Towards a long-term sustainable development vision in *the self*: a study with engineering students

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ABSTRACT: The objective of this study was the identification of the presence of a sustainable development vision (year 2030) in engineering students. The focus was on *the self*, related to the reflection and self-knowledge of the individual. Students from universities in Norway and Spain were encouraged to place themselves in the future from several interrelated perspectives. A sustainable development vision beyond economic growth, with equality and well-being, was used as a foundation of a social future in 2030. While a weak integration of the vision has been identified, emergent aspects in the self suggest potential for change and that students would benefit from further structured exploration of the self. The study contributes to engineering education by showing the relevance of a space for reflection on the self from a long-term perspective that integrates sustainable development.

INTRODUCTION

Despite the importance of long-term perspectives in the context of sustainable development, studies with individuals in engineering are scarce, and more general studies of future outlooks have often focused on social and technological perspectives. This may have been related to the acceptance of an economic, technological and social model, often prioritising the achievement of short-term benefits. Furthermore, a culture of disengagement with ethical values and well-being of society in engineering students has been highlighted as an issue that increases throughout the time the students progress in the degree programmes [1].

It is important to study how engineering students envision themselves in a long-term future because they are positioned as key agents of change. Beyond a focus on a social future, but including it as a reference, the study outlined in this article aimed at identifying the presence of a vision of sustainable development in engineering students focusing on subjectivity.

The study of possible *selves*, which falls into the study of the *self*, allows to identify if a sustainable development vision is present in one's selfhood [2]. This can indicate how the professionals of tomorrow might position themselves in relation to that vision of the future as agents of change. Such an apprehension of self can be achieved by asking engineering students to reflect and describe who they are going to be in 2030. It is hoped that the current study will contribute to engineering education by showing the relevance of a space for reflection on the self from a long-term perspective that integrates sustainable development.

THEORETICAL FRAMEWORK

The theory of possible selves provides the theoretical basis for the apprehension of the self from a future-based perspective [2-4]. Possible selves are conceptions of the self in the future directly related to the position of the individual in his/her social context [2]. Possible selves are related to motivation from different angles. First, by identifying an ideal or wanted self in the future, the person can aim at reaching that future self and facilitate change. Secondly, by comparing current selves with future selves, and aiming at actions to reduce self-discrepancy between present and future selves [5][6].

These possibilities of the future offer potential for self-regulation and the possibility of change in behaviour [7][8]. Self-regulation is the self's capacity to change behaviour, and increases the flexibility and adaptability of human behaviour, enabling people to adjust their actions to a remarkably broad range of social and situational demands [7]. Awareness of possible selves would enable self-regulation, and therefore, change in a context of agency towards a vision of sustainable development. Despite numerous studies on possible selves following the first study by Markus and Nurius in

a broad number of areas [2], the proposals in engineering have been scarce and have focused mostly on a short-term time perspective. A case in point is a study on possible selves of Australian engineering students, who had difficulties to imagine the future and to integrate creative perspectives in the profession [9].

In the apprehension of the self, one proposes the consideration of a social vision that can be an aspirational reference for the self. In this vision, human beings feel responsible for the protection of the planet, its resources and its ecosystems; also, they connect with the planet and feel part of it from a holistic perspective. Then, they focus on a future based on an economic system beyond economic growth [10][11].

The economic system would be in line with sufficiency strategies, if local production and well-being in a prosperity were favoured and decoupled from economic growth. Consumption, based on sufficiency as a priority that goes beyond efficiency-based strategies, curbs down the current levels of resource use. A fairer distribution of resources, instead of focusing uniquely on economic growth and the increase of profits, includes moral considerations and equality. Business would then favour fair distribution, local use of capital and sustainable use of resources. Regarding technology, its development takes place with the aim to protect the planet and to provide well-being for all [12]. Concisely, a vision of an alternative future is underpinned and driven by the evidence of failure in the current system and the need to find and integrate …*a safe operating space for humanity* [13].

