The Role of Knowledge Visualisation in Supporting Postgraduate Dissertation Assessment

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Abstract

The worldwide increase in the number of postgraduate students has led to an ever-increasing workload. This puts pressure on supervisors to maintain high standards of consistency, accuracy and fairness. This is especially true in developing countries where the increase is supervision capacity is not on a par with the growth in student numbers.

The *aim* of this research is to deploy freely available technology in order to find a way to help examiners to cope with this extra pressure, while maintaining the rigour of the assessment process.

In terms of *methodology*, we commenced by mining the literature to ascertain exactly what criteria dissertation examiners were assessing, and how they went about doing this. We discovered that examiners tend first to gain an initial impression of a dissertation by reading the summary sections of the report: the abstract, introduction and conclusion. This delivers a helpful overview that eases the subsequent thorough examination of the dissertation, where they work their way through each chapter. This "*overview then zoom*" practice is reminiscent of the primary information visualisation mantra. This led us to consider whether knowledge visualisation could be the ameliorative mechanism we were looking for.

We then carried out a systematic literature review in order to determine whether knowledge visualisation had been used in this context. This revealed a surprising lack of research on the use of knowledge visualisation for assessment. We thus commenced to study extant use of visualisations.
A case study approach was employed to study extant use of visualisations, in terms of how adequately they provided evidence of students having satisfied the previously identified assessment criteria. A number of experienced supervisors were then surveyed to gather their opinions about the role of knowledge visualisations in dissertations.

Our *findings* indicate that knowledge visualisations can indeed provide evidence that particular criteria have been satisfied within a dissertation, and they do this more efficiently than text. Given the advances in technology, all postgraduate students are now able easily to produce computer-generated visualisations, so requiring their inclusion would be no great impediment.

We *conclude* that knowledge visualisations demonstrate promise in terms of supporting assessment of postgraduate dissertations.

Our *recommendations* are that the deliberate deployment of knowledge visualisations in this context be investigated further to determine whether this initial promise can be realised in actual practice.

Introduction

Universities across the globe are enrolling increasing numbers of postgraduate students (Kruss, 2006; Taylor, 2002) and some Universities are struggling to cope with the growth (Bitzer & Albertyn, 2010). I'Anson and Smith (2004) explain that the difficulties relate to wider trends in higher education including widening access, coping with large groups of students and the increasing occurrence of plagiarism. In South Africa, in particular, the pressure on institutions and academics to deliver more postgraduates is rising (Bitzer & Albertyn, 2010) exacerbated by the emigration of many skilled South Africans over the past two decades (The Economist, 2008). For example, at the University of South Africa the number of dissertations more than doubled from 2010 to 2012, while supervision capacity did not increase proportionally [Van Biljon and De Villiers, 2013]. During this period, the supervisors who resigned were generally replaced by junior academics with minimal supervision experience [Van Biljon *et al*., 2014]. From a practical perspective, it seems time for an investigation into findings ways to support overloaded supervisors.

Dissertation assessment is essentially a knowledge transfer process, from the student to the academic community, as represented by the examiner. Dissertation assessment differs from other kinds of question-based marking. If someone has too many exams to mark recruiting more markers can ease the situation. One can assign different questions to different markers so as to ensure consistency. In this case, many hands make light work. Dissertation assessment, on the other hand, is not amenable to this intervention. It has to be read in its entirety by one person, serially, working from beginning to end. Efficiency gains have to be achieved by improving the content of the dissertation itself.

The investigation being reported here explores whether this improvement can be achieved by including knowledge visualisations in dissertations. The technology required to produce visualisations is widely available, accessible and eminently usable. The production of adequate visualisations is no longer the purview of artists or graphical designers. There is evidence for its use in other educational contexts (Dawson, 2010; Melero *et al*., 2015; Wang *et al.,* 2011; Schnotz & Kürschner, 2008; Baumeister & Freiburg, 2011).

