

SUSTAINABILITY IN THE PRODUCT DESIGN CURRICULUM; EVALUATING THE EFFECTIVENESS OF INTEGRATION IN PROJECT BASED LEARNING

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ABSTRACT

This paper presents a case study in the context of experiential learning in product design teaching at university level.

In the "Basic Design" cycle, in the product design specialisation, at the ISD (Institut Supérieur de Design) Valenciennes, France, the study of sustainability issues is integrated into the core project based design module. The overall aim of this 2-year experiential module is the acquisition of methodology to be applied in more autonomous projects in the second cycle (years 3 to 5). Sustainability is considered a key subject within this module and by introducing students to environmental issues related to design early in their training it is hoped that they will intuitively apply a sustainable design approach, or "reflex" to all subsequent projects. This core module has remained quite stable for a period of 8 years, particularly in the final 4 trimesters, providing a valuable opportunity for a long-term overview.

This paper summarizes initial findings of a qualitative survey based on feedback from students and ex-students at different stages of their academic and professional careers, focusing on recollections of the design project module in years one and two of their studies. The results highlight a range of points that appear to have had a positive impact on the learning experience, while also indicating areas for potential improvement. Elements of teaching and learning which may help to embed a "sustainability reflex" are identified, as are other useful insights into the effectiveness of this experiential module.

Keywords: Sustainability, experiential learning, design education, student feedback, teamwork

1 INTRODUCTION

The ISD runs three parallel 5-year masters degree courses, in engineering product design, transportation design and numeric design. This research focuses on year two of the Basic Design product (BD) cycle (years one and two), where students build on the introduction to design and design methodology of the first year, and gain confidence in their ability to respond to design projects individually and in teams. This project based design thread accounts for around 25% of the student's timetable. Sustainability issues are the focus of at least one project per year within this thread and are logically a component in other projects, but are not taught as a separate subject at this level elsewhere in the curriculum.

This research uses student feedback on a relatively stable teaching module over a period of eight years to evaluate where this project-based approach is most successful and how this in turn can be applied to successfully introducing students to the complex issues surrounding sustainability. Sustainability is considered part of essential design methodology but can it be taught in a problem solving and experiential situation? What role can teamwork (an important part of the ISD teaching project) play? At what stage in a student's learning cycle can sustainability be successfully introduced?

1.1 Sustainability and design teaching

"Le design est l'activité créatrice qui consiste à concevoir des expériences à vivre à l'aide de formes".

[1] "Design is the creative activity that consists of imagining (living) experiences with the help of form". Design teaching can be described as helping students to acquire the skills needed for the activity defined above by Stéphane Vial [1]. "Sustainability" refers 'to the viability of our collective

future and includes issues of social equity, public health and wellness, and ecological stability'[3] and will be used in this article rather than "sustainable design" or narrower terms such as eco-design, 'reducing the environmental impacts of products throughout their life-cycle' [2].

The need to embed sustainability in design education is linked to the idea that 'Designers actually have more potential to slow environmental degradation than economists, politicians, businesses and even environmentalists.' [4] Hanks, Odom, Roedl & Blevis suggest that 'designed things themselves shape us in complex ways, as much as we shape the world by means of our own designs' [3], meaning that product design has the potential to modify behaviour. These authors also highlight some of the paradoxes related to sustainability for the current generation of students. This generation may be more ready to reject individualistic needs, and engage in more service orientated activities, but at the same time are not very worried about global warming. Heightened awareness of environmental issues also does not necessarily translate into more sustainable purchase practices.

Recent research on embedding sustainability in Design curricula suggests lack of consensus on how to integrate the subject. Should we 'be educating all designers to deal with sustainability issues or would it be better to educate specialists...' [2]. Is it difficult to introduce a subject with very wide scope in already crowded design study programs? [5] Gomes da Silva and Kowaltowski also highlight the complexity of the subject which needs 'new procedures, teams and support tools' and a holistic approach. O'Rafferty, Curtis and O'Connor [6] cite UK Design Council research that identifies 30 different skills to practice more sustainable product design, though some of these such as knowledge of manufacturing techniques and materials would not count as 'new' skills.

