AC 2011-2483: EXPLORING THE VALUE OF DEMOCRATIC ASSESSMENT IN DESIGN BASED ACTIVITIES OF GRAPHICAL EDUCATION

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Exploring the value of democratic assessment in design based activities of graphical education

Abstract

A significant change in the philosophy of graphical education in Ireland has taken place since 2007. The introduction of a new subject *Design and Communication Graphics* (DCG) has broadened the traditionally focused syllabus. The understanding of geometric and descriptive principles in the context of predefined applications is now governed by a subject that supports conceptual endeavours. DCG provides students with the opportunity to develop a skill set that will allow them explore and learn within and beyond their subject domain through the medium of design without make.

With the objective of codifying the initial teacher education practices, an introspective analysis was taken to explore student's performance within a core graphics module at the University of Limerick. Students from year 3 of the undergraduate *Materials and Construction Education* and *Materials and Engineering Education* initial teacher education programmes were tasked with a thematic design brief that required them to produce a graphical portfolio of their design solutions. To encourage diverse, imaginative, and creative engagement in this design activity a democratic non-criterion referenced approach to the assessment was employed. Students judged their peer's work and agreed on a ranked order of the strongest, weakest and relative positions of each design portfolio. The relationship between the student's assessment heuristics and their performance in the design task are discussed in the context of evidence of learning.

The paper explores the interdependence of domain specific knowledge and skills, pedagogical strategy, and flexibility in evaluating student capability and competency in graphical education. The need to establish the currency that defines effective pedagogical intervention is presented.

Curricular change

Responding to the evolving needs of society, the Department of Education and Science in 2007 philosophically shifted the focus of graphical education. The introduction of *Design and Communication Graphics* (DCG) to replace the vocationally originated *Technical Drawing* brought with it a significant number of challenges. DCG provides students with the opportunity to develop a skill set that will allow them explore and learn within and beyond their subject domain through the medium of design. The analytical and design driven approach is envisaged to form the core of a subject that encourages students to become enterprising, creative and empowered during their learning experience. Notably the DCG subject embraces the inclusion of design based problem solving without placing emphasis on the production of an artefact. Instead students must communicate their design solution by means of a graphical portfolio. This is a significant shift from the traditional design-make-appraise approach that is well established in technology curricula.

With the objective of codifying the initial teacher education practices, an introspective analysis was taken exploring student's performance within a core graphics module at the University of Limerick. The study set out to establish the core attitudes, skills, and knowledge required to become an effective facilitator of the design approach to graphical learning. This paper explores the design without make philosophy of DCG by first presenting some of the generic issues surrounding design within technology education.

Approaching design education

In recent years design activities are the topic of much discussion and research within technological education. Mawson outlined that the "*design process*" is well established as a structure for contemporary technology education[1]. However, he goes on to say that progressing technology education is dependent on teacher's embracing a contemporary pedagogy. This is highlighted in the studies of Moreland & Jones[2&3], where they argue that the importance of developing teacher expertise must focus on knowledge about the subject, knowledge in the subject and general pedagogical knowledge, which all have implications for thinking about teaching, learning, and assessment in technology.

With the objective of assisting teachers and awarding bodies many design process models were developed. This gave a defined and standardised structure to engage with what is a complex, iterative process[4]. Recognised as helpful guides the documented design and reporting structures resulted in developed pedagogical practice. Mawson reports on the adherence of technology teachers to a linear concept of the design process[1]. Kimbell et al. [4] also noted that although helpful guides to teachers, defined models were dangerous tools as they prescribed the stages that pupils needed to complete.

Mioducer and Dagan identify two distinctly different approaches to design activities in technology education[5]. The structural (design process model) approach orders the learning activity in terms of the stages of a design process, this approach has clearly signposted summative outcome. The resulting design approach is driven by the model that the teachers selects and is dependent on teacher's interpretation and

implementation of its stages. However there are concerns that this mechanistic approach restricts the students' abilities to achieve a holistic view of the design activity. Alternatively the functions approach emphasises the teaching and study of design functions rather than stages. The functions approach may require the student to decide on and use several functions at any stage in the process requiring the contextualisation of functions during the solution generating process. This approach requires the teaching of the different design functions so as to facilitate students achieving their vision based on critical decision making.

The functions approach to design instruction is a more effective model in supporting the construction of holistic, flexible, and effective mental models of the design process[5]. Much of the discussion within design and technology centres on the relationship between design and make. Baynes[6] makes two critical points in relation to this relationship

1. There is a temptation to overvalue and hence to over assess the finished product.
2. There is often a mis-match between the pupil's imaginative vision and the pupil's ability to achieve it in reality

Valuing design without make

It is difficult to contextualise *Design and Communication Graphics*, which has similarities with *Art and Design* and yet is comfortably housed in technological education within the Irish second level curriculum. Rutland[7] explored the approaches to designing in *Art and Design* and *Design and Technology* in the UK curriculum which gives a valuable insight into the objective of DCG. She highlighted that designing as a term is used in both subjects but that its interpretation varies between the subject domains. Attention is drawn to the need to make explicit the nature of design in each of these subjects and how its treatment could lead to confusion if not addressed.