The deployment of visualisation in the assessment context has not been researched extensively, as the next section shows, despite the ubiquity and ease of use of supporting technology for creating visualisations. The aim of this study was to find out whether it would be possible to harness the ubiquity of technology, and facilitating software in particular, as follows: *require the inclusion of knowledge visualisations within dissertations in order improve their knowledge communication ability, thereby easing assessment while retaining assessment thoroughness.*

In terms of methodology, we carried out a preliminary investigation on two fronts. The first was to determine whether we could link existing assessment criteria to visualisations used by students in completed dissertations. If this were possible, it would suggest that assessors could use these to quickly check whether students had achieved important milestones, as part of the initial overview sweep through a dissertation. We also interviewed supervisors to gauge their expectations and experience of visualisation deployment by research students. We discovered that the majority already expected the use of visualisations in dissertations.

The study reported here is in the nature of an explorative investigation: we offer our findings in order to pique the interest of other researchers, thereby to encourage more exhaustive investigations into this topic.

Visualisation and Communication Enhancement

A number of studies explain that humans have innate visualisation processing abilities. For example, Ungerleider & Haxby (1994) point out that visual processing is the most richly represented sensory modality in the human brain. Reading relies on the same visual areas, but requires additional processing and cognition, and is more resource-intensive. A visualisation is a coherent unit, presented in a format that the human brain prefers to process (Chen, *et al*., 2009). There is evidence of the power of visualisations in enhancing communication (Card *et al*., 1999; Bresciani & Eppler, 2008). Many different labels and conceptions exist in different domains to explain the integrative power of visuals for knowledge transfer. Therefore it is necessary to revisit the basic terminology and clarify the intended meaning in the context of educational technology before proceeding to any discussion of how these can be represented. The fundamental constructs of data, information, knowledge and visualisation are depicted in Table 1.

		Visualisation		
Concept	**Explanation**	**Explanation**	**Example**	**Assessment**
Data	A representation of facts, concepts, or instructions in a formalized manner suitable for communication, interpretation, or processing by human beings or by automatic means (Chen, Ebert, Hagen, Laramee, Liere, 2009).	The use of a visual representation to gain insight into a data set towards supporting the transitioning of data to information (Chen et al. 2009).	Visualisation of descriptive statistics such as Pie Chart, Bar Chart and other descriptive statistics graphs.	Proof that student has gathered data and is able to present it in a visual format.
Information	The meaning that is currently assigned by human beings or computers to data by means of the conventions applied to the data (Chen et al. 2009).	The use of a visual representation to support pattern detection in data towards knowledge creation (Card, Mackinlay, Shneiderman, 1999; Carneiro & Mylonakis (2009)).	Visualisation of inferential statistics such as identifying clustering concepts in factor analysis. Google Trends generated graph of search for flu-related terms https://www.google.com/trends/	Evidence that student, by using an information visualisation technique, is able to gain insights into the information, thereby to extract knowledge.
Knowledge	Understanding, awareness, or familiarity acquired through education or experience. Anything that has been learned, perceived, discovered, inferred, or understood. The ability to interpret information Chen et al. 2009)..	The use of a visual representation to support the (inherently social) processes of creating and sharing knowledge between at least two people (Burkhard, 2005; Eppler 2013). The creation and transfer of knowledge by visualization happens independently of technology (Meyer, 2009).	Concept Maps http://cmap.ihmc.us/docs/images/Theory/Fig1CmapAboutCmaps-large.png	Evidence of knowledge synthesis, contribution, relatedness and ability to communicate knowledge gain.

Table 1: Basic constructs in data, information and knowledge visualisation

In postgraduate assessment the dissertation is the main artefact the candidate will be judged on. Furthermore, the assessment of most masters' qualifications does not include a viva so the dissertation is the only artefact assessed. Optimal presentation is critical. In this context knowledge visualisation can be particularly powerful since the non-linear nature of a visualisation makes knowledge visualisation particularly effective in terms of improving communication (Bertschi *et al.,* 2011). Furthermore can make knowledge more accessible, manageable, and transferrable and generally more valued (Eppler & Burkhard, 2007).

Knowledge Visualisation and Assessment

To provide an evidence-based overview of the use of knowledge visualisation in assessment we performed a systematic literature overview using the search string [(‘*knowledge visualisation’* OR ‘*knowledge visualisation’*) AND ‘*assessment’*], optimising for relevance. The searches (based on title and abstract) produced fewer than 200 results per database. These publications included all the keywords but only those that were about the use of knowledge visualisation in assessment were retained. The searches were carried out from 24-26 March 2016. Two researchers performed the searches independently and conferred to reach consensus.