1.2 Related theories of learning

Experiential learning theory, ELT, defines learning as 'the process whereby knowledge is created through the transformation of experience' [7]. The ELT model describes a four-stage learning cycle based on concrete experience, reflective observation, abstract conceptualization and active experimentation. These actions are placed on a bi-polar axis of perceiving and of processing. Although the theory presents a cycle, studies show that all learners do not experience each stage of the cycle equally. Demirbas and Demirkan [8] confirm the relevance of ELT to the process followed during a design project; students transform a field of inquiry (problem) into a proposition or scheme (alternative solution). This learning process is also characterized by continual dialogue and sharing of information. The findings of their study suggest that freshman design students have a learning style close to the axes of the Learning Style Grid thus having more potential to react to all stages of the ELT cycle. This model is very useful for giving structure and better understanding of the project based approach regularly used in design education, confirming the idea of experience gained in projects being re-applied and refined.

Current research shows that ELT is useful in relation to team learning, creating more opportunities for experience, and also because members learning styles may be combined to create heterogeneous teams.

Research cited by Adams, Kayes and Kolb [7] identifies problems related to teambuilding, with self-selected teams generally not advocated despite there being inevitably 'more disagreement to work through, personality clashes to cope with and conflict to resolve'. Another important issue in team work is successfully creating a conversational space where members can develop and refine the team's purpose, and develop a climate of trust and safety, allowing both for discussions of purpose (concrete experience) and reflective observation.

Research cited by Dym et al states that "design education should be refocused on teaching designers to better function in group situations" [9] And many positive arguments can be found for teamwork, for example increasing levels of confidence and comfort levels in work, but teams' beliefs about their own capabilities termed 'collective efficacy' can have a strong influence on cohesion and satisfaction within a group and need to remain positive for successful outcomes. Tim Brown [10] of IDEO talks about the "power of small teams" and the ability of teams to "liberate creativity".

Existing research shows the important role of the emotions in design students' learning [11], and the fact that they give meaning to experiences. Emotions can be seen as reactions to fulfilled, unfulfilled or exceeded expectations, which may mark events and be subsequently analysed and interpreted by students. Emotions will influence the way that students react to information and learning and will also affect the way students subsequently represent events to themselves.

Basic Design years: 2007 -2009: (name ?)

(Please fill in the project zones in order of preference, with 4 shades of the same colour, pale or white = few memories or negative memories, dark = very positive or strong memories)

					1) Eco – project Sharing
2) Cardboard Toddler chair	3) SLS	4) Urban Gardener	5) Sushi Pack	6) Room in a room	7) Positive energy - Home / domestic product

Comments :

(I am interested to see which projects you remember well, with positive, negative....memories and if you have perhaps re-worked or re-used, published these etc... You may comment good or bad memories as you wish. Your comments can cover several aspects and can be anecdotes, impressions or more concrete elements. You do not need to comment a choice – light or dark – if you do not wish to.. Add zones to the first year zone if there are projects you specially enjoyed, and number as in the example. Example of how to fill in the form below. Use the numbers to identify the projects and erase those not used.)

Figure 1. Student reply form

2 METHODOLOGY

The orientation chosen for the first stage of data collection was to focus on collecting reactions ‘memories’ of past projects, with both a simple evaluation system and the opportunity for students to comment freely on positive and negative memories. The method chosen was an e-mail exchange, a simple form of correspondence, allowing a certain invisibility [12] and giving space and time to participants. Rautio [12] suggests that written correspondence is the most appropriate method for conscious reflection, meaning making and interpretation of one’s experiences.

Figure 1 shows the reply form sent to students. The only guidelines are a range of open questions, so as not to encourage answers predicting researchers’ expectations, therefore sustainability and team projects are not mentioned. Colour shading is used instead of a numerical grade system to encourage a slower, less automatic response, and allow students to better visualize their replies.