Both programmes of study highlight commonality and synergy that aligns with the goals of the DCG curriculum. The stated competencies developed in *Art and Design* of *investigating, analysis, designing, evaluation, and making informed choices about media* contrast with the defined competencies of *Design and Technology* which are *Making, applying knowledge of materials, production processes and aesthetics*. DCG emulates the competencies of Art and Design in the context of Technology. This would suggest that a redefining of the design approaches is required to facilitate the DCG student.

Research conducted by McCormick & Davidson suggests that teachers see the product outcomes and associated skills as important in themselves, and in the end these products tend to take precedence over the process of design and problem solving[8]. This issue may also exist in the Irish Technology curricula and may find teachers now struggling to establish what to value in the design activity in DCG as there is no requirement for the student to produce a product outcome. Barlex & Trebell[9] state that the removal of the requirement to make what has been designed affords students the opportunity to conceive ideas for products that are not

constrained by their ability to realise. They also propose that, if students were not confined by assessment objectives they are more likely to take risks and produce genuine, relevant and personal solutions. DCG promotes a design without make approach that encourages teachers and students to focus on the process of developing and communicating their design ideas. But care must be taken so that the communication of the ideas for assessment does not in itself become the '*product'* of the activity.

Confirmatory in sorting

The contemporary education discussions that examine the assessment objective focus on the important differences between assessment *of* and *for* learning[10]. Prashnig[11] argues the need to focus on how students learn and highlights the misguided emphasis being placed on "*what people know*", and promotes the importance of a paradigm shift from "*knower to learner".* This is supported by Kimbell[12] who highlights the conflict that exists between curriculum policy and assessment policy, with the difficulties centring on standardisation and testing. This questions the validity of what it is we are actually measuring. The assessment challenge is amplified within technological subjects as Kimbell[4] argues that the essence of the problem with design based educational activities lies in the transformation of active capabilities into passive products. The mode of representing also forms a challenge in presenting capability as the manner in which design students operate may be indescribable within the linguistic reporting format[13].

Guilford expressed the view that it is difficult to develop design based attributes due to the conforming nature of schooling[14]. The mismatch between the rhetoric about the importance of conceptual aptitudes and the value placed on creative talent raises concern about the coherence of educational strategy. Design driven subjects on the one hand envisage a creative, iterative, fluid process based on the application of a broad multi-disciplinary base of knowledge and skills, while on the other hand must contend with the requirements of assessment, time management, resources, and the production of predetermined evidence.

The didactic transition of information can often circumvent student engagement and result in learning being an abstract activity without context or application. What is often more worrying is when we (as educators) present our experience and meaning for students to accept, eliminating the need for students to create their own[15]. Diluting or even depriving students of the most significant element of creating meaning and constructing understanding.

Therefore the paralysis in divergent thinking fuelled by assessment driven pedagogy and the anxiety surrounding the acquisition of credit to achieve educational attainment, undermine the inclusion of design. McCormick & Davidson state "*The desire to ensure success prevents failure to produce outcomes, and reduces the risk in the process*" [8]. They report that teachers' toleration of failure is generally in the making rather than the ideas stage and propose that "*teachers have to allow more risk and some degree of failure to produce outcomes*. This leads pupils and teachers alike, to adopt a cautious approach that treats the stages and functions of design as

hierarchical steps that the pupils are to be directly assessed on, creating a linear approach to an activity that should be treated much more globally[16].

Assessment criteria that over define the stages and functions of design can render the objective benign as the exploration, experience and decision making that is central to learning is removed. Looking for evidence of students' graphical capability and knowledge must be based on their comprehension, *"The student should understand how the various elements of drawing interrelate as parts of the graphics language"* [17]. For example students should make decisions on the appropriateness of functions and stages and not respond to the weightings of assessment headings. Intelligent thought involves self-monitoring and awareness about when and how to use skills and that expertise develops in a field of study as principled and coherent ways of thinking, not just as an accumulation of knowledge[9].

Diversity in education

Being less definitive when stipulating requirements and outcomes of design focused activities can also be problematic. An open brief can result in a lack of meaningful cognition, as the importance of the previously '*learned*' content is lost in terms of relevance and application. Striking the balance between scaffolding meaningful engagements and narrowing the potential outcomes needs further exploration.

