A Data-Driven Approach to Teaching Research Methods: *i*Method, a Proof-of-Concept

Ben Kei Daniel
Higher Education Development Centre, 65/75 Union Place West, University of Otago, Dunedin 9016, New Zealand

ben.daniel@otago.ac.nz

Abstract: Courses in research methods play a critical role in postgraduate education. However, postgraduate students face considerable challenges in learning the subject matter. The present paper introduces iMethod, a software application designed to track students' engagement with the content of research methods courses. *i*Method harvested data, analysed students' engagement, and presented the outcome to a teacher through a dashboard rendered in real-time. As a proof-of-concept, a usability study on *i*Method was conducted with a sample of postgraduate students and early career academics (n=37) at a research-intensive university in New Zealand. Key findings suggest that students and academic staff found *i*Method a valuable application for enhancing research methods learning. In particular, students value its content for understanding fundamental concepts while valuing its inquiry facilitation and providing helpful information on research methods. Participants said iMethod could expand knowledge, offers guidance, and the content is accessible to a diverse range of students. Lastly, participants reported that iMethod facilitated easy knowledge sharing, and the interface design was user-friendly and intuitive. The paper contributes to the growing need to promote research into the curriculum design of research methodology programmes and the quality of teaching research methods courses.

Keywords: Research Methodology, Learning Analytics, Visualisation, ***i***Method

1. Introduction

Research methodology is a foundational subject in postgraduate education, playing a critical role across various disciplinary contexts. It involves employing systematic approaches and procedures to investigate well-defined problems (Daniel & Sam, 2011). However, teaching research methodology or methods is challenging due to students' diverse backgrounds, prior knowledge, interests, and expectations (Earley, 2014; Kilburn, Nind & Wiles, 2014; Saeed & Al Qunayeer, 2021). The varied backgrounds of students and the pedagogical content knowledge and experience of teachers make teaching and learning this subject highly demanding.

This paper introduces ***i***Method, an online platform I developed in 2018 to track, gather, and visualise learning analytics related to students' engagement with content in the research methodology courses. ***i***Method allows teachers better to understand students' engagement patterns in online learning, tracking their progress and identifying specific challenges they may face with the course content. It presents a visualisation dashboard to research methods instructors, enabling them to observe how students interact with the content. With ***i***Method, teachers can analyse and gauge the correlation between the amount of time students spend viewing a piece of content and the difficulty level of a piece of content. Such information can be used to redesign learning materials or appropriately support students.

2. Related literature

Research methods learning is an integral part of postgraduate education. However, research indicates that research methods courses' learning outcomes are poorer than other subjects (Daniel, 2019; Earley, 2007; Lehti and Lehtinen, 2005; Murtonen, 2015). Students learning research methods face several challenges, including a mismatch between the content design and the expected learning outcomes, difficulty connecting theoretical constructs to practical aspects such as data analysis, becoming competent in data analysis and statistics, and engaging critically with literature. Some students associate quantitative methods with mathematical and statistical knowledge, leading to numerical anxiety and avoidance of the subject.

Additionally, framing the right research questions and responding to conflicting views and directions from multiple supervisors can be challenging for students (Daniel, Kumar & Omar, 2018). Research suggests that teaching research methods to meet diverse expectations is challenging due to the increasing diversity of students pursuing postgraduate education (Teddlie & Tashakkori, 2009). Research methods can be complex for some students to comprehend, and the time available for teaching is often inadequate (Benson & Blackman,

2003; Daniel, 2017). Given the complexity of teaching and learning research methods, it is crucial to research the pedagogy of research methods to improve learning outcomes (Kilburn, Nind & Wiles, 2014).

3. Data-driven educational research

For several years, research into students' learning outcomes associated with research methods has depended on self-reported data. While providing valuable insights, surveys and interviews are unlikely to provide authentic information about students' behaviour and how they engage with learning materials on research methods. I proposed a dual pedagogical research approach involving the combination of self-reported student surveys and learning analytics research. Learning analytics can capture various data and provide insights to enable users to make informed decisions (Susnjak, Ramaswami & Mathrani, 2022). By combining self-reported data (questionnaires and student evaluation forms) and learning analytics, teachers of research methods can examine students' perceptions of the quality of the learning and how they experience the teaching process and gain some insights into students' authentic behavioural patterns in a course.

The growing interest in data-driven instruction is evidence of the potential of utilising data to understand complex learning problems (Howard et al., 2022). When teachers use student-generated data, they will respond to learning problems effectively. Data-informed teaching practice allows teachers to collect, analyse and use data to shape their teaching and learning processes. This would also enable them to reflect and improve their teaching by utilising information collected from the learning environment, students and their learning processes (Ndukwe & Daniel, 2020). For example, while the student experience survey allows students to share their experiences and opinions on how research methods should be taught or to reflect on their learning, capturing student learning activities through examining how students engage with learning materials can better inform the identification of valuable pedagogical intervention.

