Improving the Pedagogy of Research Methodology through Learning Analytics

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Abstract: Teaching research methodology is complicated because students often come from a wide range of disciplines, with different prior knowledge, diverse interests and expectations, as such, employing a pedagogical approach that appeals to all students is difficult to achieve. Subsequently, students experience many challenges when learning research methods, to the extent that courses on research methods are increasingly becoming unpopular. The current article presents the design, development and testing of ***i***Method; a digital learning environment for students to access various forms of online resources (e.g. text, video and audio) on research methods. ***i***Method tracks and captures student learning analytics, and present the teacher with a dashboard on students' learning trajectories, to enable teachers to identify challenges students face in learning research methods. The learning analytics harvested from ***i***Method were used to inform the design of a pedagogical programme—analytics and research methods (ARM) that brings together a variety of workshops to support student learning. The article contributes to the growing need to improve the quality of teaching research methods courses.

Keywords: Research methodology pedagogy, learning analytics, dashboards, iMethod, teaching research methods

1. Introduction

Research methodology occupies a central role in postgraduate education, with courses taught at all levels and across a wide range of disciplinary contexts. Universities offer research methods to postgraduate students to enable them to effectively engage in research leading to the award of higher degrees. However, the teaching of research methods courses puts incredible pedagogical demands on the instructor, because students often come from a wide range of disciplines, with different prior knowledge, diverse interests and expectations (Lewthwaite and Nind, 2016). Because of this, many instructors find it challenging to design and develop courses that adequately meet the needs of all students. Further, the multidisciplinary nature of research methodology creates different interpretations and value judgement on how the content of research methods courses may be determined and how the subject should be taught.

Students, on the other hand, face significant challenges in learning research methods, some do not see the value of the subject beyond postgraduate education (Daniel, Kumar and Omar, 2017). Also, the multidisciplinary nature of research methodology makes it complex for students to master the fundamental concepts. As one student noted (Daniel, 2017):

> *"Research methodology is a broad body of knowledge, and the content draws from many disciplines, making it more complex for us students. Besides, little time is available to cover all the essential concepts within a semester. Also, there are many contrasting views between teachers of research methods and supervisors; each thinking that their orientations are better than the other."*

Some students associate the difficulty in learning research methods to poor pedagogical design and delivery, as one student pointed out: "*the problem with learning research is "poor learning materials, less practice equipment, and negative attitude to teaching research."* Some students particularly stressed the failure of linking theoretical discussions when teaching research methods to concrete examples (Daniel, Kumar and Omar, 2018). The challenges of learning and teaching research methods courses are summarised in figure 1.

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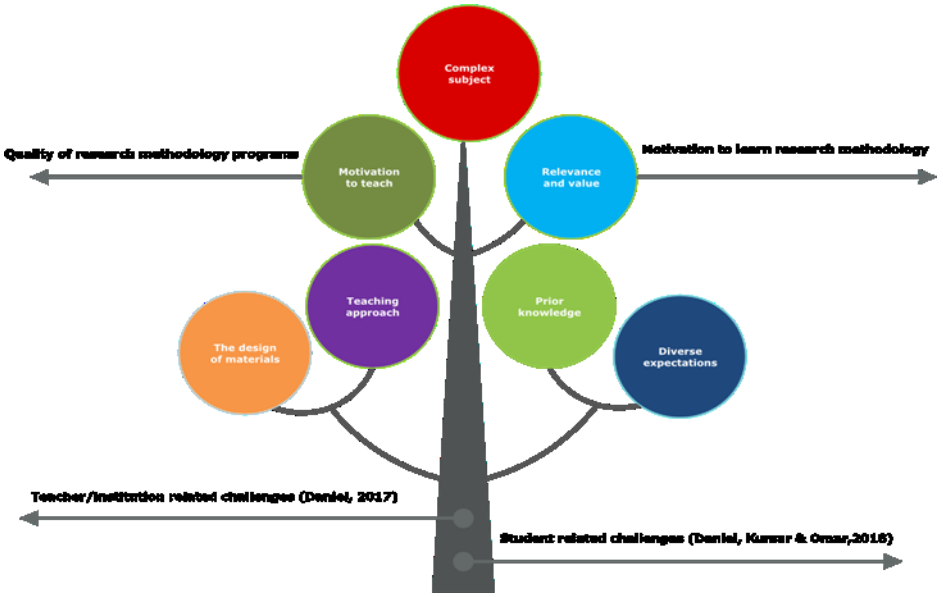