Kimbell reports that criterion referenced assessment reduced the process of assessment to a box ticking exercise that was driven by statements of attainment which on their own tended to be meaningless[18]. This is cause for concern considering "*Learners can be excellent in design and technology in dramatically different ways*" [18]. Therefore the outcomes and solutions to design problems can often involve more variables than can be represented in a sequence or loop[19]. Where the true value of design based activities lies in autonomy, the context for the identification and need to acquire relevant multi-disciplinary knowledge, demonstration of capability, problem solving, communication, and synthesis. Facilitating diversity in response to design must be supported. So how do we help students manage uncertainty, welcome ill defined problems and take ownership of their own learning?

This paper reports on the approach to a graphics based design activity at the University of Limerick. Initial Teacher education students explored the concept of removing external assessment criteria and defining the criteria that are applicable to their design solutions. The essence of this approach is based on students showing evidence of progressive enquiry within the area of study and not a reactionary response to standardised assessment. The approach is strengthened by the fact that the student body took a democratic approach to what they perceived to be good and poor solution.

Uncovering Design and Communication Graphics – Method

When trying to ensure an authentic measure of the competencies and capabilities of students within graphicacy, a number of key questions guided the focus of the study

- Could the students effectively distinguish between stages and functions of design with the scaffolding of assessment criterion removed?
- Would students graphically communicate their design solution effectively?
- Will students work produce evidence to suggest that they understood the conceptual approach of a DCG brief (by comparative experience)?
- Is there evidence on completion of the process that the students have the capacity to reflect on the activity and derive an educational value/meaning?

Approach

This study was conducted with third year undergraduate students on the Materials & Construction and Materials & Engineering initial teacher education degree programmes at the University of Limerick. The activity took place within their Engineering Design Graphics 1 module in the first semester of year 3. The approach taken to the graphics module was to divide the semester in two. The initial half of the semester focused on developing core fundamental graphical competencies (i.e. design sketching [20], parametric CAD and plane and solid geometry), with the remainder of the module enabling students to engage with a design brief. This front loading gave a context for learning and an application for the more advanced knowledge and skills that followed.

The DCG syllabus states that *"A thematic approach is seen as appropriate to developing and contextualising the cognitive and psychomotor skills associated with this area of the programme* [communication of design]*"* [20]. The design task employed a thematic brief characterised by social conscience, personal and real experience, grounded in a design without make philosophy.

Students were asked to design a device or artefact that would enhance the life of an elderly person. The task involved graphically communicating their design evolution by means of an electronic portfolio. The task focused on the development of ideas, investigation and exploration of concepts and the appropriate communication of the solution. Students were not limited by the number of sections or stages in the reporting, but the importance of effectively communicating their design journey was emphasised. The task gave autonomy to the students to evidence their capabilities and comprehension of design and communication graphics within the constraints of assessment criteria.

To encourage diversity, imaginative and creative engagement in the design activity a democratic approach to the assessment of the design task was agreed. As a result the relationship between student and assessor and the need to second guess the values and preferences of the teacher/module leader were relaxed. A comparative pairs engine[21] was used to aggregate the judgements of 115 students (6 students were not available for the judging) as they made holistic binary judgements on the merits of their peers work. This approach removed the weighed criteria that dominates design activity and gave students the flexibility to make decisions relative to their own

design approach, solutions and highlights. Not having to predict what *'he/she is looking for'* is one aspect of the approach taken, not being able to align your solution to what everyone wants renders the dominate '*formulaic, routinised, and predictable'* approach insufficient[22]. Students must become the co-constructors of their own meaning.

Initial Teacher Education Students

The performance of 121 year 3 Materials and Engineering Technology and Materials and Construction Technology student teachers was analysed as the basis of the study. To avoid apathetic participation, the module structure ensured that the design activity was weighted at 25% of the overall module. Students engaged in the development of individual design solutions and democratically decide on the rank order of their peers. Determining the grade boundaries within the ranked order was the role of the module leader.

Designing the learning activity

The objective of the learning activity (design brief) was to provide students with an opportunity to develop graphical capability and literacy. The evaluation focused on the appropriateness of application, the level of analysis and synthesis and the capacity of students to create subjective and formal meaning. This evaluation is central to establishing the rationale for what we teach and prove evidence to govern good pedagogical practice.

Kimbell et al. discusses the value of open ended design challenges. The open ended nature of a thematic brief is a rich vehicle to encourage autonomous, diverse and personally defined engagement[4]. The chosen thematic brief formulated from an analysis of population pyramids for both developed and developing countries as comparators that highlighted our ageing populations. This formed the basis of a brief that tasked students with designing a device/artefact that would enhance the quality of life of an elderly person.

