Impacting Mindset and Innovation on Sustainability via Global Thematic Hackathon

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Abstract:
Innovations related to social, economic and environmental grand challenges are common targets for societies as a whole, but also to universities and business schools in them. The paper studies an example how an intensive intervention via a local implementation of a global 3-day design hackathon (ITFP = Invent for the Planet) on global needs has impacted participants' understanding and motivation towards sustainability issues and solving them. The paper approaches the research objective by studying via qualitative research approach the motivation letters the participants submitted when applying for the event, learning outcome report immediately post-event and their self-reported orientation to the issue area one month post-event. In addition, views of impacts were collected from the local facilitators and coaches to reflect their considerations to the views of the learners. The theory base of the paper discusses the approaches and models of behavioral change (nudging, planned behavior, functional triad etc.). The analysis offers insight whether short-term interventions can have an effect to a sample that is already exposed and interested in the topic since a course is a non-obligatory element of studies for all participants (from both business and engineering schools).

1. INTRODUCTION

Integrating issues in sustainable development (SD) is a relevant topic in higher education today and, increasingly, higher education institutions (HEIs) attempt to take a role as promoting agents of SD principles (Ramos et al., 2015; Stough et al., 2018). HEIs contribution to the transition towards a more sustainable society can be divided to: 1) creating knowledge that can be transferred to the society, and, also, 2) preparing their students to take their future role in society needing sustainability (Stough et al., ibid.). Leal Filho et al. (2016) propose that to address these two potential areas of impact, higher education institutions should find new ways and methods that cross the boundaries of curricula of disciplines and are project-based. Typically transdisciplinary approach has been embraced within sciences (e.g. within engineering science), but crossing the boundaries between sciences such as technological, social and humanities has been more rare (Tejedor et al., 2018).

Parallel to the growing volume of sustainability-addressing programs and projects in HEIs another phenomenon of fast-paced innovation events a.k.a. hackathons has emerged. A hackathon is an event (Kolog et al., 2016) where students and subject field specialists collaborate intensively in teams with the aim to create and design novel solutions to a given task in a limited time. This type of learning is seen to be inquiry-based and student centric (Kienzler and Fontanesi, 2017) with potential to stimulate and maintain students' interest to the subject area (Abdullah and Mtsweni, 2015).

The two phenomena of learning settings have - not surprisingly – occasionally merged. One implementation of an event with sustainable development content and hackathon process is Invent for the Planet (IFTP), developed at and facilitated by Texas A&M University, that reached in 2020 more than 25 universities across continents and timezones.

This paper studies the motivations to and impacts of a sustainability-oriented global innovation event and more precisely one local implementation of it. The units of analysis is thus the event and its impacts as perceived by the student participants pre- and post-event as well as the viewpoints of the facilitators of the learning process.

Research questions set for the study to reach abovementioned objectives were:

- What are the origins and direction of motivation for students to apply to a sustainability-oriented specific study unit?
- What are the learnings students self-assess to have gained from a team-based, sustainability-oriented intensive study arrangement?
- How do the learning support staff (facilitators and coaches) depict the potential outcomes of the study unit to various stakeholder groups/levels of impact

2. LITERATURE REVIEW

2.1 Theories on impacting behavior

The issues related to environmental concerns and initatives are available in width and depth. But, as Ölander and Thøgersen (2014) claim: "Information has not been proven a very successful means to promote voluntary behaviour change to protect the environment." One societal response to this difficulty would naturally be establishment of norms and punishments of breaking them. This, however, may need sacrifice of motivation based on making personal choice. In "libertarian paternalism" –driven societies the concept of *"nudging"* refers to steering individual towards a decision without breaching their free choice (Cohen, 2013). The individual choices would then create "an informed consent" (ibid.).