METHODOLOGY

Collection of Data

The procedure for data collection involved asking participants about their self-conceptions in writing. Interviews were also considered, but for a different part of the project, and therefore, are not included in this article. Then, the author followed a sequential collection of data that prevents reductionism in the study of the self through avoiding being too directive, allowing self-expression of participants, and avoiding interference with the process of data collection [14].

A list of enquiries was developed by the author and submitted to other researchers and colleagues for comments, resulting in improvement. After this, the author piloted these enquiries with a group of students with characteristics similar to the definite sample prior to applying them for data collection, and introduced modifications. He did not collect specific data on the students' previous background on forward thinking and sustainable development, and therefore, information on their previous education in this context is not considered.

Guidance on how to answer the enquiries was provided only by means of highlighting the importance of answering in first person and as if the answer was not directed to others, but to the person that was answering. The questions were given to participants sequentially one by one, with the intention of providing a space to focus on just one question at a time. The data related to the present was collected first, and then in relation to the future (2030). The time designated to answer the questionnaire was approximately 40 minutes.

Two types of inquiries were included, both open-ended: one in relation to the present or the future in general, and the second related to a specific area (i.e. the economic system and consumption). Both types aim at facilitating the apprehension of the self with minimum direction or interference from the researcher, assuming a certain level of dispersion in the answers. The first type of enquiry would place the participant in a position of subjectivity: *I reflect and answer to myself* both in relation to the present and future. Both the economic system and consumption areas are interconnected when a vision of sustainable development is concerned, thus allowing for more comprehensive and unified data. The questions that formed the enquiry are as follows:

Complete the following sentences with the characteristics of yourself that you consider relevant.

−   I… (5 statements).

Complete the following sentences about yourself in relation to the following aspects:

−   With regards to the economic system, I...
−   With regards to consumption, I...
−   Think about yourself in the year 2030. How do you imagine yourself in 2030?

Be specific in your description when completing the following characteristic of yourself:

−   In 2030, I… (5 statements).

Continue thinking about yourself in 2030. Describe how you imagine yourself with regards to the following aspects:

−   With regards to the economic system, I…
−   With regards to consumption, I…

Participant**s**

The group of participants was formed by 30 and 27 first-year degree students in engineering at the University of Barcelona (UB, Spain) and the University of Tromsø (UiT, Norway), respectively. The average age of participants was $M = 20.64$ years ($SD = 3.18$), with the lowest and highest age of 17 and 30 years respectively, and with 59.3% male and 40.7% female students.

Analysis of Data

A total of 798 self-conceptions were expected from participants, out of which 736 were classified into categories (62 were unanswered or invalid). Self-conceptions were provided mainly in the form of one or several sentences. The categorisation was developed aiming at fairness and accuracy when processing the participants' answers. The author then input the self-conceptions corresponding to the present and future (2030) into the SPSS system.

The participants' answers were classified into specific categories, which were created from the integrated review of all the self-descriptions in an iterative way. During the process of codification, precision in the classification of the self-conceptions was very important. The grouping of self-descriptions aimed also at avoiding an unnecessarily excessive number of groups and at the same time ensuring that no detail in the data was lost. For example, the description …*I believe the main priority for me is to continue at present with high levels of consumption of objects regardless of their use*, would relate to the category *consumes a lot*. The repetition of content in self-conceptions in answering a question (specifically within the five statements) by one participant was not considered.

The analysis of the self-descriptions of participants in relation to the present and future was based on the frequency of self-conceptions provided by the group of participants. The data in groups were separated, corresponding to groupings of self-conceptions for each category, which meant the quantification of responses that were obtained in an open way. The groups of answers where then compared to the characteristics that conform to a social vision of sustainable development according to the overview presented in the theoretical framework.

The author used the statistical calculations of $\chi2$ to identify any significant differences in the results between the two groups. To detect these differences, he focused on self-conceptions present in at least 10 participants (15%). He also used the statistical calculations of $\chi2$ in the results between the present and future, to identify significant differences related to the groupings of participants in relation to self-conceptions in the present and future. Differences according to age, culture or nationality were not included, although one may discuss some of the potential of these perspectives.