Figure 1: The challenges of learning and teaching research methods courses

This article describes a research programme concerned with the investigation of students' experiences and challenges they face when learning courses in research methods. The current research involved the use of a conventional educational research approach and learning analytics, to enable the collection of various sources of data to enrich the understanding of the challenges students face in learning research methods. Furthermore, the article discusses how the outcome of this research informed the design of ***i***Method; a digital learning environment that enables students to access online learning resources on research methods. Also, ***i***Method serves as a research space for the acquisition of trace data on students activities, thus supplementing insights gained through self-reported data (e.g. survey data and student evaluation of teaching).

2. Related research

Research methods play a critical role in the academic development of postgraduate students. However, learning outcomes associated with research methods courses are poor compared to other subjects (Earley, 2007; Lehti and Lehtinen, 2005; Murtonen, 2015). As diversity in students' goals for postgraduate education increases, teaching research methods that meet all students' expectations have become very difficult (Teddlie and Tashakkori, 2006; 2009). Since research methodology is a complex and technical subject, many postgraduate students find it difficult to thoroughly understanding of the content of the subject (Benson and Blackman, 2003). Despite the growing awareness on the complexity of teaching and learning research methods, there is a shared agreement in the literature that there is a need to develop an adequate pedagogic culture necessary to ensure excellent teaching and learning of research methods(Earley, 2014; Wagner and Ice, 2011; Kilburn et al., 2014).

However, the lack of pedagogical research on research methods courses has significantly hindered the development of useful research needed to advance the quality of teaching and learning. Also, those involved in teaching research methodology in higher education are unable to draw upon pedagogical evidence in the literature when developing their teaching (Earley, 2014). Further, Daniel, Kumar and Omar (2017) identified several challenges students face in learning research methods, some of which include:

- the content of research methodology not meeting learning objectives,
- difficulties aligning theoretical constructs to practical aspects such as data analysis,
- issues with data analysis and the proper use of statistics,
- difficulties in framing the right research questions,
- difficulties in engaging with the literature in a critical way

In attempts to better understand the key challenges students face in teaching of research methods, Daniel (2017) proposed a dual-research approach involving the use of self-reported students' surveys and learning analytics research. Student experience survey allows students share their experiences and opinions on how

research methods should be taught. Learning analytics is concerned with capturing student learning activities, and demographic data to inform pedagogical intervention. Learning analytics utilises computational tools and approaches for the exploration of educational data sets to improve learning (Chatti et al. 2012; Gašević, Dawson and Siemens, 2015; Lias and Elias, 2011). Learning analytics enable instructors to track and understand student engagement with content of courses and possibly develop appropriate pedagogical interventions.

The use of learning analytics provides instructors with feedback about students' learning (Bañeres and Serra, 2018) and offer them with useful insights to develop a better quality of educational content, improve student learning activities and provide real-time research informed feedback to students. Learning analytics provide the instructor with the ability to monitor the quality of student learning so that they can use the outcome to develop appropriate teaching strategies to help students acquire needed knowledge in research methods (Amigud et al., 2018). More specifically, instructors of research methods can use learning analytics to track student learning, predict student performance and identify strategies to improve student learning through providing personalised feedback (Ferguson, 2012; Roberts et al. 2016).

Learning analytics can also provide students with more personalised information to enable them to make informed choices in determining the direction of their learning. The personalisation of learning afforded by analytics is critical to inexperienced learners, especially those who might be interested in understanding their progress in a course and benchmark their performance against others in the class. Research suggests that understanding one's learning trajectory and comparing it to others make students aware of their learning dispositions (Siemens and Baker, 2012; Wise, 2014).

