Responsible Practices in the Wild:

An actor-network view on learning for responsible practices as translation through mobile apps

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ABSTRACT: Competence to enact responsible practices, such as recycling waste or boycotting irresponsible companies, is core to learning for responsibility. A variety of smartphone apps have been created to support such practices, while accompanying people through their lives. We aim to explore the role of such apps in learning processes of responsible practices 'in the wild', outside formal educational environments. We therefore designed learning interventions as part of a university course in which students were required to perform a smartphone-supported responsible practice over a three-week period in their everyday lives outside the classroom. The 21 participating students were required to maintain a daily learning journal (diary) in which they reflected on their responsible practice and on how apps supported them. Through a thematic analysis of 557 mentions of apps in the learning process documented in learners' diaries we identified five types of app-agency (*what* apps do): cognitive, action, inter-personal, personal development, and material dimensions. Findings were interpreted through an actor-network perspective: With the help of apps, learners constructed a heterogeneous network of human and nonhuman actors. Each actor contributed parts of the necessary competence for responsible practices enactment, a heterogeneous competence network weaving a web of human and nonhuman competences. The process through which new actors are enrolled into such networks is called translation. In order to understand *how* apps enable responsible practice, we connected app agency to four moments of translation: problematization, interessement, enrolment, and mobilization. Based on our analysis of how the mentioning of apps in students' learning diaries *changed over time*, we further theorize app learning as a translation process. This translation process generates networked learning through recurrent translation cycles, each focused on enrolling a different set of actors with their competence into the network. We contribute to the learning for responsibility literature by showcasing how app-supported learning may create real-life actor-networks enacting responsibility, and by priming an actor-network pedagogy for 'learning in the wild'. We also contribute to the actor-network learning literature by conceptualizing heterogeneous competence and the first processual model of learning as the construction of competent actor networks through translation.

KEYWORDS: mobile apps; social and environmental practices; actor-network theory

"I've laid out the five 'breakfast' items ... in front of me.... The first thing I'm scanning is my Dr. Oetker cereal. I joined a couple of Buycott campaigns, ranging from environmental sustainability to LGBTQ+ rights. Buycott doesn't indicate that my cereal is conflicting!" (Carlos, responsible purchasing)[i]

Carlos is an undergraduate student learning responsible consumption practices. As part of a seminar on responsible lifestyles at a German university, Carlos and his peers undertook individual self-directed learning projects to learn responsible practices. They chose mobile apps that supported their responsible lifestyles outside the classroom 'in the wild'. Carlos chose responsible purchasing practices that support responsible companies and products through his purchasing decisions. He used the Buycott app that uses his smartphone's scanning function and contributes to his competence to assess brands based on responsibility criteria. Such learning to enact responsible practices (e.g. Laasch & Moosmayer, 2015; Osagie, Wesselink, Blok, Lans, & Mulder, 2016a; Pohling, Bzdok, Eigenstetter, Stumpf, & Strobel, 2016) is of high relevance and urgency as global problems ranging from climate change to modern-day slavery demand more responsible practices in both professional and private lives (e.g. Laasch & Conaway, 2016; Randles & Mander, 2009).

However, we still know very little about the role that smartphone applications (apps) can play in learning responsible practices. Considering Carlos' engagement with his smartphone in assessing his breakfast seems to suggest that an actor-network perspective on learning (Fenwick & Edwards, 2018; Fox, 2005; Thumlert, Castell, & Jenson, 2018) may provide valuable insights both into processes of app-based responsible practices learning and into learning processes more generally. From an actor-network perspective, competences are what the network needs for enacting a specific practice: this includes both human and nonhuman actors' competences. For instance, Carlos cannot practice responsible consumption unless his breakfast 'learns' to be responsible: to consist of 'responsible' cereal, milk, bread, and cheese. It appears that Carlos' successful learning of responsible consumption practices depends on his success in constructing a network. This network consists of the Buycott app, the responsible breakfast, responsible products from equally responsible brands, and other actors. Each actor contributes necessary pieces of competence required for Carlos to consistently practice responsible consumption.

Actor-network theory has attributed a central role to technological devices (Callon, 1991; Latour, 1994a). Particularly mobile apps may be actors facilitating the construction of actor-networks in learning processes (Thumlert et al., 2018). In our example, Carlos' learning relies on using his smartphone's camera to scan product barcodes. This information enables the Buycott app to check the practices of related brands for potential conflicts with environmental sustainability and LGBTQ+ rights. These are the responsibility themes that Carlos selected in the Buycott app, and which he wants to address through his responsible consumption practice. Social practices such as responsible consumption thus "depend upon heterogeneous materials networked together in and through technological devices" (Fox, 2009, p. 34). Practices are instrumental in interrelating competence between humans and nonhumans (Bigum, 1997). The basic interest in understanding the role of smartphone apps in learning responsible practices through an actor-network perspective leads to our first research question on app agency, asking: *What kind of agency do apps develop in students' learning of responsible practices?* (What do apps do?)

Our approach locates learning of practices between learners and other human and nonhuman actors, constructing a network of competences for enacting the practice (Fox, 2000, 2002). We thus build on the sociology of knowledge and particularly on actor-network theory (e.g., Callon, 1986). This sociological approach extends more traditional approaches viewing learning as psychological and cognitive processes in learners' heads (Fox, 2002). In actor-network theory, learning is conceptualized as a process of network construction, and this process is called 'translation' (Callon, 1986, 1991). Actors acquire the competences to enact a specific practice (i.e. they learn), by creating a network of actors. Actors bring together and swap their respective competences (Callon, 1999; Sørensen, 2018). Responsible practices are thus learned by configuring a network of actors that bring together the competences necessary for the specific practice. From an actor-network perspective, the learning process consists of learners' construction of this (heterogeneous) network of human and nonhuman actors (Fox, 2000, 2002, 2005, 2009; Thumlert et al., 2018). Such construction of a network of heterogeneous competences relies on the networked competences of humans and nonhumans acting together. In our attempt to understand apps in the learning of responsible practices, we thus address the learning process and ask our second research question: *How do apps participate*

in the construction of students' competent actor-networks that enact responsible practices? (How do apps do it?)

Our understanding builds on the duality of the translation concept that represents the process of translation as well as the outcome of this translation process (Laasch, 2018). As a process of continuous becoming (Tsoukas & Chia, 2002), the translation process happens in iterations, each leading to a distinct version of an actor network (Callon, 1986). Carlos' responsible consumption actor network becomes different every time a new actor is translated into it. This also implies that the role of apps may change both in process and outcome. Our interest in understanding such dynamics of learning responsible practices with apps over time leads us to our third research question: *How and why does apps' agency in the learning process change over time?* (How app roles change over time?)

In order to address these questions, our paper continues as follows: First, we review the extant literatures on *mobile learning of responsible practices* (*'in the wild'*) and on *actor-network learning*, which inform our further argument. We then introduce our *data and method*, a diary study performed in the context of a course on responsible lifestyles with 21 student participants, each involved in a distinct app-supported responsible practices learning project. Our *findings* section is structured along our three research questions. First, we explore what apps do; second, we explain how apps do it; and third, we explore in more depth how app roles change over time. We then synthesize our findings and theorize an actor-network *model of learning as translation* by empirically illustrating three cycles of Carlos' responsible learning. Finally, in discussing our theoretical contributions to the literatures of mobile learning, of learning for responsibility, and to an actor-network perspective on learning and our practitioner contributions, we present a proposal for a pedagogy for learning responsible practices 'in the wild'.

LEARNING RESPONSIBLE PRACTICES 'IN THE WILD'

In the following sections we will position our article at the intersection of three discussions, namely of mobile learning, competences for responsibility, and an actor-network perspective on learning.

Mobile Learning with Apps

Mobile learning refers to information and communication technologies enabling learning on the go, situated in a variety of real-life settings (Alexander, 2004; Motiwalla, 2007). Learning technologies have evolved from stationary desktop computers for distance e-learning, to partly mobile laptops and tablets, to the ubiquitous ('u-learning') smartphones and their apps. Today's learning devices often blend into the background of everyday life (Lee, 2015).

In actor-network thinking, mobile learning technologies interact with human learners through a variety of technological competences such as organizing and sharing knowledge on the go (Hwang, Chu, Lin, & Tsai, 2011). They enable access to content and provide an environment to create artifacts such as figures, pictures, and texts (Mouza & Barrett-Greenly, 2015). Mobile learning technologies also help to personalize learning (Mouza & Barrett-Greenly, 2015) and to provide support through personalized feedback (O'Malley, Dowdall, Burls, Perry, & Curran, 2014). Mobile devices further facilitate a variety of human-to-human functions such as enabling collaboration (Reychav & Wu, 2015), making social web-2.0 functions mobile (Cochrane, 2014), and even substituting human mentors with machine mentors (Alario-Hoyos, Estévez-Ayres, Pérez-Sanagustín, & Leony, 2015). Furthermore, they may support self-reflection and monitoring of behavior (Semple, Sharpe, Murnaghan, Theodoropoulos, & Metcalfe, 2015). They may also enable the gamification of learning and the connection to local environment(s) through context-sensing (Chiu, Tseng, & Hsu, 2017; Schneider & Schaal, 2017).[ii]

Combining these competences of mobile learning devices with learners' experiences (Chan, Walker, & Gleaves, 2015), a distinctive mobile learning pedagogy has emerged (Kearney, Schuck, Burden, & Aubusson, 2012). Traxler (2007), summarizes six types of mobile learning, five of which refer to either enhancing the classroom experience through mobile learning, or to transferring formal education to locations outside the classroom. One of them, however, situates learning outside the classroom and detached from formal education:

"Informal, personalized, situated mobile learning – The same technologies are enhanced with additional functionality, for example location-awareness or video-capture, and deployed to

deliver educational experiences that would otherwise be difficult or impossible" (Traxler

2007, p.3).

We chose types of such "real-world scenarios with access to the online resources" (Hwang et al.,

2011: 1023) as our empirical context. The learning design of this article is characterized by two

further aspects: First, low transactional distance, i.e. instructor feedback and interventions are reduced

to a minimum to ensure learners self-directed learning. Second, non-socialized learning, where

learners should primarily interact outside the educational group, e.g. with local shop owners or their

flat mates (Park, 2014).