Finally, the author underlines that he does not intend to generalise from the analysis of results to a population of engineering students.

RESULTS AND DISCUSSION

The results are presented in two blocs, firstly the general perspectives, and secondly the part related to the economic systems and consumption. The author presents the analysis for significant differences between the two groups. There were no significant differences identified between the grouping of participants in relation to the present and future. Following the criteria used in the analysis and described in the methodology, self-conceptions present in only one of the groups are also highlighted. No significant differences were identified in the results between men and women.

General Self-conceptions

General self-conceptions appearing more frequently and relevant to this study include: conceptions related to the future in *ownership of money and properties* (31.6% of participants - high presence), and related to work and the profession, such as the importance and need of *work stability* (17.5%), *success* (10.5%), and *satisfaction with work* (12.3%).

Also, in a work-related vein, *occupied/with work in the future* was a conception of the self when placed in 2030 in more than a third of the participants (35.1%); and in this case, it was reinforced even further with a high percentage of participants (24.6%) with this future-oriented self-conception when placed in the present. The rest of self-conceptions are broader and of less relevance to this research (Table 1).

The author hypothesised to identify similar results in the two groups. This was confirmed, as no significant differences were identified in most of the results between the two samples. The author considered categories of self-conceptions with a minimum of 10 participants (17.5%) of the total sample integrating the two groups. He only identified some differences in one case (information not tabulated).

On this basis, one can see a significant difference in the self-conceptions that integrated *ownership of money and properties* in relation to the future (with a $\chi2 = 6.518$; $p = 0.011$), concerning 13 participants from UiT and five participants from UB. In addition, nine participants from UB showed a self in the future that assimilates *work stability*, with only one participant from UiT (90% of the answers from the Spanish University).

Table 1: General self-conceptions according to participants in the present and future.

Category (self-conception)	Percentage of participants			
	Present		Future	
	n	%	*n*	%
Family appreciation	3	5.3	39	68.4
Ownership of money and properties	2	3.5	18	31.6
Work stability	0	0	10	17.5
Success	1	1.8	7	12.3
Satisfaction with work	1	1.8	7	12.3
Traveller	1	1.8	6	10.5
Good professional or Researcher in technological solutions	0	0	5	8.8
Category (self-conception)	Percentage of participants			
	Present		Future	
	n	%	*n*	%
Occupied/with work in the future	14	24.6	20	35.1
Has completed degree	11	19.3	1	19.3
Healthy	11	19.3	11	19.3
Self-sufficient	6	10.5	8	14.0
Interest in knowledge	8	14.0	7	12.3
Committed to help society	5	8.8	9	15.8
Category (self-conception)	Percentage of participants			
	Present		Future	
	n	%	*n*	%
Defined by his/her own personality	20	35.1	2	3.5
Good worker	18	31.6	0	0
Motivated/initiative	15	26.3	3	5.3
Lazy/sleepy/inactive	12	21.1	0	0
Enthusiastic about fitness/sport	11	19.3	4	7
Intelligent/open-minded	8	14.0	2	3.5
Unsatisfied	6	10.5	1	1.8
United to a place	6	10.5	2	3.5
Future-oriented	3	5.3	4	7
Manager/director	2	3.5	0	0
Other	6	10.5	6	10.5

The author recognised from the outset various general characteristics in the self that need further exploration. In this sense, valuing money and property or having an occupation and work stability, present significantly in the self of participants in relation to the future. This calls for further enquiry and may highlight motivations for entering engineering studies, as well as the needs of students focused on a concrete socio-economic context.

On the Economic System

With respect to the self in the context of the economic system (Table 2), participants integrated a hopeful perspective for a better situation in the future. Thus, there were conceptions of a self associated with a position that integrates a *better economy* (21.1% of participants in the future and 7% in the present); and those related to a future, where the *financial crisis is overcome* (14%).

