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Demystifying Research (Methods): Epistemological Design to Reduce Student Anxiety and Increase Content Enjoyment

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Completed Research Paper

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Abstract

Research Methods is a frequently-unloved course for students and instructors alike. However, successful research methods courses are linked to high-value and long-term outcomes such as stronger career preparation and higher information literacy. We propose reimaging Research Methods courses for Information Systems and Information Technology degrees as an epistemic undertaking to reduce student anxiety and increase positive experiences with research. We outline and evaluate one such course in this proof-of-value case study, finding that over half of the students achieved these goals. Those students who did not realize the intended outcomes did not have a worse experience; however, their newfound understanding of research cemented their disinterest in pursuing research careers. We propose reconsidering Research Methods' institutional inclusion in IS curricula as a mechanism supporting diversification of junior researchers.

Keywords: IS education, research methods, IS curriculum, epistemology

Research Methods in IS Curricula: Quo Vadis?

Research Methods courses are typically the instance where the systematic scientific approach specific to information technology (IT) and information systems (IS) is introduced and integrated (Wagner et al. 2011). As such, Research Methods (RM) courses fundamentally address several of the Areas of Individual Foundational Competencies in the 2016 Global Competency Model for Graduate Degree Programs (MSIS), including critical thinking, ethical analysis, and problem-solving, and are often linked to statistical competency and oral and written communication (Topi et al. 2010, 2017). RM play a role in 'learning how to learn' (Agarwal and Ahmed 2017); these courses contribute not only to domain knowledge but also to the epistemic capacities of students. Students who understand research have stronger preparation for their future careers inside and outside of research (Markham 1991; Patten and Newhart 2017). Those who understand research are also better able to capitalize on new information and trends in their jobs later (Earley 2014; Patten and Newhart 2017) via their systematic exploration of the design, concepts, and practices that comprise research (Papanastasiou and Zembylas 2008). Beyond core topical exposure is the pressing societal need for research literacy (Markham 1991). Being under-equipped to understand and interpret research at a societal level has shown devastating downstream impacts on problems large (anti-vaccination campaigns) and small (inability to distinguish between valid and invalid sources) (Earley 2014).

Despite the important role Research Methods courses can and do play in increasing knowledge and decreasing unfamiliarity, or the epistemic development, of IS and IT students, it is frequently an unpopular course. Literature suggests that this issue can be linked to the student and their expectations, the instructor and delivery, or the relative transferability of the content (Papanastasiou 2014; Walker 2017). In terms of expectations, students do not tend to see value in Research Methods courses if they are not planning a career in research, report feeling unempowered and confused by understanding and using research, and have trouble placing the content in their field of study (Papanastasiou 2014). Pedagogical literature points out several reasons for the failure of Research Methods courses at the instructional level. The pain points are found to be linked to its delivery and perceived unclear outcomes, and mismatches between the stated goals and provided materials and activities at the instructor level (Earley 2014; Markham 1991)

Transferability is particularly pertinent to IS. IS intersects several other domains with different methodological practices. IS has been characterized as a spectrum between 'predominantly social' and 'predominately technical' named the 'axis of cohesion' in a recent MISQ article (Sarker et al. 2019). Reflecting the axis of cohesion, IS and IT (graduate) training exists across business schools and technical programs (Tan et al. 2018). This split-existence defies a unified canon on the need for RM and the required content when RM is implemented. Additionally, the formal preparation of IS and IT graduates errs towards the practitioner lens (Tan et al. 2018). This leaves departments, instructors, and students making ad-hoc conclusions on the role and desirable characteristics of RM and its content (Wagner et al. 2011).

We propose the problem statement as such: Research Methods is neither a uniform course offering (see *Availability of research opportunities for IS students)* nor is the content uniform when in place (see *Literature Review*). Students avoid RM, actively dislike the course when required to attend, and report high anxiety about the content, perhaps due to the lack of unified understanding from IS instructors and researchers. Yet, RM has been found to contribute greatly to the epistemic development of students and have a positive impact on their future careers when appropriately developed and implemented (see *Literature Review*). This proof-of-value case study (Nunamaker et al. 2015) tackles the structure and delivery of a graduate-level RM course (see *Case Study: Demystifying Research with Epistemic Design*) in response to the high-level research question:

How does epistemic design affect student research anxiety, research predisposition, and perception of research usefulness?

We propose and validate the impact of the course objectives on students' attitudes towards research (see *Validating the Approach*). We argue that RM provides a mechanism for mentors to develop junior researchers from a broader participant pool based on demonstrated interest and skills rather than prior exposure, which should have a net positive impact on the diversity of future recruits and applicants to IS and IT research programs (See *Discussion and Conclusion*), then propose related considerations for IS curricula and address next steps (see *Limitations and Future Work*).

Literature Review

Information Systems Curricular Guidelines

A holistic education in the IS community requires a curriculum that connects aspects of IS research and practice to provide a complete educational experience to the IS student. Efforts to unify the content of the IS curriculum for graduates and undergraduates span decades (Ashenhurst 1973; Gorgone et al. 2003; Topi et al. 2010, 2017). Typically, the process includes courses in systems analysis and design, data management, and IT infrastructure from a managerial and technical lens as well as domain-specific interests (i.e., healthcare, IT project management). What is clear is that in the decades since the first unified IS curriculum has been introduced is that the agreed-upon outcomes for students change based on collegial input.