An alternative approach in acting for behavioral change is that of "planned behavior", in which paradigm a central factor is the individual's intention to perform a given behavior. Intentions are assumed to contain the motivational factors that influence a given behavior; they indicate "how hard people are willing to try, of how much of an effort they are planning to exert, in order to perform the behavior" (Ajzen, 1991). Thus, by affecting intentions the behavior can be altered. However, not all intentions are carried out to action; some are abandoned while others will be revised to make them fit to changing circumstances (Ajzen, 1985). To affect to both intensions and their deployment into action interventions are introduced. The achieved effects of interventions vary a lot from modest to strong – depending on both the context and type of interventions. As Steinmetz et al. (2016) state: To produce an intention to perform the behavior, the intervention must target many facets such as behavioral, normative, and control beliefs that will determine the final behavior of interest.

The concept of functional triad was created by Fogg (1998) for a construct for improved persuasion. Persuasion attempts to steer others toward the adoption of some intended (by the persuader) behavior via a reasoning process (Reardon, 1981). Fogg's original field of triad application was that of computer systems, but since the introduction the functional triad has been applied to various instances and areas of behavioral change e.g. Robinson et al. (2017) for impacts of professional competences in health. As the name of the model hints, there are three elements that affect to persuasive capacity of a "system". The first dimension of functional triad is its role as a tool.). Tools deployed can provide information that enables improved decision-making (Xiao & Benbasat, 2007) and/or shapes mental models of individuals using the tools (Mutschler, 1990). The second triad role in impacting behavior is media. As media, systems can create persuasive experiences, as symbolic media for presentation of information or as a sensory media for experiencing the information. Thirdly, a system can be seen as a social actor with which people interact. The original Fogg's social actor role for a system was based on "Computers as Social Actor" (CASA) approach (Reeves & Nass, 1996), which suggests that people attribute social characteristics to (computing) technologies, when those are perceived to contain and reflect features associated with human (social) behavior (Xu et al., 2018). Xu et al. (ibid) focused their study to the receiving end of the persuasive system. They perceived Functional Triad on the following 3 outcomes: (1) persuading users to use a system, (2) persuading users to follow the proposal based on the outcomes of the system and (3) persuading users to recommend the system to others. In the last respect, the behavioral change is expected to be able to radiate outside the boundaries of the actors directly impacted by the triad.

The intervention under study had at its face elements of nudging instead of norming, planned behavior in its aim to turn intentions into action and a system with embedded structure, information and communication. The potential applicability of these three paradigms made the IFTP event a meaningful unit of analysis for the paper.

2.2. Impacting sustainability behavior

Despite the widespread familiarity of challenges in sustainability a low level of sustainability-enhancing behavior may prevail (Marcell et al., 2004; Eagle et al., 2015). Pappas and Pappas (2015) claim that a truly successful stance to sustainability may lead to successful behaviors becoming personality characteristics. Their research indicates that students' desire for integrity and individual value consistency mean that short interventions may precipitate a lasting behavioral or values change (ibid.). Findings by Whitley et al. (2018) indicate that one's values matter in environmental decision-making, but different values are associated with different behaviors. Those with altruistic values are more likely to engage in a range of sustainability behaviors than the ones with egocentric values. For those with the sustainability orientation, the Value-Belief-Norm theory models the pathway between values and behavior.

Godfrey and Feng (2017) remark that communicating sustainability challenges and solutions do not suffice to change for sustainable practice. Consumption patterns did not change significantly as result of the university wide sustainability campaign, as the observed students opted for less sustainable choices due to time-pressure and convenience (ibid. The information-oriented structure commonly used in environmental education assumes that symbol-based knowledge directly leads to motivation and action but often fails to create a lasting impact on behavior (Dutta and Chandrachekaran, 2018). Initiatives based on practices and actions in the world have been more successful in creating transformative behavioral changes. (ibid.).