Database	Link	Total	References of relevant publications	Discussion
Google Scholar (since 2010)	https://scholar.google.co.za	40	(Wang et al., 2011; van Biljon & Renaud, 2015A)	Many of the results can be categorised as pertaining mainly to Knowledge Visualisation concepts, Information modelling, Corporate communication, Architecture, Education, Engineering Design and specific projects using knowledge visualisation. The other results included Knowledge Visualisation in the field of medical diagnoses, geological and other natural science research, data mining, business management, information management and knowledge representation. There were a number of papers in education but those concerned automated assessment without a knowledge visualisation components.
IEEE Explore	http://0-eeexplore.ieee.org.	178	None	
ACM	http://dl.acm.org/	79	None	
DBLP	http://dblp.uni-trier.de/	26	(van Biljon & Renaud, 2015B)	
ERIC	Eric.ed.gov	59	(Narumi & Gotoh, 2014)	
Scopus	https://www.elsevier.com/solutions/scopus	27	(Ifenthaler, 2014; Ifenthaler, et al. 2014; van Biljon & Renaud, 2015B)	
Springer	www.springer.com	170	Pirnay-Dummer, & Ifenthaler, 2009; van Biljon & Renaud, 2015B)	

Table 2: Results of a literature search on knowledge visualisation for assessment

Table 2 shows that despite the large number of publications containing the terms “*knowledge visualisation*” and “*assessment*”, only seven focused on the creation of visualisations by students to support assessment. This confirms that the purposive use of visualisation as a means of supporting assessment has received very little research attention so far.

Our systematic literature review was unable to find any investigation into the deliberate deployment of knowledge visualisations to make dissertation assessment more efficient. It is possible that such research has been carried out, or is in the process of being carried out, but there is no evidence of this in the current research literature.

The Assessor's Task: Dissertation Assessment

We need first to understand how examiners assess dissertations: *what* they are assessing and *how* they go about assessing, before we can determine whether visualisation can improve the efficiency of the process.

What is Assessed?

A number of publications enumerate the individual aspects of dissertations that examiners assess:

	James (1998)	*Mullins & Kiley (2002)*	*Ananthakrishnan (1994)*	*Golding et al. (2014)*	*Phases*
Content (Micro-Level Rhetorical, Staging and Discourse Features)					
Synthesis of Related Work	Demonstrate an intention to understand the relevant related research	Synthesis	Ability to interpret others' work in so far as it applies to one's own	Engages with the literature	1,2,3
Relate Own work to Related Research	Provide evidence that they are able to relate ideas to prior knowledge and experience		Ability to infer the significance of his work in the context of knowledge on the subject already existing.	Engages with the literature	2,3
Critical Appraisal	Examining the logic of the arguments made by other researchers	Understanding			3
	Show that they have interacted vigorously and critically with the content	Researching the right problem			3
Research Rigour		Correct use of methodological and theoretical perspectives	Clear approach to the subject and ability to define a problem, plan a study and realise and overcome difficulties		1,2
		Worthwhile Results	Ability to record and analyse data		3

Quality of Writing (Macro-Level Schematics and Structure)				
	James (1998)	*Mullins & Kiley (2002)*	*Golding et al. (2014)*	*Phases*
Structure	Show that they can organise principles and integrate ideas	Cohesiveness & Clarity; Everything fits together; Being able to explain at the end of the thesis what had actually been argued in the dissertation	Coherence	1,3
Argumentation	Draw conclusions based on the evidence	Coherence Accuracy of Logic Well explained	Engages with the findings	1,3
Professionalism		Attention to Detail	Presentation details are important	1,2,3

Table 3: Assessment Criteria for Postgraduate Dissertations

In essence, assessors are looking for **evidence** that the student:

E1: has provided a *synthesis* of related work,
E2: has *related* his or her work to other research,
E3: is able to appraise other work *critically*,

E4: demonstrated *research rigour,*
E5: has provided a meaningful *structure,*
E6: has produced a convincing *argumentation,*
E7: has conducted the research *professionally.*

How is Assessment Carried Out?

