live. Humans perceive and act in the world and do that through technology. Hence, if we want to understand how humans relate to their surroundings, we must turn our attention to technology. Technology can mediate in a variety of ways, which is made clear in the introduction of Don Ihde's (1990) four Human-Technology relations (cf. equations 1 through 4). Verbeek presented additional Human-Technology relations in his guest lecture. Equations 5 to 7 are also discussed by Robert Rosenberger and Peter-Paul Verbeek (2015a, 20–22).

Equations 1 to 8 are all variations on the formula 'Human—Technology—World,' where brackets, hyphens, arrows, and other symbols are added to formalize and represent different relations. When a relation or entity is put in brackets—"(x)"—it means that the bracketed relation or entity is isolated and unified as one in the relation. The hyphen is a symbol of bridging between two entities. An arrow pointing to the right refers to human perception of the entity that the arrow points

Embodiment relation (pair of eyeglasses):	(human—technology) → world	(1)
Hermeneutic relation (ultrasound scanning):	human → (technology—world)	(2)
Alterity relation (ATM machine):	human → technology (– world)	(3)
Background relation (air conditioning):	human—(technology—world)	(4)
Fusion or cyborg relation (cochlear implant):	(human/ technology) → world	(5)
Interactive or immersion relation (smart toilets):	human ↔ technology / world	(6)
Augmentation relations (Google glasses):	(human—technology) → world + human → (technology—world)	(7)
Encounter relation (autonomous busses):	human ↔ technology ↔ world	(8)

towards, and a double arrow—"↔"—indicates a two-way relation. The symbol "/" means that two entities have emerged into one. A plus sign means that two different relations are present simultaneously.

In the course, this vocabulary was used to analyze selected case studies, including Verbeek's case study on obstetric ultrasound (2008), Ihde's study of Galileo's telescope (2011) and Rosenberger's study of design against the homeless (2017), and students were asked to identify which of the relations (1) to (8) fitted the case studies.

3.3 Intentionality

The teaching of postphenomenology in the course also introduced technology ethics by focusing on how intentionality and ethical values are embedded and emerge in human-technology-world relations.[1] This has two consequences:

> First of all, mediation analyses can be used to develop *moral assessments* of technologies, evaluating the quality of their mediating roles in human practices and experiences and their impact on moral actions and decisions. Second, mediations can be explicitly designed into a technology. (Verbeek 2011, 94)

A person can do things in the world through technology that she cannot do without, and hence inscribe her intentions into it. Mediating technologies co-shape both humans and the world in which they live (Verbeek 2005, 130). When one ethically assesses a technology, the focus should therefore be on human-technology hybrids, as it is such hybrids that perform moral actions with ethical consequences for humans, society and the environment:

> Moral mediation always involves an intricate relation between humans and nonhumans and the 'mediated agency' that results from this relation therefore always has a hybrid rather than a 'purely nonhuman' character. When technologies are used, moral decisions are not made autonomously by human beings, nor are people forced by technologies to make specific decisions. Rather, moral agency is distributed among humans and nonhumans; moral actions and decisions are the products of human-technology associations. (Verbeek 2011, 53)

And:

> [T]echnologies do indeed 'have' intentionality—intentionality is 'distributed' among human and nonhuman entities, and technologies 'have' the

> nonhuman part. In such 'hybrid intentionalities,' the technologies involved and the human beings who use the technologies share equally in intentionality. (Verbeek 2011, 56)

The responsibility of an immoral act and its unethical consequences is distributed between humans and technologies. Humans are part of the responsibility for their (good or bad) intentions that they inscribe when they interact with technologies and for the intentional consequences resulting of their interaction with technologies. But, human intentions are often directed by technologies. Technologies are moral agents too. Their intentionality manifests itself in both directing humans in certain directions and in unforeseen and unintended consequences. The full spectrum of actual ethical consequences are always a result of human-technology interactions. The individual is not sovereign and free, but entangled with technology and the directedness of interactions. Intentionality thus becomes a hybrid affair:

> (1) intentionality is hardly ever a purely human affair—most often it is a matter of human-technology associations; and (2) freedom should not be understood as the absence of 'external' influences on agents but as a practice *dealing* with such influences or mediations. (Verbeek 2011, 65)

This means that when making ethical judgements, one should be self-reflexive and consider how technological mediations and hybrid affairs are decisive for actions and decisions.

