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A TALE FROM THE TROPICS: EDUCATION FOR SUSTAINABILITY AND THE VALUE OF PROJECT-BASED LEARNING

Deborah ANDREWS and Barney TOWNSEND
School of Engineering, London South Bank University

ABSTRACT
In September 2016 two academics from London South Bank University were invited to Guadeloupe, a French Overseas Département in the Caribbean, to teach students about design and innovation for sustainability. The project involved final year baccalauréat students on Applied Arts and Innovation and Technology streams at the Lycée Polyvalent Raoul Georges Nicolo. The aims of the project also included developing and extending staff knowledge of Design Methods, English language and design terminology as well education about and for sustainability.
Art and science are sometimes combined in UK design education, but remain distinct under the French system; this project represented an opportunity for students from different subjects to work together and learn new approaches from their peers and academic staff. Project-based learning has always been core to design education and its value is being recognised and adopted by many disciplines. It was key to this programme, the results of which far exceeded the expectations of the local school teachers and visiting lecturers. It encouraged unprecedented levels of engagement and developed social skills and confidence among a group of students who generally lack motivation but whose attendance is mandatory. In addition to describing the project and learning outcomes, the paper includes qualitative research, analysis and comparison of feedback from teachers and students at the Lycée. The paper also highlights the challenges of teaching in a different cultural context and describes what the authors learnt and how these experiences are contributing to their pedagogic practice.

Keywords: Project based learning, interdisciplinary education for sustainability.

1 INTRODUCTION

Guadeloupe is an archipelago of nine islands with a population of 465,000 covering approximately 1,800 km^2 in the Lesser Antilles. The largest islands (Grande Terre and Basse Terre) are adjacent and separated by a small river. Both islands have diverse terrain and land and sea-based wildlife; Basse Terre is particularly dramatic, being dominated by La Grande Soufrière volcano. The islands were initially colonised by France in the 17^{th} century, becoming an Overseas Department in 1946 and a Region in 1980. Consequently, the French education system is practiced and the official language is French, (although Creole is widely spoken); students also study subjects in other languages including learning about Design in English.
The French government sponsor a Continuing Professional Development programme for teachers which involves exchange visits with other intuitions. In 2014 Mme Karine Nicolas a senior teacher and head of the 3D design courses at the Lycée Polyvalent Raoul Georges Nicolo in Guadeloupe, visited London South Bank University; she spent two weeks working with academics and students on the Product Design and Engineering Product Design courses at Lx in order to learn about British 3D Design education (which has a well-deserved international reputation) and to extend her knowledge of English design terminology to support her teaching. Karine Nicolas' visit proved very successful and she achieved her objectives, as a result of which Deborah Andrews and Barney Townsend were invited to the Lycée to support staff and students in the development of sustainable and 3D design, technology and innovation teaching programmes.
The Lycée is a 'high school of crafts and applied arts' for students between 15 and 18 years, some of whom are interested in higher education and progress to university after completing the baccalauréat;

other students are legally obliged to attend until they are 18 but some have little real interest in education. Students from all over the archipelago and nearby Martinique travel to study at the Lycée because it is the only institution in the area that specialises in applied arts and crafts. Consequently, on-site accommodation is provided for weekly boarders, some of whom are unable to commute every day and others who come from challenging backgrounds; some staff also stay on site to 'look after' these students. The Lycée is led and managed by a dynamic, committed and enthusiastic Head Teacher and staff team and atmosphere in the school is positive, engaging and caring. The school buildings were designed for the tropical climate but the classrooms are not air conditioned and even during the cool season they can be very hot and consequently classes run from 7am to 5pm and the school week is usually 3 full days and 2 mornings. The pattern of teaching and learning is however more like that in non-tropical further and higher education institutions and students study various subjects with specialist staff in different classrooms and labs. throughout the day. The profiles of the groups involved in the project typically reflect those in the UK and a significant majority of students on the Applied Arts (AA) course are female while those on the Innovation and Technology (ITec) course are male; the teaching staff prolife is very similar. In total 45 students (28 AA and 17 ITec) participated.

2 PROJECT-BASED LEARNING

Having been invited to spend two weeks at the Lycée the academics from LSBU realised that achieving the objectives for both staff and students within such a short time period would be very challenging and they decided that the most efficient and effective way of doing this would be through project based learning (PBL).

This is not a new approach: for example, the philosophers Confucius and Aristotle recognised the value of learning by experience while Socrates discussed learning through inquiry, questioning and critical thinking; more recently the educational theorists Dewey [1] and Kolb [2] have developed the approach extensively as they challenged the idea of students as passive recipients of knowledge and argued that active experiences prepare students for ongoing learning about a dynamic world.

