

Design education: Fostering the conditions for transfer through a structured and critical approach to reflective practice

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Abstract

The application of project-based and studio-based learning in design education is widespread. For this multiple-project curriculum to be effective, it is important students transfer their learning between projects as they progress through their program of study, however students are often left to connect their learning themselves. Reflection offers a means to support students to connect their learning across projects by introducing a more deliberate engagement with the learning inherent in the design process.

This paper examines a structured and critical approach to reflective practice, and the role it can play fostering the conditions for transfer. The results from this empirical study suggest that reflective practice can play an effective role to guide learners to identify and analyse the learning inherent in their project. This approach fosters transfer by supporting learners to connect their thinking from the project with thinking about approaches to other projects and thinking about their practice.

Keywords: *Structured reflection, Critical reflection, Reflection-on-action, Transfer*

1 Introduction

Design education has traditionally adopted studio- and project-based learning approaches where students are typically introduced to the principles of design through a series of projects, with the intention that their level of expertise increases as they progress through their program of study. For this curriculum approach to be effective, it is important students transfer their learning between projects. However in the traditional approaches to studio- and project-based learning, this can be problematic where the students are often left to connect the learning from their projects themselves. Further, these learning approaches typically focus on the artefact as the primary measure of learning where it is often unclear to the student what they have actually learnt, hindering the likelihood they will transfer their learning to other projects.

Reflection offers a means to support students to connect their learning across projects by introducing a more deliberate engagement with the design process. This paper examines a structured and critical approach to reflective practice, and the role it can play fostering the conditions for transfer.

Background to the study

Researchers have argued the benefits of project- and studio-based learning as a means to structure learning environments for design students that help them engage with the ill-structured nature of design problems [1, 2]. These approaches have underpinned what many

believe is an important aspect of design education, where students are taught in an environment and a manner that parallels an industry context [1]. Students learn about design through the process of creating solutions to the introduced design problem(s), rather than through deliberate and separate study of the problem itself [2]. Guided by feedback from teachers and peers, these learning approaches typically engage students with increasingly complex design projects as they advance through the course. This learning-by-doing approach reinforces a traditional pedagogical belief that the best way to learn how to design is through the act of designing [2, 3].

For this multiple-project curriculum to be effective, it is important students transfer their learning between projects as they progress through their program of study. To support transfer it is important students prepare their learning from their project in ways that foster the conditions for transfer [4]. One way to encourage transfer is to guide learners to think about their project in ways that supports them to abstract general principles from the learning experience [5, 6].

While project- and studio-based learning appear to be effective ways to approach the complex and ill-structured nature of design problems, researchers have highlighted limitations to these approaches [2, 3, 7]. These learning models typically have a primary focus on the artefact, and there can be a lack of engagement with the process, leaving the student at risk of learning little from the design process itself [2, 7]. A further risk is the potential for the learning to become overly bound within the project, where it is not always clear to the student what exactly they have learnt, nor can they express explicitly what it is they did learn [3]. If a student is not clear about what they have learnt, then it is likely this will impact on their ability to prepare their learning in ways that support transfer. The ability to transfer has been broadly defined as “the ability to extend what has been learned in one context to new contexts” [8, p. 74]. Bransford and Schwartz refer to a traditional view of transfer as “the ability to directly apply previous learning to a new setting or problem” [4, p. 68]. Transfer is often underpinned by the belief that it is more effective to broadly educate people than simply train them to perform particular tasks [9].

The ability to transfer is influenced by the degree to which people learn with understanding, as apposed to memorising sets of facts or following fixed sets of procedures [5]. Guiding students to realise potential transfer implications within their learning can improve the possibility of transfer [10].

Two forms of transfer have been described that are particularly beneficial to this study, low-road and high-road transfer [11, 12]. Low-road transfer occurs when skills and knowledge learned in one context can be readily applied to another similar context. Perkins and Salomon maintain this process occurs with relative ease because the similarities between the learning context and the new context allow the learner to recognise which skills and knowledge are useful and how they should be applied. Low-road transfer is generally evident in near-automatic performance across similar conditions, and usually relies on extensive practice to be effective. High-road transfer, by contrast, occurs when knowledge is used in a new context that is different to the learning context. Perkins and Salomon argue this type of transfer relies on mindful, deliberate abstraction of principles, either in advance of its new application or by recalling past experiences in light of a new situation and abstracting relevant principles retrospectively.