2.3. Contests and hackathons as methods of learning and behavioral change

Arranging learning opportunities in a competitive setting has been both practiced and studied extensively, to the point that is has been described a method of its own right, Competition-Based Learning (CnBL). CnBL is a methodology where learning is achieved through participation to a competition, but the learning result is independent of the success in such a competition (Johnson, Johnson and Stanne, 1985). CnBL can naturally be combined with other learning methodologies as Project-based learning (PBL). Burguillo´s (2010) empirical study on CnBL impacts on learning indicated that "the use of friendly competitions provide a strong motivation that helps to increase the student performance". Among the advantages of the competitive learning approach Burguillo (ibid.) cites interactivity, collaborative work inside the group, active participation, challenge vs. duties, and increased motivation for the students as they can explore their own topics.

Innovation competitions have also been used and discussed for industrial practice. MacCormack et al. (2013) from MIT Sloan School of Management propose that the edge of innovation competitions is in their ability to attract a variety of nontraditional solvers to the challenges. While (ibid.) nontraditional participants tend to perform worse than the traditional experts who work in an industry, competitions are able to induce greater variation , creating the possibilities that the "best" submissions with novel angle will outperform the more traditional approaches.

One specific form of learning via competing is a hackathon, in which "participants will self-organize and develop meaningful projects through structured communications" (Duhring, 2014). This typically happens in a tight timeframe of two to three days. The benefits – for the organizers - of the pace and format are proposed to be accelerating early innovation, moving quickly from ideas to first prototypes, getting diverse people onboard (Frey and Luks, 2016) as well as creation of common social knowledge and goals (Trainer et al., 2016). There might be also setbacks since the very constrained format of the events, in time and methodology, may limit the contributions to be often similar and not so innovative (Rey, 2017). Motivations and outcomes for the participants can be intangible or tangible. The first category includes the thrill of competing, the love of pastime, the passion for a cause and the potential reputational effect from participation and performance. On tangible side the winning/prize legitimizes a pursuit of a solution to the problem(s). Overall, well-designed and well-mentored competition can help participants build skills and expertise. These "softer" motivations outweigh the financial incentives for many participants. (MacCornmack et al., 2013).

2.4. Invent For The Planet – the event under study

The overall aim of ITFP is to form teams based on similar interests in a global sustainability need statement. The global facilitators to the event published the need statements (problems to which solutions were sought) to the facilitators for the orientation one week prior to the event, and the facilitators passed them to the accepted

students 4 days before the event, for individual choice and teaming up (virtually) with peers interested in the same topic area. The teams then research the topic and come up with a plan and build a simple prototype within 48 hour timeframe. (TAMU, 2020).

The process then proceeds as follows: (TAMU, ibid.) At the end of he 48-hour hackathon each team presents to a panel of local judges. Three teams are chosen for first, second and third place prizes. The first-place teams from each university will then have a week to perfect their presentation and submit a video that will be judged remotely by a global network of facilitators and narrowed down to a final five. Those five teams will visit Texas A&M University final event to pitch their idea against each other, for a chance to be named the first-place winner overall!

The 14 needs statements in the 2020 IFTP event covered issues on all three basic pillars of sustainability: Environmental (e.g. the plastic pollution of oceans, bushfires), Economical (e.g. matching economic growth with energy sustainability) and Social (e.g fake news, innovative parenting, coronavirus epidemic). The themes were further divided into subsections of Environment, Digital Technologies and Environment, Safety, Humanity, Aviation, Communications and Information Technology.