4. Learning analytics

The learning analytics approach utilises computational tools to explore how students engage with content and the learning process to gain valuable insights for improving learning (Daniel, 2019; Gašević, Dawson & Siemens, 2015; Kaliisa & Dolonen, 2022). Analytics enable instructors to track and understand student engagement with the content of courses, understand their teaching approaches and develop appropriate pedagogical interventions to support students learning (AlZoubi, 2022; Bañeres & Serra, 2018; Ndukwe & Daniel, 2020).

Learning analytics provide teachers with insights they can use to develop a better quality of content, improve student learning activities, and provide real-time personalised feedback to students (Amigud et al., 2018; Jivet & Drachsler, 2022). Results of learning analytics are presented to instructors and students in the form of visualisation dashboards. Dashboards enable teachers and students to visualise learning activities and promote awareness, reflection, and sensemaking (Park& Jo, 2015; Susnjak, Ramaswami & Mathrani, 2022).

The personalisation of learning afforded by analytics through dashboards is critical to inexperienced learners interested in understanding their progress in a course and against others in the class (Wise, 2014); personal benchmarking against others will likely help students gain self-efficacy, self-awareness, and motivation. Looking at behavioural activities generated in the students' dashboards, teachers can learn how, where and when students engage with learning online or in blended mode; the data can also be used to inform the learning design in the face-to-face classroom. Research shows that student dashboards can encourage conversation between teachers and students about their progress (Smith, 2019).

The dashboard in ***i***Method draws from the idea of early learning analytics dashboards for instructors presented in the signal system (Arnold & Pistilli, 2012). The signal systems use data collected from online learning environments to identify students who might risk failing a paper or programme of study. The signal system captures the student's learning activities and predicts learning outcomes based on three indicators: grades on the course, time spent on a task, and past and present performance (Arnold & Pistilli, 2012; Jayaprakash et al., 2014). The prediction is carried out in real-time or near real-time based on data collected from the student's engagement with content (readings, assignment performance, etc.).

The student dashboard serves as a mirror for the instructors to reflect on their teaching impact on students and make necessary changes to the pedagogy. For example, by analysing students' access patterns, particularly the time spent viewing a piece of content, the instructor of research methods can revise the information contained in a particular learning object or resource to benefit students. For instance, revisiting a resource several times suggests that the content is necessary, interesting, or challenging to comprehend.

On the other hand, ***i***Method presents students with their learning analytics dashboard. Students use dashboards to understand their learning trajectories and possibly take control of their learning performance in real-time—examples of student visualisation dashboards present dashboards that visualise self-assessment exercises (Mazza & Dimitrova, 2007). In ***i***Method, the student dashboard enables the student to reflect on and manage their learning, and at the same time, they can use data from the dashboard to identify areas where they face challenges and need support. For instance, the student activity meter (SAM) tracks and visualises course progress for students and teachers (Govaerts et al., 2012). Students can monitor their progress in the course and, by comparing their progress to peers, dashboards can improve students' motivation and incentivise change in study behaviours (Smith, 2019).

5. Overview of the iMethod Digital Learning Environment

I developed ***i***Method, a digital learning environment, to support teaching research methods courses and for students to access learning materials in place. Unlike other virtual learning environments, ***i***Method was intended as a hub for collecting analytics associated with students' engagement with learning materials rather than a full learning management system. The environment provides sound bites and just-in-time research methods advice to postgraduate students and early career academics. The feedback is provided to system users in various forms (e.g. text, video and audio). Figure 1 provides a view of the main interface.

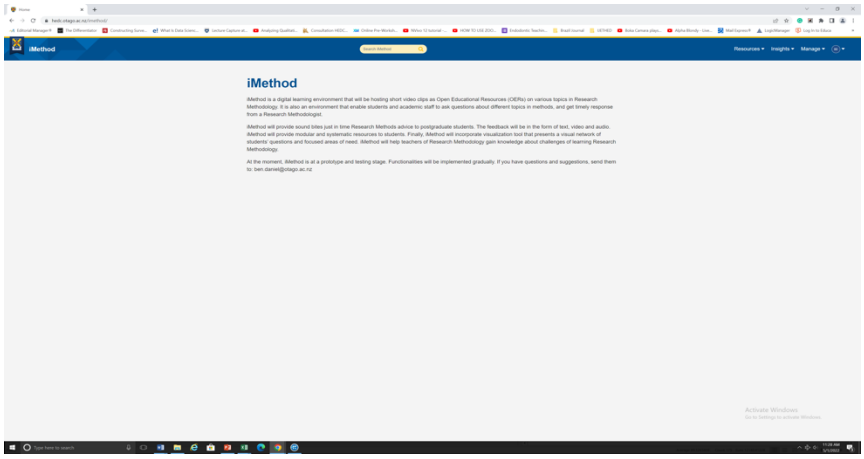

Figure 1: The main interface

In order to help teachers gain knowledge of the challenges of learning research methodology/research method and propose strategies and models of teaching the subject matter, the environment is designed in a modular and systematic structure, and it incorporates a tool that presents a visual network of students' questions. ***i***Method Proof-of-Concept (PoC) captures engagement analytics and presents visualisation dashboards for students and teachers. The core components of the prototype are presented in Figure 2.

