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Sustainability projects with a community partner: A social norm nudging effort

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Sustainability Projects with a Community Partner, a social norm nudging effort

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Singapore students from two inter-disciplinary courses worked with stakeholders of a local business association community partner on a series of sustainability topics to learn about climate change, its effects, and actions to mitigate them. They empathized with the association stakeholders, proposed a digital technology solution, tested their prototypes, and presented the final action plans. After the projects were completed, we found climate proficient (83%), motivated (83%), engaged (97%), and satisfied (70%) students; and two influencing predictors: interest/enjoyment and emotional engagement. The study results suggest that getting students interested and emotionally engaged in sustainability projects is an important first step towards the adoption of more sustainable habits. Rather than suggesting that students commit to behavioral change in support of climate action qua moral persuasion or rules, our inter-disciplinary project outcomes suggest that a more effective approach is to nudge them towards eco-friendly behavior through the sustainability needs of community partnerships via social norm.

Nudging, multi-disciplinary, community partners, sustainability project, Singapore, motivation, engagement.

I. Introduction

This study presents the teachers' perspective to design a pedagogy to communicate the United Nations Sustainable Development Goals (UN-SDG). Our climate action refers specifically to UN-SDG Goal 13 "improving education, awareness-raising and human and institutional capacity on climate change mitigation, adaptation, impact reduction and early warning" [36]. Due to the complexities and inter-dependencies [1] of the UN-SDG goals, it necessitates an inter-disciplinary culture [4, 9] within universities for a holistic understanding of sustainability. We want to equip our students with critical competencies to develop capacity for climate change adaptation.

In order to achieve these competencies, university students worked on sustainability projects with community stakeholders located at the central Singapore shopping district as a nudging approach to participate in co-creating a sustainable future. We study the role of participatory climate action [7, 25, 37] in this community partnership as an effective pedagogic pathway toward increasing climate action awareness. We argue that the participation of students in community climate actions in a locality can strengthen resilience and adaptive capacity to climate-induced impacts.

Students of Information System and Computer Science course 'Interaction Design and Prototyping' and Management course 'Innovations for Asia's Smart Cities' came up with digital technology solutions to encourage the use of sustainable packaging, to promote water conservation, to reduce food waste, etc. Our mixed method research attempts to understand what it takes to nudge Singapore students into taking the climate threat seriously so that they adopt climate change mitigation measures [8, 10, 12, 20, 22, 30], and to appraise the desired learning outcomes (climate action-related) of students.

We begin with a literature review of Singapore nudging approach and technology mediated nudges. This will provide an understanding of our nudging effort. The paper continues with the research method, results, and discussions. It concludes with a summary of our findings.

II. Literature Review

This section provides the background information about the sustainability movement in Singapore with focus on the need for multi-disciplinary education and community partnership to set up green nudges. It explores the studies on technology mediated and digital green nudges. Lastly, it explains the effect of overusing nudges and how we want to indirectly cultivate a climate friendly habit amongst our students so that they can adhere to social norms as desired by their projects.

A. Sustainability in Singapore

The Singapore Government understands that Singapore will not be spared from climate change impact [32] and that the country needs a clear road map to mitigate the effects of the earth's rising temperature [5]. It has publicly provided a list of key targets and actions that individual citizens can take [28] and during COP 27 it has committed to raise carbon tax to S$25/tonne in 2024/2025 and to achieve net zero emission by 2050 [29]. During COP26 the Minister of Sustainability and Environment highlighted the importance for youths to participate in this "journey of co-creation" [23]. With regards to Singapore sustainability education, there is arguably no strong policy curriculum that mandates how climate change should be learned, even though it is present in several school subjects. The topic is included in school subjects through the initiative of subject disciplinary specialists and middle managers of the education ministry [9].

B. Multi-disciplinary Education

With no strong national climate change education policy, ideally, educators from different faculties should join forces to reflect on current teaching practices, expand their knowledge and co-create more effective pedagogical interventions. Faced with a similar situation, Argento et al. [1] from Kristianstad University examined how sustainability was integrated into their programs with inputs from six different disciplines: computer science, business administration, education science, environmental science, food and meal science, and nursing science. They studied differences across disciplines to be used as an asset in trans-disciplinary education united by common UN-SDG Goals 3, 4, 11, 12 and 13. However, time and

resources are needed, and intrinsic motivation may not last without leadership support.

