



The development of pre-service design educator's capacity to make professional judgments on design capability using Adaptive Comparative Judgment

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Abstract

When design educators are faced with assessment tasks it is important they have a good personal construct of what it means to be capable in design education. The importance of allowing design students the facility to develop creative and innovative capacities is a priority. With standardised testing it is harder to allow for open ended and divergent projects to be facilitated and assessed. Adaptive Comparative Judgment is a dynamic assessment tool to facilitate and capture the complex iterative design process. The validity and reliability of adaptive comparative judgments as an assessment tool has been established by many in Design Education. This paper looks at the impact of A.C.J. on perspective design educators construct of design capability. An ACJ session was completed by 13 volunteers on 24 design portfolios without giving specific criteria. They had their own personal construct of capability based on a process of enculturation. During the study concurrent and retrospective commentaries by the participants were recorded to get an insight into their thinking during the decision making session. The study found there was consensus on what was evidence of capability in open ended design projects. Also it showed that engagement in the ACJ processes led to a further appraisal of what the perspective design educators construct of capability in design education. This prompts further investigation into the impact of the engagement in the ACJ on appraisal skills and the affect it has on a student's metacognitive awareness of their construct of capability in design education.

Introduction

In STEM education, there is agreement between educators and policy makers in Ireland that students can develop creativity and innovation through design based subjects. Young people are now faced with one of the most certain things in this world, an “*uncertain future*”¹. Fostering and developing the necessary skills in design students to deal with unforeseen problems is a big challenge for design educators. The benefits and value of design education are echoed by several as a catalyst to develop transferable skills.^{2,3} This creates a problem for educators in how to assess these skills? With recent debates in assessment about using standardised testing there is the question of construct validity.⁴ Are current assessment instruments measuring what it is that needs to be measured? Using open-ended tasks for assessment caters for a diverse range of learners but becomes harder to standardise. These types of problems are what will be faced by designers in the future. They will need to have the capability to deal with ill-defined problems. The underpinning capacities of creativity and innovation embody cognitive skills such as synthesis and divergent thinking. With such diverse possibilities and means of presenting and representing these capabilities it becomes harder to easily recognise these capacities. The challenge is twofold, first in defining what is important and secondly, in how to assess this.

Irish focus

In Ireland, there has been a recent change in focus at lower second level (Junior High, 12-15 year olds). With recent proposed reform from the National Curriculum Council Association there is a new focus on promoting assessment practices that award autonomy and exploration.⁵

Specifically in relation to technology education the approach has shifted from a vocational model to a more competence driven approach. Students will complete a project over a two

year period followed by the traditional summative exam at the end of the Junior Cycle period.⁵ The assessment of such projects will be done internally by subject teachers and not by an external body. This leaves teachers in unfamiliar territory as all high stakes assessment in the past was done by the state. Now, it is imperative that perspective teachers build a strong personal construct of what it means to be capable in design education, as they will be responsible for high stakes assessment. This highlights the fact that in pre service teacher education, future teachers must have the opportunity to exercise and have their beliefs challenged.

This paper tries to establish the criteria assessors are looking for when it comes to capability in design based subjects. It is outlined how a personal construct of capability in the context of design subjects is developed and why this is important when faced with the assessment of open-ended design projects. This has wider implications for perspective teachers as they will be responsible for high stakes assessment in the future.

Learning during the design process.

Here learning is examined from a situated cognition perspective. A lot of what happens during the design process is situational based where there is interaction between the neural and the social. Kimbell refers to design as an iterative process⁶ involving an interaction between the hand and the mind.⁷ Dewey⁸ believed learning is a situated activity. Solomon & Perkins⁹ examine the interrelationship between cognitive, acquisition orientated learning and situative, participatory learning. While cognition is not fully context-dependent, it is also partly context independent. Clancy¹⁰ states that situated cognition views human knowledge not as final objective facts but as:

1. Arising conceptually (e.g., dynamically constructed, remembered, reinterpreted) and articulated within a social context (i.e., a context conceived with respect to social norms)
2. Varying within a population in specialised niches (areas of expertise)
3. Socially reproduced (e.g., learning in communities of practice⁷)
4. Transformed by individuals and groups in processes of assimilation that are inevitably adapted and interpreted from unique perspectives (improvised in action, not simply transferred and applied)

Clancy found there was a shift in the cognitive research where affect, context, culture and history were taken into account. This showed a move from the laboratory to the classroom. Next, perspectives on learning in context are explored and also Clancy's view of situated cognition will be examined.

Learning: legitimate peripheral participation.