Mullins & Kiley (2002) carried out a qualitative study into what examiners do when they examine a dissertation. They reported that the usual approach was first to read the abstract, introduction and conclusion. This is done in order to gain an overview of the reported research. They then usually looked at the references. The final stage was to read from cover to cover, carefully and in detail. In summary, assessment usually proceeds as follows:

Phase 1: ***Gain a quick overview by reading those parts that provide a summary***. This phase provides a meta-view of the content and establishes a set of expectations in the examiner's mind. A Google search for "*writing an abstract*" delivered over 332 000 results[1]. The sheer volume of advice demonstrates the importance many attach to this précis, and justifiably so. Examiners will look at whether the conclusions flow from the introduction, and how well the student explains what he or she did.

Phase 2: ***Check whether the correct sources have been consulted***. This probably helps them to assess research rigour (have they consulted the right papers, whether it is up to date, and whether it is substantial enough) and, indirectly, professionalism (sloppy referencing is often an indicator of sloppiness elsewhere, according to Golding *et al.* (2014)).

Phase 3: ***Slow and careful perusal.*** The time taken for the third phase is more or less directly proportional to the number of pages, and supports assessment of the criteria mentioned in Table 3. Mullins & Kiley (2002) mention a number of questions the examiner seeks to answer as he or she does this. Amongst others, they are looking for evidence of intellectual depth and rigour, being able to see how much work has been done, and evidence of an actual argument.

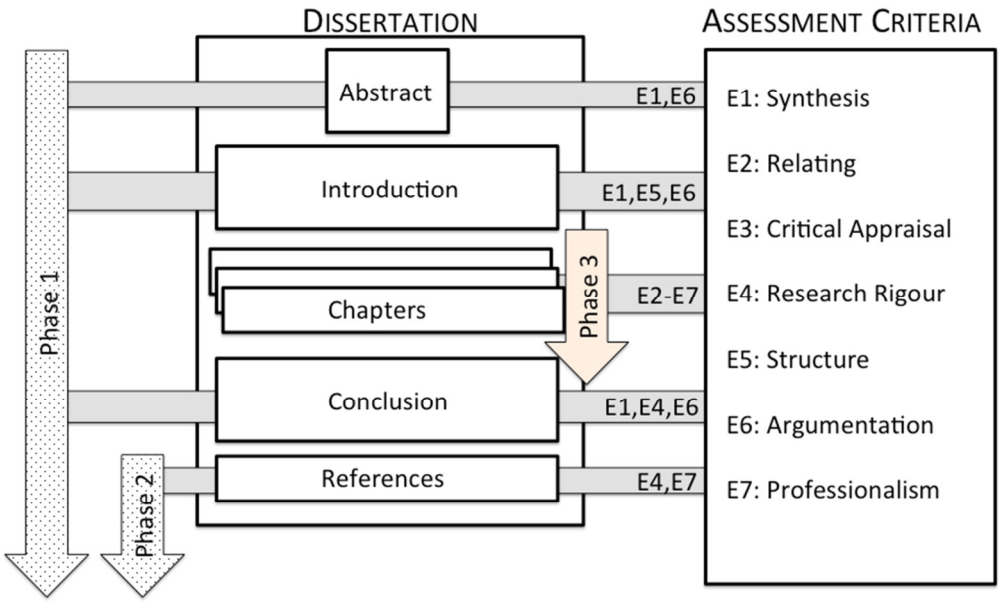

Figure 1: Mullins & Kiley's (2002) phases mapped to Assessment Criteria

[1] Search carried out 2 April 2016

Golding *et al*. (2014) report that examiners often make a decision about whether to pass or fail the dissertation by the end of the first or second chapter (early in Phase 3). This means that phases 1 and 2 are crucial: the meta-overview, and reference list scan seem to set the scene, to establish the expectations to a certain extent.

Can Visualisations Improve Communication?

Phase 1 and 2, relying on overview-type text only, suffer from a number of potential limitations: (1) text is processed sequentially, (2) the abstract is of limited length; introductions and conclusions, by their very nature, deliver constrained information payload, (3) all of these sections deliver an overview of the research report *as a whole*, and do not necessarily deliver insight into the level of knowledge mastery achieved by the student in particular areas. Nor do they support the examiner in terms of quickly judging some of the most important assessment criteria. What is needed is a way for an overview to be provided at crucial intervals throughout the dissertation, in an easily accessible and identifiable way, so as to provide a more fine-grained overview.