The outcomes of learning analytics are often presented to instructors and students in the form of visualisation dashboards, which help teachers to visualise traces of learning activities and promote awareness, reflections, and sense making (Park and Jo, 2015; Govaerts et al. 2012). Teachers can generate dashboards from student queries to understand areas where students struggle most. For instance, Yu, Shing-Chern and Tsai (2012) show how teachers can gather instant feedback on their teaching from students in class through tracking of head nods and voice shakes.

Early detection systems such as the Signal System tracks student learning activities and predicts learning outcomes based on three indicators: grades on course, time spent on a task and past performances, and present outcomes as visualisation dashboard (Arnold and Pistilli ., 2012; Jayaprakash et al. 2014). Dashboards serve as a mirrow to enable aa instructor's to reflect on their own teaching moments during a semester. As personal teaching tools, instructors can visualise their teaching moments, identify gaps during the semester, using students' data, and use such information to develop personalised professional development.

In the context of learning, dashboards provide students with the opportunity to understand their learning trajectories, and possibly take control of their learning performance in real-time. For instance, student activity meter (SAM) tracks and visualise course progress for both students and teachers (Govaerts et al. 2012). There are also examples of visualisation tools that present student assessment—for instance, dashboards that visualise self-assessment exercises (Mazza and Dimitrova, 2007).

Despite the increasing deployment of learning analytics, there is still exists a disparity of implementation of learning analytics tools across subjects. For instance, research methodology has received little attention despite the growing significance of the subject in postgraduate education, and the pedagogical challenges associated with teaching and learning the subject.

3. The research approach

The learning analytics research design approach undertaken in the study involved the development of an online learning environment (***i***Method) hosting various digital learning objects on research methods, accessible to students anytime, anywhere and on any digital device (see Figure 2). The procedure involved obtaining data through observational research (student evaluation and online survey); online software (***i***Method) was then developed. ***i***Method tracks students' engagement with content on research methods. Results of the observational study and learning analytics obtained from ***i***Method led to the development of

short workshops on research methods and analytics (ARM), and deployment of tools to support students in learning and applying fundamental concepts in research methods.

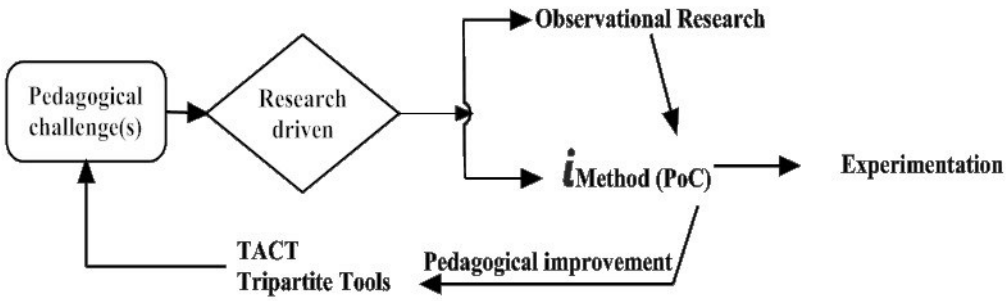

Figure 2: The research design framework

iMethod Proof-of-Concept (PoC) incorporates tracking and visualisation tools on student engagement with learning materials. Visualisations are presented as dashboards for both teacher and students. The teacher dashboard presents the teacher with activity analytics on student engagement and navigational pathways. This information provides the instructor with the ability to examine each content, track each student learning, discern learning engagement and gained an overall learning trajectory in the curriculum. The student dashboard is intended as a personal reflection and learning management tool. Students can use their dashboards to identify areas they need to focus on or seek support from the instructor of the course.

4. The design of *i*Method

iMethod is enabling students to access various forms of online resources (e.g., text, video, and audio) on research methods. The environment also enables students and academic staff to post questions and get an immediate response from research methodologist (see Figure 3).