A key challenge is to create an effective (inter-disciplinary) and science-driven curriculum in support of sustainability goals. Bacon et al. [4] from University of California, Santa Cruz (UCSC) implemented an action-oriented, inter-disciplinary sustainability science curriculum that integrates theory and practice. Their partnership between the Engineering and Social Science faculties created "REELS Project" course. This partnership breaks down faculty silos by introducing scientific and technical literacy to social science students, and teaching diversity, inequality, and environmental justice to engineering students.

In summary, the two case studies underscore the importance of multi-disciplinary education to combat the complexity of climate change. Multi-disciplinary teachers must work together to address sustainability and collaborate as a community.

C. University Community Partnership

Partnerships with the community allows our students to work on problems faced by the community using the resources and data available in the community. This type of collaboration is usually in the form of a team working in a project with experiential learning activities [4, 7, 37].

More specifically, when the community partnership project involves climate change, students may be given the opportunity to see the impacts of climate change solutions and trade-offs between mitigation and adaptation. This include how climate policies are accepted by the community and sometimes adapted based on the specific consequences to the locales where people live [25].

Another study presented the development of a bicycle parking hub at the University of Tasmania [37]. They provided opportunities for their students to understand the importance of partners such as campus operations, local council, state government and cycling advocacy groups. Some of the issues they faced were getting broad institutional support and mindset change.

D. Singapore Nudge Policy

Thaler and Sunstein [33] wrote "By knowing how people think, we can make it easier for them to choose what is best for them, their families and society." They defined nudge as "any aspect of the choice architecture that alters people's behaviour in a predictable way without forbidding any option or significantly changing their economic incentive." The nudging concept is frequently used in public policy making through 1) default options, 2) ease of choosing options, or 3) informing/reminding people of the benefit or cost of their choice, by making them more salient or the social norm.

With regards to Singapore, Chu [10], Detenber [12] and Soon [30] have provided nudging examples such as opt-out pension and organ donation-related policies, where all citizens are automatically enrolled (default option) unless they opt-out. Countries like United Kingdom, Spain, France, Australia, Canada, Germany, United States, and Singapore have government units applying behavioural insights (BI), a more comprehensive term than a nudge to policy making [30]. In Singapore, the Central Provident Fund (CPF) and Human Organ Transplant Act (HOTA) implement the opt-out policy, while Electronic Road Pricing (ERP) is a pay-as-you-use system to manage traffic congestion through nudging driver behaviour by informing/reminding them of the cost of using the road at peak hours.

Singapore is often regarded favourably in terms of cleanliness, safety, efficiency, and productivity but frowned upon on how it controls social behaviours and press freedom. Social engineering campaigns such as anti-littering, clean toilets, anti-smoking, speak Mandarin, health promotion and family planning have caused some cynicism and weary of government's 'propaganda'. While some may view Singaporeans as conforming to paternalism, civil society in Singapore has been growing over the years and pushing for more freedoms and less heavy-handedness by the government [19]. From a practical perspective, there are several potential problems associated with the overuse of nudges, such as information overload, desensitization, cynicism, and societal polarization. When nudges attempt to alter behaviour by presenting additional information, there is a risk that cumulatively people will feel inundated by messages urging them to behave in a particular way [12, 34].

Behavioural intervention through nudges is only one of many policymaking tools, not a silver bullet. It would need experimentation, data analytics, detailed planning to apply on specific issues and may have limited effect on certain behavioural change patterns, e.g., with regards to industrial pollution or drug abuse which may require much more than a nudge [30].

E. Green Nudges

Green nudges can make environmentally friendly choices more prominent or salient such as eco-labelling on air-condition, refrigerators, clothes dryer, televisions, and lamps [6] or brightly colored recycling bins placed near a lift lobby [20]. They can remind people of the environmental cost such as utility bills for energy consumption and environmental social norms such as public cleanliness [15]. Breaking bad habits by sending timely reminders to new homeowners to recycle when moving and reminding household to sort and clean recyclable items at the point of food waste segregation using fridge magnets are other examples of green nudges [20].