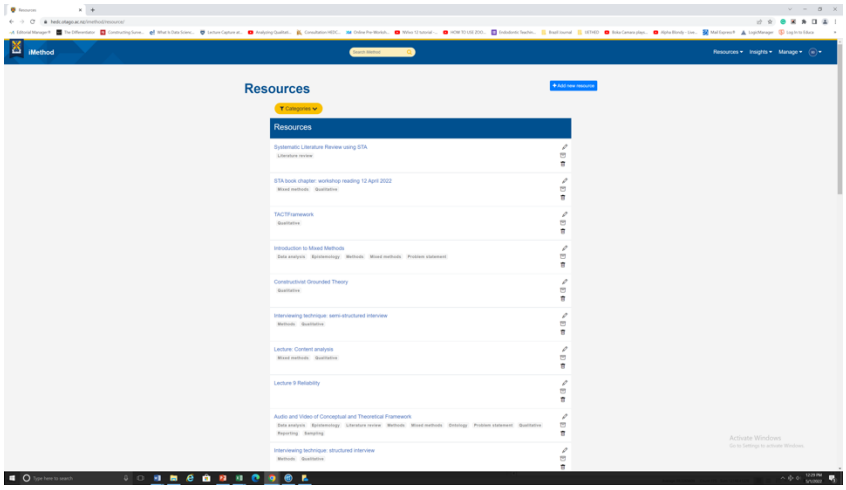

Figure 2: Example of the resources page

6. Behavioural analytics and teacher's dashboard

iMethods captures and presents behavioural learning analytics. This form of data analytics focuses on capturing actions of students' engagement with content and the overall time they spent interacting with the system. Information presented in the dashboard enables the instructor to gain insights into how students engage with content and use that information to improve the quality of teaching. Figure 3 illustrates students' interaction with learning materials, including total and unique views. This data helps educators evaluate engagement and understand individual or group difficulties with specific content. For instance, the "Introduction to Mixed Methods" had 14 views, including 4 repeat viewers, indicating specific access patterns that may require content resequencing or the instructor's attention. Teachers can also examine individual viewing patterns via the dashboard. Table 1 and Figure 4 further detail the time spent on different resources, providing insights into average and maximum engagement durations.

Table 1: Resources with time users spent engaging with each resource

Resource	Min	Median	Average	Max
Analysing your interviews	6	18	412	1607
Interviewing technique: semi-structured interview	2	8	202.75	793
Introduction to epistemology	3	4	135.8	646
Interviewing technique: structured interview	2	4	64	247
Conceptual and theoretical framework	10	43	51.6	125
Interviewing technique: Open	2	3	37	106
Theory and tools	14	24	39	95
What is Triangulation (Qualitative research)	3	10	21.5	81
Systematic literature review using STA	5	10	22.4	65
Introduction to mixed methods	3	11	16.57143	46
Lecture: methods	3	12	20.33333	46
TACT framework	3	17	20.66667	42
Lecture: Content analysis	3	19	19.4	41
Survey Design for Science and Communication	14	24	24	34
Evaluating qualitative research: Scientific rigour	4	9	12.16667	33
Overview of experiments	11	22	22	33
Reliability and validity	2	17	17	32
Constructivist Grounded theory	3	6	9.090909	30
Survey research design	24	24	24	24
Ontology, epistemology and methodology	3	8	9.75	20
Reliability techniques	3	10	10	17
Mixed methods research--definition	3	5	6.75	15
Framing a qualitative research study	7	11	10.5	14
The STA book chapter	3	5	6.727273	12
What is ontology?	3	3	6	12
Qualitative data analysis: A step-by-step guide	10	10	10	10
Understanding a conceptual and theoretical framework	4	5	5.2	8
What methodology should I use?	5	6	6	7
Ontology, epistemology and methodology	5	5	5	5
Qualitative research questions	5	5	5	5
Research hypothesis and variables	3	4	4	5
Theoretical and conceptual frameworks	4	5	4.5	5
Introduction to Validity	3	3	3	3
Total	**178**	**367**	**1263.706**	**4264**