3.4 Multistability and Ethical Design

Technologies are multistable, and that is a property with ethical significance:

> [Multistability] posits that the meaning associated with a technology is context specific and subject to change with alterations in how and where a technology is used, Verbeek stipulates that [a] script is only efficacious because it aligns with underlying cultural values. To concretize this point, Verbeek proposes a thought experiment involving a plastic coffee cup. In a culture that views the material to be worthless, he claims that the cup would have the script, *Throw me away*. By contrast, in a culture that places high value on plastic, the cup could have a different script, perhaps *Save me*. (Selinger 2014, 290)

Because technologies are multistable intended desirable effects might not occur:

> We need to recognize the multi-stabilities of all technologies and therefore the ambiguities of designer intent. Technologies typically end up in

> different relations with human beings than their designers expected, and therefore, their mediating power is hardly predictable. (Selinger 2014, 312)

An important ethical aspect of the multistability of technology is that an ethical analysis of a technology must take into account unexpected effects. This means that human-technology hybrids hold responsibility for managing the uncertainty that emerges when humans do things with technologies. Another ethical aspect is that new technologies will themselves influence how humans interpret and perceive the world. That is, new technologies will co-create the ethical values that we use when we assess technologies.

Ethics that is inspired by postphenomenology does not only concern ethical technology assessment. Since technology designers inscribe ethical values into the design of socio-technical configurations the design itself becomes an ethical act. Designers of technologies inscribe intentionality in technologies so that they can generate desirable effects when used in certain ways. Accordingly, "when desirable mediating effects are inscribed in technologies, explicitly behavior-influencing or 'moralizing' technology will result" (Verbeek 2011, 95). Technology designers thus have an ethical responsibility over their designs via the intentionality inscribed into designed socio-technical configurations.

In a recent conference paper Merlijn Smits, Bas Bredie, Harry van Goor, and Peter-Paul Verbeek present a methodology for how designers can integrate ethics into design (2019). They call their approach "Values that Matters." In this paper Smits, Bredie, van Goor, and Verbeek liaise postphenomenology to Value Sensitive Design (VSD). They appreciate VSD for its focus on inscription of ethical values in technology design, but criticize it for lacking a methodology and assuming stability of ethical values. Just as ethical technology assessment should take into accounts that new technologies co-construct ethical values, so should ethical design.

3.5 Summing Up

The introductory teaching in postphenomenology at the Master's program of Techno-Anthropology focused on two movements: on how technology influences humans' perception of the world, including how technology co-constructs ethical values, and on how designers can design ethical technology solutions. The first movement is situated on the "user-artifact" axis in the Techno-Anthropological triangle. The other movement regards the "expert-artifact" relation, and focuses on how designers can inscribe ethical values in technologies.

The teaching highlighted four central concepts of postphenomenology: Technological mediation, intentionality, multistability, and design ethics. All or almost all groups mentioned in their written assignment the following core concepts: mediation/human-technology relations, intentionality, and multistability. Fewer groups added lifeworld, value-laden technology, hybridity, scripts, experimental hermeneutics, co-constitution, and VSD as core concepts.

The teachers at Techno-Anthropology learnt that more emphasis could be directed towards how postphenomenology contributes to technology ethics, as this was not perceived in all student essays as a central focus, even though it was presented as such in class. Likewise, more attention should be put on the phenomenological origins of postphenomenology and on how the theory compares and has been influenced by Latour's and Foucault's work.

4. Critical Constructivism

A critical perspective on mainstream technology was introduced in the beginning of the course when Robert Rosenberger's book *Callous Objects: Designs against the Homeless* (2017) was discussed. The text introduces Andrew Feenberg's work and Sandra Harding's *standpoint theory* that says that all knowledge is rooted in a particular restricted set of life experiences:

> Any community will have limits on its perspective, and the dominant community will have its own pervading biases, biases that could be involved in the practices that contribute to the marginalization of those less advantaged groups. [Standpoint theory claims] that these biases can be routed out by incorporating marginalized people into the dominant conversation. The point is not that those in marginalized societal positions have a better view of the truth; all standpoints are limited and, as such, are inherently biased. . . . Sandra Harding goes so far as to claim that including the perspectives of marginalized people has the potential to make the dominant discussion more objective. (Rosenberger 2017, 58–59)