The task required students to build an online e-portfolio together with a hard copy of their design journey. As design briefs now constitute a significant element of Leaving Certificate assessment (especially within the technologies), there is often a misguided perception that solving a design brief is an execution of acquired skills and knowledge and not a rich exploratory, risk taking activity. Therefore the task was not presented as an end in its self but a mechanism for learning. Students were encouraged to present evidence of learning within their portfolio and also value their peers evidence. Unlike the initial ESCAPE project[21] approach to data collection which was in real time, the work submitted as part of this design brief can be best described as 'raw'. The work students uploaded was not in response to criteria (at least external assessment criteria) but self determined values and understanding.

The merits of an effective learning activity must be measured in the outcomes of that activity. Influenced by the organisational learning theories of Argyris who provides us with a valuable approach to exploring the consequences, actions and governing variables of ill defined or open ended learning, a *double looped learning* system was used as a framework to evaluate the depth of student engagement[23]. This approach

focused on the completion of the task (*Consequence*), their evaluation of solutions (both their own and their peers) in light of the brief (*Action Strategy*), and also explores why the task was set as a learning outcome (*Governing Variable*).

Implementing the task

The design activity that the students undertook was a core element of their module of study. The '*design for the elderly'* brief was introduced to the students following six weeks of skills building (sketching, mechanical drawing and parametric modelling) and exploration of the core principle of plane and descriptive geometry. This both developed a context for the design activity and ensured that all students were exposed to the full range of functions appropriate to the task at hand.

A non-invasive approach to the implementation was taken to ensure that students were allowed to create meaning and make decisions. Further geometric problem solving skills together with parametric modelling skills were developed simultaneously to the students completing their design brief.

Exploring learning heuristics and judgements

This section of the paper presents the observations and analysis of the student's outcomes to the '*design for the elderly'* brief. It will present the validity and reliability of the student derived rank order of completed work. Due to the quantity of portfolios produced and the potential limitless number of variables to be investigated, a stratified sampling of the data defined the parameters of this study.
Following a cursory investigation of all portfolios of work which indicated a consistent level of engagement in the task, the sampling focused on the 1st and 3rd data quartiles of the ranked order in an attempt to establish competency. This comparative approach between quartiles provides a distance (removing the 2nd quartile) to limit the influence of subjectivity in the analysis. For the purposes of this paper the bottom quartile of portfolios were excluded from the analysis as they had the capacity to increase the number of quasi-related variables (eg ICT literacy, technical issues, etc.) and distract from the focus. Establishing differences between these portfolios will help establish the currency that defines effective pedagogical intervention.

Consensus in ranking

Using the comparative pairs engine[21] 115 students produce a rank order of 121 portfolios of work. The comparative professional judgement process produced a reliability coefficient of 0.961 highlighting the robust nature of the decisions made. The misfit statistic indicated that there was no significant disagreement with regard to the position of any portfolio in the rank. On exploration of the general consensus the average misfit statistics in each quartile of the data illustrates a higher level of conformity in the lower quartiles than in the higher quartiles (See figure 1).

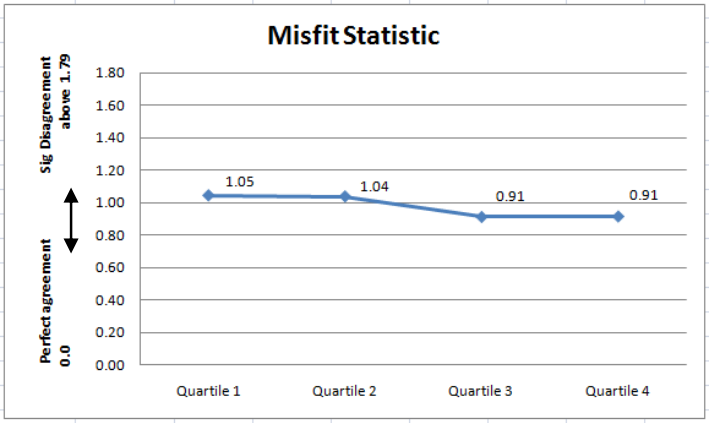

Figure 1 – Misfit statistic per quartile of data

This is also supported by a larger drop in parameter value in quartile 1 of 4.55 and a reduced drop of 1.76 in quartile 3. This indicates that there was a higher level of consensus among the students on what was perceived as poor work and less clarity in what was of value.

Navigating stages and functions

The comparative pairs process produced a reliable ranked order, illustrated by the consensus that the cohort reached when positioning their peers work relative to each other. Identifying definable differences between the data quartiles (as defined by the rank) will help to elicit the values used by the cohort to position students work on the rank and determine what warranted a high or low ranking portfolio. It is important to establish the reasoning behind the holistic decisions and the merits of this differentiation in work.

A random selection of portfolios was taken from both the 1st and 3rd quartile for analysis (see table 1 and 2). Ten portfolios were selected from each of the two data ranges and analysed using the *Design Decision Pentagon* developed by Barlex[24 & 25] as a guide[1].