Années Prépa : 2006 - 2008:

(Remplissez les zones projets en ordre de préférence, avec 4 tons d'une même couleur, pâle ou blanc = faible souvenir, mauvais souvenir, foncé = très bon souvenir, fort souvenir)

					1) Eco-comportements Veolia
2) Cardboard Coathangers	3)SLS bijoux	4) Lunchbox	5)Wire management	6)Urban Gardener	7)Eco Sharin

Commentaires :

(Ce qui m'intéresse est de voir quels projets ont laissé des souvenirs : positifs, négatifs (un éventuellement si vous avez re-travaillé des projets, ou ré-utilisé l'ensemble ou des parties également commenter les mauvais souvenirs de projet si vous voulez. Vos commentaires, aspects, et peuvent être des anecdotes, des impressions, ou des éléments plus concrets. obligés de commenter un choix – foncé ou faible. Ajouté des zones en prépa 1 si il y a des spécialement aimés, et chiffrez comme l'exemple. Exemple de remplissage ci dessous à e chiffres pour identifier les projets ci dessus et effacez les chiffres non utilisés)

- 1)
- 2) projet super sympa par ça simplicité et néanmoins des solution très varé et une ui maquette (utile)
- 3) je regrette de n'avoir pu exploiter au mieux le process car en projet flash je n'ai pu comprendre toutes les possibilités offertes par ce process que je trouve super intéressé

Années Prépa : 2003 – 2005 :

							1) Portable village – leaving no footprint
2) Small kitchen appliance	3) choc olate s	4) Lunchbox	5) Pets and owners	6) ring s	7) Leather accessories	8) Paris Olympics – jeux olympiques à Paris	

Commentaires :

- 1) Je n'ai pas aimé ce projet. Je ne me suis pas sentie touchée par le sujet, je n'ai pas compris l'intérêt du brief.
- 2) J'ai bien aimé ce projet.
Le sujet était bien, les appareils électroménagers font partie du quotidien de tout le monde donc c'est un sujet avec lequel on se sent familier et qui offre plein de possibilités. Pour le premier projet de Prepa2, je trouve que c'est le type de sujet idéal : clair, sans piège, qui aide à se sentir en confiance en début d'année je trouve. Personnellement cela m'a touchée particulièrement : je crois que c'est le premier projet de l'ISD sur lequel j'ai aimé travailler car ceux de Prepa1 n'étaient pas du tout adaptés à une jeune étudiante comme moi qui en entrant à l'ISD ne connaissait rien au design ! En effet nous avions des briefs tels que « plier-déplier », « les

Figure 2. Extracts of student replies

The data collection method generated replies of very different length and content suggesting the method allowed for individual character/interpretation. Figure 2 shows part of two reply forms as returned by students (names omitted). Several students finished their replies with thanks for the opportunity to reflect on past projects, suggesting that PPD (Personal and Professional Development) statements [11] or similar reflective practices could be profitably introduced at the school.

3 RESULTS

3.1 Quantitative analysis

Student replies to this research were collected over a period of 4 months, and cover study in the BD cycle from 2001 to 2009. All students replying were commenting on their second year of study, but at

time distances varying from 6 months to 8 years. The lack of difference in detail, emotional content or simply style in the replies suggest that the varying distance has little effect, with only the "closest" replies showing a slightly different nature. The sample of 25 replies does not allow reliable quantitative analysis for individual years but is used here to identify patterns for the whole period and highlights some points that could be explored further.