Critical constructivism was explicitly introduced as one of Techno-Anthropology's fundamental theoretical resources based on extracts of Andrew Feenberg's books *Transforming Technologies: A Critical Theory Revisited* (2002) and *Technosystem: The Social Life of Reason* (2017). An overview text was added as a supplementary reading for those students who found Feenberg's two books difficult to read (Feenberg 2008). So was a text that compares critical constructivism/critical theory of technology to postphenomenology (Rao et al. 2015).

The teaching associated critical constructivism with *Action Research* (Kemmis et al. 2013, chapter 2 and 3), a combination illustrated through the introduction of a case study from Latin America where indigenous people collaborate with action researchers to improve the hygiene in their settlement. The researchers argue that local inhabitants can change practices in collaboration with action researchers who facilitate the change processes (de Toledo and Giatti 2014).

The student papers identified two additional sources: references were made to a case study included in Feenberg's book *Technosystem: The Social Life of Reason* (2017) on contrasts between 'rational' cost/benefit assessment criteria and patients' own perceptions of an Alzheimer's medical drugs (Moreira 2012). Students also identified a paper that compares postphenomenology and critical constructivism (Van Den Eede 2011).

4.1 Origins

Critical constructivism has several sources of inspiration. The most important one is the work of the first generation of the Frankfurt School (e.g., Adorno and Horkheimer 1997; Fromm 1994; Fromm and Wisneski 2017; Horkheimer 1947, 1972, 2013; Marcuse 2004, 2013). Furthermore, Michel Foucault's studies of how knowledge and power are used by institutions to exercise social control serve as an inspiration to critical constructivism (Foucault 2012).

Feenberg deserves credit for linking the critical traditions of the Frankfurt school and Michel Foucault to technology studies and technological innovation in what he formerly called a "critical theory of technology," but now refers to as "critical constructivism." The new title weakens the links to the first generation of the Frankfurt school and also distances itself from technology by leaving out this very concept. However, critical constructivism has ties to Science and Technology Studies in general and to Social Constructivism of Technology in particular (Bijker, Hughes, and Pinch 1989; Pinch and Bijker 1984).

All student groups identified Andrew Feenberg as the central figure in critical constructivism, and almost all groups listed Jürgen Habermas and the first generation of the Frankfurt school (Herbert Marcuse, Max Horkheimer, Theodor Adorno) as inspirational thinkers. Few groups added Georg Wilhelm Friedrich Hegel, Karl Marx and György Lukács as inspiring figures. A single group also mentioned Axel Honneth and Hartmut Rosa as contemporary critical theorists. No groups mentioned Social Construction of Technology (SCOT) as an inspirational theory of critical constructivism, and neither was Michel Foucault identified as a source of inspiration for critical constructivism.

4.2 Oppression and Emancipation

A Techno-Anthropological analysis informed by critical constructivism is relevant if one encounters an oppressive socio-technical configuration—a situation where a vulnerable group is oppressed by a technology. Several of the case studies introduced in the course involved a vulnerable group: Residents in a New York settlement called Love Canal that were located close to a chemical garbage dump (Fjelland 2016), AIDS activists in the USA in the 1980s (Epstein 1998), or indigenous people in the Amazonas having little knowledge of ICTs and of Western perspectives on hygiene (de Toledo and Giatti 2014). Links between these cases and critical constructivism were not made explicitly in class. It was up to the students to establish them for example during the comparison exercise. No student groups did so in their comparison papers.

A group is oppressed if it has

> internalized the image of the oppressor and adopted his guidelines, are fearful of freedom. [The] oppressed, who have adapted to the structure of domination in which they are immersed, and have become resigned to it, are inhibited from waging the struggle for freedom so long as they feel incapable of running the risks requires. (Freire 2018, 75)

Techno-Anthropological analyses inspired by critical constructivism start at the micro level where people feel oppressed by technologies in order to contribute to a central objective of critical constructivism: the emancipation of oppressed groups so that they use technologies to promote their own agendas.