Table 1 – Random selection of portfolios 1st quartile

Portfolio Rank	*Posts*	*Design Description*
1st	18	Joystick controlled adjustable table
2nd	21	Easy open lock system
5th	8	Gate Latch mechanism
8th	15	Seat aid - help standing
12th	15	Power seat lift
16th	15	Bath elevator
19th	11	Sleep tight blanket
24th	18	Easy Pour Kettle
28th	15	Refuse Bin Carrier
30th	19	Shoe and Sock aid

[1] The use of this model for analysis took cognisance of the dissimilar emphasis between the treatment of design based outcomes in Design and Technology and technological education in Ireland.

Table 1 – Random selection of portfolios 3rd quartile

Portfolio Rank	*Posts*	*Design Description*
61st	27	Eating utensils
64th	11	Sanding support handle
67th	12	Adjustable kitchen cabinet
71st	16	Modified courier trolley
75th	13	Walking Aid
79th	14	Pill organiser
83rd	9	Shoe Aid
87th	14	Wheel Barrow
89th	3	Hearing Aid
90th	16	Visual Aid

As students engaged in a process that was self-directed and self-defined, the initial approach was to take a broad-spectrum view of the design solutions. Samples of the portfolios selected from the 1st quartile are presented in figure 2 to 5.

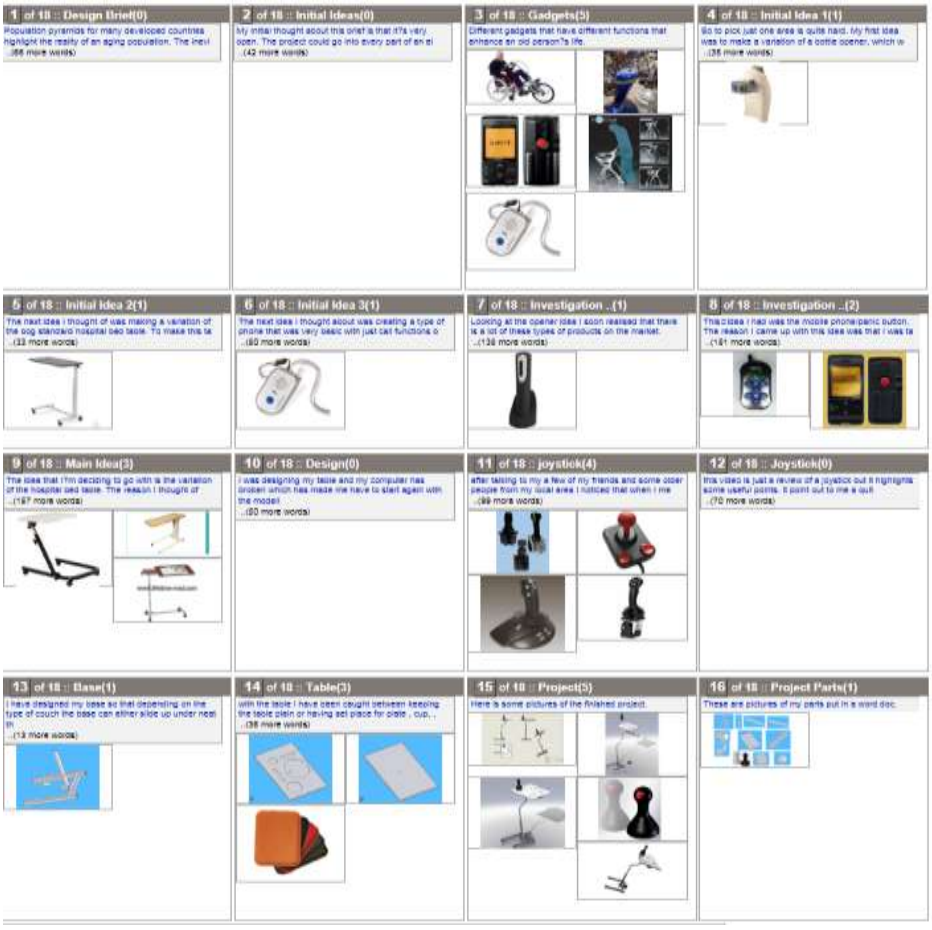

Figure 2 – Sample portfolio from the 1st quartile – ranked 1st

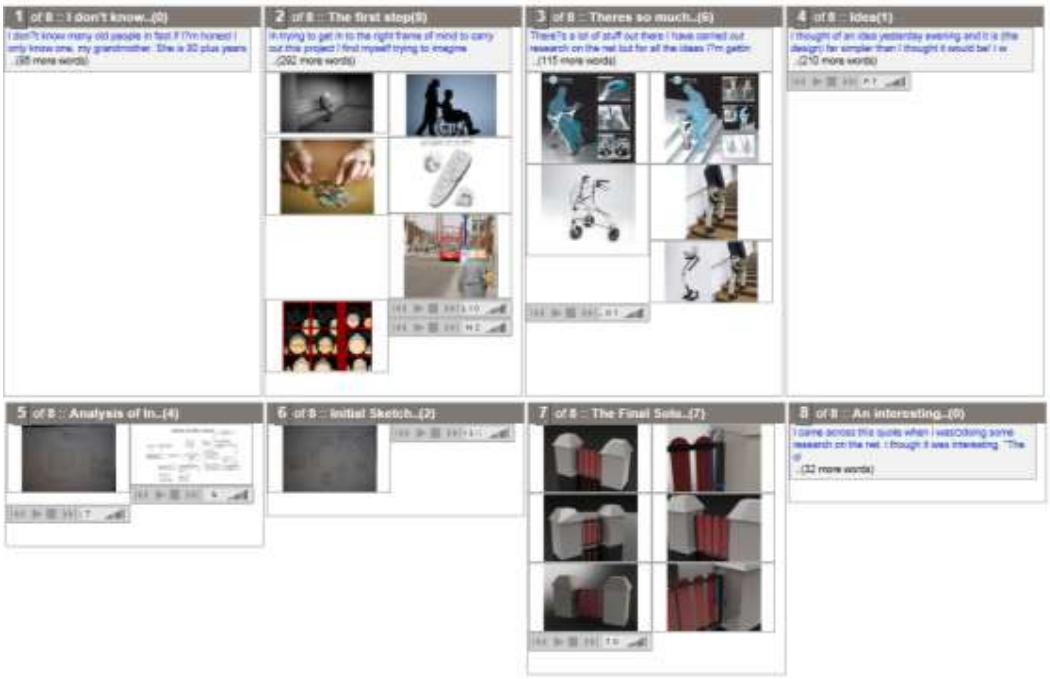

Figure 3 – Sample portfolio from the 1st quartile – ranked 5th

Figure 4 – Sample portfolio from the 1st quartile – ranked 24th

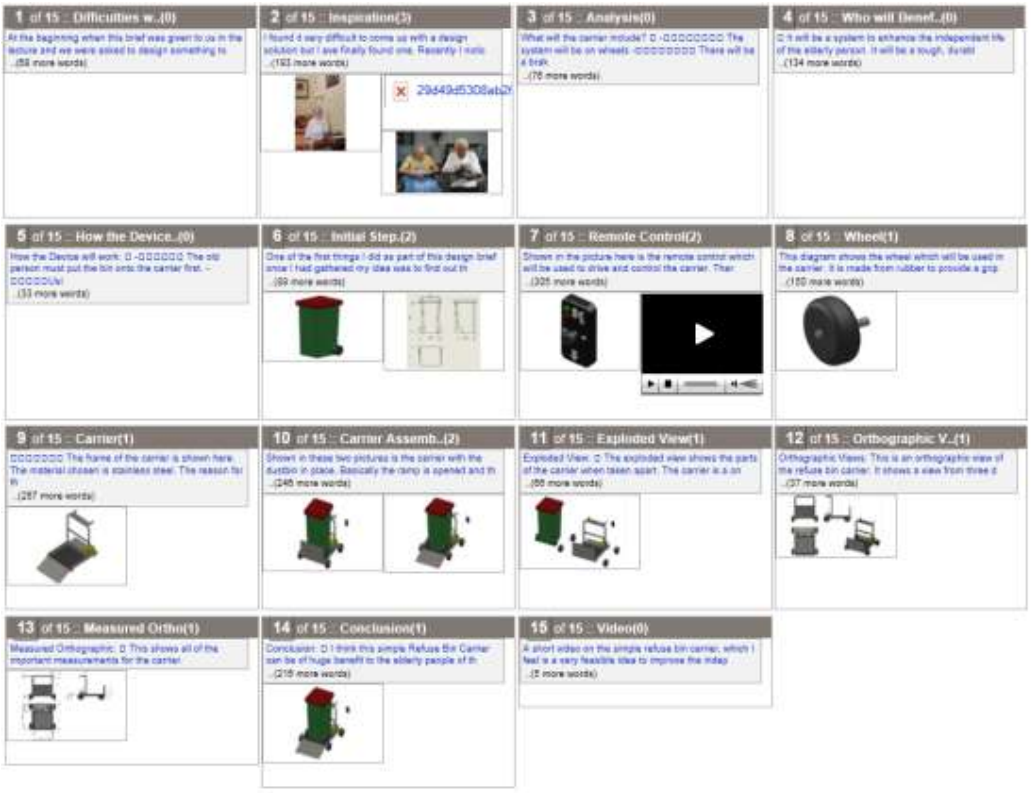

Figure 5 – Sample portfolio from the 1st quartile – ranked 28th

Samples of the portfolios selected from the 3rd quartile are presented in figure 6 to 9.