F. Technology Mediated Nudges

Caraban et al. [8] identified 23 distinct Human Computer Interface mechanisms of technology-mediated nudging to combat 15 cognitive biases. They described a framework to incur behaviour change in health promotion regarding physical activity, smoking, water intake, adherence to medication and others (31%), encouraging sustainable behaviours such as recycling, reducing food waste, water conservation or adopting eco-driving conducts (20%), increasing human performance such as improving recall or reducing information overload (18%), and strengthening privacy and security, such as nudging users away from privacy invasive applications, improving password security and others (9%).

Their findings on failed nudges echo Soon's study results [30]. The effectiveness of the nudge depended on its implementation in each context, no overt relation to the exact nudging mechanism. They attributed the main reasons for failures to lack of educational effects, nudging effects not sustaining over time, intrusiveness and reactance, and timing and strength of nudges.

G. Green Digital Nudges

Digital nudges extend the concept of nudging to digital environments and are defined as "the use of user-interface design elements to guide people's behaviour in digital choice environments" [38]. For example, to remind users to stay active by using push notifications on wearables and to raise waiter tips by setting a higher default tip on mobile payment app Square. Digital nudge designers can draw from a plethora of rich, user-centred, and tailored interventions; green digital nudges can be implemented, evaluated, and even personalized quickly.

Studies on green digital nudges pertaining to e-commerce [14], transportation [3] and smart home app [39] suggest similar results as Caraban and Soon [8, 30]. The effectiveness of the nudge depended on its implementation in each context, no overt relation to the exact green digital nudging mechanism.

H. Research Background

To avoid the effects of overusing green nudges that increase cynicism, in the Singapore context, we hope to indirectly cultivate sustainable habits. Our students work on a complex "real world problem" sustainability project that requires multi-disciplinary culture in collaboration with a local community partner. Students engage with fellow community stakeholders to understand the consequences of their adaptation choices in response to climate impacts. The project goal is to propose digital technology solutions (green digital nudges) that implement the community partner's climate actions. In doing so, we hope students will improve their climate proficiency, be satisfied, motivated, and engaged in their community partner sustainability projects and eventually nudged to cultivate a climate friendly habit as part of social norms. The locality provided a sense of place that can be a motivation to action that could change their behaviour. For example, students would calculate their own average carbon footprint and attempt to lower it by making small changes such as eating less red meat, reducing food waste or frequent vendor with sustainable food packaging.

III. Methods

This study involves student teams from an Information System/Computer Science (IS/CS) course 'Interaction Design and Prototyping' and different student teams from a Business Management course 'Innovations for Asia's Smart Cities.' Students from both IS/CS and business school formed their own teams. Both courses involved a semester long group project with the duration of 15 weeks. They were expected to spend a little more than half their time weekly on the project.

A. University Community Partnership

Students participating in this study are from both courses, and they worked with the same community partner, Orchard Road Business Association (ORBA) [26]. The focus of the community partner sustainability project is intentional to align with Singapore's sustainability effort and the launch of Singapore's 'Green Plan 2030' [5, 28, 32]. ORBA was formed in 1998, with the support of Singapore Tourism Board and has since played a pivotal role as a place maker, continually enhancing the street's position as "one of the world's premier shopping and lifestyle destinations" [27]. Aligned with national efforts [5, 32] for climate change mitigation and adaptation, sustainable place making becomes an important concern for ORBA. Their stakeholders are listed in table 1.