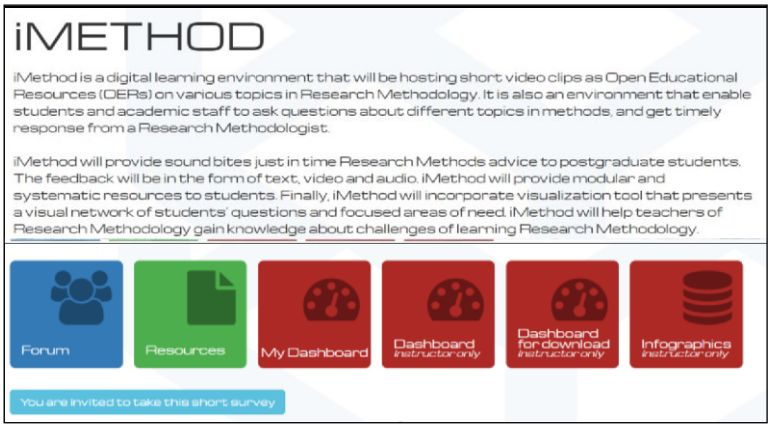

Figure 3: *i*Method main interface

The ***i***Method learning analytics dashboard is primarily a tool for instructors to visualise student engagement with online learning content and identify areas where students seem to struggle. The student dashboard provides the student with an overall learning trajectory and a summary of their learning activities, relative to others who access ***i***Method. Also, the student dashboard provides a personal visualisation of the summary of activities within ***i***Method to monitor their activities, and reflect on their learning.

5. The user experience and utility of *i*Method

Currently, ***i***Method is in beta form, and the software is continuously being tested with students studying research methods in a research-intensive university in New Zealand. Academic staff members who are teaching research methods also have access to learning objects posted into ***i***Methods. The learning analytics dashboards presented in Figure (4) shows engagement patterns and intensity meter measuring the relative size and traffic associated with a particular learning object.

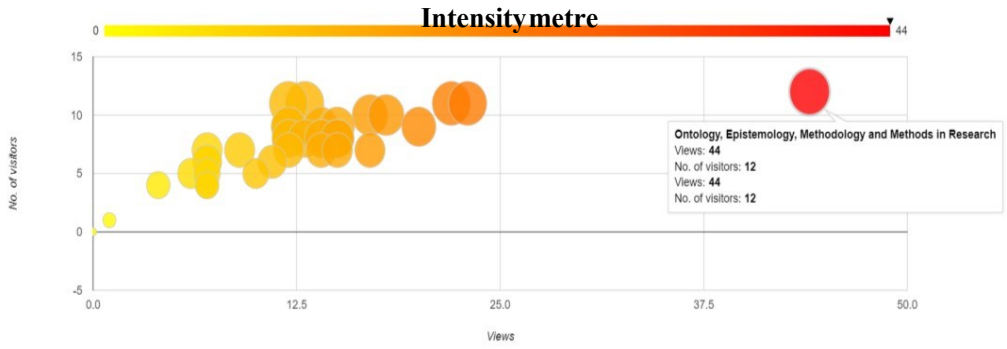

Figure 4: Visualisation of daily engagement with content for all posted resources

The learning analytics visualisation (Figure 4) provides information about student engagement with content. For instance, the frequency and intensity meter display highlights the learning objects with the highest views; the visualisation is shown in orange. The bigger the circle, suggests the more frequently a particular learning object is accessed. Moreover, the overall frequency of access across learning objects is shown in figure 5.