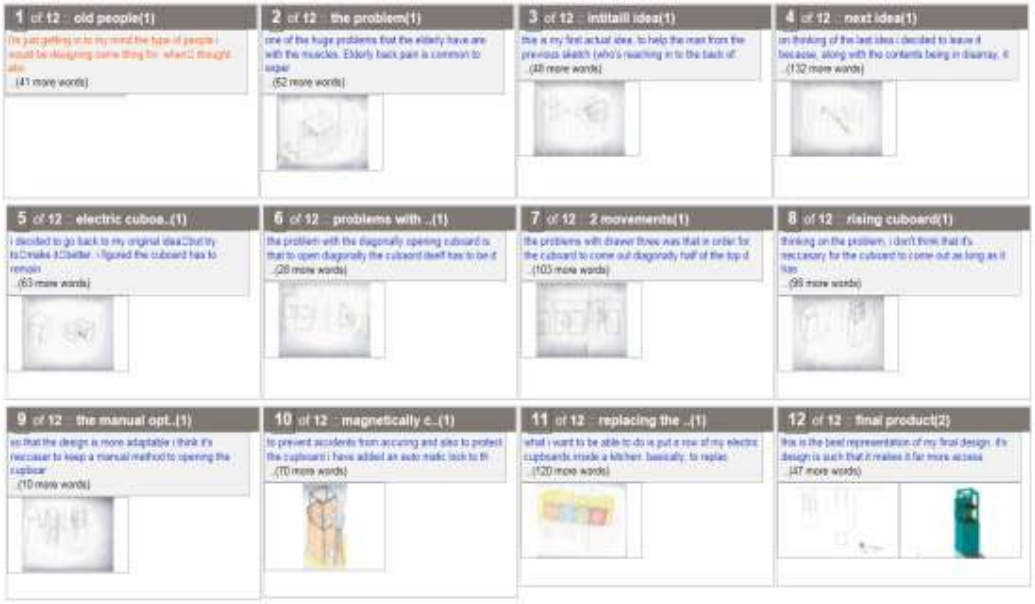

Figure 6 – Sample portfolio from the 3rd quartile – ranked 67th

Figure 7 – Sample portfolio from the 3rd quartile – ranked 71st

Figure 6 – Sample portfolio from the 3rd quartile – ranked 84th

Figure 6 – Sample portfolio from the 3rd quartile – ranked 89th

A number of key observations were made:

- There was no significant difference between the numbers of posts/sections presented on average between the two data samples. With the sample from the 1st quartile recording a mean of 15.5 and the 3rd quartile data produce an mean of 13.5.
- Subjectively there was a high degree of diversity. However, table 1 and 2 illustrate the difference between the types of design solutions. Samples from the 1st quartile tended to be more sophisticated, applied, and addressed specific needs. This differed from the 3rd quartile where solutions were aligned with existing products and lacked an in-depth level of analysis.
- No evidence of difference between the design and make activity and the conceptual design without make was observed. This suggests a conditioning of the notion that design activities across the technology subjects have the same objectives. Unlike the findings of Barlex and Trebell[9] where pupils' designs could be made albeit not by them, the majority of selected portfolios presented designs that were within the realisation capacity of the student. This would suggest that there was little evidence of pushing the conceptual boundaries.
- Portfolios in the 1st quartile clearly showed evidence of "*Fluency in the task"*[6]. Students illustrated distinct stages that they defined as critical and used appropriate functions (often more that one) at varying stages. This was in direct contrast with portfolios from the third quartile, where the students in some cases illustrated a clear lack of clarity (for example: 27 posts with unclear focus and objectives) and often an over reliance on specific functions. However were functions were selected and used the general quality was good. This could suggest a comfort within this medium.
- It was also observed that within the 3rd quartile the communication became more textual (see Figure 3), this would seem to contradict the objectives of graphical communication and question the level of understanding these students had in relation to graphical education. It also raises a question about the conditioning of students by formal education with terminal assessment techniques predicated on numeracy and literacy.
- One of the most significant differences observed between the two samples of portfolios was the level and type of reflection. Students in the 3rd quartile for

the most part did not demonstrate meaningful reflective practices, where as Quartile 1 students presented clear and objective evidence of the effectiveness of their projects, aligned with '*reflection-in-practice'* described by Kimbell, Stables and Green[26]. One student presented this design evaluation and reflections under self specified heading of *Desirability*, *Feasibility*, and *Viability* and clearly discussed the merits and failings of the project under these headings. By comparison a student in the 3rd quartile with no level of detailed investigation or reflection states *"I am hooked on the topic of mobility and I think I may have it cracked!!!"*

- Students in the upper quartile tended to demonstrate more empathy with the end user and centred design decisions and modification in the context of usability and function. This was also evident with the inclusion of interesting quotes and even a Shakespeare reflection on getting old.
- The challenge of generating ideas was highlighted by the students in the 1st quartile, with students struggling with the 'glass ceiling'. These portfolios also illustrated high degrees of analytical reasoning, iterative thinking and technological knowledge and synthesis. This was not evident in the 3rd quartile portfolios, were students tended to fix on and present the initial design or concept.