We study mobile learning supported by the use of apps on the fringes of formal education and

find this conducive to the learning of competences for responsible practices. This design is similar to

those used for learning of other new practices and lifestyle transformation (O'Brien, McCarthy,

Gibney, & McAuliffe, 2014). It is quite atypical for formal higher education (Hsu & Ching, 2013) and

formal web-based education (Alario-Hoyos et al., 2015), but resembles the occupational app-enabled

learning of new doctors (Bullock et al., 2015) and of employees' informal workplace learning (Gu,

Churchill, & Lu, 2014).

Our research focuses on apps that are designed as tools for the enactment of real-world

responsible practices rather than as educational technologies. Information and communication

technologies, including websites, online forums, case simulations, and gamified role plays, have been

found useful for ethics education ((Kavathatzopoulos, 2003)). Mobile devices have been found useful

for sustainable development education ((Schaal & Lude, 2015)). Montiel, Delgado-Ceballos, and

Ortiz-de-Mandojana (2017) showcased the use of responsibility-themed apps through the use of

GoodGuide, as a *teaching* tool *in the classroom*. However, the potential of the variety of mobile apps

for *learning* responsible practices in 'in the wild' has barely been explored.

Learning the Competence to Enact Responsible Practices 'In the Wild'

An interdisciplinary discussion of personal competences for sustainability, responsibility, and ethics is

in full bloom (Laasch & Moosmayer, 2015, 2016). It scrutinizes competences for environmental

sustainability (e.g., Hesselbarth & Schaltegger, 2014), social responsibility (e.g. Osagie et al., 2016a)

and ethics (e.g. Pohling et al., 2016). Competences are key to enacting a practice (Shove, Pantzar, & Watson, 2012; Wenger, 2010) and they make a legitimate practitioner (Lave & Wenger, 1991). The competence to enact responsible practices is relevant both in private lives (Shove & Spurling, 2013; Shove, Trentmann, & Wilk, 2009) and in work roles (Lindberg & Rantatalo, 2015). Acquiring responsibility competences is a prerequisite for enabling a variety of responsible practices in urgent demand. These practices include more generic social and environmental management practices of an organization (Pullman, Maloni, & Carter, 2009) as well as particular competences on the level of individual managers (Laasch & Conaway, 2015; Murillo & Lozano, 2006) and of departments, such as responsible purchasing practices (David, Kline, & Dai, 2005).

Acquiring competences to enact practices is best achieved through learning situated in communities of practice (e.g., Nicolini, 2012), leading to a "paradigm of situated action" (Gherardi, 2012: 14). It is such situated action that we describe as 'in the wild'. Learning of practices happens through action in everyday life, "'wild' learning occurring naturally outside classrooms" (Fox, 2002: 89), by practitioners outside the academic context "in the wild" (Callon, 2007: 33). Accordingly, learning competences for responsible practices requires getting off the "tip of a learning iceberg", that is formal education, and diving into the sea where the largest amount of learning happens (Fox, 1997: 727).

In summary, learning competences for responsible practices lends itself to learning with mobile apps through their ubiquitous participation in practitioners' lives and their variety of features, some of which explicitly aim at responsible practices. However, understanding learning of responsible practices as situated in a purely human community of practitioners (Lave & Wenger, 1991; Wenger, 2000, 2010) neglects the material, nonhuman dimension of learning practices (e.g., Shove et al., 2012). Building on an actor-network perspective, we take the human situatedness a step further and include the important material, nonhuman situatedness.

AN ACTOR-NETWORK PERSPECTIVE ON (MOBILE) LEARNING

Actor-network theory has emerged from science and technology studies and from the sociology of knowledge (Callon, 1986; Latour, 2005; Law, 1992). It has strongly influenced theories of practice

(Latour, 1994b; Law, 2000; Reckwitz, 2002) and is used widely in information and communication technologies (Tatnall, 2005). The more recent move towards studying competence and learning through actor-network theory (Fenwick & Edwards, 2018), reconnects to the philosophical roots of Deleuze's ideas of learning as the mutual alignment between human and nonhuman (Deleuze, 1968 [2004]) and Whitehead's discussions of competence (capacity) and learning as a process (Whitehead, 1927/1928 [1985]). Drawing on these advances, the following sections will unpack key aspects of this emerging actor-network perspective on learning and apply it to the context of learning with mobile apps.

Heterogeneous Agency and Competence

The core idea of actor-network theory is that neither humans nor nonhumans ever act alone (Callon & Law, 1997). Latour (2005: 71) illustrates this with the action of cutting: "Knives cut" is as incomplete a statement as "people cut." Without a human moving the knife, cutting would not take place. Nor would it without a knife. Accordingly, agency is heterogeneous, an association of humans and nonhumans through action. Callon and Law (1997: 7) illustrate a more complex actor-network enacting strategic practices, Andrew-the-strategist:

> "Andrew-the-strategist is a heterogeneous network: Andrew + fax + fellow managers + secretary + head office + trains to London + his PC + the work of scientists and engineers + the memos that circulate + the time slips filled in by employees – it is this combination that creates the possibility of strategic action."

As Callon (1999: 183) suggests, "humans and non-humans … have variable forms and competencies." Their competences are distributed across the network, but can be pooled and partly transferred from one actor to another (Murdoch, 1997). Andrew-the-strategist is competent to enact strategic practices like attending meetings or implementing strategies only because the fellow managers are competent to do their jobs, because the fax is competent (or able) to send messages, the trains are competent to carry him to London, and of course, also Andrew himself is competent to bring this network together. This exemplifies how human and nonhuman, heterogeneous competences are pooled and aligned in a human-nonhuman or (post)human actor network. Latour (1996: 373)

makes explicit this move from human to network competence by proclaiming the "complete indifference for providing a model of human competence." Competence of the entity, human or nonhuman, "depends on that of its environment" (Whitehead, 1927/1928 [1985]: 110).

Heterogeneous Learning and Learners

In the previous section we have seen how competence is distributed throughout a heterogeneous actor network that enacts a practice. Accordingly, learning a practice from this perspective means constructing this actor network and with it constructing its competence to enact the practice. As Fox (2002: 89) suggests,

"Actors can only learn or act within networks … the learning process … is a concrete effect

of a network and the learning process in turn transforms the network."

If they succeed in constructing a network of heterogeneous competence, human learners (be)come to represent the network (Callon, 1986, 1991; Law, 1992), "the learner [becomes] an actor-network comprised of human and non-human" (Fox, 2000: 864). Andrew becomes Andrew-the-Strategist able to enact a variety of strategy practices, because of the distributed heterogeneous competences he has aligned to enact these practices (Callon & Law, 1997).

An actor-network perspective moves learning away from being a "province of psychology" focused on cognition (Fox, 2000: 853) to a sociological view, a process-oriented sociology of network learning (Fox 2009, p. 31). The outcome of learning is the change of the network, which is embodied *in* and more importantly *between* the network's human and nonhuman actors in the form of their relations and alignments (Fenwick, 2010; Fox, 2009; Thumlert et al., 2018). Wright and Parchoma (2014: 241) bring the resulting conceptualization of learning to the point by suggesting that "learning assembles an actor-network and reconfigures it with that learning distributed across its heterogeneous elements rather than residing in the human learner alone." The perspective "decenter[s] a long-term educational focus on the learning by an individual human subject" (Fenwick & Landri, 2012: 1).This implies understanding learning processes and outcomes as the evolving relations between networked actors.

Mobile Technologies as Competent Actors in the Learning Process

The role of mobile technologies in the construction of actor-networks is twofold. They are competent actors and play an active role in the learning process as exemplified by the following quote by Park (2014: 79):

> "Mobile technology … scheduling and calendar applications are useful to increase an individual's organizational skills and self-regulative (or self-directed) learning ability."

First, the scheduling and calendar applications of a mobile technology provide additional competence that the human user can access and add to its own. Wright and Parchoma (2014) illustrate this point by showing how iPhone competences, such as calculation, simulation and recording of data contributed to the enactment of practices in a beer brewery. By enrolling the competent actor smartphone into a human-smartphone network, their respective competences are aligned. Both become more competent to act than either one alone. Thumlert et al. (2018: 146) call devices immediately increasing learners' competence "prosthetic things". Like a prosthesis they immediately complement the competence of the human using them. Mobile devices, for instance, can scan barcodes, take pictures, record audio, and connect to virtually limitless computing power and information, all of which a human on its own is not competent to do. This relationship between smartphone-apps and human learners is similar to the idea that technology may provide affordances, action opportunities for learners, but goes beyond them as human and smartphone merge in one network with a shared competence (Wright & Parchoma, 2011).

Secondly, smartphones are also black-boxed networks of actors (e.g. the apps, the camera, the people in social networks) (Cressman, 2009; Law, 1992; Sarker & Sidorova, 2006). They are a box full of these actors' networked competences, which is mobile as it can be carried in human learners' pockets. The mobile and the black-boxed characteristics of smartphones make them powerful actors in learning (Callon, 1986; Latour, 1994a, 2005), as they influence the relations between learners and other actors learners relate to. These competences of apps increase the "self-directed learning ability" that Park (2014: 79) refers to, as mobile apps on smartphones provide ample opportunities for relating to new actors with new competences, but also influence the characteristics of the relations created. Learning as the construction of actor networks has great potential to be developed further through this

form of technologically-enabled learning (Thumlert et al., 2018). This is particularly likely in contexts such as smartphone use, where technologies have become a ubiquitous element participating in the practices of daily life (Hayles, 2008; Mara, 2009).

These two roles of mobile devices and apps in the learning process also help us to extend the definition of what constitutes a mobile learning device beyond those explicitly designed for formal learning. Any mobile app that either adds to the human learner's competence or enables its relationship to other competent actors becomes a learning device in the moment it participates in the construction of the actor network enacting the practices to be learnt.

Learning as Processes of Translation

In the previous sections we have seen how learning can be understood as the alignment of heterogeneous competences in a network of human and nonhuman actors, as building a network enacting the practices to be learnt. We have also seen how apps and mobile learning devices may participate in the construction of such networks. However, we do not yet know much about the process through which actor-networks are constructed. Actor-network theory conceptualizes this process as 'translation' (Callon, 1986).

