Appropriating the Development of Designerly Thinking and Graphical Expertise as Subservient to the Development of Graphical Capability

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Abstract

With commensurate aims of developing graphical expertise and designerly thinking, contemporary graphical education embodies a dichotomy which can be potentiated as a complimentary or an antagonistic synergy. This paper highlights the need to develop discipline specific evidence to inform a complimentary development of these aims. The concept of embedded cognition provides a critical lens through which to view the provision of tasks to develop graphical expertise and designerly thinking as subservient aims to the holistic development of graphical capability. It is posited that the proposed research agenda can inform task provision with a discipline specific evidenced underpinning.

Introduction

Two objectives of contemporary graphical education are the development of graphical expertise and designerly thinking to serve the overarching agenda of developing graphical capability. These aims are necessarily embedded in graphics curricula as they give graphical education a contemporary societal and therefore educational relevance. This paper aims to unpack the appropriation of the synthesis of these aims using a situated cognition lens which highlights the embedded cognition implications for developing these competencies.

Graphical Education: Purpose and Practice

The ever-growing unpredictability of what will be required of and for future society has caused a fundamental shift in the discourse surrounding what competencies and skills should be developed through formal education. This has seen the placement of a greater emphasis on developing how students perceive and process problems with a reduced emphasis being placed on their subject specific knowledge (OECD, 2008, 2014). This prioritization of developing situationally appropriate problem-solving skills is considered a logical response to educating students for an inevitably unpredictable future, something the Programme for International Student Assessment (PISA) states has not been happening effectively in schools (OECD, 2008).

This macroscopic perspective reflects the narrative of a global shift. Further dissection is critical to determine how this agenda can manifest appropriately at a discipline specific level. The contemporary enactment of graphical education occurs with a pseudo-subservience to other disciplines, most notably the fields of Design, Technology and Engineering. The interdependency of the relationship between graphical education and these disciplines provides a pragmatically based rationale for its aim of developing graphical capability. This development of graphical capability occurs through the dichotomy of developing graphical expertise and designerly thinking. The development of these capacities is therefore embedded within learning tasks which are also relevant to the disciplines associated with and dependent upon graphical education. This dualistic nature of developing graphical capability is considered an apt response to the pertinent trend observed in global educational discourse.

This criticality of this alignment can be seen in research by Rynne, Gaughran, and Seery (2010) where they highlight the importance of developing strategic 3D CAD modelling expertise. They posit that developing this strategic knowledge can augment the utility of declarative knowledge and procedural knowledge when engaging in 3D CAD modelling by enacting them in a complimentary unison. This view of the effect of developing a governing faculty for the enactment of contextually relevant subject specific knowledge alludes to the importance of developing a student that can flexibly and autonomously engage with problems.

Where this research differs from the OECD's perspective stated above is its prioritization of the development of subject specific knowledge. To engage in CAD modelling task students need to either develop the relevant knowledge of the functionality of the CAD package or already have engaged with the appropriate functional aspects as required by the task. This fundamental knowledge base is highlighted as critical in the student's ability to demonstrate graphical capability. Although this research focused on "the variables that contribute to developing 3D CAD modelling expertise" (Rynne et al., 2010, p. 161) and not the variables that contribute to developing designerly thinking, it is a clear example of the relevance and benefit of developing contextually appropriate problem solving skills. Given the differing nature of designerly thinking and graphical expertise this research also highlights how the dualistic aims of developing designerly thinking and graphical expertise must be appropriated with consideration towards their dynamic coupling.

Embedded Cognition

The discipline of cognitive science has recently been influenced by arguments for an ecological approach to cognition which views cognition as a situated process (Robbins & Aydede, 2009). This situated cognition approach argues that the contextuality of cognitive processing has a direct influence on those cognitive processes. The concept of cognition being embedded is particularly central to the situated cognition thesis (Robbins & Aydede, 2009). Embedded cognition argues for the consideration of the environmental influences on cognition. This results in the thesis that

cognition can be off-loaded onto our environment through "epistemic action" (Kirsh & Maglio, 1994). Instead of visualizing how a Tetris piece needs to be rotated as a purely intramental process an individual turns it until they have identified its appropriate orientation. This perspective argues for a view of cognition as being contextually influenced and is particularly relevant to the argument of a contextually effective enactment of knowledge.