4.3 Technological Rationality

According to thinkers of the first generation of the Frankfurt school, modern society is to a high extent governed by instrumental reason, which refers to intentionally choosing the most efficient means to achieve a goal (Jay 1996). Originally, instrumental reason seemed to fit the purpose of helping people survive by controlling nature: medical science should emancipate from disease, physics, chemistry and their applications help satisfy the need for food, clothing, shelter and so on. However, as humans have developed their skills to control their surroundings, a number of destructive and oppressive aspects of instrumental reason have become visible as it subjugates more and more aspects of human existence and society. It ends up oppressing people rather than realizing its original purpose: emancipation from nature's oppression. Historically it has been a dialectical process where the emancipating driver of instrumental reason has turned into its antithesis: a new

form of coercion (Adorno and Horkheimer 1997). A society primarily governed by instrumental reason is 'one-dimensional' (Marcuse 2013).

When instrumental reason operates in the sphere of technology, Marcuse calls it a technological rationality that "establishes standards of judgment and fosters attitudes, which make men ready to accept and even to introcept the dictates of [technical] apparatus" (2004, 44). As a result, technological rationality might lead to social control and domination: "Technological rationality is indelibly marked by the presupposition that production goes hand in hand with social domination" (Feenberg 2002, 66). Technological rationality refers to a strong force in technological societies that pushes for efficiency, hierarchical organization and operational autonomy, and is, just as instrumental reason, dialectical because it has both positive and negative implications. It is a prerequisite for human survival and prosperity as it enables control over nature and the material world, while at the same time having devastating consequences in form of environmental degradation and human oppression.

4.4 Democratic Participation

According to both Marcuse and Feenberg, there exists an alternative rationality based on dialogue and democratic conversation. Often reference is made to Habermas's (2015) concept of communicative action, but at Techno-Anthropology critical constructivism is linked to action research:

> [A]ction research is a participatory process concerned with developing practical knowing in the pursuit of worthwhile human purposes. It seeks to bring together action and reflection, theory and practice, in participation with others, in the pursuit of practical solutions to issues of pressing concern to people, and more generally the flourishing of individual persons and their communities. (Bradbury 2015, 4)

Action research is based on an equal relationship between researchers and people who are negatively affected by a technology. It facilitates critique of an existing socio-technical configuration, encourages hope and imagination of oppressed people by making them realize that a better life with reconfigured technology is possible, and engages in concrete planning aimed at reconfiguration of an existing socio-technical situation.

Feenberg introduces the term 'technical code' to emphasize how technological choices influence socio-technical configurations. This code "is not merely the rule under which [technical] means are chosen. Much more than that, it is the

principle of organizational identity and survival" (Feenberg 2002, 77). The technological rationality is often reflected in the technical code, and hence in most socio-technical configurations. The democratic rationality can also influence the technical code of a socio-technical configuration, and balance the technological rationality already embedded in a technical code. The technical code consists of a technical and social part, and if one conducts a case analysis informed by critical constructivism the technical code is de-contextualised—split up into a sociogram and a technogram.

> [Bruno Latour] argues that each technology draws together a 'sociogram' of alliances of social interests around a specific configuration of technical elements, which he calls the 'technogram.' . . . The sociogram and the technogram are essentially just two sides of the same coin; a particular technical configuration reflects the influence of a particular network of actors. (Feenberg 2002, 78)

Different technical codes can and do exist. Hence, it is possible to first de-contextualize and then re-contextualize a technical code by changing the balance between the technological and the democratic rationality in the sociogram and the technogram:

> Two different configurations of production technology might each achieve high levels of efficiency, one by applying workers' skills and the other eliminating them. Under different social conditions and with different values in view, each could be successful. (Feenberg 2002, 21)

4.5 Summing Up

The way critical constructivism is presented in the Techno-Anthropological Problems and Theories course is illustrated in Figure 3. The figure suggests that one starts a critical constructivism case analysis by identifying a socio-technical configuration where a vulnerable group is oppressed. Then the configuration is decontextualized (i.e., analyzed by identifying and splitting the configuration into its social and technical elements). The configuration must then be recontextualized so that oppression is removed. In doing so one can add new or remove existing social or technical elements. All elements are then synthesized and reassembled via user-inclusive, democratic and participatory processes. In this way an oppressive configuration governed by operational autonomy, hierarchy and efficiency might be replaced by a configuration that is socially just.