Reflective practice has been identified as a strategy that can provide direct support for transfer [5]. Studies in other fields of education research have pointed to the learning benefits of introducing reflection in a structured manner [13, 14, 15] and the importance of encouraging critical reflection to increase the opportunities to learn [14, 15, 16, 17, 18]. The benefits

reflection offers to learning have also been examined in the design literature, for example, Valkenburg and Dorst [19], Dorst [20, 21] Reymen *et al.* [22], and Schumack [23] with Schön's concept of the reflective practitioner [24, 25] widely used as a conceptual basis underpinning this research. The reflective practitioner thinks about their process, or what Schon refers to as engaging in a reflective conversation with their process. Schon highlights reflection as a critical element of professional design activity, and he maintains this provides a framework for understanding and plotting the activity of the design process.

2 Methodology

This research suited a case study approach, where the researcher investigates a contemporary phenomenon within its real-life context, where the study is located within a bounded system, and is to be studied in-depth [26, 27]. This case study was conducted in a studio class in the final year of a three-year undergraduate Bachelor of Creative Arts degree (Graphic Design Major) at the University of Wollongong, Australia. By situating the study within a graphic design studio classroom, the following boundaries to the case study were established, the participants were limited to those students enrolled in the class, the research focused on the set of learning activities that were designed for the class, and the duration of the study was fixed within the teaching period in which the class was scheduled.

A mixed-method research strategy [28] was employed to allow the collection of qualitative and quantitative data to support the development of a deep and broad understanding of the case. The study employed a concurrent nested mixed-method design [29] which supports the ability to collect qualitative and quantitative data simultaneously during a single data collection phase, employ the strengths of both qualitative and quantitative methods, and gain different perspectives not possible with one approach [29].

Data were collected in the forms of a questionnaire, written reflective assessment tasks, semi-structured interviews, and observations by the researcher. This paper will specifically focus on data collected from the written reflective assessment tasks. The reflective tasks were designed to prompt participants to critically reflect on their project in ways that promoted ongoing evaluation and analysis of their design process.

2.1 The intervention

An intervention was designed with the aim to support learners to reflect on their project in a structured and critical way. The intervention, which has been identified as *structured critical reflective practice*, was informed by the principles of the reflective practitioner [24, 25], structured reflection [22], and critical reflection [15, 17]. This study was situated in the final session/semester of the three-year bachelor degree program in a subject of study where the participants were directed to create a signature design work for their graduating portfolio. Thirty-four (34) students participated in the study. The intervention was developed in three stages. In the first stage a learning framework was designed to represent the core features of a structured and critical approach to reflective practice. The framework commences with the establishment of an authentic design problem or design brief where the design context is established. The learners then engage in a cyclic process of design activity and reflection that leads to the creation of a design artefact. Once the artefact is complete, the students submit the artefact for assessment, and then enter a final reflective stage where they think back over their project with the aim to identify learning they could apply to projects in the future. This framework is discussed in greater detail in Ellmers, Brown & Bennett [30].

2.1.1 A four-step reflective process

A four-step reflective process (informed by the reflective learning framework), was developed to guide the design of the reflective assessment tasks. This reflective process was primarily informed by the principles of *reflection-on-action* [22, 24, 31]. Reymen [31] maintains that

when designers engage in a process of reflection-on-action they engage in a deliberate process of pausing to think back over what they have done, exploring the understandings that they have brought to the handling of the design process, and considering how they might approach a similar problem in the future. Reymen [22] highlights the role identifying and analysing ‘critical situations’ can play to support designers engage in the process of reflection-on-action.

Reflection-on-action can be defined as thinking about doing after doing, in such a way as to influence further doing. The goal of reflection-on-action may be evaluating past and current design situations in order to adjust next situations. This can be done by answering questions about the past like ‘What were critical situations?’ and ‘What were factors influencing critical situations?’ [31, p. 5].