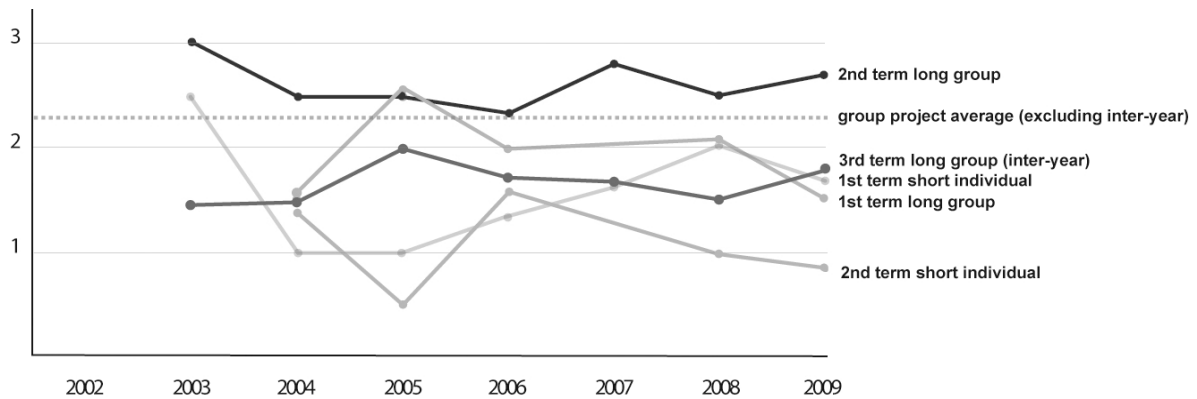


Figure 3.

The colour grading system was converted into numerical form for these quantitative results, the four shades ranked as 0,1,2 and 3. The question of individual or group working produced some surprisingly marked results, with long group projects averaging a positive rating of 1,98 (overall average score given by students for projects: 1,69) and individual short projects averaging just 1,38. Two long individual projects (average 1,7) suggest that both the length of project and the team are important factors. But closer examination of the results suggests that team working has a clear impact on the positive impression left by a project. While the score for individual projects remains quite similar in the first and second trimesters of the second year, the score for the group projects is quite different. (Figure 3, second year project average ratings) The second trimester long group project is rated at 2,67, and this score is also the most consensual – with 17 ‘3’s, 5 ‘2’s and 2 ‘1’s. The consistent high ranking of this project appears to validate the experiential nature of the BD cycle, as this project represents the point where many students will be in a position to relearn with new, more refined ideas, and so may be the correct place to introduce more sustainability issues.[13]

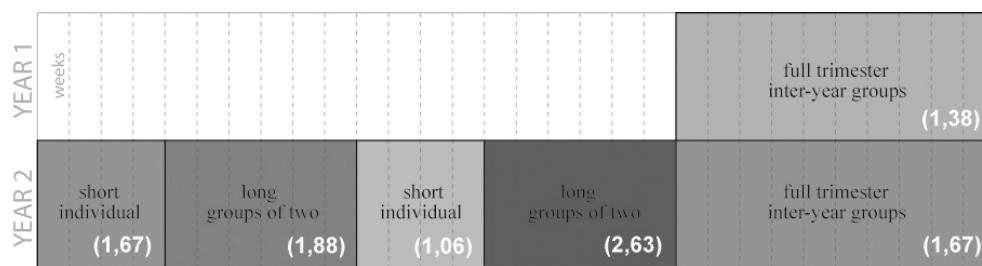


Figure 4.

Two new points emerge from this initial analysis, the particularity of the inter-year project and the importance of the moment in the year/cycle. The average rating for group projects increases to 2,21 without the inter-year project, so these results clearly suggest that it is not experienced as positively as the long project that immediately precedes it. More research is needed here to try to determine the individual impacts of project, team composition and subject. Interestingly, this score was one of the most irregular and the most polarised, with 8 ‘3’s, 7 ‘2’s, 2 ‘1’s and 7 ‘0’s. Some reasons for this appear in the qualitative section of the analysis, but the polarization the number of ‘0’s signals a problem that needs addressing in pedagogy.

Figure 4 shows the average two-year cycle (from freshman participation in the inter-year project) in colour shading similar to the reply forms (but here with more nuances). The difference in reaction to individual projects, which is in inverse direction to the progression of group projects may be explained

by the different project briefs given. For example a 'hands-on' project is often given at the start of the second year.

Scores given to projects containing sustainability issues show that this subject does not in itself constitute an attraction, but when questions of sustainability are linked to 'hands on' projects, with emphasis research models and physical experimentation, the subject is received more positively. The highest ranked "sustainable" inter-year project, average score 2, was titled "sharing" and was focused on behaviour and possibilities of collectivization of certain products and services. The results suggest that sustainability does not adversely impact the enjoyment of the project, but that the focus and precision of the project brief will have an important role to play.