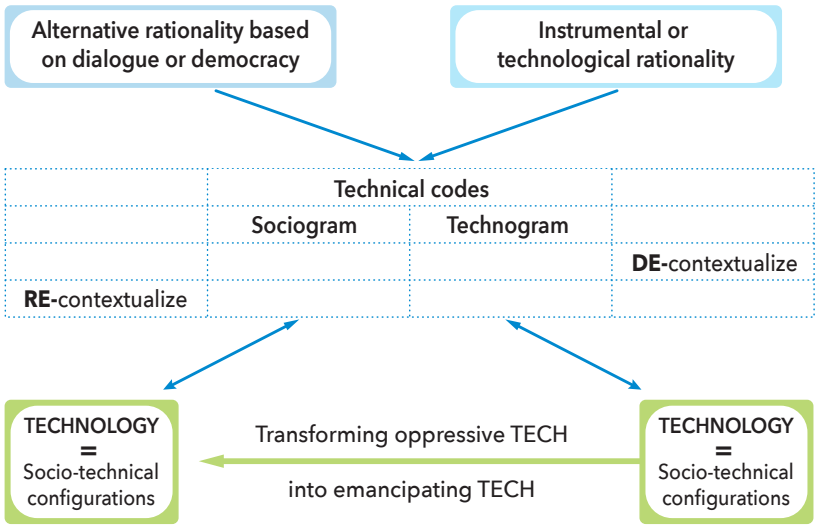

Figure 3: Critical constructivism from a Techno-Anthropological perspective. The figure shows that the objective of critical constructivism is to analyze a socio-technical configuration by de-contextualizing its technical code into its technogram and sociogram, identifying the presence of respectively technological and democratic rationality, and suggesting changes and initiatives to reconfigure the technical code by strengthening the democratic part. This endeavor is guided by an ambition to minimize oppression in concrete socio-technical settings.

The eight groups identified in total twenty-five concepts central to critical constructivism. The most listed core concepts were: Technological/instrumental rationality, participatory/democratic rationality, emancipation, oppression, technical code, value-laden technology, de-contextualisation, re-contextualisation, dialectics. Few groups also identified deskilling, intentionality, technocracy, technogram, sociogram, multistabilility, resistance, equity, social justice, system/life world, micro/macro levels, hierarchical and flat structures, power, alienation, and communicative action as central concepts. No groups mentioned action research as a core concept of critical constructivism, but most groups did mention it as a method relevant to use for doing an analysis inspired by critical constructivism.

In the future, the teachers at Techno-Anthropology program should increase the number of examples and case studies that apply critical constructivism in the analysis. Also, stronger links to Social Construction of Technology and Foucault's work could be established. The students' group essays show that the student uptake of these aspects could be improved.

5. Comparing Postphenomenology and Critical Constructivism

A few pedagogical lessons were learned by preparing and discussing student assignments that compared postphenomenology and critical constructivism. First of all, it seemed easier for the students to find case studies that are analyzed using postphenomenology than ones using critical constructivism. The reason for this might be that more case studies were included in the presentation of postphenomenology than in the presentation of critical constructivism, or that the texts distributed to the students on the two different theoretical approaches did not refer to examples to the same extent.

The class introductions to postphenomenology and critical constructivism reveal differences and similarities between the two theories. Each have their own distinct authors, concepts and methods. Ihde and Verbeek represent postphenomenology, while Feenberg represents critical constructivism with a strong reference to the first generation of the Frankfurt school. Robert Rosenberger and his book *Callous Objects: Designs against the Homeless* (2017), seems to possess interactional expertise in the sense that he—in the view of the students—bridges the two theories. This could be emphasized when teachers compare the two theories.

The third lesson learned is that students link critical constructivism to its historical origin as almost all the students link critical constructivism to the first and second generation of the Frankfurt school. Only a few students liaise postphenomenology to Heidegger and phenomenology. Students did not liaise neither postphenomenology nor critical constructivism to Foucault or branches of STS. Postphenomemology could have been related to Actor-Network Theory (ANT), and critical constructivism to SCOT. Hence, the teaching could have put more emphasis on linking postphenomenology and critical constructivism to surrounding and related theories.