As a recognised student-centred pedagogy, experiential learning is essential to Design education and, just as it would be impossible to learn to drive simply by reading the Highway Code, it is impossible to learn to design without practical experience of the process. It follows from this that it would also be impossible to learn how to design without undertaking projects, which have always been a core to design education and professional practice. It was not until the 1990s however that the term Project Based Learning was promoted and its value as a method of teaching and learning in other subjects advocated by educational psychologists [3]. Since then a number of research studies have "demonstrated that students in project-based learning classrooms get higher scores than students in traditional classroom" [4], [5]. Consequently, Project Based Learning was the optimum method for teaching the students. In addition to facilitating their learning, experiential learning was also used to facilitate and support teachers' learning. While some teachers (e.g. maths, science and language specialists) were introduced to new subject areas, teaching methods and approaches to thinking, the project also served as an opportunity for the applied arts and design teachers to extend knowledge of the various subjects and current practice outside the Caribbean. Finally, the project content was based on a subject with which the students could personally identify to reinforce what they learnt at the same time as being educated *about* and *for* sustainability. The whole project ran over 9 working days.

3 INTERDISCIPLINARY LEARNING

It was decided to combine classes for students from the AA and ITec subject areas to create an interdisciplinary learning environment. This was new to the Lycée but for over twenty years has been shown to be very beneficial because it offers students a more authentic experience that better reflects life in our multi-faceted and complex world than compartmentalised 'subject-matter packages' [6]. This approach has been successfully used with students from similar but different design disciplines (where the educational environment mirrors that of a *design* studio) [7] and with students from similar but different engineering disciplines [8]. Interdisciplinary learning has also proved successful with students from completely different subject areas and approaches to learning such as health care and management [9]. In all these cases additional unexpected outcomes from these projects were recorded.

For the past 15 years or so science, technology, engineering and mathematics have been grouped as STEM subjects and there are obvious links and overlaps between them. More recently however *art* has been added to this group in recognition of the importance of creativity as a driver of innovation and

STEAM is becoming an increasingly popular version of interdisciplinarity [10], [11]. The design project was a group project and ideally each group should have included students from Applied Arts and ITec courses. Unfortunately timetabling problems made impossible to create mixed groups of this nature; nevertheless, after being introduced to the project separately, the AA and ITec students worked in groups of 3 at the same time in the same space and interaction between the subject groups gradually evolved as the project progressed.

4 SUSTAINABILITY IN GUADELOUPE

Although part of France and the EU life in Guadeloupe is very different from that on the mainland. In Guadeloupe there are a few cocoa, coffee and fish farms but the principal economic activities are construction and cement, rum, sugar and tourism; in France tourism is also a major economic force (and it is the third most visited country in the world) but industry and agriculture are proportionally larger and far more diverse. Consequently, in France GDP per capita is almost double that of Guadeloupe (at €30,000 and €17,200 respectively) and the official level of unemployment is far lower (approximately 10% and 25% respectively) [12] The majority of capital and consumer goods and food are imported from France and China via France, as a result of which 40% of household waste is packaging; similarly, the tourist industry generates a high volume of glass from beverages. Unfortunately, in Guadeloupe the infrastructure and services to deal with this and support sustainable behaviours are either very limited or have not been developed. For example, only 10% of the population has separate collections for recycling, most of whom live in the largest town, Pointe a Pitre. The remaining 90% of the population have a choice between either taking recycling to central municipal sites or mix recycling with waste. Consequently, the large plant composed of a sorting centre and recycling facilities for plastic that was constructed in 2004 was not used for a number of years due to lack of feedstock. More recently a waste to energy plant has been constructed and now transforms 30,000 tonnes of household, industrial and hospital waste into steam and electricity; although less damaging than sending waste to landfill this does not encourage recycling. In other cases, compliance with regulations has a high environmental impact as hazardous waste such as refrigerators and fluorescent lamps are stored for periods beyond the recommended safety period and are then transported 1800km back to France for reprocessing. These factors mean that knowledge of, attitudes to and levels of sustainability differ from those in mainland Europe and that students face different challenges when designing for sustainability [12].

5 THE PROJECT: MAKE GUADELOUPE SUSTAINABLE

As stated above the brief was devised to educate students about and for sustainability, and it was based on a subject to which they could easily relate.