From a different side, 15.8% of participants, when placed in the present, included self-descriptions related to being *critical with the system*; however, without a specific mention to the future or the origin or meaning of their critical position. Another group of self-conceptions corresponded to *not occupied thinking about economics* (8.8% and 3.5% of participants in relation to the present and future), and *be part of the system* (8.8% and 7% of participants in relation to the present and future).

The remaining groups of conceptions corresponded to a self that integrates *disappointment with politicians* (8.8% and 3.5% of participants in relation to the present and future), conceptions of 7% of participants when placed in the present referred to *satisfaction with the economy*, and 5.3% or smaller percentage of participants had conceptions of the self, such as *volatile economy*, *knowledge*, *crisis continues*, *innovative change*, *collapse of the system*, *ownership of money*, *contributes to improvement* or *with limited capacity to change*.

In short, an absence of reference to agency in the answers was identified in relation to an economic system needing to be reshaped, changed and even reconsidered at the most fundamental foundation of its principles [10]. However, participants acknowledged some issues in the system today, had a critical perspective, and to some extent expressed an intention to solve them. Hope for an end to the financial crisis was recognised, without making explicit mention to

specific necessary actions. A weak presence of equality, local production in the system and self-sufficiency, points out a concrete integration of a system based on prosperity beyond economic growth.

Table 2: Self-conceptions referred to the economic system according to participants.

	Percentage of participants*			
	Present		Future	
Category (self-conception)	n	%	n	%
Better economy	4	7.0	12	21.1
Financial crisis is overcome	0	0	8	14.0
Critical with the system	9	15.8	0	0
Disappointment with politicians	5	8.8	2	3.5
Not occupied thinking about economics	5	8.8	2	3.5
Be part of the economic system	5	8.8	4	7.0
Satisfaction with the economy	4	7.0	1	1.8
Volatile economy or Knowledge or Crisis continues or Innovative change or Collapse of the system or Ownership of money or Contributes to improvement or With limited capacity to change or Other	≤3	≤5.3	≤3	≤5.3

* ≤ means equal or smaller than number or percentage

On Consumption

The conceptions of the self in relation to consumption link in a prominent way to high consumption, and in a less significant way to the need to curb down current high consumption levels (Table 3).

Table 3: Self-conceptions referred to consumption according to participants.

	Percentage of participants*			
	Present		Future	
Category (self-conception)	n	%	n	%
Less consumption	1	1.8	6	10.5
High consumption society	1	1.8	10	17.5
Continues consumption	0	0	6	10.5
Disappointed with high consumption	8	14.0	1	1.8
Consumes a lot	10	17.5	8	14.0
Careful	8	14.0	7	12.3
Sufficiency	7	12.3	4	7.0
Excessive consumption	6	10.5	0	0
Careless about consumption	5	8.8	4	7.0
Recycling or Interest in consumption or Conscious of equality	≤2	≤3.5	≤1	≤1.8
Other	4	7.0	1	1.8

* ≤ means equal or smaller in number or in percentage

In the first case, three categorisations were considered in conjunction - *high consumption society*, *continues consumption* and *consumes a lot*. The author identified aspects related to high consumption in relation to the present (19.3% of participants), and more prominently in relation to the future (42.0% of participants). In addition, were classified self-conceptions in *careless about consumption* (8.8% and 7% of participants in the present and future). Then, significant differences (information not tabulated; $\chi2 = 6.777$; $p = 0,009$) were observed between the self-conceptions in the present and the future in *consumes a lot*, that point out two different blocks of participants with a 17.5% and 14% of self-conception in relation to the present and future, respectively.

In the second case, the emergence of aspects related to curbing down consumption is apparent. The author underlined the characteristics *disappointed with high consumption* (14% of participants) and the affirmation of *excessive consumption* (10.5% of participants) in relation to the present. From a complementary approach, conceptions in the self related to the experience of low consumption should be highlighted - in an integrated way, *sufficiency*, *careful* and *less consumption* - with results of 28.1% for the present and 29.8% for the future when considered together. The rest of the conceptions corresponded to 3.5% or smaller percentage of participants in the present and 1.8% in the future, and were identified in *recycling*, *interest in consumption* and *conscious of equality*.