Distinct critical constructivism's core ideas include the dialectical relationships between technological and democratic rationality, de- and re-contextualization, sociogram and technogram, oppression and emancipation, system and life world, micro and macro level, and hierarchical and flat structures. Postphenomenology's core concepts are mediation, multistability, intentionality, human-technology relations, life world, value-laden technology. Multistability, life world, and intentionality are concepts that the two theories have in common.

The students of Techno-Anthropology associated more concepts with critical constructivism than with postphenomenology, which might reflect the fact that the vocabulary of critical constructivism is richer or more complicated than post-

phenomenology's vocabulary as presented either in the used literature or in the teaching. The teaching could have emphasized which of critical constructivism's theoretical concepts that are most central. In that way symmetry between the two theories' vocabulary could have been present in the students' essays.

The group reports presented agreement on what methodological moves the two theories make. The students established links between critical theory and action research as presented in class, even though that Feenberg does not explicitly embrace this specific methodology. Two group reports also added that critical constructivist studies can adopt critical ethnography by referring to ethnographic studies that explicitly look for oppressive structures in the field. One group report identified historical studies of technological development as a central methodology and another group report highlighted ideology critique as a possible method of critical constructivism.

The reports acknowledged that postphenomenological studies are context dependent, implying that there is no single fixed method appropriate, even though it was recognized that postphenomenology is part of the empirical turn in technology philosophy and often employs qualitative methods. Many group reports stated that specifically an ethnographic approach might be relevant for a postphenomenologist.

5.1 Comparison via Human-Technology-World Equations

Discussions in class and in students' group assignments on how to formalize critical constructivism in terms of Human-Technology-World equations were predominant. Many groups considered to which extent simple equations with three elements could capture ideas in critical constructivism. Two groups argued that Ihde and Verbeek's three-symbol mediation equations missed contextual aspects—most predominantly the structural elements embedded in the dialectics between technological and democratic rationality. Hence, one group suggested to add a second axis to the equations. The H-T-W relations would constitute the horizontal axis and was left unchanged. An orthogonal axis was added as a vertical axis. Its poles consist of the two forms of rationality embedded in critical constructivism: technological rationality and democratic rationality. The addition of a new axis was justified by noting that rationality in critical constructivism entangles all socio-technical configurations.

Several other groups discussed how critical constructivism can be formulated in postphenomenology-like equations of mediation on the form H-T-W. One group argued that the Human-entity should be either written in plural or exchanged by

another concept—social group—to emphasize the social character of individuals. This group reflected on how power relations entangle socio-technical configurations, and stated that top-down approaches to technological development prevail in neo-capitalistic societies and that the revolutionary potential of critical constructivism rests in altering that relation. That group suggested to rotate the H-T-W equations, such that the human-technology relations would be written vertically rather than horizontally.

Another group did not suggest new equations but argued that it would be interesting to see what the effects would be if the 'T' in the equations was split in a Sociogram and a Technogram, and the 'W' in Life world and System world.

The majority of the groups tried to formulate new mediating relations specific for critical constructivism. Three unique suggestions were:

Oppression:	$H \leftarrow (T—W)$	(9)
Resistance:	$H \mid (T—W)$	(10)
Emancipation:	$(H—T) \underline{\rightarrow} W$	(11)

The equations add new symbols to the ones used by Verbeek and Ihde. An arrow pointing to the left means that the item pointed towards is oppressed by the sender of the arrow. This symbol is used in the relation 'oppression' (9). This equation states that humans (H) are oppressed (←) in a technological configuration (T-W). The symbol 'I' means 'rejection' of what is placed to the right of the symbol. This symbol is used in equation 10. The underlined arrow ($\underline{\rightarrow}$) pointing to the right in equation 11 has a different meaning than the arrow in postphenomenology (1), where it denotes 'perception' of the world through technologies. In critical constructivism the underlined arrow refers to actions rather than perceptions. Equation 11 does not refer to the perception through technology, but rather to how technologies can emancipate and have impact on the world.