Legitimate peripheral participation is described as an analytical viewpoint on learning, a way of understanding learning. Lave and Wenger⁷ outline that learning through legitimate peripheral participation takes place no matter which educational form provides a context for learning or whether there is any intentional educational distinction form at all. Brown et al.¹¹ believed that learning is a process of enculturation. This is described as a process where students adopt the beliefs and values of the community that they participate in. As a person is submerged in an environment they become familiar with the behaviours of that community. Consciously or unconsciously they adopt the language and common practices of that community. Learning and knowledge is situational based and students develop constructs

when submerged in this environment. Personal constructs are formed through interaction between the social and the neural. During the design process in this study it was hypothesised that the students developed a personal construct of what it means to be capable in a design based subject through the following ways.

- Peer to teacher interaction
- Collaboration and exploration through peer to peer interaction
- Observation of practice through demonstrations from technicians/teaching assistants/peers/media



Figure 1: Student interaction in workshop.

A community of learning (Figure. 1) developed where the teacher was not the knower of all, but a facilitator. The power balance was different to that of an apprenticeship type model as students learned through social interaction and Clancy stated it was socially reproduced as they learned in a community of practice. Students were encouraged to explore using materials, modelling techniques to develop understanding. They were questioned by the teaching assistant and directed to investigate further which led them turning to their peers to collaborate. Knowledge and skill is socially constructed through the design process in a collaborative workshop environment. Students' shared experiences and parted with knowledge from previous endeavours. The evidence of their endeavours was captured using cameras, voice recorders, sketches, etc. which they presented in as an electronic portfolio to demonstrate their capability. Empowered with an epistemological understanding of what it is to be capable they were now asked to assess their peers work.

Assessing evidence of learning captured during the design process

As design is quite a complex iterative process it is difficult to assess. It requires a dynamic assessment tool to facilitate and capture it.¹² The validity and reliability of adaptive comparative judgments as an assessment tool has been established by many.^{12, 13, 14} It allows for problem solving skills and autonomous learning to be captured and valued. It is based on the Thurstone's Law of Comparative Judgement. Judges are faced with a binary decision to pick one of two portfolios based on certain criteria. In this case students produced a e-portfolio and ten were asked to democratically assess these portfolios. The first 6 rounds are a Swiss tournament and then after that the assessment tool produces comparisons for judges to make. Consensus is reached after 11 rounds of judging. After each student makes a series of comparative judgements a rank is produced. This rank is then moderated by the lecturers of the modules where they apply the grade boundaries. While there is agreement amongst the community on the positions of the rank the boundaries still allow the lecturers judge the overall standard of work. In this study no explicit criteria was given to the judges. During the comparative judgments students are faced with decisions to make on capability. This is why

the importance of a good construct of what it means to be capable in design subjects is integral so they can approach the assessment with confidence to make a professional judgement. It has been well established that there has been consensus amongst assessors using ACJ with such high reliability scores¹² but, what is it they are all agreeing on? What are the criteria that assessors are using to discriminate between pieces of work? ACJ was used in this study to establish the criteria used by students to discriminate between two projects that were presented for comparison.

Method

In this section, the details of how the study was conducted will be presented. After the portfolios were presented for assessment 24 portfolios were picked for this study. 13 volunteers completed an ACJ session on the 24 portfolios during which they were asked to externalise their thoughts for each judgement. This was recorded using voice recoding software. They made 14 comparative judgments during the session. After this a focus group discussion was held.

A mix of quantitative and qualitative approaches was taken to this study. Quantitative data was collected during the judgement session to establish agreement between assessors when making holistic judgements on student portfolios presented for assessment. Qualitative data was collected through concurrent and retrospective commentaries while participants were making the judgements. Non-invasive interview techniques were used to prompt the students to verbalise their thoughts during the decision making for the first half of the study and in the second half they were left to verbalise their thoughts on their own.¹⁵ A focus group discussion was also held after the judgement session to validate the commentaries during and after each judgement.

Participants

13 students volunteered to take part in the study. These participants are part of a four year con-current initial teacher education courses in Technology Education. They spilt across two materials biased courses, one with a wood craft bias and the other metal craft.

Table 1: 13 participants

Participants	Materials (Wood)	Material (Metal)
Male	7	3
Female	2	1

- Five males were mature student entrants (over 23 years old). They typically come from trade or industry backgrounds.
- The other 8 participants were entrants via matriculation coming straight from Leaving Certificate (High School). Their entry to the course was predicated on their achievement of points through examinations.

The design project.

The design brief prescribed was an open ended design task where participants produce a decorative artefact in tandem with an electronic portfolio. This project is cross-modular where students partake in a wood craft and metal craft modules where the focus was on content knowledge development and construct of capability.

The students were given the following design brief: *Students were asked to design and make a flower that conveyed an emotion and create a scene that reflected that emotion.* Work was documented during the process and students were instructed to present their learning during the design process through a student-defined criterion referenced e-portfolio.