The theory of 'affordances' by Gibson (1979) is particularly relevant to the perspective of embedded cognition. Gibson's theory of affordances explains how the environment surrounding an individual offers possible behavioural interactions to them. Gibson describes the nature of these affordances in relation to the individual, demonstrating the unique affordances an environment provides an individual with based on their size or external goals. For example, a concaved vertical surface which is larger in height and width than that of the individual and impenetrable by water provides the affordance of shelter during rain. Without the presence of rain, it would not provide shelter but shade if the sun were shining and without the presence of the individual would not afford anything. It is the interaction between the environment and the individual which creates the affordance. In the context of embedded cognition, the theory of affordances can be useful to demonstrate the interaction between the individual and their environment as a two-way dialogue, relevant to the individual.

An Embedded Cognition Lens on the Development of Graphical Capability

To further the applicability of an embedded cognition lens to the development of graphical capability it is apt to dissect the nature of designerly thinking and graphical expertise. Designerly thinking as described by Stables is dependent on "our ability to 'image' in our minds things we have experienced and also that we haven't; our ability to manipulate those images, both in our minds and through externalised actions such as talk or drawing; and our ability – and determination – to utilise imaging and modelling of ideas to create new future realities" (2008, p. 8). From this description, the ability to grapple with problems in a dynamic way is particularly critical in developing designerly thinking. The development of designerly thinking is the development competencies which equip students to work within and towards an unknown through the harnessing inherent human abilities.

To engage effectively in designerly thinking in a graphical context it is therefore imperative that commensurate graphical expertise is developed. In the context of graphical education this is representative of the 'knowledge base' pertinent to graphical capability. As highlighted in Rynne et al. (2010) this is not solely declarative knowledge such as geometric principles, but also procedural knowledge of how to achieve a required result, in the context of 3D CAD this can be observed as the ability to use specific modelling tools.

The centrality of the development of designerly thinking and graphical expertise to the development of graphical capability is clear. The ability to grapple with problems of a divergent

nature requires a student to be equipped with the ability to work in the uncertainty of a prescribed task, and to do so they must also be equipped with the appropriate knowledge base pertinent to the task to realize potential solutions. They require the means to enact a speculative solution to an encountered problem, if they lack the graphical expertise to realize their speculative solution they must regress and speculate based on their ability to realize.

This highlights the synergistic potential of designerly thinking and graphical expertise although from a pedagogical perspective it highlights their potential antagonistic relationship. From an embedded cognition point of view the development of graphical expertise and designerly capability cannot effectively occur in a commensurately in any task due to how a student's ability to graphically realize can limit their designerly thinking progression or their ability to act designerly can hinder their ability to effectively utilize their graphical expertise. The affordances available to the student to develop graphical capability are therefore dependent on their associated designerly thinking ability and graphical expertise.

Conclusion

This paper highlights the need for a research agenda with the purpose of investigating the nature of developing graphical capability in a contemporary graphical education context. Currently there is a dearth in the knowledge base in relation to the development of graphical capability through the commensurate development of designerly thinking and graphical expertise. It is posited that a research agenda with the specific purpose of investigating the dynamical relationship between developing designerly thinking and graphical expertise can inform the enacted practice of graphical education by developing discipline specific pedagogically oriented evidence.

References

Gibson, J. J. (1979). *The ecological approach to visual perception*: USA : Erlbaum.

Kirsh, D., & Maglio, P. (1994). On distinguishing epistemic from pragmatic action. *Cognitive Science, 18*(4), 513-549. doi:https://doi.org/10.1016/0364-0213(94)90007-8

OECD. (2008). *21st century learning: Research, innovation and policy directions from recent OECD analyses*. Retrieved from http://www.oecd.org/site/educeri21st/40554299.pdf

OECD. (2014). *PISA 2012 results: creative problem solving: students' skills in tackling real-life problems (volume V)*: OECD, Paris, France.

Robbins, P., & Aydede, M. (2009). A short primer on situated cognition. In P. Robbins & M. Aydede (Eds.), *The Cambridge Handbook of Situated Cognition*. New York: Cambridge University Press.

Rynne, A., Gaughran, W., & Seery, N. (2010). *Defining the variables that contribute to developing 3D CAD modelling expertise*. Paper presented at the IDATER online conference: graphicacy and modelling 2010, Limerick.

Stables, K. (2008). Designing matters; designing minds: The importance of nurturing the designerly in young people. *Design and Technology Education: An International Journal, 13*(3), 8-18.