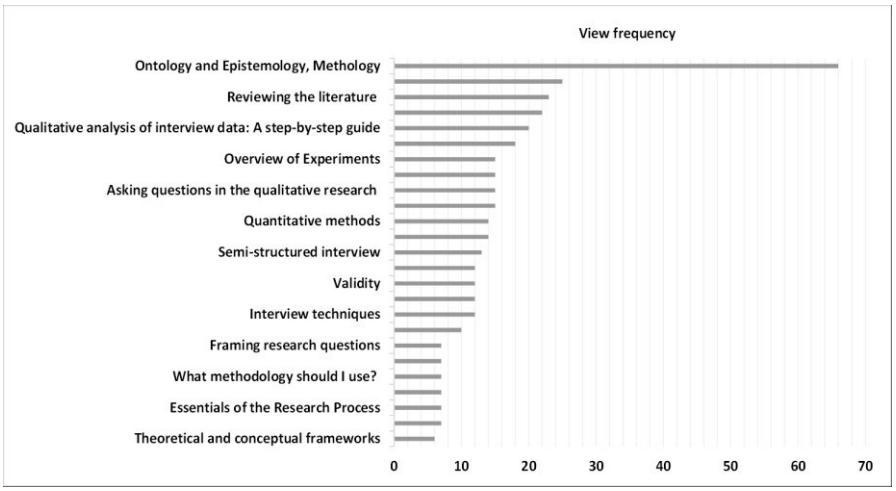

Figure 5: Overall dashboard resources and views

5.1 Activity dashboard

The student activity dashboard in ***i***Method provides the student with personalised information about their activities in the environment. At the moment, the student can view their access patterns as bar charts (see Figure 6a) and also filter activities at various stages in the semester (Figure 6b). This information is intended to help the student reflect on their learning pathways in research methods to support self-directed learning and professional development.