TABLE I. KEY STAKEHOLDERS LINKED TO ORBA

Category	Occupier-Stakeholder
Play	Cinema, Fitness, Amusement Facilities
Shop	Department stores, Retailers (Fashion, Luxury brands, etc.), Supermarkets.
Stay	Hotels
Eat & Drink	Bakeries, Cafes, Fast food, Restaurants, Pubs
Live	Residences
Work	Offices, Serviced Offices
Property Owners	Building and Mall Owners/Managers
Common Spaces	Pedestrians' walkways, Gardens, Public transport linked walkways
Property	People who live, stay, visit, play, shop, dine, entertain, work, invest and manage businesses in the Orchard Road precinct

B. Technology Solutions

Student teams worked with the ORBA partners on a series of sustainability topics and reached out to ORBA stakeholders depending on the respective user persona in their project's proposed climate action plan. The deliverables included ideas and initiative proposals, prototypes, actionable plans, and recommendations. Students formed their own project team members, and each team chose the topic of their choice. Although technology mediated nudging is not compulsory, student teams came up with a wide variety of innovative green digital nudge solutions that range from using mobile app to locate plant-based food; websites to nudge on e-waste recycling, and reducing food waste; and social media campaigns, and stakeholder engagement.

C. Research Method

Our university Institutional Review Board (IRB) approved our mixed research method: 1) a standardized online questionnaire was used to collect quantitative and qualitative data on student climate proficiency, satisfaction, motivation, and engagement, and 2) a semi-structured interview on their learning experience.

The standardized online questionnaire consists of a total of 122 items: a 9-item questionnaire on demography, a 16-item to measure learner proficiency, a 37-item to measure motivation, a 23-item to measure engagement, a 1-item on satisfaction and the rest for general course feedback such as on teamwork and the community partner.

On the learner climate proficiency measure, the response options were on a 6-point Likert scale, adapted from the Dreyfus' Five Stage Model of Adult Skills Acquisition [13] and ranged from (0) "No Knowledge" to (5) "Expert". Items involved the insights student gained from the course content and/or project on climate change, actions, mitigation, adaptation, carbon footprint, carbon offsetting strategies, decarbonization, carbon sequestration, corporate ESG, UN-SDG, etc. The Cronbach's alpha reliability [35] in this study is 0.967.

Learner satisfaction was measured as a general indicator of the student's level of satisfaction towards the sustainability project with ORBA. The single-item measure "Please rate your level of satisfaction toward the ORBA experiential 'climate action' project" included response options on a 5-

point Likert scale that ranged from (1) "Very dissatisfied" to (5) "Very satisfied."

D. Motivation

Intrinsic motivation in the learning process is closely related to factors that result in positive learning outcomes, such as student engagement [16, 21]. Deci and Ryan [11] suggest that intrinsic motivation leads one to do things "for their own sake," and inherent interest in the subject becomes a driving force for the individual. Another study [2] examines intrinsic motivation as it is often associated to student's performance and achievements which can be attributed to student success.

To examine intrinsic motivation, a 37-item measure was adapted from the Intrinsic Motivation Inventory [17]. We considered six sub-scales of intrinsic motivation that include: *interest/enjoyment*, *perceived competence*, *effort/importance*, *pressure/tension*, *value/usefulness*, and *perceived choice*. We replaced the seventh *relatedness* sub-scale with a separate set of teamwork questionnaire, since inter-personal interactions, friendship formation, etc. can be measured with teamwork. We presented the items in relation to the sustainability project with ORBA. For example, on motivation *interest/enjoyment*, the item is "I enjoyed the ORBA experiential 'climate action' project very much." Response options were on a 5-point Likert scale and ranged from (1) "Not true at all" to (5) "Very true." The Cronbach's alpha reliability in this study is 0.908.

E. Engagement

Student engagement is an "integral component" for learning effectiveness [21]. For instance, Winkler and Söllner [40] consider individual "input" from learners such as predisposition, self-efficacy, learning styles and learning motivation might affect the learning process in technology-mediated learning. Extrinsic factors beyond the individual learner, such as the involvement and quality of course instructors, relevance of course materials, and quality of feedback may also influence the level of engagement experienced in the learning process [16, 18].

To examine student engagement, a 23-item measure was adapted from the Student Course Engagement Questionnaire [31]. This study considered the different dimensions of student engagement including *emotional*, *participation*, *skills*, and *performance* engagement. Some items are adapted to the ORBA project. For example, instead of "coming to class every day," we changed it to "attempted all project-related research and tasks" as students do most of the project outside of class time. Response options were on a 5-point Likert scale and ranged from (1) "Not at all characteristics of me" to (5) "Very characteristic of me." The Cronbach's alpha reliability in this study is 0.955.