Step one of the 4-step reflective process aimed to initiate the process of reflective thinking by prompting the participants to pause and stand back from the design activity, through the activity of summarising their design process. This is important as the activity of designing often results in the designer being so immersed in the activity, they are not always in a position to consider their process critically and rationally [32].

Step two builds on step one, and aims to promote critical reflection by prompting learners to review their design process, identify critical situations in their process [22], and then explain their rationale. Critical situations are “situations that have an important influence on the further direction of the design process or the product being designed” [22, p. 169]. The concept of ‘critical situations’ has parallels with ‘critical incidents’ described by Ghaye and Lillyman [33], and Tripp [33, 34]. Identifying and analysing critical incidents from the design process requires an interpretation of the significance of an event [34], and subsequent analysis of the event can help the practitioner develop their practice further and increase their level of expertise [33]. Identifying and analysing critical situations from the design process can have an important influence on further development of the design project [22].

Both steps three and four were designed to foster the conditions for transfer, where the learner draws observations from their current project in a manner that can be applied to projects in the future, or addresses the broader context of their design practice. This form of transfer has been referred to as ‘preparation for future learning’ [4]. Step three was designed to prompt the learner to connect thinking about their project with thinking about subsequent development of their project and has parallels with the principles of low-road transfer [12]. Step four aimed to prompt the learner to extend their thinking further and in light of their observations from steps one-three, consider how they might now approach other design projects, or their design practice, in the future. This has parallels with the principles of high-road transfer [12]. The 4-step reflective process is summarised in Table 1.

Step 1	Initiate a reflective thinking process by pausing and standing back from the design activity and review the design process
Step 2	Critically reflect on the project by identifying and evaluating critical incidents from the process
Step 3	Connect thinking about the project with thinking about further development of the project
Step 4	Connect thinking about the project with thinking about possible approaches to other projects in the future and/or design practice

2.1.2 *Reflective assessment tasks*

A series of learning activities were designed in the form of written reflective assessment tasks which were introduced to the learners at different stages during and after the development of their design artefact. The tasks consisted of a sequence of inter-related learning prompts whose design was informed by the aims of the reflective learning framework and the 4-step reflective process. Learning prompts for this study are defined as questions or hints that aim to encourage learners to think about aspects of their project in specific ways. Learning prompts can assist learners to engage at a metacognition level where they move beyond the application of knowledge, to gain an understanding of the knowledge. That is, a situation where learners understand how a task was performed, not just applying the skills necessary to perform the task [35].

Two forms of the reflective tasks were developed, a minor task and a concluding task. The minor task guided the learners' reflective thinking during the development of the project at three key developmental points, while the concluding task directed the learners to reflect back over the whole project including reviewing their responses to the three minor tasks.

This paper will focus on results from the minor reflective assessment tasks. The participants were asked to complete the minor reflective task at three key points during the design project. This included after the design proposal presentation, the design prototyping presentation, and the presentation of the final design artefact. The aim was to guide the learner to link thinking about their project with thinking about subsequent development of their project, and thinking about how they might approach other projects in the future. The task also served to guide participants to document their process and thinking during the project for reference when completing the final concluding reflective assessment task. The first minor task was deployed in a training role, with the aim to familiarise the participants with the new reflective method and as such was not included in the results. This approach addressed the possibility that some participants might perform poorly due to a lack of understanding of the task requirements. This equated to a total of 68 participant artefacts that were analysed (reflective assessment tasks two and three, multiplied by 34 participants).

2.2 **Approach to data analysis**

To code the participant artefacts, a cognition taxonomy was developed to identify the levels of reflective thinking evident in the reflective assessment tasks. This taxonomy was developed based on the work of Bennett [36], which was informed by the work of Hatton and Smith [18]. Hatton and Smith developed what Moon [15] identifies as one of the better known frameworks describing levels of reflection. Bennett describes five levels of cognition, reproductive description, summarising description, interpretation, judgement, and generalisation. In collaboration with Bennett, these cognition levels and their descriptors have been modified to allow application to this study. A sixth level of cognition has been added, identified as abstraction, with the aim to differentiate thinking that moves beyond the context of the design project to address wider or future design practice. These levels of cognition along with their descriptors, are outlined in Table 2.