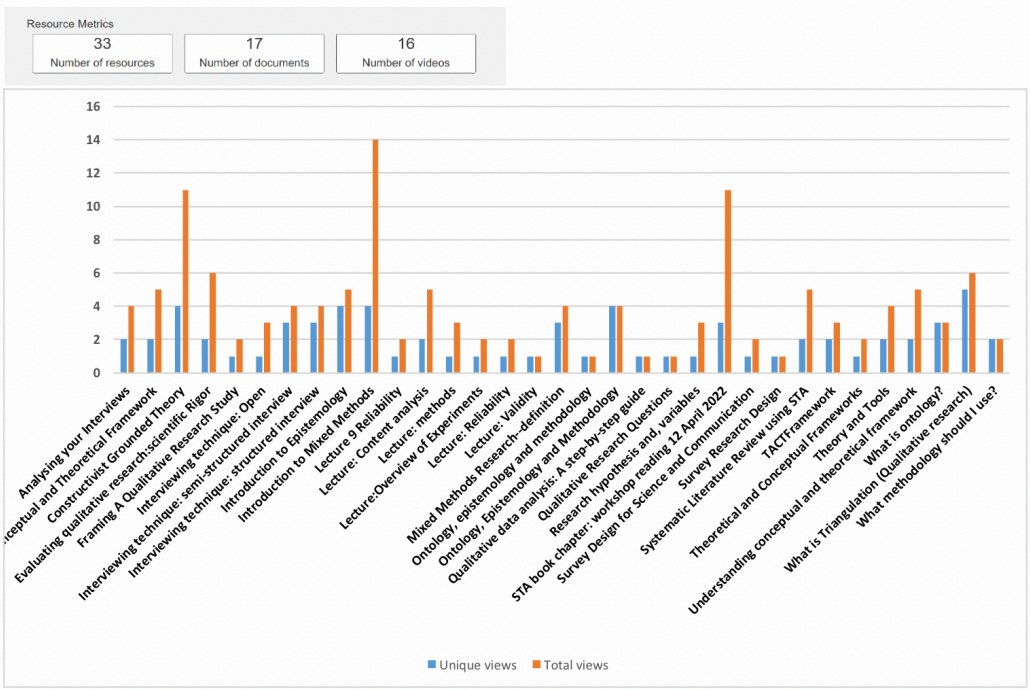

Figure 3: User engagement analytics

iMethod records the duration student spends on each resource, creating attention metadata! (Table 1) that help teachers to provide targeted support to students. Attention metadata! in ***i***Method, an approach that describes data gathered about a student's focus within a digital platform. This can encompass details such as a student's duration with certain screen elements and content, the items they select, and the sequence of accessed materials. The analysis of attention metadata! helps the instructor gain an invaluable understanding of students learning behaviours, which can be used to inform the instructional design of learning materials that enhance the learning experience.

Maiorana Csizmadia and Richards(2021) noted that attention metadata! enables instructors to track content interactions and identify where students dedicate most of their time. This helps tailor the necessary learning support. Table 1 shows students' engagement durations for various research method resources, and Figure 4 displays the average and peak times spent with these resources.