In the learning context, translation can be understood as a process through which an actor (the human learner) includes, or rather translates, other actors and with them their competences into their network (Callon, 1986). Translation is a process of mutual definition in which actors engage in a struggle, a negotiation to mutually align each other's logics of action (Akrich & Latour, 1992; Callon, 1991). It also entails continuous efforts to stabilize these networks over time (Callon, 1986; McLean & Hassard, 2004), to ensure the ongoing enactment of the learner's aspired practices. Accordingly, competence of actors and of the network "varies along the translations transforming them" (Callon & Law, 1995 as cited in Murdoch, 1997). Human learners assume the role of a 'primus movens' initiating translation (Callon, 1986), a change actant transforming the network (Bengtsson & Ågerfalk, 2011), and of a heterogeneous engineer assembling of the human-nonhuman network they need to enact the practices they wish to learn (Deleuze & Guattari, 1987; Latour, 2005; Law, 1987).

Callon (1986: 59) stresses the "four moments of translation" of problematization, interessement, enrolment, and mobilization as foundational processes of actor-network construction. Figure 1 provides an initial conceptual framework illustrating the application of translation on the learning process, with each moment a step in the learning process (Fox, 2000). However, they do not necessarily happen in a strictly sequenced manner as moments overlap and recur (Callon, 1986).

Translation in the learning context starts with an initial learning impulse, which could be extrinsic, such as a course assignment, or intrinsic such as a learner's aspiration to act responsibly. In the moment of problematization, the learner determines the goals of the learning project and identifies key actors and their competences to be enrolled in its actor network. During interessement, learners negotiate with key actors to disassociate them from competing networks that may be in conflict with the learner's goals. In the moment of enrolment, actors and their competences begin to play a role in the network. During the moment of mobilization these actors are aligned with the learner's characteristics until they mutually represent each other. The four moments are described in greater depth in Figure 1

For instance, Andrew may have started assembling his strategic practices network by feeling a desire to become a strategist. He might have demonstrated his potential to make great achievements for the company as a strategist to his superiors and colleagues (problematization). He might then have begun to disassociate actors from competing networks, for instance, when applying for a large part of the budget for strategic visits, which previously had been committed to funding other activities (interessement). Then he might have begun to enroll actors and their competences, for instance, by moving the fax machine closer to his desk (new communication competence) or convincing his boss (formal decision making competence) to give him strategic decision responsibilities. He has now established the basic actor network with the competences of a strategist (enrolment). Finally, Andrew might align his network until it becomes him, for instance, by customizing his business cards with job title 'strategist', or by personalizing memos with the type of information he prefers (mobilization). At this stage, Andrew has become Andrew-the-strategist, representing the network, as he and the network have learnt to be competent to enact strategic practices.

Please insert Figure 1 about here.

Figure 1 provides an initial conceptualization for the process of learning as translation. However, we know little about the role played by mobile technologies in this process and we still lack a nuanced, empirically undergirded conceptualization. The following methods section provides the research design for studying the role played by apps and their competences in the process of learning as translation.

DATA & METHOD

The qualitative methods chosen in this study draw from a social practices methodology (Gherardi, 2012; Nicolini, 2007, 2009; Shove et al., 2012) and an actor-network methodology (Adams & Thompson, 2011; Fenwick & Edwards, 2010; Latour, 2005; McLean & Hassard, 2004). The following sections describe empirical setting, the data collection relying primarily on longitudinal diaries, and the thematic template analysis.

Empirical Setting: Seminar 'Living the "Good" Life'

The empirical context of this study is situated learning projects of the seminar Living the 'Good' Life' at a German University. Each of 21 students engaged in a different app-supported learning project (see appendix Project Assignment). The goal was to learn a responsible practice in their daily lives. The 21 days of the learning project led into a three-day in-class seminar during which students shared their experiences. Each student's learning was supported by a variety of apps. For instance, Christy's goal was to "become competent to produce zero-plastic-waste when it comes to food". She used Instagram, Pinterest and Farmstand in combination. Carlos' responsible consumption practice was centered on Buycott and Rank a Brand. Learners' projects and mobile technologies are summarized in appendix Table A. 1.

Twenty students studied bachelor programs, one her PhD, with half of them in the faculty of business and economics, with at least two students each from sociology, psychology, and political

sciences, as well as individual students from history, theology, and German language. Most students were female with only three male participants, between 20 and 27 years old, with a majority of 22 and 23 year olds. Fifteen students were German, four French and one each from the USA and Switzerland. The seminar was a credit-bearing elective in each of their respective degree programs.

The seminar's underlying rationale was to transfer competence for responsible practices "from office to home" and vice versa (Shove et al., 2012: 51; Soltes, 2017). This pedagogy relies on learning in students' private lives, while enabling them to transfer these practices to their professional lives once they start to work. This pedagogy is a mixed form of lifestyle-integrated mobile learning (Lee & Chan, 2007) and problem-based learning for sustainability (Dobson & Bland Tomkinson, 2012). While students changed their private practices, they often connected to companies' practices. For instance, Carlos used the Rank a Brand app to support his responsible consumption practices and learned that "there's a catalogue of over 30 criteria that are evaluated for every company ... things like ... no forced or slave labor, no child labor, no discrimination of any kind and a safe and hygienic workplace?" In the final essay assignment students reflected on tactics for transferring their learning of private responsible practices to a future workplace.

Data Collection: Diary Studies and Qualitative Surveys

As illustrated in Figure 2, data collection emphasized the use of students' qualitative diary entries in which they described their learning process on a daily basis. We also used qualitative surveys comprised of questions about their competence development. This data collection technique was driven by two main considerations: First, in ANT, the data collection mantra is to ethnographically follow the actor (Adams & Thompson, 2011; Latour, 2005) while the actor is building the network in order to trace the enrolment of actors with their competences (Thumlert et al., 2018). Physically following the learners was not feasible, both due to the invasion of their private lives and the number of learners involved. The closest alternative is a diary-study design, a form of auto-ethnographic interviewing (Hayano, 1979; Heyl, 2001). Diaries can be used to answer a wide range of qualitative research questions: About experiences, understandings and perceptions, accounts of practice and influencing factors (Braun & Clarke, 2013). They are often used to access the details of mundane,

routine, taken-for-granted phenomena that other methods cannot reach. Because diaries encourage participants to record their experiences and perspectives temporally and often spatially close to when and where they happen, the method satisfies the 'follow the actor' mantra.

Secondly, in order to study the temporal-sequential aspects of the learning process, longitudinal data collection was necessary. We used the mixture of diary and qualitative surveys to create an intensive longitudinal study (Fraley & Hudson, 2014). Diaries track a sequence of experiences and events (Milligan, Bingley, & Gatrell, 2005), and can help explain how practices evolve over time (Braun & Clarke, 2013). The 21 days of diary entries were short enough to control data quality and keep participants engaged but long enough to avoid capturing only unusual experiences (Milligan et al., 2005).

The qualitative surveys provided longitudinal, sequenced data on students' self-evaluation of their competence development, that is, of learning outcomes. The diary, by contrast, mostly included data related to the students' learning process, often describing their interaction with the apps. Given the relational nature of actor-network theory, the diary data was more central to the analysis presented in this article as it provided relevant data about the learning as translation processes. It enabled a study of "process and an acknowledgement that effects (desirable and undesirable) take time and depend upon interactional sequences which must be studied closely to understand how they produce effects" (Fox, 2009, p. 31).[iii]

Please insert Figure 2 about here.

Thematic Template Analysis of App Agency

Given the evolving nature and scarcity of existing research on the agency that apps develop during the learning process, we decided to conduct an inductive thematic clustering of learners' app agency mentions (Gioia, Corley, & Hamilton, 2012). This process relied on thematic template analysis which runs through several iterative rounds of analysis (Fereday & Muir-Cochrane, 2006; King, 2004; Vaismoradi, Turunen, & Bondas, 2013).

Round 1 (precoding). We first extracted the individual mentions of apps' agency in the learning process from diary texts. Examples are Alina's (swapping things) statement "the app helps here … [to] rate the other buyers/sellers once you made a transaction", or Tabea's (regional consumption) description of "the app 'Food Miles Footprint', which is calculating the miles and CO_2 emission of groceries." The above descriptions were identified as app agency, as the app appeared as a subject (or as complementing the subject) in a sentence with an active verb: Apps were described to be 'doing' something. Through line-by-line coding (Saldaña, 2012), using the qualitative data analysis program NVivo we identified a total of 557 such mentions.

Round 2 (thematic clustering). Similar codes were clustered inductively using thematic analysis. For instance, Carlos' (responsible consumption) description of "scanning the aforementioned items with the Buycott app" and Sarah's (a good deed a day), "post it on Instagram …, a photo related to it" were clustered under the first-order concept of 'hardware use,' due to the use of the smartphone camera. Such clustering processes led to a total of 42 first-order concepts (see left column of Figure 3). The coding up-to-here was truly inductive and minimally influenced by conceptual preconceptions. Several of the first-order themes that emerged, however, reminded one of the authors of aspects of technology seen through an actor-network lens: 'App-networks', 'co-acting', 'accessing material actors', and 'getting to know new people'. As a consequence, we took an abductive leap (Dubois & Gadde, 2002; Josephson & Josephson, 1996) and started analyzing and refining the coding from an actor-network perspective.

Round 3 (template refinement). Similar first-order concepts were further clustered, resulting in second-order themes, which were then grouped to aggregate dimensions of app agency. New structures were, where applicable, framed along the lines of an actor-network perspective, such as the aggregate dimension of 'material' as well as the second-order theme of 'enabling relationships' (see right and middle columns of Figure 3). However, where an actor-network labelling did not capture the pre-existing first-order concepts, it was not forced onto the data. For instance, the 'cognitive' aggregate dimension is something actor-network theory usually would not take an interest in. The visualization of the resulting data structure in Figure 3, displays 42 first-order concepts, 14 second-

order themes, and 5 aggregate dimensions, following the Gioia method for visualizing themes in qualitative data (Gioia et al., 2012).