Table 2: Timeline of Project

Week	Workshop Activity
Week 2-5	Students engage in 4 activities that develop the necessary skills and knowledge for the design project. Material processing, material selection, etc.
Week 5-12	Students design and realise decorative design projects and complete an e-portfolio in tandem. The e-portfolio and artefact were presented for assessment at the end of the module.

The e-portfolios produced during the project were submitted for holistic judgement which was carried out by the students. This was done through ACJ. The stages of the data collection are outlined in the Figure 2. The details of the student during an ACJ session are outlined in the previous section.

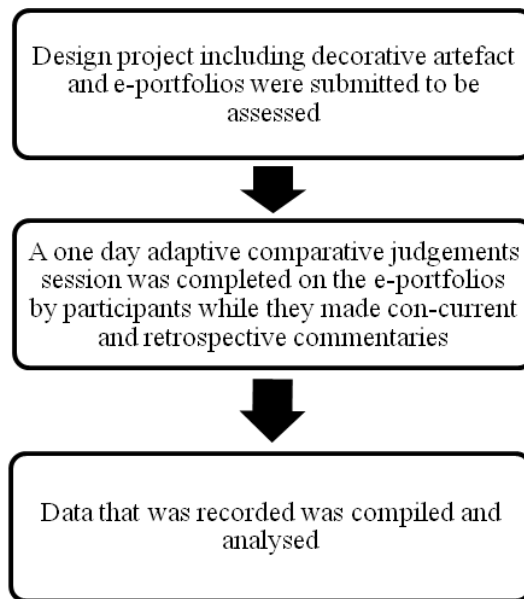


Figure 2. Stages of data collection for research study

The study was designed to gain an insight into participant’s thinking when carrying out the judgements. Participants verbalised their cognition during the judgement session. An audio recording of the commentary was made. In addition, the judgements and commentaries were recorded in tandem using screen and audio capture software to allow correlation afterwards. Participants had to make 14 comparative judgements and comment on each comparison. The results of the comments will be presented in the next section.

Before the study took place, participants were asked to take a trial judgement session before the official one to ensure they were comfortable verbalising their thoughts during the session. This was to ensure a more authentic and richer data set so participants were not unfamiliar with the situation with having to speak their thoughts aloud. A different data set was used so that students were not exposed to the portfolios before they commenced the judging session

for this study. For the first half of the judgment session of the study participants were prompted to comment on their judgements by researchers asking non-invasive question. For example;

- “What did you like about this portfolio?”
- “Why did you choose Portfolio A instead of B?”
- “What was your initial reaction to the portfolio?”

For the second half, participants were encouraged to independently comment both concurrently and retrospectively when making judgements. A content analysis was used to analyse the commentaries and to extrapolate the qualities that judgments were being made on. A focus group discussion was held after the judgements had taken place. This provided a richer insight into participant’s cognition during the commentaries. It helped to qualify statements made and understand certain phrases used by the participants. The findings of this discussion will be discussed in detail in the next section.

Findings

A rank order was produced after the participants completed the judgements. All 24 portfolios were ranked from best to worst based on the criteria of the judges. There was a high level of agreement between judges on the rank order. This is remarkable because without explicit criteria the participants were still able to discriminate between portfolios and produce a rank of the 24 e-portfolios (Fig.3). The rank shows a reliability coefficient of 0.82.

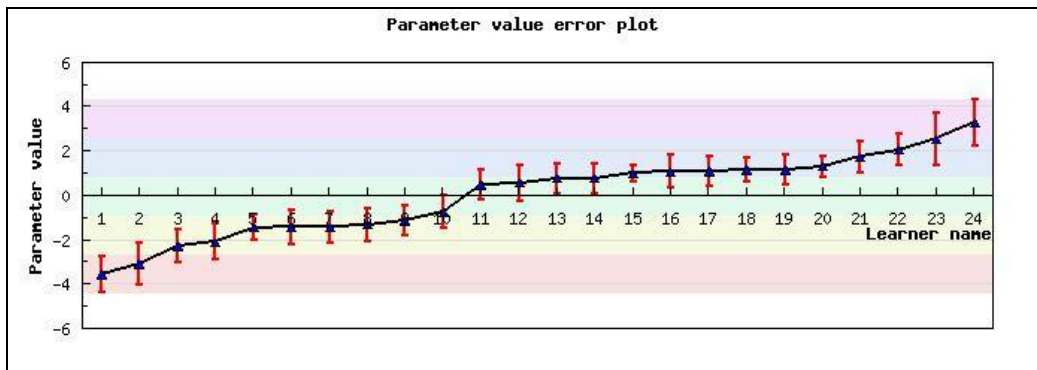


Figure. 3: Rank of 24 portfolios created after conclusion of judgement session.