Visualisations could feasibly mitigate during the time-consuming and effortful third phase so it is worth investigating their use further. When one studies this kind of tool the first step is to investigate extant use. We need to determine the purpose of visualisations in completed dissertations, and examine how students had used them. Since the supervisors are guiding and advising research students it is necessary to consult them too.

We also discovered that some conferences had recently started requiring academics to provide video previews of their papers (CHI, ACM UIST, IEEE VIS). The journal publisher Elsevier requires graphical abstracts of accepted papers, saying the graphical abstracts: "… *allow readers to quickly gain an understanding of the main take-home message of the paper*". These more visual summaries essentially augment the papers, providing the potential reader with a snapshot that can be quickly assimilated as a unit, in parallel, far more efficiently than reading the entire paper or, apparently, the textual abstract. We considered that it was worth investigating whether they could help in the assessment context too.

Investigation into Knowledge Visualisation's Potential

The study was steered by two research questions, namely:

Q1: Can visualisations in dissertations be linked directly to key assessment criteria?
Q2: What are supervisors' views on the deployment of visualisations in dissertations?

In response to the first question we employed a case study as research strategy, as recommended by Yin (2014) when investigating a phenomenon within its real-life context, especially when this happens over a sustained period, as advocated by (Creswell, 2009). The case under study was chosen because of the pressure on supervision capacity caused by an increase in students and a concomitant decline in supervision capacity at the University of South Africa. The single-site case study employs Masters dissertations and supervisor views on the use of visualisation in assessment as units of analysis.

Ethical clearance was obtained from the University of South Africa to examine 30 Information Systems dissertations, representing 73% of the dissertations completed during the period (2002-2012) – the rest were available in the archive so we could not use them. We randomly chose ten of these for our analysis. Having analysed them, we felt that we had reached saturation point in terms of an

exploratory analysis since the indications were fairly consistent across the majority of the dissertations. The use of visualisations in dissertations is not deliberately incentivised or explicitly rewarded at the University so this study examined emergent and extant behaviour.

Procedure for investigating the use of visualisation in postgraduate dissertation assessment:

Q1: **Case Study into Use**: We carried out a case study of 10 randomly chosen dissertations, in order to determine whether knowledge visualisation, in particular, had been used. Such an approach is advised by Zeiller (2005) as being particularly applicable to studying knowledge visualisation usage. We wanted to see how students had used visualisations, and whether they helped us to gain an insight into the dissertation. We sought out knowledge visualisations only (both tables and figures), to determine whether any of these could conceivably help the reader to gain a quick overview, and whether they could assist in assessing the criteria mentioned in Table 3.

Q2: **Feedback from Supervisors**: We asked 13 experienced examiners to complete a short questionnaire which asked about their supervision experience, their expectations related to the use of visualisation by their students generally, and specifically to explore their perceptions about the role of visualisation during assessment.

Q1: Case Study Investigation

Berstchi (2007) argues that the only way to study knowledge visualisations is to be deconstructivist, to evaluate the mechanisms that have been used by the creator to construct the visualisation to discover their underlying meaning.

To analyse the dissertations we were guided by Luk (2008), focusing on micro-level rhetorical features of the dissertation, not macro-level linguistic features or structure. The main aim was to determine whether students had used *their own* knowledge visualisations to present particular milestones in their narrative. The milestones provide evidence of some of the assessment criteria (E1 to E7) enumerated above. Such visualisations can be expected to perform a particular communicative function in terms of knowledge transfer, and to achieve a coherent goal. As such, we excluded text from our analysis, focusing primarily on visualisations (figures and tables), and considered them in terms of their potential mapping to the assessment criteria enumerated in Table 3.

As a first step, the two researchers independently identified the knowledge visualisations that students had produced themselves, and could be classified as knowledge visualisations. We then met to agree. We independently reviewed all identified visualisations to classify them in terms of their milestone purpose. The stated purpose, in each instance, was derived from the captions. We worked together to determine whether each instance could be classified as a "milestone visualisation", in terms of providing evidence of having satisfied an assessment criterion. The classifications are shown in Table 4.

We discovered that those visualisations that satisfied E1 (consolidating/synthesising) and E2 (situating/relating) were pretty well covered by all but one student. The visualisations that presented comparisons sometimes acted as an indicator of student mastery of the research literature, and at other times indicated that they were able to critically appraise others' work. Sometimes these, too, served to relate the student's work to that of others. Some examples of the deployment of visualisations by these students are given in Table 5.