5.2 Relations to the Techno-Anthropological Triangle

No student group failed to relate postphenomenology and critical constructivism to the Techno-Anthropological triangle. In postphenomenology two movements are strong: How technology mediates human perception of the world, and how designers can inscribe ethical values into technologies. Hence, postphenomenology was situated in two places of the Techno-Anthropological triangle: The different forms of technological mediation were situated between the users and artifacts, and the ethical design approach was linked to the designers and the artifacts. The

Techno-Anthropological triangle seems to capture well the two different movements associated with postphenomenology.

A call could be made for directly including the perspectives of users in design processes, whereby the designer—user relation is activated. However, this focus on bringing users and designers together is not predominant in postphenomenology. Co-design, participatory design, action research and trading zones are not immediately associated with postphenomenology, which therefore does not cover the full spectrum of Techno-Anthropology, as the expert/designer—user linkage is not dominant in postphenomenology. Attempts to develop this aspect in a postphenomenological perspective are beginning to emerge (Smits et al. 2019).

Critical constructivism also consists of two movements: oppression and emancipation. An analysis guided by critical constructivism starts by identifying situations where technical experts fail to involve users and affected social groups in their design. Hence, technological solutions/artifacts are criticized because the user perspective has been neglected. The neglect of user involvement often results in oppression. Emancipation refers to a transformation where the technology users and affected social groups take power over a technology by domestication, are involved in co-design of socio-technical solutions or decision-making processes. Critical constructivism aims at facilitating user—expert collaborations as a way to twist an oppressive socio-technological configuration into an emancipating one. That focus on how vulnerable social groups and technology users can collaborate with technical designers is by Techno-Anthropology established by linking critical constructivism to action research. User influence on technology design can both be reached by influencing technology designers, though users of technology also can hack technologies (user—artifact).

The Techno-Anthropological triangle seems not to capture central elements in critical constructivism, namely the pressure from technological rationality (e.g., efficiency, hierarchic power relations and operational autonomy). The embedded triangle, presented in Figure 2 seems more appropriate to capture the more general message of critical constructivism. Before a socio-technical configuration can be recontextualized and transformed into an emancipated one, political struggle must take place and resulting changes must be incorporated in both the institutional and societal layers so that democratic values are promoted to complement efficiency and hierarchy. From a critical constructivist perspective, one can say that political change processes on the institutional and societal levels in relation to technology need more attention in Techno-Anthropology.

In postphenomenology the institutional and the societal layers are situated in the world part of the human—technology—world relation, which of course influence the design of technologies.

5.3 Technology is Value-Laden

It was recognized that both theories perceive technologies as value-laden and potentially support participatory technology design. All student groups associated critical constructivism with politics of technology, and postphenomenology with ethics of technology. Half of the student groups were able to clearly reproduce the ethical elements of postphenomenology as presented in the course. Few groups were able to provide examples of political struggles of oppressed groups.

It was not easy for the students to compare normative aspects of the two theories, and there was a lack of coherence in the student's reflections. However, many reasonable fragments pointing to different normative approaches were put forward in the different student papers:

- Critical constructivism explicitly supports social movements whereas postphenomenology has a broader political agenda.
- Critical constructivism starts out by criticizing oppressive socio-technological configurations whereas postphenomenology does not find it unproblematic to decide who is oppressed and who is free.
- In early writings, critical constructivism associated with democratic socialism and postphenomenology to liberal democracy.
- Critical constructivism refers to social justice and democracy in its ethical orientation whereas postphenomenology does not subscribe to any specific ethical value-system.
- Critical constructivism seems to subscribe to fixed and existing ethical values, whereas postphenomenology highlights how new technologies co-construct ethical values.
- Critical constructivism looks at the power structures as something existing that can be identified from the outside, while postphenomenology perceives power as something that is constructed and emerges from the inside in different spheres. No group referred to Verbeek's "Resistance is futile: Toward a non-modern democratization of technology" (2013) where Feenberg's concept of power is discussed.

These viewpoints are only fragments and not thoroughly referenced or supported by quotations in the student papers. This is partly because they are based on discussions in class rather than on text analysis. Many student papers found the paper by Rao, Jongerden, Lemmens and Ruivenkamp (2015) useful for their discussions in their comparison of the two theories. A taped lecture by Verbeek and his guest lecture also provided useful input to the students' comparisons.