The five student teams of JAMK University of Applied Science worked on the following 5 need statements:

1) Ocean trash heaps (environment)
2) Preventing injuries of distracted pedestrians (safety)
3) Australian Bush-Fires (environment)
4) Waste management in aviation industry (aviation)
5) Seamless air travel (aviation)

3. RESEARCH METHOD

The research method applied to this paper was of qualitative and interpretive nature. Qualitative approach was chosen partly due to the amount of potential respondents: The 2020 implementation at the university in scope was consisting of 16 students across yearly cohorts and disciplines. The student body consisted of participants from 7 nationalities, on top of which the 6 persons involved in facilitating the process and supporting the student teams consisted of 3 different nationalities. Thus, the small sample size would not have allowed a full scale of quantitative analysis with statistical significance. In addition, the cross-cultural and cross-disciplinary nature of the respondent pool could have led to differing interpretations of the respondents if subjected to a closed multiple-choice survey questionnaire. Instead, the participants wrote :1) short open-ended motivation letters to support their application to the event one month prior to the event .2: Reports of their learning outcomes immediately after the event. 3) Assessments of potential impacts of the type of programs they participated to different stakeholders and layers (society, school, career, personal). The impact assessment was also sent to the facilitators and coaches of the event for comparison to students' views. As the respondents were able to express themselves in their natural manner, the interpretation of their intended meanings was left to researchers, that is a basic tenet of qualitative (interpretivist) research.

The data collected was subjected to thematic content analysis. The themes were sourced from the prior-art literature on learning impacts, behavioral change and education for sustainability – added with a themes arising from the data itself. Once the themes were defined, a vocabulary for each theme was created to be used for content analysis, which aimed at recognizing patterns of thought between respondents as well as disagreements within the respondent group and potential discrepancies between the student vs. learning support group.

An example of theme-vocabulary structure used in content analysis:

Themes of Learning Outcomes	**Words categorized to the theme**
Collaboration	together, group, team, people, joint, cooperate, collaborate
Challenge	contest, competition, winning, needs, problems, challenge
Communication	presenting, sharing, showing, talking
Creativity	innovation , create, new, idea, solution, prototype
Crossculturality/-disciplinarity	diversity, different, studies, country, culture, international, (a)cross

Career	useful, future, work, career

The findings of content analysis are presented in the results as word clouds for their communicativeness as well as summary tables. In addition, a graphical illustration showing the perceived benefits of such events for entrepreneurship – views from participants vs. facilitators – is shown.

4. RESULTS

The motivation letters (16 pcs) that the students wrote as part of their individual application to this study unit (that belongs to the category of optional studies for all programs at the university) were analyzed for their content per teams.
First, Figure 1 below offers an overview of the motivation letter contents in form a word cloud.

Figure 1: Overview of contents of pre-event motivation letters (word cloud).

Table 2 below summarizes the most common themes in the motivation letters. The themes appear in the table in the order or their appearance in the individual motivation letters i.e. if a theme was repeated in the same letter, the repetitions did not count for the analysis. The motivational issues were divided into two baskets: 1) Sources of motivation = which prior actions, attitudes and values were addressed 2) Orientation of the motivation = which usage value the respondent addresses to the event on offer.

Table 2: The most common themes in the pre-event motivation letters

Motivational Sources (context)	**Motivational Orientation (utility)**
team work	innovation process learning
issue importance	preparing for future
values	cross-disciplinarity
earlier practice with the issue area	team process learning

Next, the self-reported learning outcomes (15 reports) were analyzed. The assessments were done immediately post-event as a free-format text as part of study unit completion (not affecting the grading, that was pass/fail for the whole study unit. Figure 2 illustrates the content of reported learning outcomes as a wordcloud.