3.2 Qualitative analysis

The quantitative results cannot be used alone and student comments help to make sense of the results. These confirm that attitudes to sustainability are very varied, from the very positive and implicated to indifferent and also 'overload'; *"the project I enjoyed the least despite being sensitive to ecology! Saturation...too many eco projects in BD"*

Several short individual projects combined questions of sustainability with hands-on projects and these appear to have been very successful, particularly when the subject and/or approach has appeared surprising and new to students. Two comments on a project based on designing instructions for DIY found-object toys: *"the question of a 'home-made' object gave a new approach"*, *"the constraint of found materials, recuperated/readapted really interested me"*. These projects also generated many comments relating to the emulation created by the model making. An 'exhibition' format for the final presentation of these projects also created interest and awareness in the work of others.

Although sustainability is not often mentioned in student replies, related issues such as human centred focus, behaviour and service design are widely commented; *"which showed me that a service could be a response to a design brief"*, *"the chance to explore a whole new service"*, *"the subject was more about service design"*. The product of service concept, [14] introduced by McDonough and Braungart is just one example of the importance of the idea of service for designers in relation to sustainability.

The polarized reactions mentioned in the quantitative analysis to the often sustainability-oriented inter-year project, are confirmed in the comments, with reactions falling into two categories. A large number of replies react to the nature of the subjects given, seen as very wide and hard to get to grips with, particularly when this project was in the freshman year, with the "sharing" project (mentioned earlier) a clear exception. A smaller number of students are very positive about sustainability oriented long projects, and seem to have integrated ideas of behaviour change and going beyond redesigning [14] *"I adored this project. From then on I've kept this implication for ecology, even if it means completely re-questioning design."* *"I really liked working on peoples behaviour, and their way to act with regard to the environment."* Identification of a clear target is highlighted by several students in their replies, *"I enjoyed working from a kind of defined user and not from a type of object to design"* and though this as a standard part of most design projects, a very human-centred and behavioural approach seems to be a way of making sustainability issues more accessible/tangible.

Nearly all replies comment on problems and emotions related to teamwork, with the inter-year project creating most problems of differences of opinion between the two year groups, of management, and group dynamics. All but 4 students talk about teams and mostly as very positive experiences with working in pairs the most positively rated. In certain cases the team is cited as the reason for a very negative experience - though mostly in the inter-year project. The team seems to reinforce emotions related to a project with both positive and negative outcomes, and this team-working/emotion link will be an important point to study in ore detail. Comments also seem to confirm the idea of 'collective efficacy' [9], and suggest that early identification of (self) doubts on group capabilities will be important.

Although many students commented positively on projects that were seen to be clear and limited in scope, there are also many comments that support the idea that attitudes evolve through a project, and that there is satisfaction to be gained from making sense of a problem that was at first hard to understand. Overcoming difficulties is a recurring subject that seems in retrospect to generate very positive memories, but more often in the team context than in individual projects.

Student replies show that there are conversations, observations and reflections on the work of others, *"I saw the difference of style between girls and boys"*, *"I liked ...the emulation between the teams"*, *"gave the occasion to discover each person's project"*. This is more true of projects with model or

poster presentations than computer slide show presentations, with intermediate paper presentations also creating strong positive memories for discovering others' work. This emulation creates very useful learning opportunities, where students see various solutions to a problem by exchanging with other teams and may be useful in dealing with the complexity of sustainability.

4 CONCLUSIONS

This is an ongoing project that has brought up points that go beyond the initial question asked and can form new research questions. Student replies seem to confirm the relevance of an experiential model for design teaching, whilst also highlighting the variety of learning styles within a student cohort. Results show the quality of student reflection on their learning environment and personal development and also that it may be useful to increase opportunities for reflective activities. The research points to moments in the student curriculum that are likely to create more positive outcomes and thus lasting 'reflexes' whilst signalling potential problem areas and solutions regarding the question of sustainability. More research will be needed to better understand the possibility of creating a sustainability reflex, but it appears from this initial feedback analysis that a combination of projects in an experiential cycle has embedded useful understanding of some sustainability issues and certain strengths and weaknesses of the approach are more clearly identifiable for future improvement.

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