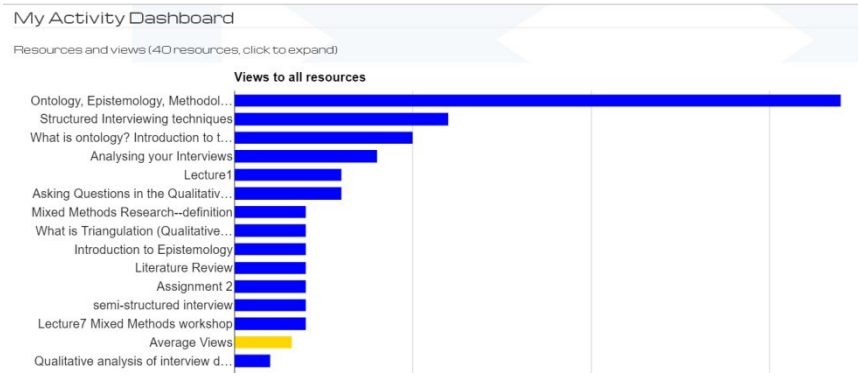

Figure 6a: Overall resources access

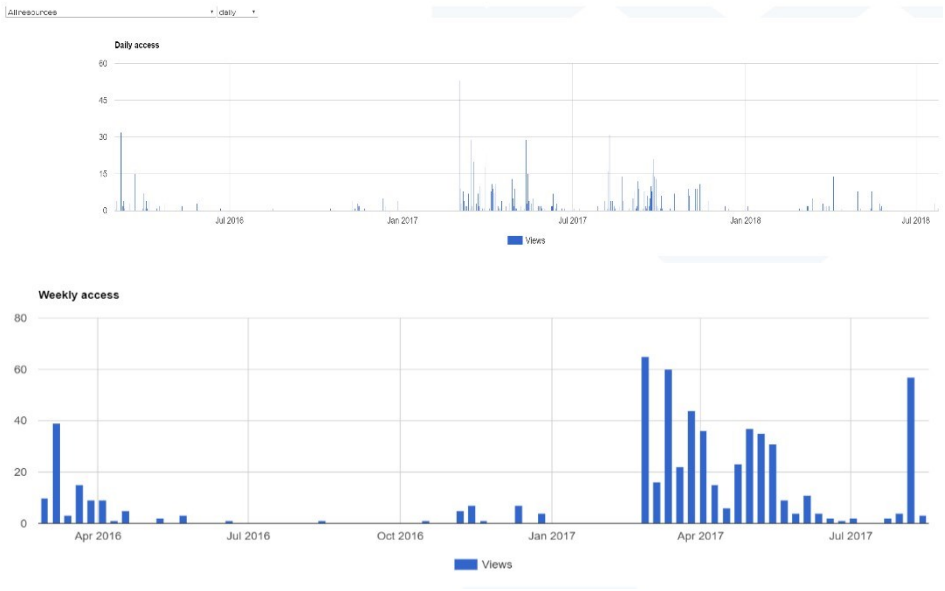

Figure 6b: Overall resources access for a student

5.2 Learner experience

To examine whether ***i***Method contributes to student learning, a study was undertaken with volunteer students and academic staff members to test the software and assess the extent to which the software supported student learning. An online questionnaire consisting of 8 items measured on a Likert scale was utilised to collect data. The learner's experience questions focused on the extent to which the learning analytics dashboard on ***i***Method contributed to student learning. There were also questions aimed at measuring how learners engage with various content provided in the ***i***Method learning environment. Participants were asked whether using ***i***Method improved their learning experience, particularly, whether the software helped them to better understand the core concepts in research methods better. Twenty-two students voluntarily participated in the study, the majority (15, 68%) identified as PhD students, and (4, 18%) enrolled in the Master's Degree (see table 1). Table 1: Participants' demographic information

Demographic factor	**n (%)**
Academic status a	
PhD student	15(68)
a Master student	4(18)
a staff member	3(14)
Division	
Academic division	13(59)
Interdisciplinary	3(14)
Science	3(14)
Health Science	3(9)
Commerce	2(5)

Results of the study suggest that students found ***i***Method useful in their learning. Students said that the content provided in ***i***Method helped them better to understand the fundamental concepts in research methodology. They also said the dashboard helped them to reflect on those areas in research methods they lack skills and knowledge (Table 2). In addition, students who used ***i***Method found the dashboard and visualisation elements of useful to their learning. They indicated that "learning analytics dashboards served as a metre for reading progress in learning and teaching." The dashboard also afforded students with the ability to monitor and manage their learning.

Table 2: Overall usability of *i*Method and support for student learning

Usability evaluation dimension	n (%) SA	n (%) A	n (%) N	n (%) DA	n (%) SD
Accessing my dashboard increase my awareness of what content I need to focus on.	8(36)	12(55)	0(0)	2(9)	0(0)
Accessing learning resources on iMethod helps me reflect on my learning.	16(73)	3(14)	0(0)	2(9)	1(5)
Overall, the content of learning resources helps me better understand concepts in research	8(36)	12(55)	0(0)	2(9)	0(0)
After accessing *i*Method, I am more likely to seek further materials or help on research methods.	5(23)	5(23)	10(46)	2(9)	0(9)
Overall accessing materials on iMethod contributed to my learning of research methods.	10(46)	10(46)	0(0)	2(9)	0(0)

SA = strongly agree; A = agree; N = neutral; DA = disagree; SD = strongly disagree

Providing students with supplementary learning materials is critical to learning. "**i***Method is a great opportunity for the users to find all current and suitable resources in one place. Also, users can share relevant queries and request for more resources. Appropriate and wise responses also added great value to it!"*

Users who frequently used ***i***Method found software a valuable learning resource and stated that software should be widely deployed in other subjects. "**i***Method would be precious as a tool if it were more widely utilised." "I used it only at the time I was studying the course. It could similarly be used to upload material for other courses quite easily, such as for leadership, if they resolved to do so."*

Participants also mentioned that ***i***Method enriches the student learning experience. It made research methodology accessible to many students, as one participant observed: "***i***Method *improved my learning experience. I love iMethod, it has made my study easier with resources provided there."* ***i***Method also served as a useful support platform, *"It is a useful platform for an audience who seek advice on research methods".*