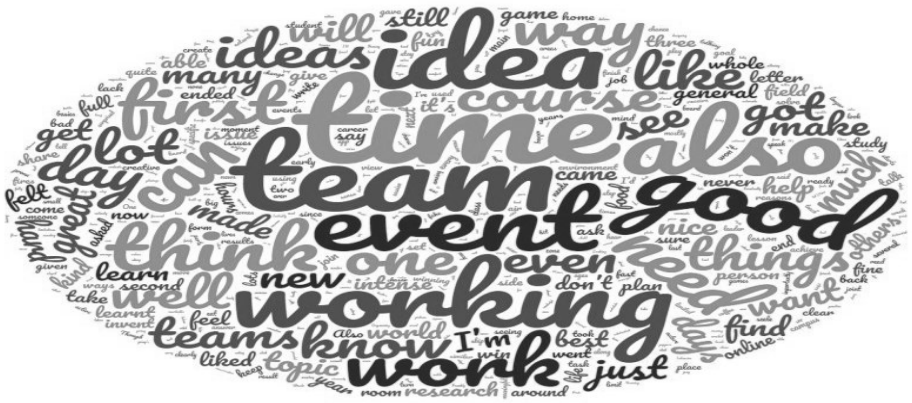

Figure 2: Learning outcomes as a wordcloud

Table 3 summarizes the content of learning outcomes –assessment across themes.

Table 3: The themes of learning outcomes with examples of expression

Most common themes of Learning Outcomes	**Density of theme vocabulary across 15 individual reports** (the most common expression **highlighted**)
Collaboration	together (7), group (7), **team (14)**, people (12). joint (2), cooperated (1), collaborated (1)
Challenge	contest (1), competition (7) , winning (9), **needs (12)** , problems (6), challenge (3)
Communication	**present (9)**, share (4), show (3), talk (6), discuss (3)
Creativity	innovation (5), create (10), new (10), **idea (14)**, solution (10), prototype (5)
Cross-culturality/-disciplinarity	diversity (1), **different (8)**, studies (2), countries (3), cultures (5), international (3), (a)cross (3)
Career	useful (2), future (4), **work (6),** career (3),

The models of affecting behavior from the literature review were the additional lenses though which the content analysis of the process was conducted.

Table 4: Practices across the models of behavioral change

Behavioral Change type	**Practices within the study unit/event**
Nudging	inviting voluntariness asking for motivational context and learning reflection incentivizing
Planned Behavior	incentivizing direction by need statements

	pressure to make ideas into tangible solutions
Functional Triad	team process blueprint (tool) shared platform (media) the online network (social actor)

Lastly – 1 month after the event the perceived benefits of contest-based and sustainability-oriented events (like the IFTP experienced was asked from the facilitators (6 people) and their views were reflected with views of students (only 2 were contactable for immediate evaluation. limited by the approaching paper submission deadline). The target was to find out potential shared vs. diverging views between the two stakeholder groups. The layers of impact from individual to general benefits were: Individual personal benefit, Individual Career Benefit, School (University) level benefits, Societal benefits. Figure 3 below summarizes the findings of that analysis.