			Dissertation										
	Assessment Criteria		Student1	Student2	Student3	Student4	Student5	Student6	Student7	Student8	Student9	Student10	Total
Visualisation Purpose	E1: Consolidating/ Synthesising/ Comparing		11	3	4	13	10		6	6	15	16	84
	E2: Situating/ Relating			2	1	3	2		4	3	1	5	21
	E3: Critical Appraisal												
	E4: Research Rigour	Methodology				2	3		1			2	8
		Correlating						8					8
		Knowledge Contribution				5	7						12
	E5: Structure			1		4	5		3	2	1	5	21
	E6: Argumentation												
	E7: Professionalism												
		Total	11	8	5	27	27	8	14	11	17	28	

Table 4: Purpose of Knowledge Visualisation in terms of Assessment Criteria

Criteria	*Visualisation Examples from our Case Studies*
E1: Synthesis of Related Work	Diagram depicting the critical elements of an awareness programme (Student1) Hierarchical Structure of Mobile Agent Communication (Student3)
E2: Relate own work to Related Research	Presenting the rationale for the research study, positioned within the related research (Student2)
E4: Research Rigour	A Diagram showing the research design process flow (Student4) A mapping of how knowledge management strategies could be mapped to a knowledge management architecture (Student5)
E5: Structure	Dissertation and Chapter Maps (Student4)

Table 5: Visualisations providing evidence of criteria being met

Visualisations to satisfy E4 (research rigour) were widespread. Some visualisations detailed the research methodology while other tabularised the research review to highlight the authors, methodologies, constraints and main findings. Some of the dissertations we studied did include chapter maps to ease assessment of writing quality, especially in terms of structure. As we worked through the dissertations it became clear that to assess E3, E6 and E7 would still require perusal of the entire dissertation, but that visualisations could well ease assessment of the other criteria.

How can we claim that visualisations will ease the process when the reader still has to read through the entire dissertation? The argument is based on the fact that it is a lot easier to work your way through a document if you have an overview, and a good idea of what to expect. The visualisation will provide such an overview in an easy-to-process format. Supervisors, according to Mullins and Kiley (2002), are already seeking out textual overviews, so augmenting these with visualisation-type overviews should improve the process substantially.

Q2: Feedback from Supervisors

All of the interviewees had supervised masters' students to completion and examined masters' dissertations. The participants all encouraged their students to use visualisations, 10 always did so, two often and one sometimes (no one responded with "rarely" or "never"). When asked if they expected the presence of knowledge visualisations when assessing dissertations: 11 answered "yes" and two responded with "sometimes". Table 6 depicts the number of supervisors who would encourage visualisation in the given dissertation section together with their motivations as to why they believe it to be useful.

Section	Yes	Quotes
Introduction and overview	5	To give an overview of anticipated structure; In presenting a thesis map; Chapter map, indicating sequence and interrelationships
Literature review	10	Outline + scoping of environment; To demonstrate connection of theory; Tables and figures which explain an overview of a country's or continent's data; In summarizing the literature; More in the form of a table to summarise and compare themes. Often also repeating one or more models proposed in the lit, especially if they were going to be used later. To show an overview of essential concepts
Research Design	9	To show flow of research; To give an overview of anticipated structure; Definitely-especially a visual explanation of the research methodology is important. Also how the different terms (epistemology, theoretical framework, methodology and methods) are interrelated; Research process, summarising methodology
Presentation of results	13	Almost always; Definitely-revisit methodology and show how the results address the different aspects for the methodology; In summarizing results; Graphs where appropriate and other forms such as time lines, networks with indications of relationships; Just charts and graphs
Presentation of findings	11	Summation of findings; Almost always some need; If more "sense making" required to help reader; Results and findings especially if qualitative; In summarizing findings; This may be building or confirming a model. To check a coherent framework and findings; Just charts and graphs

Table 6: The parts of the dissertation where supervisors encouraged visualisation

The introduction and conclusion constitute "good practice" as far as writing scientific reports is concerned but one does not expect to see new knowledge reported in either of these masters dissertation chapters – only a summary or a précis thereof. Knowledge is presented within the body of the dissertation and that explains the relatively low number, five out of 13, expecting visualisations in the *Introduction* and *Overview* sections.