Moreover, ***i***Method serves as a convenient platform for asking questions and sharing answers with the instructor and peers. *"It allows questions and answers which foster knowledge sharing and exchange. "****i****Method is a valuable platform to share and gain access to a range of resources."* ***i***Method was viewed as a "one-stop" learning space for those beginning to learn research methods. "*It seems to have research value, especially to beginners because of the materials collected in one space." To Otago students, it may be useful because it has a forum for discussions for students in different disciplines.* **i***Methods provides learning pathway and moments of reflections.*

6. Educational intervention

The learning analytics obtained from ***i***Method led to the development of short—three hour workshops, analytics and research methods series (ARM). ARM is a series of research-informed teaching workshops on research methodologies, analytical models and digital technologies. The ARM programme consists of introductory and advanced training in research methodologies for both students and academic staff (see Figure 7). The initiative was designed to;

- develop a comprehensive pedagogical process-outcome research design that combines processoriented data and student experiential data to tackle challenges students face in learning research methods courses;
- contribute to the pedagogical literature on research methods and,
- support competence development in research methodology among postgraduate students.

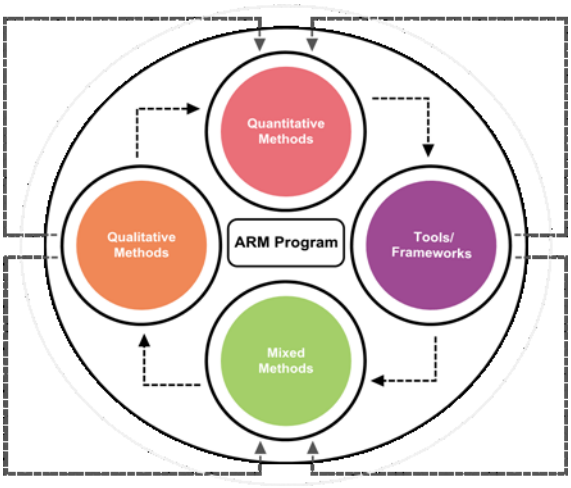

Figure 7: The ARM programme

7. Evaluation and the ARM initiative

The ARM workshops were evaluated along with the pedagogical design of the content and how they were facilitated. Participants were also asked to share their experience of the workshops. Participation in the evaluation of the workshops was voluntary, and ethics were obtained from the University where the ARM programme was designed.

7.1 Participants

The ARM workshop participants were undertaking different research degrees and were at various stages of their programme, with the majority at the early stages of their research (see table 3).

Table 3: Demographic characteristics of workshops participants

Demographic information (N=214)	n (%)
Age	
18-24	11(5)
25-34	62(29)
35-44	77(36)
44-45	51(24)
55 +	11(5)
Name of workshop	
Digital Tools	18(8)
TACT	61(29)
Visual analytics	28(13)
Survey design	25(12)
Data analysis with Nvivo	44(21)
Gender	
Male	111(52)
Female	101(48)
Degree type	
Bachelor	33(16)
Diploma	10(5)
Masters	143(68)
PhD	24(12)
Stage of research	
I am planning my research	156(74)
I am doing my research	10(5)
I am writing up my thesis	21(10)
I have submitted my thesis	14(7)
I am making amendments to my thesis	9(4)

Overall, those who participated in the ARM program indicated they gained an enhanced learning experience. In particular, they mentioned that the tools and models presented in the ARM program were useful to their

research (see Table 4). As one participant noted: *"participating in ARM workshops prepared us to look forward to doing more research because we have learned many things, including the terminology in research methodology, conceptual and theoretical framework."*

Table 4: Participants views on the design and facilitation of ARM

(1 = strongly agree; 2 = agree; 3 = neutral; 4 = disagree; 5 = strongly disagree)