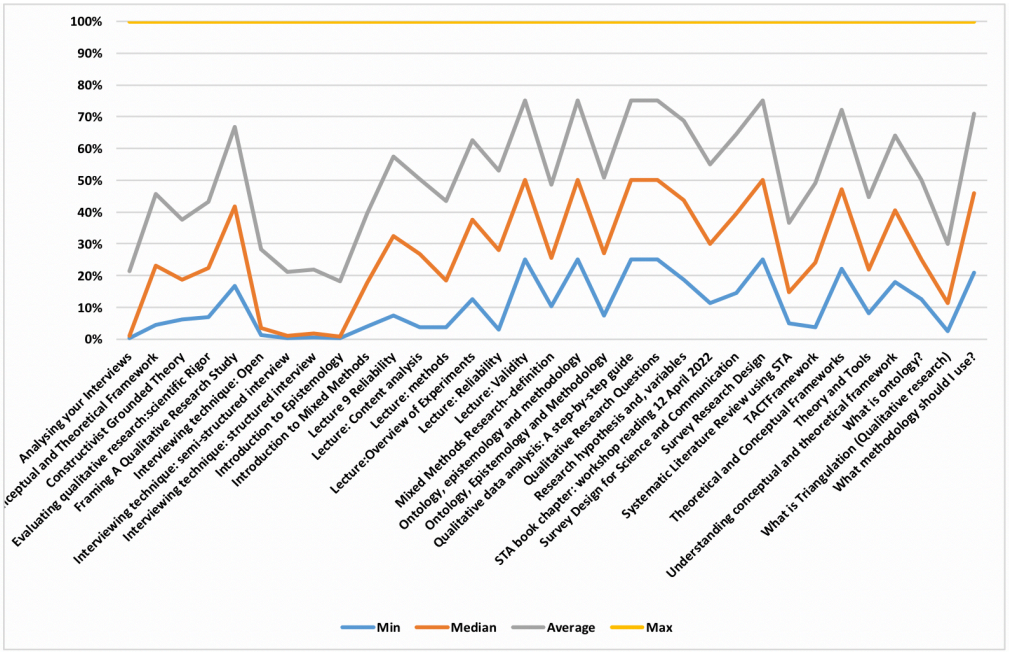

Figure 4: Average and maximum time spent on engaging with resources

Figure 5 illustrates the correlations between access and views of different resources; the darkness of the line signifies the strength of the association between them. For example, a darker line would appear between the two resources if user ***A*** views resource ***'r'*** and then views resource ***'q'*** within a specific time ***'t'***. This correlation implies that these two resources are often accessed or viewed in tandem, possibly because they are related in content or theme or because one resource naturally leads to the other in the progression of the course material. This information is invaluable for the instructor as it allows them to map out a network of resource access among students, potentially unveiling learning behaviour patterns. By analysing these associations, the instructor can better understand how different resources are interconnected in the students' learning process. This can inform the structuring of the course content, ensure that related resources are appropriately linked, and even identify potentially confusing or difficult areas in the coursework.

Moreover, these correlations could help identify resources that consistently appear in close proximity, suggesting a possible relationship in the difficulty level. If a particular resource is viewed right after another, it could imply that the second resource is a more complex extension of the first or that students find it challenging to comprehend. Armed with this information, the instructor could revise the course material or offer additional support to ensure better student understanding and engagement.

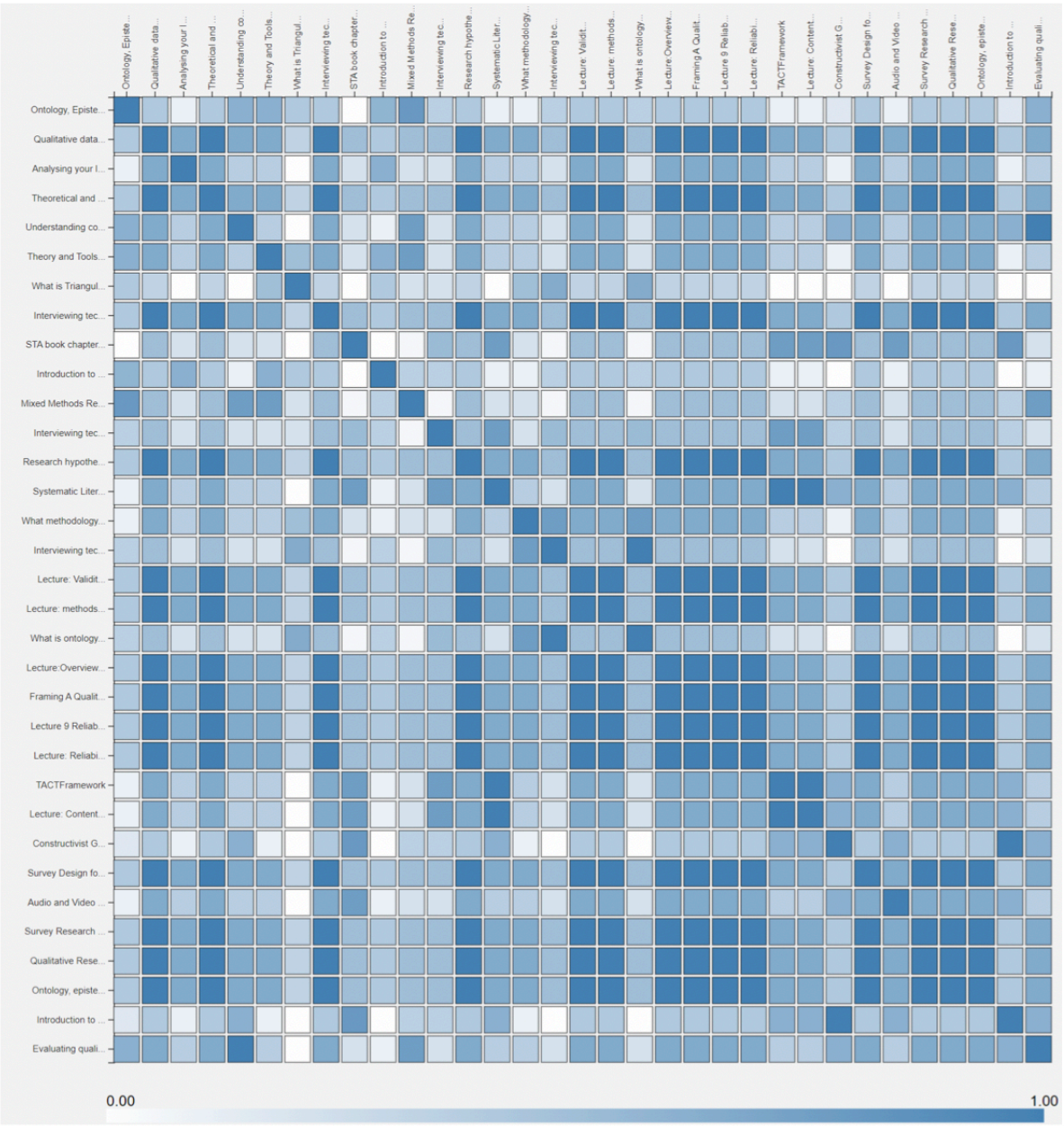

Figure 5: Resources viewing correlation matrix patterns

7. The usability and user experiment

To test the usability of the software, user experience and the value of ***i***Method in supporting student learning, I developed an online questionnaire consisting of 8 items. The assessment items were measured on a Likert scale and were administered to postgraduate students and academic staff who had engaged with ***i***Method. The assessment items consisted of questions intended to learn about the learner's experience and the extent to which the analytics dashboard built into ***i***Method contributed to student learning—other assessment items examined learners' engagement with the various content provided in ***i***Method. In addition, users were asked whether accessing ***i***Method improved their learning experience.