To code the participant artefacts the computer software program QSR NVivo was employed. The participant artefacts (the reflective assessment tasks) were coded at a sentence level, representing 'units of meaning' [37] with each sentence aligned to one of the six cognition levels. When considering what cognition level the sentence should be coded, the sentence context was taken into account, and if there was any coding doubt, the sentence was aligned to the lower cognition level.

Cognition levels	Cognitive Descriptors
Abstraction	Presents a general principle or procedure that moves beyond the design project to address wider or future practice.
Generalisation	Presents a general observation or draws a generalising conclusion within the context of the project
Judgement	Goes beyond re-presenting or interpreting information to offer a value judgement or claim
Interpretation	Seeks to explain or make sense of an event or statement by interpreting information from the project.
Summarising description	Descriptive response that summarises or synthesises or recounts information presented in the project. This includes re-wording and re-structuring of a number of events into one statement. This type of response does not present new information from beyond the project
Reproductive description	Descriptive response that reproduces information directly from the case with no elaboration

3 Results

The results collected from the participant reflective tasks are reported in Table 3. The data represents the number and percentage of participants whose responses aligned at each cognition level and across the 4-step reflective process where n=34. For example, the row reporting the results that align with Step 1 describing the design process, indicates that of the 34 participants, responses from 25 participants were identified as aligning with the cognition level ‘reproductive description’. That is, 74% of the participants described their process in ways that aligned with the cognition level ‘reproductive description’.

4-Step reflective process	Cognition levels					
	Reproductive description	Summarising description	Interpretation	Judgement	Generalisation	Abstraction
Step 1: Describing the design process	25 (74%)	34 (100%)	16 (47%)	2 (6%)	0 (0%)	0 (0%)
Step 2: Identifying critical incidents	2 (6%)	25 (74%)	34 (100%)	33 (97%)	4 (12%)	0 (0%)
Step 3: Linking with further project development	0 (0%)	8 (24%)	30 (88%)	30 (88%)	17 (50%)	10 (29%)
Step 4: Linking with design practice	0 (0%)	4 (12%)	29 (89%)	23 (68%)	25 (74%)	24 (71%)

This results from Step 1 (see Table 3) of the introduced reflective process suggest that when prompted to describe their design process, learners can summarise, synthesise, or recount information from their design project in ways that align with the cognition level Summarising description. In this study learners achieved this by pausing and standing back from the design

activity and describing their design process in a written form. This is consistent with the initial stages of reflection-on-action as described by Reymen [31].

The results associated with Step 2 of the introduced reflective process indicate that learners can explain or make sense of their project by identifying critical incidents from their design process in ways that aligned with the cognition level Interpretation. In this study 74% participants subsequently described the critical incidents by summarising or recounting information from the project (Summarising description), and 97% of participants offered value judgements or claims about the critical incidents they had identified that aligned with the cognition level Judgement. This outcome has parallels with reflection-on-action as described by Reymen [31] where learners explore the understanding they have brought to the handling of the design process.

Reviewing the results from Step 3 reveals that 88% of the participants reflected on their project in ways that had parallels with the cognition levels Interpretation and Judgement. That is, they identified issues from their reflective observations that could inform how they subsequently approach further development of their project (Interpretation), and subsequently explained their rationale (Judgement). Half of the participants also presented generalising observations and/or conclusions within the context of their project consistent with the cognition level Generalisation, while 10% also drew general principles or procedures through their reflections that addressed the wider context of their practice consistent with the cognition level Abstraction.

The results from Step 4 indicate that when participants were prompted to link their thinking from the project with thinking about how they might now approach the broader context of their practice, not all participants drew observations or conclusions from their project in ways that could inform their approach to projects in the future. This is illustrated by the results where 74% of the participants reflected in ways that aligned with Generalisation where participants draw conclusions from their project in a manner that could inform projects in the future in a similar context to the project. A similar percentage of participants (71%) drew conclusions from their project in a manner that could inform projects in the future, but did so in a way that was consistent with Abstraction, where their reflections moved beyond the project context and engaged with the broader context of their practice. The results also reveal that while 89% of participants identified aspects from their project they felt could inform projects in the future (Interpretation), fewer participants (68%) subsequently offered a rationale about their claim (Judgement).