Round 4 (learning process theorizing). The previous round's thematic template of app agency was used to theorize the involvement of apps in the learning process in a sequence of three interrelated analyses. First, app agency themes were matched with the four moments of translation, showing how the app influenced the process of learning as translation. Secondly, the intensity of app agency mentions by learners was mapped quantitatively over the 21 days of the learning process, as visualized in the upper part of Figure 5. App agency mentions were juxtaposed with learners' perceived competence levels in the lower part of the same figure. These quantifications are not meant for statistical purposes or for a minute analysis of distribution, but as a visualization to make complex qualitative data accessible (Auer-Srnka & Koeszegi, 2007). Third, the assumption that had emerged from previous analyses that learning as translation might happen in a sequence of translation cycles was explored further. This occurred through an in-depth analysis of Carlos' learning process, which served as the basis for a scaffold of a conceptual model of learning as translation (see further below in Figure 6).

To increase the rigor of the coding process a sequential qualitative verification mechanism was adopted (Miles & Huberman, 1984; Morse, Barrett, Mayan, Olson, & Spiers, 2002): The first-author-coder shared the results of each round of analysis with the two co-authors who critically questioned main coding decisions and interpretations, which in a several cases led to adjustments in the template.[iv]

FINDINGS

This findings section will address our three research questions on app agency (research question 1), apps in the learning process (research question 2), and the change of app agency over time (research question 3).

App Agency

Figure 3 visualizes the thematic template outcomes finding five types of agency apps were assuming in the learning process: cognitive, action, interpersonal, personal development, and material.

Please insert Figure 3 about here.

Cognitive (C). Apps provided cognitive competences, which can be further classified as informing and analyzing. The two most strongly represented themes in *informing (C1)* were apps providing students with background information on the practices they aimed to learn (C1.1). Apps also helped students to access detailed information from vast databases and through search functions (C1.2). An example is Ina's (sustainable seafood) search for the sustainability of herring: "I have to look at all three apps, The Good Fish Guide and the two 'Fischratgeber' [fish guides] by WWF and Greenpeace, to find out what they say about herring." Apps helped learners to develop trust in information through perceived impartiality (C1.3), and they helped them to keep up-to-date by sending relevant information, for instance, through news alerts, newsletters, or ongoing updates (C1.4): Lara (supporting SDGs), stayed 'app-to-date' by scanning a German newspaper "on Zeit-online app." Apps also provided an *analyzing (C2)* competence by ranking alternatives (C2.1) for action, and by providing decision support (C2.2): Lola (sustainable beauty) oriented her cosmetics purchasing decisions using Codecheck, which "ranks the impact of the ingredients from 'not harmful' to 'somewhat harmful' and 'very harmful'." Apps also triggered further thinking and analysis (C2.3).

Action (A). Apps played an important role in *initiating action (A1)*. They enabled learners' initial actions (A1.1). For instance, Penelope (mindfulness) had never done yoga, but emboldened by the app had "decided to begin my first experimental day with a yoga session (30 minutes). I have used the app Down Dog." Apps also lent learners the competence to take spontaneous ad-hoc action on the go (A1.2), and to remind them of action (A1.3). Alina (swapping) realized "the advantage of having it organized through an app: I could answer from wherever I was." Apps also participated in *ongoing actions (A2)*, by organizing timing or financing, for instance through scheduling functions, and by providing free access (A2.1). They provided recipe-like guidance on how to enact a particular practice

(A2.2) and supported learners' routinization of actions (A2.3). Finally, apps contributed to the competence to enact *future action (A3)* by helping learners to envision new actions (A3.1). Apps also supported the extension of existing actions to new contexts (A3.2): Frank (recycling) reports that "with the help of the app I intend to extend the recycle process to fashion." Apps also recommended new actions (A3.3) and facilitate experimentation to fit new actions into existing practices (A3.4).

Inter-personal (I). Apps also facilitated human relationships. Apps *enabled relationships (I1)* by providing opportunities to meet other practitioners through social networks (I1.1) and to build trust, for instance, through peer evaluation mechanisms (I1.2): *"*The whole process does rely on a certain amount of trust. … The app helps here a bit, because you can rate the other buyers/sellers once you made a transaction with them" (Alina, swapping). Apps facilitated co-action (I1.3) by becoming an integral actor in *human-human exchange (I2)*: Frank (shared mobility), socializes (I2.1) with other users of the carpooling app BlaBlaCar. Aurelie (ethical decisions) watches video blogs on her smartphone to judge peers' moral attitudes (I2.2). Sarah broadcasts her good deed a day through Instagram (I2.3), also serving her as an important human, or rather heterogeneous feedback forum (I2.4). Apps also provided avenues for *impacting others (I3)*. This might happen by benefitting others (I3.1): Julie (eating for good), uses Share the Meal, to donate "0.40€ every day, so one person has enough to eat for one day." Another example is political activism aimed at influencing other humans, their organizations and institutions (I3.2) through online petition apps like Change.org or Petitions.

Personal development (P). Apps connected to aspects of students' personal development competence. Apps enabled the appreciation of *themselves [leaners] in context (P1),* by facilitating shocking, eye-opening experiences (P1.1): Heidi (combatting slavery) harnessed the self-assessment competence of Slaveryfootprint, an app that estimates the number of humans working under slavery-like conditions to enable the app user's consumption: "My result was that 32 slaves work for me. This was a real shock." Apps also provided spaces for continuous self-assessment (P1.2): Charlene (sustainable fashion), reports that "Good on You suggests to ask yourself whether you would have worn it three or four years ago... if this question is answered with no, this piece might probably not be my style." In the area of *empathy and meaning (P2)*, apps provide a variety of support mechanisms for students' meaning-making (P2.1). Apps helped developing students' moral attitude towards

aspects of their environment, and compassion for other beings (P2.2). Apps also fulfilled a variety of

personal support agencies, from motivation (P3.1) and emotional wellbeing (P3.2), to tracking

behaviors (P3.3) and boosting self-discipline (P3.4). Jenny (healthy living) provides an example:

"Mein Wasser is an app where I can track how much water I drink."

      Material (M). The material dimension covers instances where apps connected learners and

new material actors (M1). Apps provided students with the competence to access material actors

(M1.1), such as locating and booking a local bike for hire. Apps also became anthropomorphized, as

they were sometimes perceived to act like human beings and to exhibit human qualities (M1.2).

Examples are statements like "this App is gonna show me around my area" (Jada, slow life), "Goy

[GoodOnYou] recommends that brand" (Charlene, fair fashion), or "at a point, the man [voice of app,

giving instructions] told me to look what going on in my belly" (Penelope, mindfulness). Apps may

also allow learners to change them (M1.3), for instance, when Irene (protecting water) states that she

"can toggle it [the DropCountr app] to allow me to use my hometown in California" or when Carlos

(responsible consumption) lists new brands: "I'm heading over to Rank a Brand. Whoops, there's no

Dr. Oetker! You can request brands that you think are missing, which I did." The material dimension

also enabled students to enroll *new networks (M2)* or to connect to existing localized networks. This

could be networks of mutually complementing apps (M2.1): "A smartphone represents a toolbox:

messages, video-call, metronome, transportation tickets, radio, sport trainer, music of course"

(Aurelie, ethical decisions). Apps also used GPS and localized functions to create access to local

material networks (M2.2): Elaine (veganism) used "HappyCow to find restaurants." Finally, apps also

provided the competence to move between the *virtual and material (M3)* worlds, for instance, when

re-channeling materials and resources (M3.1). An example is second-hand clothing in the

Kleiderkreisel app, or using hardware functions like barcode scanning (M3.2): "When you want to

buy something, you can scan the barcode and the app shows you if this product matches with your

values (Heidi, combatting slavery)." Apps facilitated a blended type of online-offline actions (M3.3).

For instance, Heidi describes how one can report assumed forced labor through the Anti Slavery App

online, and possibly facilitate the freeing of modern-day slaves in the offline world.

Through the above five dimensions of heterogeneous action and competence involving the human learner and the app, we have seen how app and learner connected, pooled, sometimes transferred their competences.[v]

Apps' Role across Moments of Translation

As illustrated in Figure 4, we will now match the themes of app agency presented above with the moments of translation for which they were found to be most relevant. This creates a processual appreciation of app-supported learning, which explains the changing role of apps across moments of translation.

Please insert Figure 4 about here.

Problematization. During problematization, apps' ability to shock students (P1.2) may trigger powerful problematization processes. Apps meaning-making-enabling competences (P2) help to make problems personal by helping to develop learners' moral sentiments. This app agency leads into the consolidation of the students' self-defined learning goals, of the responsible practice students wanted to learn and why. The quality and degree of elaboration of these learning goals, or rather learning problems, is increased by the app-provided background information (C1.1) providing wide contextual knowledge. Connecting with other practitioners through 'apped' social media (I2.2) like Facebook or Instagram gives access to experience, leading to a better appreciation of the learning goals. For instance, Elaine (veganism) came from a French family background where dairy consumption was considered unproblematic. Particularly cheese was cherished and taken-for-granted. Accordingly, Elaine "was worried about negative reactions from ... family" and it took her until day 19 of the learning project to problematize or "confess" to her parents and brother that she was becoming vegan. As her family being core actors of the network she relied on to enact the practices of her life, she could not become Vegan-Elaine without them. As the confession started during a Skype call on her smartphone, Elaine describes that "they [family members] told me all the clichés and stereotypes ... but I was prepared to counter with some arguments." Elaine describes how she used the

variety of mobile resources available to problematize animal-based nutrition, from watching online videos (e.g. Cowspiration), famous sportspersons' blogs on vegan life, to newspapers and scientific articles, all shown on her smartphone.

Interessement. Apps also participated in the moment of interessement by giving actors access to a wide variety to interessement devices. Such devices used to separate key actors from competing networks or for learners to position themselves between the actors they want to enroll and the competing networks. For instance, activism apps (I3.2), particularly, the ones sending petitions, can be used as a device to separate actors from the networks enacting irresponsible practices. Responsible consumption apps (I1.3) like Buycott fulfill a similar function by affecting sales and creating an incentive for companies to disassociate themselves from irresponsible practices. In doing so, the distancing actors free themselves to join the networks enacting responsible consumption. Apps' competence to recommend alternatives (C2.1) may also help to disassociate material actors: Emily (zero palm oil) improved her competence to live without using palm oil when one of her apps recommended alternatives to her beloved chocolate spread: "There is a substitute for everything, even chocolate spread (chocolate spread usually contains at least 20% Palm oil)!" Without the app-recommended alternative, the chocolate spread actor would have remained enrolled in the competing palm-oil consumption actor network. With the non-palm-oil substitute, chocolate spread became eligible for enrolment in the Zero-Palm-Oil-Emily actor network.