7.1 Methods and procedures

The experiment carried out engaged a convenience sample to enable us to collect data from students and academic staff. Participants (n=37) were volunteers who participated in a series of workshops on research methods and interacted with iMethod. Participants were self-selected—a non-representative sample recruited from students and academic staff in the institution where the research was conducted. They identified as PhD students (21, 57%), Master's students (5, 13%) and academic staff (11, 30%). They came from various subject domains, including Sciences (8, 21.6%); Health Sciences (6, 16.2%); Commerce (3, 8.1%); Interdisciplinary (3, 8.1%) and Humanities (17, 45.9%). Data from the closed-ended questions were summarised using sample statistics (frequencies and proportions Table 2). Data obtained through the open-ended questions were thematically analysed.

8. Results

The overall usability and user experience results suggest that both students and academic staff found ***i***Method helpful in supporting the learning of research methods. Students, in particular, reported that the content provided in ***i***Method helped them better to understand the fundamental concepts of research methodology. One participant said: *"**i**Method is an excellent opportunity for the users to find all up-to-date and suitable resources in one place."* Others said the application enables them to ask questions and acquire helpful information to support their learning: *"….users can share relevant queries and request more resources…."*

Through ***i***Method, some participants said they were able to extend their understanding of research methods and consolidate their knowledge of the fundamental concepts.

> *"This is an institutional treasure. This is invaluable for consolidating and increasing my understanding of research methods. Consolidating what I know has allowed me to focus on areas I want or require a more detailed understanding."*

Table 2 represents survey responses where participants have rated different aspects of their experience using ***i***Method. The ratings are based on a five-point Likert scale, often used in questionnaires to ask respondents about their level of agreement with a statement.

Table 2: Usability and user experience ratings

Statement	F(%) SA	F(%) A	F(%) N	F(%) DA	F (%) SD
The dashboard presentation increases my awareness of what content I must focus on.	17(45.9)	15(40.5)	(2.7)	2(5.4)	2(5.4)
Access to the learning resources on ***i***Method helps me reflect on my learning.	25(67.6)	7(18.9)	0(0)	2(5.4)	3(8.1)
Overall, the content of the resources helped me better understand concepts in research	17(45.9)	15(40.5)	3(8.1)	1(2.7)	1(2.7)
After using ***i***Method, I sought additional materials or help with research methods.	17(45.9)	6(16.2)	10(27)	2(5.4)	2(5.4)
Overall, accessing materials on ***i***Method contributed to a better understanding of key concepts in research methods.	18(48.6)	15(40.5)	0(0)	2(5.4)	2(5.4)

F = frequency; SA = Strongly agree; A = Agree; N = Neutral; DA = Disagree; SD = Strongly disagree

From this data shown in Table 2, it can be concluded that most respondents had a positive experience with using ***i***Method, as the most considerable portion of responses for each statement were either "Strongly Agree" or "Agree". However, there is some variation in the responses, particularly in the statement about seeking additional materials or help, where 27% of respondents remained neutral.

8.1 Interactive dashboard for soliciting feedback

Participants found ***i***Method a valuable platform for seeking advice on research methods. One teacher commented, "***i***Method allowed students to ask questions and obtain answers". Another one said that *"**i**Method provided students with the opportunity to reflect on their learning."* A student said: "***i***Method allowed me to ask questions directly and share knowledge." Another student indicated, "***i***Method was best *for reflecting on my learning by accessing my Dashboard, and the software is user-friendly."*

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

Both students and teachers found ***i***Method convenient because it facilitates knowledge sharing and access to various resources on research methods.

> *"**i**Method is a great platform for users to find all current and suitable resources in one place. The platform enables users can share relevant queries and request more resources!"*

1. Scale usage to other courses in the programme

Participants said ***i***Method is a valuable learning resource and suggested that it be widely deployed in other subjects.