	Mean(n=214)	Std.Dev
Overall, I found the tools and models presented in the ARM program useful to my learning	1.3	0.6
The content of this ARM program was easy to understand	1.8	0.8
The ARM program was a good supplement to the lectures and textbook readings	1.5	0.7
The ARM program was useful to my research	1.4	0.6
ARM activities helped me to understand material covered in other lectures and textbook readings	1.6	0.6
This ARM program activity should be used again in other training workshops or courses next year	1.9	2.4
This ARM program was an efficient way of teaching research methods	1.6	0.6
This ARM program captured and held my interest	1.5	0.6
This ARM program was a valuable learning experience	1.6	0.9
This ARM program was engaging	1.6	0.6
After completing the ARM program, I have gained a better understanding of the content of research methods	1.6	0.6
I understood how to apply the concepts covered in the ARM program in my research	1.7	0.7
The ARM program was well organized	1.6	0.8

Students indicated that the teaching approach undertaken in the workshops was engaging, and practical, as one participant reported: "*the workshop was more engaging and practical the teaching method was excellent and engaging.* "Also, participants were satisfied in the way the workshops were facilitated "*the facilitator exhibited the different ability to tackles difficult concepts easily and understandably." "I am lucky that I attended the workshop! I have never had such an incredible teacher like you! Great experience!*

Some students recommended the ARM workshops be offered to postgraduate supervisors. "*There is a need to invite all research supervisors to such workshops so that they develop knowledge and embrace new information to help students."* Further, the ARM has also motivated some students to view research methodology differently. *"Participating in this workshop has opened up my mind to various aspects of research, and I now used various aspects of research especially I can now know when and how to apply the theoretical framework to my study. "Participating in the ARM workshops has given me the courage to boldly think of studying research methodology as a vital discipline beyond my degree."*

8. Summary and conclusion

Students enrolled in postgraduate education continue to face a significant number of challenges in learning research methods. While other factors may contribute to problems students face in learning research methods, the design and development of research methods curriculum play a significant role. This article introduces a data-informed approach to explore challenges students face in learning research methods, through the use of learning analytics—a data-driven research approach for conducting educational research. The research reported in this article utilised a design-driven learning analytics approach to examine student engagement with the content of postgraduate research methods courses, to develop instructional support that meets diverse student needs.

The approach used in the present study involved the integration of data from multiple sources to inform teaching and student development (Lodge and Corrin, 2017; Tan et al. 2017). Unlike other previous studies that predominantly depended on literature reviews or perception-based data (Wagner and Ice, 2011; Lewthwaite and Nind, 2016), the combination of observational and learning analytics approach in this paper provided a better and more in-depth understanding of student challenges in learning research methods

courses and propose remedial learning programs. The learning analytics research design approach proposed in the paper enables teachers to track and render in real-time student access patterns to instructional materials.

Moreover, the learning dashboard presented in ***i***Method provides a consolidated view of multiple sources of data to instructors to deliver real-time feedback, and direct students to seek support (Corrin and de Barba, 2014; Pardo and Siemens, 2014). Feedback provided through learning analytics is notably better than traditional methods, where students wait for their instructors to read and grade their work. Learning analytics dashboards are personalisation learning tools students can use to learn about how they individually perform and proactively seek support in areas where they need help, and to explore further opportunities to engage in self-regulated learning.

Also, instructors can utilise learning analytics as personal digital reflections tools to gauge their teaching performance during the semester. As tools for teaching enhancement, instructors can use dashboards that summarise student engagement data and identify teaching gaps during a semester. Instructors can then use such information to develop personalised professional development opportunities to help them improve their teaching in a subject.

The outcome of the learning analytics led to the development of remedial workshops, as well as a set of tools and templates to help students navigate the complexity of learning the content of the research methods course. Data generated from the ***i***Method environment provides instructors of research methods courses with useful information to understand the specific challenges students face in learning research methods. The design and deployment of the ARM workshops demonstrate the need to focus on curriculum interventions as opposed to learning analytics approaches that focus on only identifying students at-risk.

As ***i***Method is currently in a beta version, we plan to broaden the deployment of the software to classes in both undergraduate and postgraduate students, extract insights into students' learning experience. We will also conduct system performance evaluation and usability studies on ***i***Method as a supplementary learning environment and a research environment for collecting learning analytics.

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