Holism and value

As an educator how do you know if your students have reached a level of proficiency within a design focused discipline? As a learner how do you know when enough is enough? This paper explores both the students learning activity and the level of consensus achieved within the assessment of that learning. This section explores the judgements made by the students on their peers work.

The data indicates that from a total of 1113 judgements only 22 comparisons fell outside the parameter value that defines acceptable decisions (mean plus 2 standard deviations). Each student together with an agreed position on the rank order also recorded a confidence value as an assessor. Based on a critical assumption that the ability to critique design is related to the ability to effectively execute design, would a student's position on the rank be reflected in the level of consensuality in judgement of their peer's portfolios? It was hypothesised that the higher the student was positioned in the ranked order the more coherent their valuing of other students work would be. Therefore a Spearman rank correlation coefficient was used to assess the relationship between the students' position on the rank and their weighted mean square score as a judge (confidence value). The results of this test indicated that this was not the case (correlation coefficient of -0.11 and $p = 0.902$). Students who executed better projects did not necessarily make more coherent decisions on other students work. As educators the question remains, how do we make explicit what is implicit?

The question of hegemonic practices

The thematic design approach reduces the capacity for students to engage with the activity as a means to an end, focusing on the finished product. However for some students it appears that open design tasks can result in a lack of meaningful cognition,

as the importance of the previously '*learned*' content is lost in terms of relevance and application. Students who cannot employ individual heuristic rather than algorithmic strategies[27] struggle in forming the operational management required to make design decision. The failure to devise a meaningful individual heuristic lies in the lack of comprehension in the declarative and procedural subject specific knowledge acquired.

The design without make approach that DCG supports is a welcome addition to technological education. Baynes[6] highlights how we need a lot more research and investigation into the imagination and how it can be fostered by teaching and learning and he suggests that graphics can give us that opportunity. However, the findings in this paper suggest that students remain conditioned by the design and make approach which dominates technological education. There was no evidence to suggest that students took an imaginative, high risk, conceptual, systems based approach to solving the brief. This is not surprising in the context of Initial Technology Teacher Education as the cohort of students also major in either metal or wood craft disciplines.

It is noted that removing the shackles of the criterion referenced assessment afforded the students the opportunity to demonstrate a greater comprehension of the area of study, as the design decisions, the development of stages, coupled with the selection and use of appropriate functions can all demonstrate evidence of learning. Therefore if students can identify and create the need for the communication of critical elements of their design, make decisions on how to best communicate these elements and make critical judgement on the value of other designs, are they graphically competent?

The consensus that the student body reached was a reliable ranking of the 121 portfolios. However, it is not correct to assume that the top end of this rank represented excellence. What is inferred is that the students all agreed on what were the strongest, weakest and relative positions of each design portfolio. Although the students were given no explicit criteria for the holistic judgement of their peers work, the results show a significant level of agreement when judging these diverse solutions. Students who did not perform well on the task, showed no difference in their performance as a judge. So the two related questions remain,

1. If students have acquired relevant knowledge and skills that predicates good design ability, why can they not reach a higher level of consensuality by comparison to their peers when making judgements?
2. For students who did not perform as well on the task, is the critique of portfolios and subsequent inferred reflection on their own work an essential element of their learning strategy?

Is it fair to expect initial teacher education students to have such a mastery of their subject area that not only do they know the answer to the question posed but they know the origin of the next question? Scaffolding with guided questions forms a critical stage in creating new meaning. Being able to elicit the next question is the goal of effective pedagogy. John Dewey's philosophy on education highlights the interrelated nature of learning as the combining of experience, education and democracy[28]. Is there significance in this order? And how can we ensure our practices allow for the constructive alignment of intervention and learning?

Conclusion

Domain specific knowledge and skills, pedagogical strategy and flexibility in evaluating student capability and competency all play a critical part in facilitating a valuable learning experience. Integrating the democratic process as a learning tool encourages students to make critical judgements that proved to be reliable. Therefore it can be concluded that:

- Students have the capacity to identify evidence of learning
- Students have the capacity to judge the value of analytical thinking even if they did not achieve this themselves
- As a group, students reached a reliable consensus based on a functions approach to the development of stages and functions of design within a graphical '*design without make'* activity

This paper scrapes the surface of the importance and value of graphical education and the potential richness of a conceptually driven *'design without make'* learning activity.

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