> *"**i**Method is a valuable resource that needs to be deployed widely across courses. I used it only when studying ….research courses. If they resolved to do so, it could similarly be used to easily upload material for other courses, such as for other courses. The research methods lecturer uploaded materials often for the course, which was a valuable course information source to us students."*

Others remarked that… *"more courses should use this platform."* And that they found it helpful. *"It is beneficial and can be applied in difficult courses to make learning easier."*

8.1.1 Usability findings

Overall, participants found the design of the ***i***Method user-friendly, "***i***Method *is user-friendly, an observation also echoed by a second participant: "user-friendly and easy to navigate through."*

"The interface is simple and loads fast." The simplicity of the presentation of the interface made it appealing to those who feel they are technologically challenged. *"Extremely practical to use even for a techno dinosaur like me."* Some reported that the materials were well-organised and with a well-balanced structure. *"I thought the layout and the style make the software easily accessible. The folders on the homepage are well-arranged."*

Participants also commented that it was easy to navigate. *"Entering **i**Method only takes a few minutes to figure out how it is structured; it is straightforward."* Those who described ***i***Method as user-friendly said, *"It is extremely user-friendly."* In addition, one participant said that their experience was improved. *"User friendly with user experience enhanced."* Others found it suitable for learning research methods and simple to use. *"Stable, convenient and user-friendly." One participant commented: "At the moment, it seems simple. The dashboard is an interesting feature."*

9. Conclusion and future directions

Research methodology plays a vital role in postgraduate education, but it remains a challenging subject to teach. This paper reports a data-driven approach to pedagogical research design to understand students' challenges in learning research methods. It draws from previous research on the challenges postgraduate students face in learning research methods and the difficulties teachers of research methods encounter when teaching the subject to diverse students. The paper presents ***i***Method, a software application designed and developed to track students' navigation and behavioural patterns, thus allowing teachers of research methods to collect, analyse, and visualise learning analytics that they can use to optimise teaching and provide better support to students.

The feedback from students and academic staff on the usability and user experience of ***i***Method highlights the application's significant contribution to research methods learning. Students, in particular, found the content available in ***i***Method highly valuable for understanding fundamental concepts and found the application's ability to facilitate inquiry and provide helpful information on research methods. Participants who took part in the usability and user experience study said ***i***Method served as a valuable tool for expanding knowledge and solidifying understanding, offering guidance and accessibility to a diverse range of students. Both students and teachers praised ***i***Method's convenience, as it facilitated knowledge sharing and provided easy access to research method resources. The user-friendly design and intuitive interface were positively received by participants, emphasising its ease of navigation.

Data generated from the ***i***Method environment provides instructors of research methods courses with helpful information to understand students' specific challenges in learning research methods. For example, the outcome of the learning analytics led to various workshops with tools and templates to help students navigate the complexity of learning the content of the research methods course (Daniel, 2019). The design and deployment of an analytics and research methods workshops programme demonstrated the need to focus on curriculum interventions instead of learning analytics approaches focusing on only identifying at-risk students.

10. Limitations

As ***i***Method is currently deployed as a proof-of-concept in a beta version, data collected and used in the paper were limited to six months. As such, the observed learning analytics may not reveal stable patterns. In the future, it is necessary to broaden the software deployment to classes for both undergraduate and postgraduate students, extract longitudinal learning analytics, and develop student learners' models that can be used for personalisation and adaptive learning. In order to acquire an understanding of the vast-scale utility of the software and examine user experience, a large sample size will be required. Moreover, the usability and user experience sample is limited to 37 users.

References

Amigud, A., Daradoumis, T., Arnedo-Moreno, J. and Guerrero-Roldan, A.E, 2018. A Procedural Learning and Institutional Analytics Framework. In: Caballé S., Conesa J. (eds) Software Data Engineering for Network eLearning Environments. Springer, Cham. Lecture Notes on Data Engineering and Communications Technologies, vol 11.

Arnold, K. E. and Pistilli, M. D. 2012. Course signals at Purdue: Using learning analytics to increase student success in *Proceedings of the 2nd international conference on learning analytics and knowledge* (pp. 267-270), ACM.

Al Zoubi, D. 2022. From Data to Actions: Unfolding Instructors' Sensemaking and Reflective Practice with Classroom Analytics. Companion Proceedings of the 12th International Conference on Learning Analytics & Knowledge LAK22: Learning Analytics for Transition, Disruption and Social Change, p.134-140. March 21-25, 2022, online.

Bañeres, D. and Serra, M. 2018. Predictive Analytics: Another Vision of the Learning Process. In: Caballé, S. & Conesa, J. (eds) *Software Data Engineering for Network eLearning Environments. Lecture Notes on Data Engineering and Communications Technologies,* vol 11. Springer, Cham.

Benson, A. and D. Blackman. 2003. "Can research methods ever be interesting?" *Active Learning in Higher Education,* 4(1),39–55. Doi:10.1177/1469787403004001004

Daniel, B.K. 2019. Improving the pedagogy of research methodology through learning analytics. *Electronic Journal of Business Research Methods*, *17*(1), 43-53.

Daniel, B. K. 2017. *i*Method and Learning Analytics Research Design for Pedagogical Enhancement of Research Methods Courses. Proceedings of *E-Learn: World Conference on E-Learning in Corporate, Government, Healthcare, and Higher Education* (pp. 769-777). Association for the Advancement of Computing in Education (AACE).