F. Sample Population

To qualify for data analysis, all MCQ questions must be completed. At the end of the data collection period, 41 responses were received. However, only (n=30) completed responses (73.2%) were accepted. The sample consists of 56.7% (17) female students and 43.3% (13) male students. 40% (12) of the sample were in their first year of study, while 26.7% (8) were in their second year and the remaining 33.3% (10) were in their third year. Students were from a multi-discipline background as they are enrolled in all the six schools of the university: 6.67% (2) from Accountancy, 53.3% (16) from Business, 23.3% (7) from Computing and Information Systems, 6.67% (2) from Economics, 6.67% (2) from Law and 3.33% (1) from the Social Sciences.

IV. Results

This section presents the proficiency, satisfaction, motivation, and engagement scores.

A. Proficiency

Based on a 6-point Likert scale (0-5), adapted from the Dreyfus' Five Stage Model of Adult Skills Acquisition (2004), 83% (25) of the surveyed students reported professional working level or higher proficiency (>2). One student acquired an expert proficiency (>4), 33% (10) of the students acquired full professional proficiency (>3 and <=4), 47% (14) of the respondents indicated that the project equipped them with professional working proficiency (>2 and <= 3), 13% (4) of the students reported having limited proficiency (>1 and <=2) and one (3%) student attained elementary proficiency (<=1) towards the learning outcomes listed for these courses and projects.

B. Satisfaction

Based on a 5-point Likert scale (1-5), on the item "Please rate your level of satisfaction toward the ORBA experiential 'climate action' project," 57% (17) of the students were satisfied, 13% (4) were very satisfied while 23% (7) of the respondents indicated that they were neither dissatisfied nor satisfied with the project. There were 2 students (7%) reported being dissatisfied.

C. Motivation

Table 2 shows the results for intrinsic motivation and each sub-scale, that falls within the score of unmotivated (<=2), somewhat motivated (>2 and <=3), motivated (>3 and <=4) and highly motivated (>4). Most of the students (83.3%, 25) were motivated of which 73% (22) stated that they were motivated vis-à-vis 10% (3) who were highly motivated. There was no student who was unmotivated, and 17% (5) of students were somewhat motivated.

TABLE II. Results for Intrinsic Motivation

Sub Scales	Unmotivated	Somewhat Motivated	Motivated	Highly Motivated
Interest /Enjoyment	0	5	18	7
Perceived Competence	0	12	14	4
Effort /Importance	0	2	17	11
Pressure /Tension	8	16	6	0
Value /Usefulness	0	10	16	4
Perceived Choice	0	6	22	2
Overall (Average)	0	5	22	3

On the six motivation sub-scales, the *effort/important* sub-scale performed the best with 93.3% (28) motivated (17) or highly motivated (11), while the *pressure/tension* sub-scale performed the worst with 80.0% (24) unmotivated (8) or somewhat motivated (16). Intrinsic motivation is associated with high level of effort which assesses the person's

investment of his capacities in what he is doing. On the other hand, the *pressure/tension* score indicates that students are 'unmotivated' due to the stress at having to succeed with project-related tasks in the learning process. This aligns with how *pressure/tension* is a "negative predictor of intrinsic motivation" [24]. However, *interest/enjoyment*, the most direct self-report measure for intrinsic motivation, and *perceived choice* scored at least 80.0% (24) for motivated or highly motivated. *Perceived competence* and *value/usefulness* may have less motivated students, but they still scored with at least 60% (18) of students were motivated. These 60% of students reportedly felt that they were effective and developed self-regulatory activities in performing the project tasks.

D. Engagement

Table 3 shows the results for engagement and each sub-scale, that falls within the score of not engaged (<=2), somewhat engaged (>2 and <=3), engaged (>3 and <=4) and highly engaged (>4). Most of the students (96.7%, 29) reported to be engaged of which 73% (22) were engaged and 23% (7) were highly engaged. There was no student who was not engaged and only one student (3%) who was somewhat engaged.