Regarding the *Literature Review* section, ten of the examiners expected to see visualisations. Visualisations situated here could be very useful to the examiner. For example, the student performs a literature review that mines the relevant research literature. The writer of each of the sources contributed new knowledge to the field but to this particular student this is information, to be understood, consolidated, synthesised and presented in a coherent format. A good student may well produce new knowledge in this chapter, perhaps in the form of a taxonomy or a consolidation from a novel perspective, but that is unusual and generally not expected.

Discussion and Implications

The results of a single case study research are not generalizable. Our main aim is to suggest that the use of visualisation in the assessment context warrants further investigation.

Based on our study, we conclude that the considered inclusion of visualisations could support examiners in quickly gauging the level of achievement within a given dissertation. Considering the assessment phases, it acts as an intermediary step between the existing phases 2 and 3. Phase 1 provides a quick overview and sense of the argumentation quality. Phase 2 provides a quick overview of the research rigour and professionalism of the dissertation. The new Phase, coming between the existing phases 2 and 3 would scan the Knowledge Visualisations to assess some of the key assessment criteria presented in Table 3. Phase 3 would then commence, probably now more efficiently since the assessor already has a good idea of what the dissertation is about, and what the student has achieved.

We should consider encouraging candidates to include specific standard visualisations to support the assessment of the core criteria. For example, a literature synthesis visualisation would signify understanding of, and engagement with, the related work. A research flow diagram would show how artefacts (e.g. questionnaires) are informed by literature and how the different sources of information are integrated. A visualisation that situates the student's research within the overall research area could help the examiner to determine how well the student understands the scope of their work, how it relates to the work of other researchers. Furthermore, students should be encouraged to depict their final findings in diagrammatic format if at all possible to support assessment of the final outcome and potential knowledge contribution.

It seems that knowledge visualisations could indeed support more efficient and effective assessment by allowing triangulation with the traditional text-based assessment.

Limitations

There are some limitations to our study. The first is that, in inferring the purpose of the visualisation we could have attributed it to the wrong assessment criterion. We were attempting to gauge purpose from the student's caption. Yet we felt that this was how the assessors themselves would act, so that this replicated our anticipated use of the visualisations. The second is that the institution in question is somehow singular, and that their visualisation use does not generalise to other institutions. We acknowledge this, and plan to carry out similar studies at other institutions to ensure that our initial favourable impressions of visualisation's potential are indeed founded. The third is that we did not account for visualisation quality – we merely checked the purpose. We could not require inclusion of visualisations without providing guidelines to help students produce high quality visualisations.

The use of any visualisation admittedly poses risks. The risks could be both designer- and user-induced and relate to cognitive, emotional and social human aspects (Bresciani & Eppler, 2008). Hence the promotion of knowledge visualisation in research reporting should be based on validated guidelines and standards, which is a required focus of future research.

Research Conclusions

Knowledge visualisations demonstrate the potential to provide evidence that particular assessment criteria have been satisfied at pivotal points within a dissertation. We conclude that visualisations can add value: for both student and examiner. Their deliberate deployment in this context warrants further investigation with larger groups and in other disciplines.

Conclusion

Visualisations are proposed as a mechanism to complement other assessment criteria, never as the sole means of assessment. At the moment, the inclusion of visualisations seems to be dependent on the whim and preferences of the supervisor. Arguably the appropriateness of visualisations may be related to the subject area but the general benefits of visualisations in knowledge generation and transfer do not seem to be subject-specific.

If, as we believe, visualisations can be helpful to examiners, it is necessary for us to formalise their inclusion and to provide more guidance to students in their production. No comprehensive guidelines on the appropriate use of knowledge visualisation in postgraduate dissertations seem to exist at present. If these can be fashioned, then visualisation could well constitute efficacious assessment support. The evaluation of such guidelines in different disciplinary fields would also be of interest.

The publication requirements were addressed as follows

a. The analysed dissertations are publicly available from one institution's website. If this manuscript is accepted we will provide the URL
b. This research was approved by the Research and Ethics Committee of the same institution. The dissertations were all from graduated students, so they were not disadvantaged in any way by our perusal of their dissertations. Moreover, we did not report their names in this document, referring to them as Student1, etc.
c. There are no conflicts of interest.

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