5.4 Complementing Theories?

Techno-Anthropology is an interdisciplinary research area that emphasizes the importance of building bridges between different disciplines and perspectives. The question at stake is whether postphenomenology and critical constructivism can be combined, or should rather be used separately? Here, it is argued that there is good reason to combine the two theories in an analysis of a socio-technical configuration. Postphenomenology brings forward nuances on how technology mediates and affects human perception of technology, just as it can guide designers to be sensitive to ethical values. Critical constructivism is occupied with oppressed groups and how to pave the way for political changes that are required for recontextualisation of an oppressive socio-technical configuration. Technological change is not possible without knowledge of users' perceptions, and the new ethical design solutions that postphenomenology brings with it. Simultaneously, change will not take place if users are not involved or are without political struggle on the institutional and societal levels. The two theories bring forward different elements required for technological change.

In *The SAGE Handbook of Qualitative Analysis*, fourth edition, Yvonna Lincoln, Susan Lynham, and Egon Guba (2011, 120–23) discuss interdisciplinary validity criteria. They compare the validity of interdisciplinary research with a crystal that reflects and refracts different angles and approaches. It would be in line with a postmodern reading of Techno-Anthropological to include postphenomenology and critical constructivism in one analytical approach (though not excluding other approaches). One group of students suggested a simple model that covers the analytical perspectives of both critical constructivism and postphenomenology by linking the Human—Technology—World axis with an orthogonal axis expanded by 'top-down/technological rationality' and 'bottom up/participatory approaches.' In fact, Robert Rosenberger's work shows that the two perspective can in fact be fruitfully combined. He has shown this in his book *Callous Objects: Designs against the Homeless* (2017), which many Techno-Anthropology students identify as relevant to both theories. Furthermore, the two theories use similar concepts

such as multistability, intentionality, value-laden technology and lifeworld. Both theories find a focus on technology users important, and advocate for inscription of certain moral intentions in technological solutions. User participation and responsible technology design are also central to Techno-Anthropology even though participation is not explicated in the Techno-Anthropological triangle.

6. Conclusion

This paper presents a didactical experiment conducted within the Master's program in Techno-Anthropology in which students and teachers provided a comparison of critical constructivism and postphenomenology on the basis of different teaching elements (e.g., introductory lectures, a written exercise requiring students to compare postphenomenology and critical constructivism, a guest lecture by Peter-Paul Verbeek and open class discussions between students and teachers).

Postphenomenology is concerned with how technology influences humans' perception of the world—including how technology co-constructs ethical values, and on how designers can design ethical technology solutions. One starts a critical constructivism analysis by identifying a socio-technical configuration where a vulnerable group is oppressed. Then the configuration is decontextualized and recontextualized via user-inclusive, democratic and participatory processes so that oppression is removed.

This paper's analysis shows that both postphenomenology and critical constructivism are, in the students' perceptions, relevant to Techno-Anthropology as an interdisciplinary discipline. The different teaching elements successfully enabled the students to grasp both postphenomenology and critical constructivism. Three aspects of critical constructivism—technological oppression, rejection and emancipation—were formulated in the form of human—technology—world relations.

Class discussions located postphenomenology and critical constructivism at different locations in the Techno-Anthropological triangle: Postphenomenology is located at the user—artifact and the expert—artifact interfaces and centered on the technological artifacts, whereas critical constructivism centers oppressed technology users, and locates around the user—expert and the user—artifact interfaces. The embedded Techno-Anthropological triangle seems most connected to critical constructivism.

The paper argues that there is good reason to combine the two theories in a Techno-Anthropological analysis of technology. The two theories share a vocabulary and basic assumptions about technology. Most importantly, they both

perceive technology as value-laden and inscribed with interests and values. Postphenomenology brings forward nuances on how technologies mediate and affect our perception, just as it can guide designers to be sensitive to ethical values. Critical constructivism aims at technological change by revising the technical code of a socio-technical configuration, which is an endeavor that involves different layers: the micro level, the institutional level and the societal level. If the validity of Techno-Anthropological analysis can be compared to a crystal that refracts different angles and approaches it might well include both postphenomenology and critical constructivism as these two theories brings forward different aspects of a socio-technical configuration under scrutiny.

Note

1. Don Ihde does not abide to this ethical turn in postphenomenology, which is primarily represented by Verbeek and Rosenberger.

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