Daniel, B.K., 2019. Using the TACT framework to learn the principles of rigour in qualitative research. *Electronic Journal of Business Research Methods*, *17*(3), pp.118-129.

Daniel, B., Kumar, V. and Omar, N. 2018. The postgraduate conception of research methodology: Implications for learning and teaching. *International Journal of Research & Method in Education*, 41(2), 220-236.

Corrin, L. and de Barba, P. 2014. Exploring students' interpretation of feedback delivered through learning analytics dashboards. In *Proceedings of the ascilite 2014 conference* pp. 629-633.

Daniel, P.S. and Sam, A.G., 2011. *Research methodology*. Gyan Publishing House.

Earley, M. A. 2007. Lessons learned from students' research experiences [Editorial]—*Journal of Research Practice,* 3(1). Retrieved [January 11th 2015], from http://jrp.icaap.org/index.php/jrp/article/view/93/75

Gašević, D., Dawson, S. and Siemens, G. 2015. Let's not forget: Learning analytics are about learning. *TechTrends*, *59*(1), 64-71.

Govaerts, S., Verbert, K., Duval, E. and Pardo, A. 2012. The student activity meter for awareness and self-reflection. In *CHI'12 Extended Abstracts on Human Factors in Computing Systems* pp. 869-884. ACM.

Howard, S.K., Swist, T., Gasevic, D., Bartimote, K., Knight, S., Gulson, K., Apps, T., Peloche, J., Hutchinson, N. and Selwyn, N., 2022. Educational data journeys: Where are we going, what are we taking and making for A.I.? *Computers and Education: Artificial Intelligence*, p.100073.

Jayaprakash, S. M., Moody, E. W., Lauría, E. J., Regan, J. R. and Baron, J. D., 2014. Early alert of academically at-risk students: An open-source analytics initiative. *Journal of Learning Analytics*, *1*(1), pp. 6-47.

Jivet, I. and Drachsler, H. 2022. Springer Nature. Designing the Learning Analytics Cockpit-A Dashboard that Enables Interventions. In Methodologies and Intelligent Systems for Technology Enhanced Learning, 11th International Conference (Vol. 326, p. 95).

Kaliisa, R. and Dolonen, J.A. 2022. CADA: a teacher-facing learning analytics dashboard to foster teachers' awareness of students' participation and discourse patterns in online discussions. *Technology, Knowledge and Learning*, pp.1-22.

Kilburn, D., Nind, M. and Wiles, R., 2014. Learning as researchers and teachers: The development of a pedagogical culture for social science research methods? *British Journal of Educational Studies*, *62*(2), pp.191-207.

Lehti, S. and Lehtinen, E. 2005. Computer-supported Problem-based Learning in the Research Methodology Domain. *Scandinavian Journal of Educational Research*, *49*(3), 297-324.

Mazza, R. and Dimitrova, V. 2007. CourseVis: A graphical student monitoring tool for supporting instructors in web-based distance courses. *International Journal of Human-Computer Studies*, *65*(2), 125-139.

Maiorana, F., Csizmadia, A.P. and Richards, G.M., 2021, April. Metrics Based on Attention Metadata for Learning Resource and Assessment Repository. In *2021 IEEE Global Engineering Education Conference (EDUCON)* (pp. 413-419). IEEE.

Murtonen, M. 2015. University students' understanding of the concepts of empirical, theoretical, qualitative and quantitative research. *Teaching in Higher Education*, *20*(7), 684-698.

Ndukwe, I.G. and Daniel, B.K. 2020. Teaching analytics, value and tools for teacher data literacy: A systematic and tripartite approach. *International Journal of Educational Technology in Higher Education*, *17*(1), 1-31.

Park, Y. and Jo, I.H., 2015. Development of the learning analytics dashboard to support students' learning performance. *Journal of Universal Computer Science*, *21*(1), p.110-133.

Saeed, M.A. and Al Qunayeer, H.S., 2021. Can we engage postgraduates in active research methodology learning? Challenges, strategies and evaluation of learning. *International Journal of Research & Method in Education*, *44*(1), pp.3-19.

Smith, P., 2019. Engaging online students through peer-comparison progress dashboards. *Journal of Applied Research in Higher Education*, *12*(1), pp.38-56.

Susnjak, T., Ramaswami, G.S. and Mathrani, A. 2022. Learning analytics dashboard: a tool for providing actionable insights to learners. *International Journal of Educational Technology in Higher Education*, *19*(1), 1-23.

Teddlie, C. and Tashakkori, A. 2009. *Foundations of Mixed Methods Research*. Thousand Oaks, CA: Sage.

Wise, A. F. 2014. Designing pedagogical interventions to support student use of learning analytics. In *Proceedings of the Fourth International Conference on Learning Analytics and Knowledge* (pp. 203-211). ACM.