- **Project Context**: students were reminded that "Many people do not live in a sustainable way – they do not know about or understand sustainability and/or if they do understand the concept they do not put the theory into practice".
- **Project Brief**: In order to address this, students were asked to "Design a toy and/or game that will increase understanding of sustainability (sustainability literacy) among different user groups and encourage them to live more sustainable life styles. The proposal should involve some engineering principles and low technology."
- **Design Process**: The project was essentially an intense two week course in which the structure and milestones were similar to those employed on various modules on the BSc design courses at LSBU Lecture material was also adapted to match the project requirements and students were introduced to new terminology and subject material to help them to develop the design proposals.

Teaching staff from the Lycée attended the various sessions and both observed and participated in the on-going activities. The students worked in self-selected groups of 3 and were first introduced to the principles of sustainability and, through group discussions, we learned about their perception of what was available to support sustainable behaviour in Guadeloupe. Following distribution and discussion about the brief students were introduced to and then employed the Design Council's Double Diamond design process model [13] after they implemented the 4 stages (Discover, Define, Develop and Deliver). In addition to brainstorming they were also introduced to a number of creativity techniques including bodystorming, W5H2, Six Thinking Hats and Random Words, [14], [15] image association techniques and SCAMPER [16]. Other lectures and activities included anthropometric measurement, basic ergonomic principles, human centred design, user profiling and advice about sketch modelling

and PowerPoint slide design. At the end of the first week each of the 15 groups had to present their rationale and concept in a 90 second Elevator Pitch to all other groups and staff. At the end of the second week each group exhibited their 2D and 3D work in a 5-minute presentation to their peers and staff.

6 PROJECT OUTPUT AND LEARNING OUTCOMES

There was not enough time to execute the four stages of the Double Diamond process model in depth but each group answered the brief and produced a design proposal for a toy or game to educate the public about aspects of sustainability; the type of output was typical of the above process and included concept and development drawings, at least one 3D sketch model and a final PowerPoint presentation. Some groups also produced CAD models and there was evidence of basic engineering principles, mechanical and digital technologies. Considering the factors discussed in section 4 above it was not surprising that the emphasis of the design proposals was the environment rather than social concerns although one group designed *Bio-Bike-Car*, a pedal-powered vehicle selling fruit and vegetables and making smoothies to promote healthy eating and exercise. Other proposals included a game and tool to reduce and collect plastic waste from the sea, and another group designed a skittles game and app to encourage people to separate recycling materials correctly.

Typically, there were differences in individuals' learning styles as defined by Fleming (Visual, Auditory, Reading, Kinaesthetic) [17]. There were also differences in the approaches to the project by the two main student groups, which were probably due to prior educational experience. For example, in general AA teaching and learning tends to be student-centred and inquiry-based while that of the ITec students tends to be teacher-centred, instructional and more formal. The most immediate differences in response to the project as a whole were not unexpected:

- **Working methods and process**: this was the ITec students' first real exposure to divergent design thinking and working to an open brief; initially they struggled to generate more than one idea and to iterate whereas the AA students were familiar with the process started work as soon as the briefs were introduced, produced a number of concepts and developed their ideas
- **2D work**: the standard of drawing was predictably higher among the AA students whereas the ITec students were more familiar with CAD and consequently they were keen use digital tools to illustrate their design work
- **3D work**: AA students were familiar with use of 'scrap' materials for 3D modelling and they were confident and inventive whereas the ITec students were new to sketch modelling and were initially reluctant to work with 'scrap' materials although they were persuaded and coached by visiting staff to make 3D sketch models
- **Presentations**: the AA students were more used to standing up and presenting their work to their peers and staff so they prepared, were relatively organised and delivered fairly confidently. This was another new experience for the ITec students who were shy and awkward and 'fooled around' during the preliminary Elevator Pitch; however, they were better prepared, more organised and delivered their final presentations more confidently and maturely.

Based on their extensive experience of PBL and interdisciplinary education Deborah Andrews and Barney Townsend had hoped to achieve the objectives and these outcomes, although the success of the project was not guaranteed. In this case however the positive outcomes far exceeded their and the expectations of the Lycée staff. After initial shyness and reluctance to mix the majority of AA and ITec students integrated and there was some knowledge exchange as the AA students helped the ITec students to draw and make models and the ITec students discussed technical issues with the AA students. Due to the AA students' enthusiasm the working atmosphere was consistently positive throughout the project but the group dynamics and behaviours gradually evolved; for example, while the AA students engaged from the project launch initially the ITec students were uncommunicative and appeared to be uninterested. As the project progressed their attitude changed and they became more animated, involved and prepared to discuss the project at length with the teaching staff. A notable shift in the engagement level came for a struggling ITec group who were persuaded to make a 1:1 scale sketch model and then bodystorm playing the game to improve the design. At the end of the project the overwhelming consensus of opinion among the teaching and management staff was that the ITec group had engaged more, studied harder and produced more work than they had done for any other assignments. and a number intend to develop their projects for their baccalauréat.