Enrolment. Apps provided a variety of competences for enrolling actors: Apps may give access to enroll local actors (M2.2, I1.1) and networks (M2.1), from vegetarian restaurants and shared bikes to local networks of people like Alina's (swapping things) 'Free Your Stuff' Facebook group. Apps provided competences for developing human actors' relations, such as trust building (I1.2) and impartial information (C1.3). They also provided opportunities for human co-action (I1.3): Penelope (mindfulness) enrolls her father, and in another occasion her friends, to meditate with her using the Downdog app, or thousands of people join an online activism campaign on Change.org. Phones' hardware functions (M3.1), such as GPS, barcode scanning, voice capture, and screens facilitate the enrolment of a variety of virtual actors from the palm of learners' hands. Smartphones and their app stores enable the enrolment of an unlimited number of apps through download: "Food Miles Footprint

is ... helping me to calculate the CO2 emissions from groceries coming by plane and ferry from different countries. But as I eat regionally, that doesn't really help me to live the daily life! So I downloaded a second app to accompany the first" (Tabea, local consumption).

Mobilization. In the moment of *mobilization* learners align the network with their personal aspirations and style. They attempt to make it 'theirs,' which allows them to take it with them as part of their identity. A mobilized network allows for the actor to transfer the network and with it the enactment of practices, letting it take root in other contexts of distinct practices and locations. Mobilization requires alignment of actors, for instance, when Carlos (responsible consumption) adds his favorite muesli brand to the Rank a Brand database (M1.3). This alignment or customization of the network may also be achieved through apps' competence to identify a variety of alternative options and actions (C2.1, A3.3, A3.4) for anything from vegan recipes (e.g. Is It Vegan?), to fair fashion choices (e.g. Good on You), and on to your personalized activist campaigns (e.g. Change.org). A variety of personal development app agencies (P), facilitates learners identification as part of the network, and of the network as part of who they are and want to be. Examples are apps' competences to enable self-assessment (P1.1), for developing an personal and compassionate relationship towards the actors in the network and the ones affected by it (P2.2), and to track learners' behaviors and goals against their alignment with the network (P3.3): Sarah (a good deed a day) titled her Instagram account 'be the nice one', or *"Sei die Liebe"* in German. Sarah made her doing of good deeds, and the entire network required for doing so, her virtual identity, conveyed through by Instagram's broadcasting competence (I2.3).

This analysis of the distinct app agencies across the moments of learning as translation has provided an appreciation of the role played by apps throughout the learning process.

App Agency over Time

The above findings have provided insight into how apps participated in learning across the moments of translation. However, we still know little about the timing and sequencing of heterogeneous competence development throughout the learning projects. Understanding learning as a *process* of translation suggests a sequencing of distinct aspects or stages of learning. The four moments of

translation suggest a sequencing beginning with problematization, on to interessement and enrolment, ending with mobilization in the last days of a project. If this were true, we would expect to see app agency related to problematization, for instance, 'shocking' (see Figure 3) to be more concentrated in the early stages of learning projects. App agency related to mobilization, for instance, 'broadcasting actions' would be expected to be achieved predominantly in the last stages. However, this effect could not be verified in the empirical material, as most app agency types were found to be distributed rather evenly over the duration of projects. This is consistent with actor-network theory's ontological foundations seeing reality as a continuous, never-ending process. This process consists of repetition in a sequence of cycles of translation.[vi] We found evidence for these recurrent relational encounters of learning as translation through the next analysis.

Figure 5 maps the total frequency per day with which students mentioned app agency throughout the learning process. It serves as a visual illustration of the intensity with which students relied on app-enabled heterogeneous competence as part of their learning as translation. This allows for interpretations regarding the role apps may have played in the learning process longitudinally.

Please insert Figure 5 about here.

First, in almost regular periodic intervals (Day 4, 8, 12, 15/16, 20) we see how app participation spikes. Similar spikes can be found throughout individual diaries as well. We explored the reasons behind such increased app usage by looking at students' diaries. We realized that spikes typically were reflective of a new aspect of responsible practices that students were grappling with, by often relying on the competence provided by the apps. In such translation cycles, the intensity of app participation builds up as learners test how to use the app to enact a particular aspect of their new practice and decreases once they succeed (or give up). This observation implies that students appeared to have learnt in a sequence of cycles of translation, visible in the aggregate dimension as Cycles 1-4 in Figure 5. These translation cycles will be analyzed in greater depth further on through Carlos' (responsible consumption) learning process.

Secondly, we see that, after an initial rise, the overall intensity of app mentions in the enactment decreases over time, as learners' perceived competence increases. The decrease in intensity of app usage is represented in the decreasing height of spikes as the learning projects progress. We identified three distinct interpretations for this phenomenon.

1) **Competence transfer.** With increased competence, learners and their network might become increasingly competent in doing what the apps were doing before and therefore rely less on app agency.

2) **App normalization.** Students might get used to the apps as taken-for-granted part of their enactment and might mention it less due to the lack of novelty.

3) **Less competence required.** Students' encounters with new, challenging aspects of the responsible practice requiring app competence might decrease over time.

Third, in the accumulated chart above it appears that in the last three days the app agency levels off to a few mentions per day, but does not return to zero. This could be interpreted as a plateau phase before another heightened translation period. However, in most individual students' charts this leveling-off effect is even more pronounced and app use did not demonstrate significant spikes afterwards. We interpret this as apps' competence becoming a necessary element of the usual long-term enactment of the practice to be enacted.

A majority of students explicitly mentioned that they would keep practicing their projects, such as Penelope (mindfulness) who stated that she "will continue for sure ... I think my life will be better, easier if I continue". Apps had often proven useful for further practice, as exemplified by Charlene's (fair fashion) statement: "Wow, the 21 days have gone by so fast ! I am somehow melancholic, I ...like the routine of my fair fashion practice. And I am really convinced of the app Good on You". This implies a long-term sustained heterogeneous competence shared between app and student with the app becoming not only an actor in learning, but also a fixed element of the learning outcome of being competent to enact the practice.[vii] For instance, Heidi (combatting slavery) mentions in her last post, how the Slaveryfootprint app lent her the self-assessment competence she needed as part of her continued practice*:* "I used the last day of the project to do the Slaveryfootprint

again. I filled in all the things I changed during the last three weeks ... I really got four slaves less ... 28 slaves working for me ... way too much, but it is a progress and I ... want reduce it even more."

A PROCESS MODEL OF LEARNING AS TRANSLATION

We are now able to synthesize a process model of learning as translation from the previous findings. As visualized in Figure 6 we will first zoom into the learning process of Carlos (responsible consumption). This analysis connects previous findings to the theorizing of a more generic process model of learning as translation, beyond the responsible practices context, and beyond the application of apps.

Please insert Figure 6 about here.

Responsible-Consumption-Carlos' Translation

Early on Carlos describes an uneasiness, a need to change and to develop responsible consumption competence. This is an initial problematization aimed at breaking the larger task of enacting responsible consumption down into smaller, doable units:

"I've chosen the practice of voting with my purchases… I feel a bit overwhelmed … I won't be able to purchase in a way that's contributing to the solution of ALL problems ... As a starting point I've designated food." (Day 1)

In the political food consumption context, the apps Buycott and Rank a Brand directed him towards responsible brands as the first set of actors to be enrolled: To "make informed buying decisions … Buycott lets you join 'campaigns', each campaign focuses on different aspects of just and sustainable purchasing" (Day 1), while "'Rank a Brand' ... give[s] you a ranking based on sustainability and social responsibility. The ranking goes from A to E, A is "shop away!" and E is "better put your wallet away" (Day 2).

In the previous findings section we had suggested that peaks in app agency might indicative of periods of heightened translation activity and for a sequencing of the larger learning projects in

several cycles of translations. Carlos' first translation cycle, was the Brands and Companies

Translation, as the apps Buycott and Rank a Brand supported his problematization process through

which what brand to choose became a morally meaningful matter of concern:

> "I'm just realizing how much power I as a consumer actually have and haven't yet learned
>
> how to yield that power responsibly ... changing from a "bad" company to a more responsible
>
> one" (Day 3).

Buycott served as an interessement device in the second moment of translation, by telling Carlos

which brands he could not purchase from, to disassociate his network from them as their

irresponsible practices contradicted his social values. Rank a Brand, on the other hand, provided

Carlos' responsible purchasing network with the competence to proactively identify brands

leading in responsible practices and to enroll them into his network through the purchase.

Mobilization took two forms. On the one hand, Rank a Brand's competence to personalize the

campaigns used for evaluating products made every brand evaluation an extension of Carlos'

personal values, from "environmental sustainability to LGBTQ rights" (Day 5). On the other

hand, apps and their carrier the smartphone literally served to mobilize responsible purchasing

competence network, "a good tool to have in my pocket" (Day 3).

Throughout the 21 days of his project, Carlos ran through two more translation cycles, each of

them centered on a different set of actors and moments of translation assuming distinct forms.

Translation cycles also differed in terms of the involvement of apps. The second cycle, the Breakfast

Products Translation (Day 5-9) was born in response to Carlos' feeling of being overwhelmed by the

variety of brands to be evaluated. It resulted in an attempt at focusing on consistently enrolling a

smaller set of actors, the products consumed as part of his breakfast: "Time to take some coordinated

action! I've laid out the five 'breakfast' items I'm gonna be focusing on" (Day 5). Carlos' main

aspiration during this cycle was to consistently purchase 'good' products by focusing on the more

limited variety of the breakfast products. Previously he had identified the practice of rushed shopping

as main threat to making good purchasing choices, "mindlessly picking up things at the supermarket

… in a rush" [Day 4]. Buycott's barcode scanning function served as an interessement device to

disassociate him from the mindless-shopping-enacting network. He prepared purchasing decisions by

scanning products in the freezer at home and used the scanning function in the supermarket to make ad-hoc informed decisions. The third cycle, Retailers Translation (Day 9-20), was induced by the need to identify a place where to buy pre-screened responsible products from responsible companies. During this cycle, app use was reduced: "I've not been using the apps ... and I don't think they could be of much help at this point" (Day 20). This increasing independence of apps in later translation cycles coincides with the decreasing intensity of app use across learners (see Figure 5 further above).