In short, future characteristics of the self related to high consumption predominate significantly, with a clear discrepancy between the present and future. This would suggest a motivational element in favour of high consumption that could be related to the image of a future based on an unsustainable consumption model of society, which has been highlighted in studies of self-discrepancy and consumption [15][16]. The high consumption-based results show alignment with a traditional main stream approach to issues related to the economy, and in relation to the issues of inequality that can be directly connected to unsustainable consumption [9]. Although with less prominence, characteristics related to change towards sufficiency in consumption were also observed. This points out, at least in an incipient way, to the proposal of well-being and prosperity with less consumption [9][10], as well as to the great transition initiative scenario [17], with an alternative future vision. With less certainty, these findings could point out an emerging level of agency to change the economic system following the principle of integrating development without growth, fairness and equality in the global economy.

LIMITATIONS

While recognising the value and newness of studying future perspectives and a vision of sustainable development in the self, the present study is limited in that it has focused on some angles of such a vision. In this vision, it is of particular relevance to pay attention to the detail that connects with the urgency of today's environmental, social and economic issues at the global and local level. Furthermore, potential for continuing the enquiries about the self, should be underlined taking the present study as a first step. This could open up further work on hopes, fears and challenges of students in becoming agents of change for sustainable development. From a different angle, and in line with the work of Cech [1], it is promising to include the age and the stage of life in a complementary proposal for studies. This must include an enquiry that interrelates vision, self and the challenges that people face at local, national and global levels.

IMPLICATIONS FOR ENGINEERING EDUCATION

Students and professionals in engineering education can benefit from a dialogue about the importance of a self that integrates a vision of the future. It is important, therefore, to identify this long-term perspective, as well as facilitate reflection and self-knowledge. The current study opens avenues for further studies in other countries in the consideration of a transnational and cultural perspective in engineering education.

In this case, discussions with several groups of engineering students are taking place on the basis of these results and the expansion to further studies of the self. This study is seen as a seed for further reflection with new groups of students in the international arena to identify emergent aspects in the self as sources for innovation. Furthermore, the design and implementation of such studies offers potential for awareness, self-regulation and change. In this, there is potential for a study in the context of technological development that involves engineering students, as well as stakeholders from industry, which provides inputs to strengthen the acceptability and design of studies.

The author proposes several examples that can inspire studies of the self and agency in students. A basic question that comes up from the present study is: *What matters to me?* A question often directed to students that may bring good outcomes in relation to the definition of future projects. Further examples are:

- *Who am I as an engineer in the context of climate change?*
- *What economy is possible as a vision?*
- *What consumption is necessary in the future and what is my role in it?*
- *What alternative scenario of low consumption exists and who am I there as a professional?*

On this part, the proposal developed by Bennet and Male [9], albeit with a focus on the short term, can be of use in identifying relevant enquiries about the role of engineers and their fears about the future.

The process of envisioning social and personal futures is also a useful foundation for more creative work and potential self-regulation. Furthermore, self-regulation in engineering students could benefit from a more detailed sustainable development vision that includes specific projects on long-term alternative futures. For example, specific projects obtained from the Great Transition Initiative [18], as well as the Transition Towns Project [19] provide a good basis. From this outlook, it has been useful to consider the taxonomy of the future based on scenarios.

CONCLUSIONS

In the present study, the author identified the emergence of some aspects that point towards the integration of an alternative vision in engineering students. With this research, he offers some theoretical underpinnings and new avenues that can be of use to further explore the integration of a vision in those who potentially can become actors of change as engineers. This aims at going beyond a situation, where engineers are only instruments for technological development and is aligned with a commitment of sustainable development. The analysis of results provides the basis to study the self in engineering education, with the objective to develop forward thinking capabilities, the integration of future challenges, and a better position in understanding the place of students as professionals in contributing to a better society.

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