7 STUDENT AND STAFF REFELCTION AND FEEDBACK

As stated in the Introduction the primary aim and objectives of the LSBU academic visit to the Lycée were to support staff and students in the development of sustainable and 3D design, technology and innovation teaching programmes. The direct and indirect learning outcomes described above illustrate the overall success of the project and the contribution to and value of PBL in an interdisciplinary environment to this success; it was decided that personal reflections would also be useful to inform future teaching and CPD activities as a result of which students and Lycée staff who were directly involved in the project completed two questionnaires. Both included ten very similar open questions: while students were asked about their personal experience of the project, staff were asked about their personal experience and their perception of the students' experience. Deriving from open questions made analysis of results more difficult than Likert-style questions for example but they are summarised as follows:

- **What new things did you learn about during the project:** both groups learned more about sustainability and how design can contribute to solving related problems; they also broadened knowledge of design methods and creativity techniques as a route to innovation. Staff also commented on the value of quick practical activities to engage students, that the project enabled them to meet colleagues from other disciplines and most importantly how to teach sustainability.
- **What did you enjoy most**: both staff and students enjoyed collaborating with peers from the other courses; students also enjoyed learning about new means of tackling problems associated with unsustainable living and staff enjoyed the linguistic exchange
- **What did you enjoy least**: both groups noted that the time on the project was too short; apart from that students said there was nothing that they didn't enjoy about the project.
- **How beneficial was it to work with students from a parallel study stream?** About 10% of students didn't find this beneficial, but over 60% said it was a little beneficial. In this case there was a marked difference between staff and student responses and 66% of staff response said it was very beneficial.
- **What did you learn from working with students from a different study stream?** Having made the above comments, the next response was slightly contradictory because the majority of students commented that they learned a lot about different ways of working.
- **How much has your behaviour regarding sustainability changed has a result of the project?** This is a very difficult question to answer particularly in view of factors such as the poor recycling infrastructure in Guadeloupe and again staff and student responses differed: 45% of students said that their behaviour had not changed, 39% that it had changed a little and 17% a lot. Staff were more positive and 67% said that it had changed a little and 33% a lot.
- **Was the method of teaching more or less formal than you were used to**? Students thought that the approach was more formal and staff that there was little difference
- **What were the main differences that you noticed between the way that the English and the French teachers teach you?** In this case most students felt there was little difference but commented that classes were more intellectually intense but less tiring. Both groups noted that the balance between theory and practice differs and that the English method involves a lot more practical work. Staff also commented on the positive response to the students, that they had more independence, were trusted to make their own judgments, but were challenged about their ideas.
- **What were the most useful things the English teachers brought to the project?** Both staff and students commented that they had learned about new aspects of sustainability and benefited from English language communication; the students also felt that they specifically benefited from specialist staff knowledge and experience and learning about new design methods.

8 CONCLUSION

Although this is an individual case study the design output, enthusiasm of the AA students and changed attitudes of ITec students clearly demonstrate the value of Project Based Learning and interdisciplinary study. Both student and staff feedback and the general consensus of opinion further confirm this. There is some variation in perception of behaviour change and staff recognise greater change among students than they do in themselves. This may be due the short timescale of the project, the limited time for personal reflection and to the high level of implicit learning i.e. they have learned things about which they are unaware at present.

The aims and objectives of the exchange visit by the LSBU staff have been met and expectations exceeded in most cases. The project was highly successful and benefited both students and staff and there is a positive legacy for both groups: having taken part in PBL and interdisciplinary teaching and learning, staff at the Lycée are now confident that they can and will run this and similar projects. Similarly, some formerly unmotivated students are now working hard and want to gain their baccalauréat qualifications. Finally, the students at the Lycée in Guadeloupe have learnt more about sustainable design and sustainability but with such limited infrastructure to support this it is currently very difficult to implement everything that they have learnt. The experiences gained during this visit and project have also benefited Deborah Andrews and Barney Townsend who are now more aware of the impact of geographical location and political factors on sustainability and of variations in staff and student perception of the same activities both of which has enriched their teaching.

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