The previous description provides a sense of forward-movement, of increasing competence through extending the network. However, the sequence of translation cycles described here does not only unfold in forward translation enrolling the next new actors. It also translates backward, to maintain and reenroll existing actors as newly enrolled actors change the network's relations. For instance, while forward focusing on enrolling retailers as actors during the retailer translation, Carlos also translated backwards engaging into the Brand Translation. He checked the "Guten Tag" brand, which he had bought in Löwenladen, a local organic produce shop: "For each and every Guten Tag (and other off-brand products too) article I'll have to try to figure out who produces them and if they're worth supporting" [D12]. Such back-translations also provide an appreciation of the continued involvement of the apps' competence in enacting the responsible purchasing practices. Although Carlos mentions during the third translation cycle that the apps were of little help, the Responsible Purchasing Carlos network still relies on the apps' competence to disassociate or enroll suitable brands and products: To find out about the Guten Tag brand on Day 11, he falls back on checking it with Rank a Brand.

Scaffolding a Process Model of Learning as Translation

What we witnessed in Carlos' process repeats across learning projects. Learners did not learn in a linear fashion going in a straight line from little competence too much competence. They rather learnt sequentially in repeating learning cycles of translation. Each of these translations focused on making a different type of actor part of their responsible practices network. As mentioned above and in line with Laasch (2018), we use translation as a dual concept including learning as one coherent process as well as its sequential-iterative nature. For instance, Frank (shared mobility) ran through three

translations (each enrolling distinct key actors), the urban work commute (Stella sharing scooters/ Car2Go), the long-distance holiday travel (Train App/ BlaBlaCar carpooling), and the university inter-city commute (Subway, BlablaCar). Another example is Elaine (veganism) whose translations were breakfast (vegan breakfast ingredients), socializing in restaurants (friends, waiters, menus), healthy body (vegan sports personalities, health studies), and the family translation (parents, siblings, prejudices, French cuisine). Pairing these cross-case insights with the earlier findings, we can build a theoretical scaffold of a more generic learning as translation process model (lower part of Figure 6).

Through an actor-network lens, learners' translation processes are induced by a learning impulse that creates an initial tension leading to problematization. In our case this impulse is being challenged to enact a responsible practice as part of daily lives for 21 days. Learners enter into the first moment of translation by problematizing what is irresponsible in their current practices and why to engage in a new one. They identify a first (set of) actor(s) to enroll. Learners enter the interessement moment of translation as they disassociate actors from networks enacting irresponsible practices, enroll new key actors (enrolment), and customize the network to make it theirs (mobilization).

This first cycle of translation is likely to lead to an incomplete actor network incompetent to enact the new practice. This tension between the learner's network's current competence and the aspired competence goals leads into the next problematization moment. A new cycle of translation starts, but this time centered on enrolling distinct actors. This second cycle of translation, and every subsequent cycle of translation, consists of both forward translation and backward translation. Forward translation leads into future cycles and the enrolment of new actors with their competences. Back-translation aligns new actors and actors that were enrolled earlier creating coherence and a stronger relational interweaving of the network. Imagine the learner sitting at a weaver's loom, moving the weaver's warp back and forth between the threads. With every forward and back-translation, every back and forth movement in the emerging fabric, the leaners' competence to enact the practice increases. The heterogeneous network becomes more competent with every recurrent round of translation. Every new actor in the network and every new thread in the fabric adds to its overall size but also readjusts and pulls into place the already existing threads as it relates to them.

CONRIBUTIONS, DISCUSSION, AND CONCLUSION

We applied an actor-network perspective on learning to study the role of mobile apps in the learning of responsible practices. We conducted a longitudinal analysis of apps' role in the learning of 21 students' over a three-week period. We can summarize the apps' role in the learning process through three main findings. First, apps supported the learning process providing a variety of competences (Figure 3) across all four moments of translation (Figure 4). Secondly, app use was of highest intensity in the early stages of the project as it complemented learners' own competence enabling them to begin enacting the responsible practice. App involvement decreased as learners' perceived competence increased (see Figure 5). Third, we have seen how this learning evolved in a sequence of cycles of translation in each of which the role of apps differed. We further theorized by providing a scaffold of a process of learning as translation (Figure 6).

We contribute to the learning for responsibility literature by showcasing how situated learning may create real-life actor-networks enacting responsible practices 'in the wild'. We also provide hands-on materials for instructors on how to apply the learning method and assignment. A second area of contribution is to the emerging discussion on learning through an actor-network perspective, for which we provide the scaffold of a conceptual model of learning as translation which may be used to further develop a heterogeneous, human-nonhuman pedagogy. Finally, we also contribute to the mobile and actor-network learning literatures by offering a heterogeneous learning perspective: Learners engage with apps in the construction of networks of human-nonhuman actors, which are competent to enact new practices.

This paper's dominantly qualitative research design and the narrow context of learning of responsible lifestyle practices is both a limitation and a vantage point for future research. First, future research might go deeper into particular aspects of the learning as translation process, of particular competences and roles of apps in it, gaining insight into the magnitudes of apps' agency through quantitative research designs. Secondly, future research might probe the transferability of the learning as translation process to distinct learning settings, such as the classroom, or non-educational self-directed learning. This study was conducted in a unique small group of mainly German female learners, suggesting future studies transferring it to wider, less specific settings. We will now briefly

discuss the theoretical implications of this study and suggest additional further research directions for each discussion.

Learning for Responsibility as Performative Practice?

By illustrating how students constructed actor-networks for enacting responsible practices, we have showcased how learning responsible practices 'in the wild' can encourage students to construct more responsible realities. As they construct networks of responsible actors, key practices of their lifestyles change towards responsibility. Accordingly, their reality and that of the actors enrolled in these networks changes with it. This finding appears particularly meaningful considering the urgent mission of education for responsibility to create real-life change (e.g. Hesselbarth & Schaltegger, 2014; Nabi, Liñán, Fayolle, Krueger, & Walmsley, 2017; Swanson, 2004).

Typically, educational interventions are built on the belief that education for responsibility will result in change once students leave the classroom or finish their degree programs (e.g. Sandri, Holdsworth, & Thomas, 2018). Learning that creates students' personalized actor networks enacting responsible practices instead has an immediate 'world-making' effect. This construction of actor networks enacting practices as a new reality relates to the idea of performativity (Callon, 2007; Gond, Cabantous, Harding, & Learmonth, 2016), particularly to performative practices, a type of practice that makes new realities come true (Cabantous & Gond, 2011; Kornberger & Clegg, 2011).

Future research may explore the performative role of learning for responsibility bringing together recent advances in performative education (Fenwick & Edwards, 2013; Säljö, 2010) and in the corporate responsibility discussion (Ligonie, 2017). Such research might, for instance, compare the performative effects of distinct situated learning designs, such as action learning, immersed, or service learning (e.g. Fadeeva, Mochizuki, Brundiers, Wiek, & Redman, 2010). Further research may critically evaluate the performative nature of other popular, but non-situated methods, such as case studies, project-based, or problem-based learning (e.g. Dobson & Bland Tomkinson, 2012). Such an evaluation of different educational methods would shift the evaluation of their effectiveness from assessing knowledge about responsibility, to their effectiveness in creating new realities in the form of responsible actor networks.

Repositioning the Role of Apps in Learning

The conceptual development of heterogeneous learning and competence allows for re-conceptualizing the role of apps as learning actors exerting their own agency and inserting their own competences. The nuanced appreciation of distinct app agency types advances a pioneering series of publications studying mobile learning through an actor-network perspective (Thumlert et al., 2018; Wright & Parchoma, 2011; Wright & Parchoma, 2014).

The related processual lens of learning as translation provides a middle ground between the extant extreme perspectives on the role of apps either as passive tools offering affordances to be used by learners (Cochrane & Bateman, 2010; Lai, Yang, Chen, Ho, & Chan, 2007; Park, 2014), or the technological deterministic perspectives in which apps determine what learners can do (Kucirkova, 2014; Melhuish & Falloon, 2010). The novel concepts of heterogeneous learning and competence operationalize previous studies of teaching and learning through an actor-network perspective (Fenwick & Edwards, 2010; Fox, 2009; Thumlert et al., 2018; Wong & Tatnall, 2010; Wright & Parchoma, 2014).

Future research in this uncharted territory should study the networked dynamics between human and nonhuman (particularly mobile apps') competences throughout the learning process: Under what conditions and through what mechanisms does app competence transfer to human learners' individual competence? How and when is the nonhuman app competence transferred to other nonhumans? How may apps' characteristics restrict learners' competence acquisition, and therefore hinder network learning?

Towards an Actor-Network Pedagogy?

We have seen how apps, other nonhuman actors, and human actors were assembled to pool complementary competences to enact practices. Only few of the competences were of a cognitive nature. Accordingly, learning from an actor-network perspective differs considerably from the received cognitive view on learning.

An actor-network perspective on learning for responsibility responds to the repeated call for more holistic or transformative pedagogies that go beyond the cognitive dimension (Laasch &

Moosmayer, 2015; Montiel, Antolin-Lopez, & Gallo, 2017; Sipos, Battisti, & Grimm, 2008). Also, the heterogeneous nature of competence embodied in actor networks broadens the understanding of recent advances in individual competences (e.g. Osagie et al., 2016a; Osagie, Wesselink, Blok, & Mulder, 2016b; Pohling et al., 2016; Wiek, Withycombe, & Redman, 2011), to a relational (human-nonhuman) understanding of competence.

These unusual features of learning seen from an actor-network perspective have disruptive implications for pedagogy. A variety of questions for further research can be aimed at shaping a coherent actor-network pedagogy: How to use devices (technological or not) inside and outside the classroom? How to effectively foster actor-network construction and to induce processes of learning as translation? How to conceptualize and facilitate nonhuman actors' learning? How to assess and evaluate learning outcomes of an actor network? Further research addressing such questions may build on both recent advances actor-network pedagogy (Fenwick & Edwards, 2010; Fox, 2009; Thumlert et al., 2018), and on perspectives on teaching and learning in the philosophies underlying actor-network theory (Deleuze, 1968 [2004]; Whitehead, 1927/1928 [1985]).