On the four engagement dimensions, the *skills* and *participation* engagement performed the best with 86.6% (26) highly engaged or engaged. These engagements are through practicing skills in the project and participation with instructors and fellow students. The *emotional* and *performance* engagement variance (>0.4) and standard deviation (>0.6) are larger than the rest. This suggest that they vary widely in their emotional involvement and engagement through their perceived performance. Despite the wider variance, at least 66.6% (20) reported to be highly engaged or engaged.

TABLE III. RESULTS FOR ENGAGEMENT

Dimension	Not Engaged	Somewhat Engaged	Engaged	Highly Engaged
Emotional	0	10	16	4
Participation	0	4	19	7
Skills	0	3	20	7
Performance	1	5	15	9
Overall	0	1	22	7

We asked students about their engagement level before and after the project. Response options were on a 5-point Likert scale and ranged from (-2) "Actively disengaged" to (2) "Thoroughly engaged." The change in engagement level shows one outlier with -3 score, 3 students with -1 score, 8 students with 0 score, 10 students with 1 score, and 8 students with 2. Four students seemed to be less engaged (-3 and -1) which may be due to the wider variance from their *skill* or *performance* engagement score. Most of the students 60.0% (18) were more engaged after the project.

V. DISCUSSIONS

Based on the result section, we will investigate (i) the motivation sub-scale *pressure/tension* as a "negative predictor of intrinsic motivation," (ii) four students who were less engaged (-3 and -1) which may be due to the wider variance from their *skill* or *performance* engagement score, and (iii) two students who reported being dissatisfied. But, first, we calculate the Pearson's correlation coefficient for all the variables we collected in table 4.

TABLE IV. PEARSON'S CORRELATION COEFFICIENT

Pearson's Correlation	M	M1	M2	M3	M4	M5	M6	E	E1	E2	E3	E4	P	S
M: Intrinsic Motivation	1.0													
M1: Interest/Enjoyment	0.8	1.0												
M2: Perceived Competence	0.7	0.5	1.0											
M3: Effort/Importance	0.7	0.6	0.6	1.0										
M4: Pressure/Tension	0.4	0.1	0.0	0.2	1.0									
M5: Value/Usefulness	0.8	0.8	0.4	0.5	0.2	1.0								
M6: Perceived Choice	0.4	0.2	0.1	0.0	0.1	0.3	1.0							
E: Engagement	0.3	0.2	0.5	0.2	-0.1	0.1	0.1	1.0						
E1: Emotional Engagement	0.2	0.0	0.4	0.1	0.0	0.0	0.2	0.9	1.0					
E2: Participation Engagement	0.3	0.3	0.5	0.3	-0.2	0.2	0.2	0.9	0.8	1.0				
E3: Skills Engagement	0.3	0.2	0.5	0.2	-0.1	0.1	0.1	1.0	0.8	0.8	1.0			
E4: Performance Engagement	0.2	0.2	0.4	0.1	-0.3	0.2	0.1	0.8	0.6	0.7	0.7	1.0		
P: Proficiency Average	0.4	0.2	0.5	0.2	0.0	0.4	0.1	0.5	0.4	0.4	0.4	0.5	1.0	
S: Satisfaction	0.6	0.7	0.5	0.3	-0.2	0.5	0.2	0.2	0.0	0.2	0.1	0.3	0.0	1.0

A. Motivation

The intrinsic motivation has a strong (>=0.8) correlation with *interest/enjoyment* and with *value/usefulness*; a moderate (>=0.6) correlation with *perceived competence* and *effort/important*; but a low correlation (<=0.4) with *pressure/tension* and with *perceived choice*. Between motivation sub-scales, we see a strong correlation between *interest/enjoyment* and *value/usefulness* but no significance (T-test paired sample for means p=0.93 and Wilcoxon signed rank test p=0.86); and a moderate correlation between *interest/enjoyment* and *effort/important* with significance (T-test paired sample p=0.00 and Wilcoxon signed rank p=0.00).

We refer to investigation (i) to look for any negative correlation between *pressure/tension* and any motivation score. It is interesting to note that *pressure/tension* have negative correlations with engagement, engagement dimensions, proficiency, and satisfaction. However, they are low negative correlations (>=-0.4) that can be ignored.