4 Discussion

The findings from this study demonstrate that when supported by a structured and critical approach to reflective practice, students reflected on their design process in ways that are consistent with the principles of reflection-on-action [2, 24, 31]. This was evident when students deliberately paused to think back over their design process, evaluated the understandings that they had brought to the development of their project, and considered how they might now approach further development of their project or design projects in the future.

This study also demonstrates that a structured and critical approach to reflective practice can support students to reflect on their project in a critical manner. This outcome has parallels with what Mezirow [17] describes as critical reflection, where the learner critiques the presuppositions on which their beliefs have been built in a way that leads to a transformation of perspective. This outcome also responds to common criticisms of reflective practice where reflective thinking by the learner can often be non-critical and non-reflective in nature [15, 18, 38, 39]. In this study critical reflection was evident when participants challenged their thinking in an analytical manner, such as identifying and analysing critical incidents from

their design process for review, and then challenged their thinking about their approach to that situation.

The results from this study also indicate that critical reflection is unlikely to occur frequently, which supports the findings from Hatton and Smith [18]. In this study, not all participants reflected in a critical manner, nor did participants critically reflect all the time, however, the study found that one way to support critical reflection is through critical incident analysis [33, 34]. Critical incident analysis aligns with the principles of reflection-on-action described by Reymen [31], where designers evaluate the design work by analysing critical situations in their design process. In this study, this form of evaluation was evident when participants reviewed their project, identified critical moments in the development of their project, and then made value judgements or claims about why they thought the incidents were critical.

The findings from this study show that when guided by a structured and critical approach to reflective practice, students can make connections from their reflections about the project with thinking about their approach to further development of the project. These reflective connections occurred in a similar design context to the project, and in some instances in the broader context of design practice. Making connections through their reflections with thinking about their practice in a similar context to the current project has parallels with the principles of low-road transfer described by Salomon and Perkins [12]. This is, where skills and knowledge learned in one context can be readily applied to another similar context.

One of the more important findings from this study is that some students connected their reflections from the project with thinking about the broader context of their design practice. This was evident when participants identified learning from the project that could be applied to design situations beyond the project context. Some participants shifted their focus away from their project to consider the more generalised context of their design practice. For example, considering a modification to their design process by deciding that in future they would make a deliberate decision to consider alternative concepts throughout the development of the project, or create more prototypes of their artefact with the aim to test their ideas further. In this study the introduction of a structured and critical approach to reflective practice, supported learners to connect reflections beyond the project context to other project contexts and/or their design practice. This could be interpreted as similar to the principles of high-road transfer described by Salomon and Perkins [12] where knowledge is applied in a context that is different to the learning context. It is important to note that not all participants made these connections, nor did those making these connections do so consistently.

Conclusions

The outcomes from this study indicate that reflection, introduced as a structured and critical practice, can support design students in a project- and studio-based learning environment to engage with the learning opportunities present in the design process in ways that foster the conditions for transfer. The outcomes suggest structured critical reflection has a key role to play fostering the conditions for transfer.

Researchers have suggested that critical incident analysis can help the practitioner develop their practice further and increase their level of expertise [33]. Research by Lawson and Dorst [40] examines the phenomenon of design expertise in greater detail. One element they identify as central to the development of design expertise is reflective practice. In light of the findings from this study, there is considerable potential to further examine the relationship between a structured and critical approach to reflective practice and the development of design expertise.

In its most successful form, a structured and critical approach to reflective practice, can support students to reflect critically on their project in ways consistent with the principles of reflection-on-action, and in ways that foster the conditions for transfer consistent with the principles of both high- and low-road transfer. However, the limited empirical research linking project- and studio-based learning in design education, structured and critical reflective practice, and transfer, indicates there remains much to learn.

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