Conclusion

We started from Carlos' attempt to learn responsible consumption in engagement with his breakfast and his app. This example led us to a sociological approach to learning that is radically different from dominant psychological learning approaches. It shifts the focus from what's happening in learners' heads to what's happening in learners' networks. Actor-network theory offered a theoretical basis for this exploration – an exploration that was substantially motivated by the topic of the thematic symposium, There's an App for That! Apps play a crucial role in our lives today. We have to learn to use apps, and apps help us learn through interaction with our increasingly connected world. In order to remain relevant for these kinds of learning processes, we as educators need to get a better understanding of what's happening between Carlos, his cereals, LGBTQ+ rights and his app. Our paper aimed to take a first step in enabling educators to enhance the competence of their networks to facilitate and support Carlos' and his peers in learning with their apps out there in the wild.

Ethical approval: All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed consent: Informed consent was obtained from all individual participants included in the study.

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Figure 1 Moments of Learning as Translation

3. Enrolment

How to define and coordinate the roles of actors?

Actors have to be given a role in the emerging actor network. Their role has to be defined according to the network's aspired enactment. The role is what each actor can contribute to the network.

Learners assemble their actor network, altering their and the network's competence as they access and enrol key actors and their competences.

4. Mobilization

How to become a 'spokesperson' representing the network?

To mobilize a complex network of many actors means to have them represented by few actors, which in turn requires a high degree of agreement and alignment between actors so that they can be represented by few 'spokespersons'. This agreement may be betrayed when controversies emerge.

By aligning and changing actors to more closely correspond to learners' personal style of enactment, learners become the network's spokesperson.

2. Interessement

How to disassociate actors from competing networks?

Actors may already be enrolled in other, possibly competing networks. Translation requires to disassociate (Latin inter-esse='to be in-between') them from the inhibiting effect of the roles in competing actor networks.

Learners require time and space to recurrently engage in processes of persuasion with key actors.

1. Problematization

How to become indispensable for key actors?

The initial purpose of enactment of the network is defined. If the network and its purpose becomes an 'obligatory point of passage', 'indispensable' for all key actors to achieve their own purposes, they will enact it.

Learners' processes of learning-goal definition, and/or identification with goals, is their problematization involving the understanding of key actors and of their competences.

Learning impulse

Figure 2 Course Sequencing with Integrated Longitudinal Deep Case Data Collection Design

Figure 3 Types of App-Agency and Competence

1st order themes	2nd order themes	Aggregate dimensions

- Background information (C1.1)
- Targeted information (C1.2)
- Trustworthy information (C1.3)
- Keeping up-to-date (C1.4)

→ Informing (C1)

- Ranking alternatives (C2.1)
- Decision making (C2.2)
- Triggering thinking (C2.3)

→ Analysing (C2)

Cognitive (C)

- Affording action (A1.1)
- Ad-hoc action (A1.2)
- Reminding of action (A1.3)

→ Initiating action (A1)

- Organizing action (A2.1)
- Process guidance (A2.2)
- Routinization (A2.3)

→ Ongoing action (A2)

- Envisioning action (A3.1)
- Extending existing actions (A3.2)
- Recommending new actions (A3.3)
- Facilitating experimentation (A3.4)

→ Future action (A3)

Action (A)

- Getting to know new people (I1.1)
- Trust building (I1.2)
- Co-action (I1.3)

→ Enabling relationships (I1)

- Socializing (I2.1)
- Accessing others' experience (I2.2)
- Broadcasting actions (I2.3)
- Feedback (I2.4)

→ Human exchange (I2)

- Benefitting others (I3.1)
- Activism (I3.2)

→ Impacting others (I3)

Inter-personal (I)

- Self assessment (P1.1)
- Shocking (P1.2)

→ Oneself in context (P1)

- Meaning making (P2.1)
- Fostering compassion (P2.2)

→ Empathy & meaning (P2)

- Motivating (P3.1)
- Emotional wellbeing (P3.2)
- Tracking behaviors and goals (P3.3)
- Self-discipline (P3.4)

→ Personal support (P3)

Personal development (P)

- Accessing material actor (M1.1)
- Anthropomorphization(M1.2)
- (Re)Shaping apps (M1.3)

→ New actors (M1)

- App network (M2.1)
- Accessing local materials (M2.2)

→ New networks (M2)

- Channelling resources (M3.1)
- Hardware functions (M3.2)
- Blended online-offline action (M3.3)

→ Virtual-material (M3)

Material (M)

Figure 4 App Agency across Moments of Translation

3. Enrolment (Enr)

How to define and coordinate the roles of actors?

Apps' role: Apps enabling the relationship building and interconnectedness between heterogeneous actors together enacting responsible practices.

Salient app themes: Accessing local materials (M2.2), getting to know new people (I1.1), app network (M2.1), trust building (I1.2), trustworthy information (C1.3), co-action (I1.3), channeling resources (M3.1)

4. Mobilization (Mob)

How to become a 'spokesperson' representing the network?

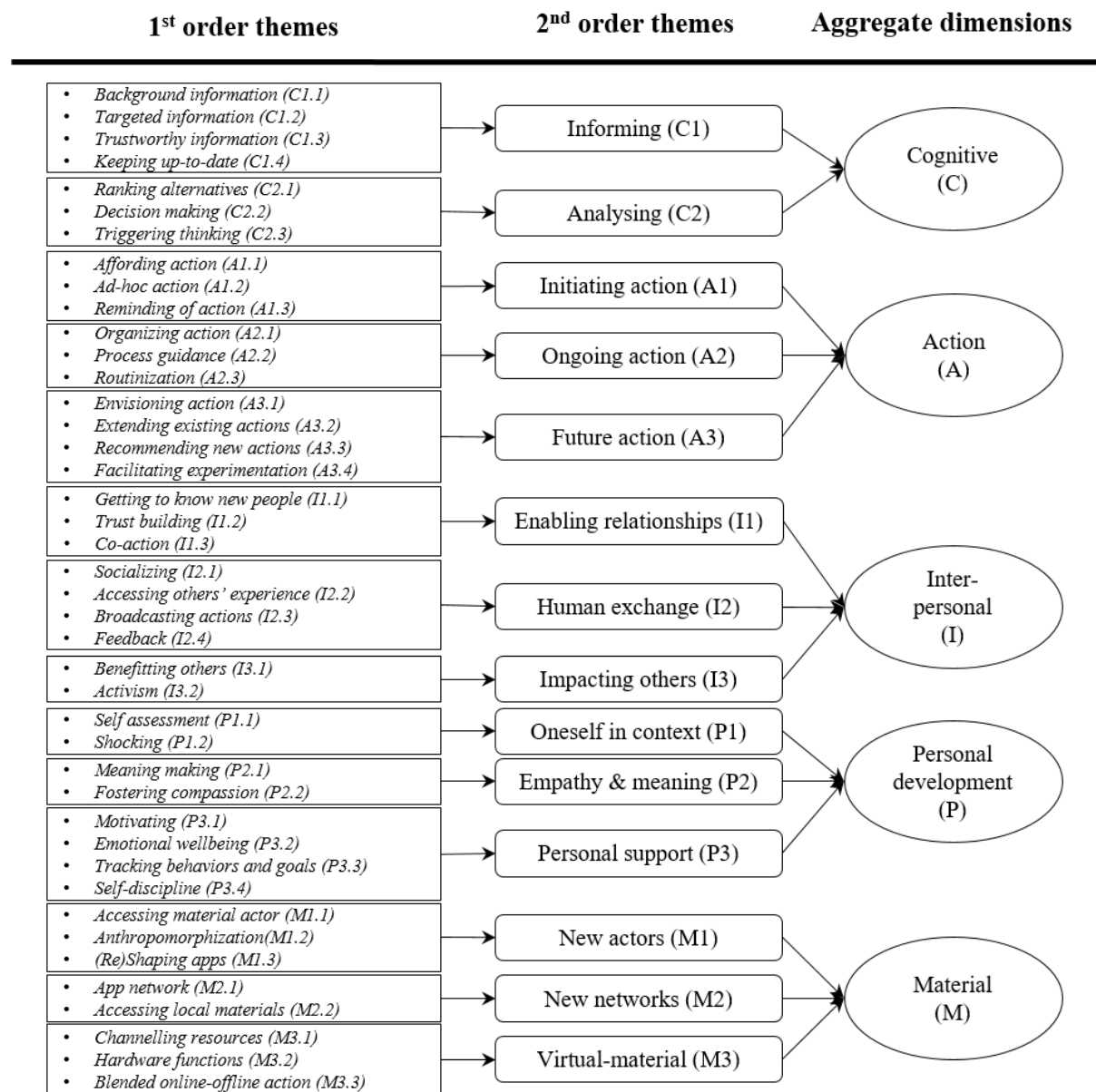**Apps' role:** Apps allow learners to customize and shape the network according to their preferences. Apps may also foster emotional ties with the network and its enacted responsible practice and make it literally mobile in the form of the mobile phone as app/network access point.

Salient app themes: (Re)shaping apps (M1.3), ranking alternatives (C2.1), recommending new actions (A3.3), facilitating experimentation (A3.4), self-assessment (P1.1), fostering compassion (P2.2), tracking behaviors and goals (P3.3), activism (I2.3)

2. Interessement (Int)

How to disassociate actors from competing networks?

Apps' role: Apps and their functions often serve as interessement devices, disassociating core actors to be enrolled from competing networks of irresponsible practices.

Salient app themes: Activism (I3.2), co-action (I1.3), ranking alternatives (C2.1)

App-enabled learning assignment

1. Problematization (Prob)

How to become indispensable for key actor(s)?

Apps in moment: Creating the competence network becomes an obligatory point of passage for the learner, as key actor of the responsible practice network to be created.

Salient app themes: Shocking (P1.2), meaning making (P2.2), background information (C1.1), accessing others' experience (I2.2),

Figure 5 Use of Apps and Perceived Competence over Time

Intensity of app mentions per day

Perceived competence in weekly surveys

Figure 6 A Process Model of Learning as Translation

i) Translation(s) of the Political-Consumption-Carlos network

ii) Generic learning as translation(s) process

APPENDIX

Project Assignment

Assignment Instructions for Leaners. The seminar "Living 'the good life': Sustainable, responsible and ethical lifestyles in theory and practice" is centred on an experiential learning project (https://en.wikipedia.org/wiki/Experiential_education), which will be carried out before we meet in person during the three day seminar. Your experience with living practices related to a sustainable, responsible or ethical lifestyle over a period of 21 days will be the core piece of your learning. In preparation of our seminar, I would ask you to please do two things:

1) **Understand the assignment:** Please attend the brief introduction session on Skype. It will serve to give you further instructions regarding the experiential learning project, to discuss your more detailed and personal questions, and to get everything ready for your learning project to start.