Based on our investigation, intrinsic motivation correlates with most of its sub-scales. There is a statistical significance to conclude that *interest/enjoyment* leads to *effort/importance*,

and that motivation sub-scale *pressure/tension* as a "negative predictor of intrinsic motivation" can be ruled out for our sample data due to only one small negative correlation.

B. Engagement

All the engagement scores have at least a moderate (>=0.6) correlation between them. However, only *emotional* engagement has p-value of significance (<0.05) with all the rest of the engagement p-values (E-0.01, E2-0.049, E3-0.01, E4-0.045). Thus, we can conclude that for our sample students, *emotional* engagement is a good predictor of the rest of the engagement: *participation*, *skills*, and *performance*.

With regards to investigation (ii) the four students who were less engaged (-3 and -1), our earlier result suggests that this may be due to the wider variance from their *skill* or *performance* engagement score. We calculated the correlations between change in engagement with the engagement scores and found that none of the Pearson's correlation coefficients were above 0.4, which denotes a poor correlation. Thus, our findings do not support "less engaged which may be due to the wider variance from their *skill* or *performance* engagement score." Based on our investigation, *emotional* engagement is a good predictor of all engagement. We cannot conclude that wider variance in *skill* or *performance* correlates with less engaged students.

C. Satisfaction

There is a moderate (0.72) correlation between intrinsic motivation *interest/enjoyment* with satisfaction. The T-test paired sample for means p=0.045 and Wilcoxon signed rank test p=0.017 are both significant which suggests a relationship between students' *interest/enjoyment* motivation and satisfaction.

With regards to the investigation (iii) of the two students who reported being dissatisfied, a further review of their qualitative responses highlighted the following specific reasons: (i) lack of communication with the community partner, (ii) limited receptiveness towards ideas proposed by the student teams, and (iii) misalignment of student and community partner expectations.

On further investigation, we found that the four less engaged students included these two dissatisfied students. Reviewing their survey scores, average *interest/enjoyment* is the biggest difference (less interested), especially with the dissatisfied students while average (more) *pressure/tension* and (less) *perceived competence* are the 2nd and 3rd biggest difference. However, there is no difference for the dissatisfied students.

Based on our investigations, *interest/enjoyment* in motivation leads to satisfaction, and on average less *interest/enjoyment* leads to less engagement. Dissatisfaction may be caused by lack of student communication with the community partner, and on average *perceived competence* and *pressure/tension* (more) can lead to less engagement but not dissatisfaction.

D. Limitation and Future work

This study was conducted within one term using 30 valid responses from Information Systems/Computer Science and Management students working with ORBA as community partner. This is a special case study that may not be generalizable, limiting the external validity. For future work, we plan to continue this study with another community partner and more students to avoid sampling bias.

VI. Conclusions

Singapore understands that nudging is only one of many policymaking tools, not a silver bullet and needs to focus on specificity and details. It would need experimentation, data analytics, detail planning, context, and exact nudging mechanism to apply on specific issues [8, 30], such as sustainability in Singapore. We are a multi-disciplinary team of educators, without a strong national climate change education policy [9], that experimented with a specific pedagogy to indirectly nudge students (via social norm) towards a more sustainable behavior and equip them with climate proficiency for sustainable habit adoption.

We collected motivation, engagement, satisfaction, and proficiency data that shows most participating students were motivated (83.3%), engaged (96.7%), satisfied (70%) and that they attained professional working climate proficiency (83%). Intrinsic motivation *interest*/*enjoyment* is a good predictor for student *effort*/*importance*, as well as satisfaction. On average less student *interest*/*enjoyment* can result in less engagement. *Emotional* engagement is a good predictor of all engagement. Thus, we encourage getting students interested and emotionally engaged in a sustainability project as the first step towards student adoption of more sustainable habits. While coming up with green digital solutions to address climate impact, our students were interested and engaged with fellow stakeholders who live and play in the same locality to participate in co-creating climate actions.

We hope that by sharing our findings, we can encourage further experimentation on conducting specific multi-disciplinary courses required to tackle complex sustainability projects with a local community partner.

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