Consistency of Judgments

The graph above (Figure. 3) shows the rank of portfolios after the judgement session. There is some disagreement with the rank position of some of the portfolios. The parameter value of portfolio 23 on the graph (in this case the 2nd highest ranking portfolio) indicated by the red line is a significantly larger in comparison to other parameter values. The parameter value shows the certainty of its position on the rank. The wider the red line is along the parameter value scale on the Y axis the less certain that portfolio is in the correct rank position. Compare this with 15 (10th in rank) and 20 (5th) which are quite tight in comparison and there has been consensus that they are in the correct position on the rank. With indecision on certain portfolios it leads to further discussion in the next section.

Criteria for Judgments

By analysing the video and audio records of the judgment process, it was possible to establish what criteria the judges were using in judging any given portfolio.

Two random judges were selected from which it gives an insight into the criteria for judgements being used by the participants. Table 2 below shows the criteria that these

assessors were making judgements on. These criteria were found due to a detailed content analysis.

Table 2: Criteria for judgement from participants 3 and 7

Criteria for judgements determined by participants	Participant 3	Participant 7
Conceptual design	•	•
Design Realisation	•	
Communication	•	•
Emotional engagement	•	•
Mastery of Craft	•	•
Aesthetics		•

The criteria outlined above are common through the participant’s commentaries on the judgements. Despite the fact they were not given explicit criteria they still valued what is important in design based education. The list above was the result of categorisation of comments during the analysis such as the following example:

- For Communication:
 - “Oh that is clear....”
 - “I can see clearly what is being conveyed...”
 - “Emotion has shone through...”

Judges behaviour

The judgements became more fluid and they took less time for each judgement as they progressed through the judgements. This also showed through the judgment session insofar as they were more confident of their criteria but also felt more comfortable on making judgements. This was noticeable not only in the time they took to make judgements but also in their tone of voice. For example, at the start of the judgements participant 3 was struggling with one particular comparison. While he thought both were a good conceptual design he had to shift the focus of the criteria on to the mastery of craft so he could discriminate which portfolio would win the comparison. The participant was quite definitive with his decisions when it came to the last few judgements,

“I liked it from the outset. Anymore looking around is only time wasting”

Another comment made by the participant was where he said he was going with his “*gut instinct*” and picking portfolio A. This was his 13th judgement of 14. Participant 7 developed a definitive set of criteria as she progressed through the through the process. She commented on her 12th judgement where it was based on “*clear communication of the emotion.*” During the focus group discussion the criteria presented in Figure 2 was qualified y discussions with the students. As it came to the end of their judgements there were confident in their decisions and the criteria they were basing them on. One participant commented

“if it didn’t convey an emotion, it was hard to engage with it”

Another said:

“I knew straight away that it was good”

The above comments show that the construct of what they thought was capability was definitive in their mind and there was less searching and hesitation when it came to making decisions. They were looking for transferable skills including that would be associated with good communication like good sequencing a logical progression to the story of the project.

Professional judgement

Based on the formulation of their personal construct through a value laden course of study, student teachers showed that they could confidently and reliably make professional judgements based on criteria that are shared amongst their community. Engagement in the ACJ process promoted reflection on their understanding of the subject area. They were forced into a situation where they had to question their epistemology of design subjects. This developed their appraisal skills which are important attributes for a design educator. It was quite clear the judges knew what they were looking for but if it was not clear they would have to go deeper into the portfolio. More time was spent exploring the portfolio in detail. In some case there were situations where some criteria overrode other criteria. If both portfolios were impressive the judge would have to go down the list of criteria. There is reason to suggest that the participants had some hierarchical structure on their criteria. This may be due to their previous experience is something that merits further investigation.

Participants were forced to make a self-audit of their construct of capability and re-evaluate what they believe as important during cases where there were close decisions. Being forced into decisions of this nature required the design educator to reflect and appraise their understanding of capability. They were forced into a metacognitive awareness of their personal construct of capability and further investigation into this is needed to see what effect this process may have on their metacognitive awareness and metacognitive processing.

Conclusion

ACJ was successfully used to capture student's criteria for creating the rank order. Analysis of the judgment activity showed that there was an agreement on what was evidence of capability with high reliability coefficient.

There is a case for further investigation to use ACJ as means for professional development of design educators. As it is only when design educators are engaged in an internal dialogue on their construct of capability that is when they are forced to appraise it? As a consequence there is a need for a robust method to validly and reliably extract the thoughts of a design educator when they are engaged in the ACJ process. For this, further methods of discourse analysis will be explored to delve deeper into their professional inference.

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