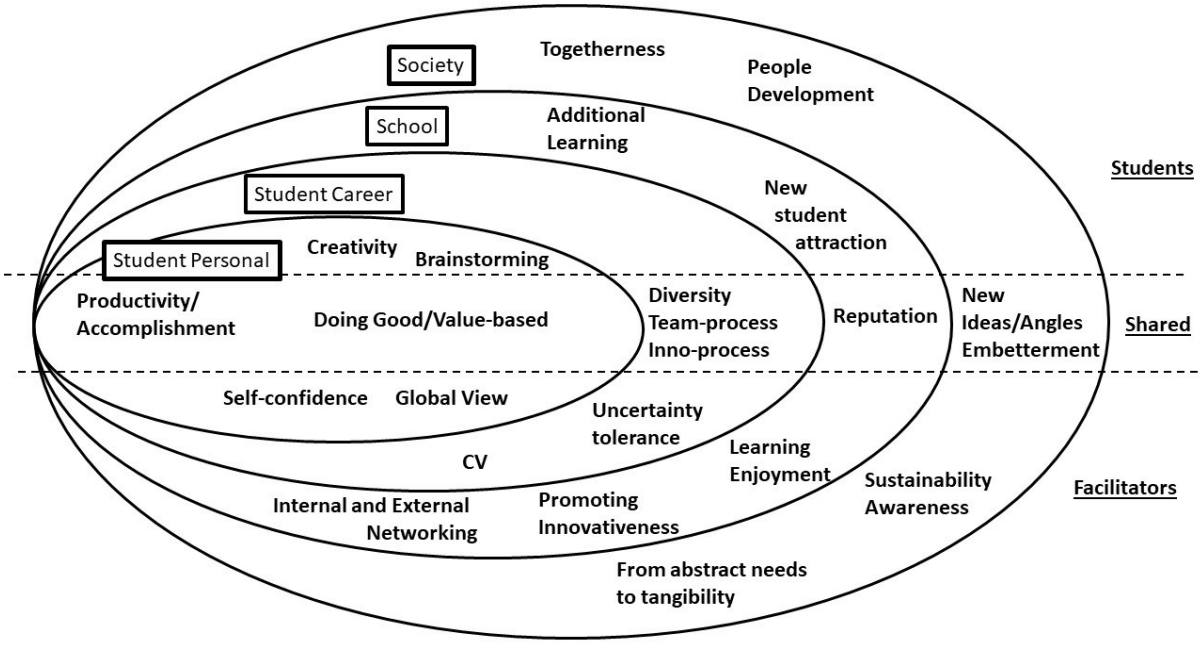

Figure 3: Perceived impacts across layers between facilitators and students

5. CONCLUSION

The overarching summary - derived from the expressions of learning outcomes of the themes – describing the sustainability-focused innovation event ITFP is that (see Chapter 4/Table 3 & Figure 3 for detail) the event drew together people with different backgrounds to create and present as teams ideas based on true needs, and, while doing so, learn also skills for their future work. These longer-lasting effects contain understanding of team and innovation processes in organizations. For the organizing parties the effects are in reputation and increase in the quantity and quality of their relationships. The societal impacts are on one hand tied to the outcomes – new solutions to known problems – and on the other hand the benefits relate to belongingness and empowerment as well as development of future workforce.

It is noticeable that the competitive nature (there were both local small-scale and global larger-scale awards) was not important as a motivator for participation nor largely referred to as learning outcomes nor in perceived benefits. The role of competition and success in it was not highlighted as a personal motivator or outcome nor was it seen as an important part of the contribution to any layers of impact. Thus, the MacCormack et al. (2013) finding of more meaningful role of soft values vs. competitive values got confirmed. The facilitators did see the hackathon as a way of improving learning experience (via method), while students saw the contribution to learning be more impacting substance knowledge (additional learning).

In relation to the topic area of the event, the student reported societal embitterment and values as their motivators as well as perceived benefits. The learning reports did not contain commentary of behavioral change on individual level. The voluntary nature and strong and clear theme on sustainability hint that this kind of events self-select people already oriented to sustainability. In that sense, the effects on individuals are rather focused on maintaining and fortifying/amplifying sustainable behavior.

Based on the findings it seems plausible to state that structured and networked events like IFTP can impact future behavior in ways described at all three theoretical models presented: Nudging, Planned Behavior and Functional triad. Interestingly the future behavior that can be anticipated where more of processual type: Participants reported the learnings of innovation and team processes as core takeaways, rather than the knowledge on the subject area. The voluntary nature of the program may have self-selected students with value and behavioral base already resonating with the theme area of the event, and thus the foreseeable changes specifically in sustainability were not seen as important. The behavioral theories reviewed seem in this setting to better applicable to the behavioral change within the organizing body, to whom the benefits perceived differ from the individual level ones. The concept of learner should perhaps in these studies be the HEI responsible for arranging and facilitating the process. Exposure to sustainability hackathons may over time cause changes that the earlier research has adapted to an individual level.

The small yet covering sample size and contextually (one university in Finland at one point of time) limited scope set limits to the generalizability of the findings. Hence, longitudinal studies following the participants and/or comparative studies between year-to-year-implementations and different locations (geographically and academically) would shed additional lights on the impacts to innovations on sustainability via short-term interventions.

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