2) **Choose a learning project:** Your experiential learning will be guided by the use of a smartphone app (e.g. for saving energy, sustainable transportation, eating vegan,…). Please have a look at the indicative list, which outlines areas of practices and exemplary apps, chose one topic and a learning goal you want to achieve.

3) **Get the app ready:** Download a relevant app you would like to use. Please make sure it works on your phone. Once you have done so, please let us know which topic, app(s), and learning goal you have chosen. To ensure variety, there will be only one student per topic. First come first served.

4) **Start your learning journey**: Start your learning diary in your personal (you and the course instructor have access) password-protected blog site (https://liveagoodlifeweb.wordpress.com/about/). As first diary entry, please mention A) the practice you have chosen (e.g. climate friendly personal transportation, or using sustainable cosmetics) and why you have chosen it B) the app(s) you intend to use and why C) your 'competence goal', (e.g. "I want to be competent to have zero-carbon impact from my transportation", "I want to become competent to use only sustainable cosmetics").

5) **Daily reflection on your learning:** Every day for 21 days, reflect on your learning practice in brief daily entries each of at least 150 words length. These should cover contents from the following themes:

   a. **Experience:** Your recent activity and experience related to your practice and app(s).

   b. **Learnings:** *What* learning and/or development have you achieved through this experience? If you think you haven't learnt anything during the last day, reflect about why not.

   c. **Learning events:** *How* have you realized this learning? For instance, you could describe an anecdote of an 'aha moment' or of an event that made you learn.

   d. **Others:** Whatever else you consider worth mentioning.

6) **Final reflection and presentation:** Summarize your learning experience in a final blog entry, which also serves as the basis for your presentation during the face-to-face seminar. Make sure its contents cover your experience, learnings, learning events, the role of the app, recommendations for fellow students who might want to learn to practice the same lifestyle, and how you could apply the lifestyle in your future professional life.

Instructor Note. We recommend instructors who want to apply this assignment in their courses to familiarize themselves with the principles of the following related methods:

- Experiential learning (Kolb & Kolb, 2005; Lai et al., 2007);
- situated in real-life immersions (Anderson, Reder, & Simon, 1996; Lave & Wenger, 1991);
- relying on self-directed learning (Candy, 1991);
- in a flipped classroom design (Bishop & Verleger, 2013; Roehl, Reddy, & Shannon, 2013; Tucker, 2012).

Given the self-directed nature of the assignment, the instructor provided a list with areas of responsible practices, and potentially helpful apps, but left the final choice of which apps to use and of the particular learning goal to the student. Vetting apps' quality and their usefulness for the learning process was not a preparation of the learning process, but a continuous aspect of the learning process itself.

A key aspect for this learning design to be effective is the instructor's assumption of an enabling role who supports learners to set up their learning projects before the first day of the project. From Day 1 one the instructor becomes a vigilant observer leaving students to their steer their own learning process. The instructor is meant to only intervene when it becomes necessary in order to ensure that the learning and reflection process remains ongoing.

The reflective diary is the instructor's core instrument for fulfilling this role. A good practice was to touch base in a non-judgmental way with learners who had not written a diary entry for at least two days. Such messages' content was aimed at positively reinforcing learners' past reflections and asking them to continue the story.

The unusual nature of the educational design might also lead to occasional challenges. For instance, one student resigned from the course before it started as she believed a sustainable life is one lived without a smartphone and learning practices with a smartphone was against her values. Some students first were afraid that travel or personal commitments (e.g. weddings, peak times at work) might be make the interruption of their learning project necessary. However, they were able to integrate their responsible lifestyles learning into these important episodes of their lives; after all that is what the learning project is meant to be about.

Table A. 1 Overview of Learning Projects

Name, practice	Competence goal	Apps	Web-resources
Alina, swapping things	To become competent to swap and exchange products in my everyday life more often than buying new	shpock, kleiderkreisel	Facebook group "Free Your Stuff", Google, clothing recycling NGO websites, specialized recycling websites
Aurelie, ethical decisions	To be aware of the ethical decision in the daily routine, find a balance, and try to call more and more people into question	Making an Ethical Decision (Markkula)	Online newspapers (e.g. slate.fr, dreuz.info, thelocal.fr), NGO websites (e.g. http://www.greenclimate.fund), personal development websites (e.g. http://www.empathguide.com), Blogs (e.g. http://gatesofvienna.net), YouTube, Google, own blog
Carlos, responsible consumption	Identifying companies with particularly harmful or responsible practices to make more informed choices	Buycott, Rank a Brand	Google, company sustainability reports, company websites, supplier codes of conduct
Charlene, fair fashion	To deal with the chapter clothing so that my behaviour is fair to the producers and to the Environment.	Fair Fashion?, der nachhaltige Warenkorb, Good on You (GOY), Rankabrand, Kleiderkreisel	Fashion blogs, Wikipedia, Tchibo Social and Environmental Code of Conduct, Tchibo homepage, recycling page Fairwertung
Christy, zero-waste consumption	To produce zero-plastic-waste when it comes to food and learn no-waste options to all the waste I produce	Instagram, Pinterest, Farmstand	Plastic consumption websites
Elaine, veganism	To become a vegan person without feeling "restricted", or increasing my food budget, while eating as deliciously	Food Monster, IsItVegan, HappyCow	Food sustainability documentaries online (We feed the World, Food Inc., The Cowspiration, Fast Food Nation, The world according to Monsanto), vegan websites (e.g. https://www.vegansociety.com), technical terms overview online (https://www.happycow.net/files/ingredients-to-avoid.pdf.), vegan movie Forks over Knives, online articles

Emily, zero palm oil	To be able to stop my usage of palm oil products	PoP – Produkte ohne Palmöl- ZERO, GoodGuide	
Frank, shared mobility	To use a shared mobility service every time I would normally use my own car	Moovel, Stella, Car2Go, BlaBla Car	
Heidi, combatting slavery	To be able to combat modern day slavery and child labor through shopping	The Anti Slavery App, LabelOnline, Buycott	Slaveryfootprint.org, Made in a Free World website, Google, brand websites (Birkenstock, H&M, Only, Oreo)
Ina, sustainable seafood	To either eat sustainable seafood or quit eating seafood altogether	The Good Fish Guide, WWF/ Greenpeace Fischratgeber	Online documentaries, online articles, followfish label website, online interviews
Irene, protecting water	To be competent in using as little water as possible and to support business practices that are like-minded	Water Use Calculator, Dropcountr, H20 Tracker	websites on saving water, rodalesorganiclife.com
Jada, slow life	My absolutely competence goal is to slow my life down.	Slow Food Planet, BlaBlaCar App	
Jenny, healthy living	I want to be able to live a healthier lifestyle.	Mein Wasser, Smartwatch app, Breathe, GYMONDO, Pinterest	
Jeremy, recycling	Pick up one trash part belonging to one of the six categories (bottle/can, plastic bottle, plastic/vinyl, tobacco, burnables and non-burnables) a day	Pinterest, Recyclart, PIRIKA, WhatGoesWhereRecycle	
Julie, eating for good	Competent to use healthy and sustainable food for a good cause	Share the meal, Lifesum, MyFitnessPal, Kitchen stories, runtasty, eat smarter, hippie lane, non- GMO project shopping guide, healthy food, true food, code check, fruit checker"	Google

Lara, supporting sustainable development goals (SDGs)	To become competent in supporting the four goals I chose in my personal situation and to act (goal 4: quality education, education, goal 10: reducing inequality, goal 12: sustainable consumption & production patterns, goal 16: peace, justice).	ODS in Action, Amnesty Mag, Zeit Online App	Thesustainery.blogspot.de, change.org, compact.de, TED talks, utopia.de, Leitmedien.de, Facebook, Frankfurter Allgemeine Zeitung (newspaper), website Ability Watch
Lilly, vegetarianism		Green Kitchen, Chefkoch	
Lola, sustainable beauty	To be competent to use only cosmetics that fulfill my criteria for being a sustainable, environmentally friendly and healthy product.	Codecheck	Drugstores' online websites, online stores, labels' websites, brand websites
Penelope, mindfulness	To meditate every day to train the spirit and manage the anxious nature in order to become a better person and to better understand our world	Downdog, Daily Yoga, Mind, Zenfie, Breathe	Online lectures
Sarah, a good deed a day	Competence to intentionality do good and become more aware of the needs around me.	Instagram, Calendar for Good, Act	Facebook
Tabea, regional consumption	Recognize seasonal and regional groceries and substitute the worst goods for better options	Food Miles Footprint, Der Saisonkalender	

ENDNOTES

[i] Student names are anonymized and presented with a phrase describing the responsible practices they learn.

[ii] However, there are also a variety of limitations and user complaints about apps limiting their usefulness (Khalid, Shihab, Nagappan, & Hassan, 2015; Park, 2014). Also, apps' typical short-term usage brings challenges (Henze, Pielot, Poppinga, Schinke, & Boll, 2011).

[iii] Student diaries and surveys were not only a means of data collection but also fulfilled the equally important pedagogical function of providing reflective spaces, a key element of self-directed learning projects.

[iv] The analysis of data relied on unique techniques and methodological assumptions of theories of practices and of actor network theory. These included a flat ontology (Latour, 2005; Schatzki, 2016), avoiding hierarchies and ex-ante dualisms (McLean & Hassard, 2004), and analytical practices of zooming in and out as well as punctualization and blackboxing (Cressman, 2009; Law, 1992; Nicolini, 2009).

[v] Repeatedly we found mentions of what apps did *not* do. One might consider such app limitations as impediments to the learning process. However, our reading of most of these instances is that app limitations prompted students to engage in further construction of their actor network by enrolling for alternative apps or actors with the required competence.

[vi] See particularly the works of Deleuze and Whitehead (DeLanda, 1998; Deleuze, 1968 [2004]; Whitehead, 1927/1928 [1985]).

[vii] Lilly (vegetarianism) and Carlos (responsible consumption) did not mention the app in the last week of their projects, making it reasonable to assume that the app had not become a permanent part of their heterogeneous competence.