The Association of Computing Machinery (ACM), Association for Information Systems (AIS), and Association for Information Technology Professionals (AITP) develop and update model systems of IS Curriculum and Guidelines frequently in use in degree-granting programs and for IS Education researchers. The curriculum guidelines are designed to "help IS faculty produce competent and confident entry level graduates" and the authors emphasize that it is intended to "guide, not prescribe" (Gorgone et al. 2003, p. 5). The task force that created the curriculum also mentions that the curriculum is adaptable to most IS programs and focuses on the development and management of technological solutions to business problems. The MSIS (Topi et al. 2017) is built with the intention to resolve the issue of theoretical scope. The model document states that it "explicitly recognizes that business is not the only domain of practice for IS programs and considers alternatives such as healthcare, government, education, and law." MSIS 2016 also highlights principles such as "The target professional profiles of various MSIS programs vary" and "Different professional profiles require different sets of competencies". Allowing for extended perspectives in high-level IS Curriculum is a noticeable shift in direction for both ACM and AIS.

Among the courses in an IS Curriculum, the nature of a Research Methods course is unique. RM connect academia and research. Successful graduates have demonstrated increased job performance inside and outside of research, and those in industry are better able to anticipate and respond to trends (Patten and Newhart 2017). RM have always been at the forefront of research development in the academic setting, but many curricula do not include Research Methods in their recommendations (Ashenhurst 1973; Topi et al. 2010, 2017). This is likely linked to the practitioner focus of the IS Curricular Guidelines (Bohler et al. 2020). In focusing on the future careers of our graduates and industrial stakeholders (Burns et al. 2018) we may be inadvertently under-serving our own industry of academic research. A potential solution for this is the implementation of course(s) that may develop students into capable researchers.

Pedagogy of Teaching Research Methods

General purpose, required courses are recognized for issues linked to heterogeneity of the students in terms of experience and interests (Walker 2017). The ACM Retention Committee summarized the expected issues of introductory programming courses; while they are proposed as specific to computing, the issues apply broadly to prerequisite and gateway courses in technology as well. Student-side issues to expect include interest, expectations, and perceived difficulty. Instructor and institutional-side issues are more closely related to scaffolding students with diverse perspectives and backgrounds and adjusting instructor assumptions related to these aspects, marrying demonstrated interest to skill progression, and managing demand with limited staffing and constrained resources (Walker 2017). Best practice kits for introductory and required courses abound, yet introductory and gateway courses remain a topic of interest to technical education researchers since optimized delivery and learning outcomes achievement remains an open question.

Despite the amount of high-quality pedagogical research being conducted within IS, IT, and Computer Science, there is a lack of pedagogical research conducted on the best methods of instruction for RM (Lewthwaite and Nind 2016). This absence is paired with what some have called a lack of pedagogical culture within educational research specific to research methods (Kilburn et al. 2014). While IS Education has a well-established research tradition, no standards exist for instruction of research methods based on theory or research (Lewthwaite and Nind 2016). Otherwise stated, while IS Education research informs how to best achieve learning in courses linked to the IS Curricula, research on IS research training is lacking. This leads to gaps in understanding of what students will learn in a Research Methods course and how students learn in these settings (Earley 2014). This also leaves instructors and their departments to form practices based on their reliance on their "peers, trial and error, and methodological knowhow" (Lewthwaite and Nind 2016, p. 414). This distinction is crucial because instructors' confidence in teaching RM is important to helping students overcome the difficulties that they face within these courses (Balloo 2019).

Concern over this state has been in place for decades (Markham 1991). Still, the body of knowledge on effective RM have been produced by small, specific case studies, typically outside of IS or IT (Earley 2014). The establishment of pedagogical practices specific to IS and IT is vital to having the most positive impact on students who tend to have negative feelings toward research methods courses. Students are likely to run into challenges during the RM course that act as a hindrance to their learning outcomes and scientific thinking skills (Balloo 2019). Students come in with misunderstandings about research, a disinterest in research, and anxiety due to their perception of the course's difficulty (Earley 2014). To break this set of expectations, 'hooking' students on research as a starting point early on has been found to make them more attracted to research spaces (Lewthwaite and Nind 2016). Constructivist classroom practices have been found to be supportive of increasing interest and strong student outcomes (Hall 2018; Hall et al. 2020). Self-regulation and monitoring of learning are important to students' understanding of content and research processes (Azevedo et al. 2013). This is important to students being able to monitor theoretical concepts, inspect their understanding, and adapt to different methods of learning (Pintrich 2000). Reflexivity refers to students being able to acknowledge their position within their research based on their own knowledge, background, and standpoints, paired with differing perspectives in order to see the bigger picture of their research (Lewthwaite and Nind 2016). Students should be given the opportunity to reflect on the research process in regards to their attitudes about research and the experiences within their research (Kilburn et al. 2014).

Students tend to have a gap in understanding of what they are learning in RM and the relevance that it has for them (Earley 2014). Utilizing constructivism is recommended for demystifying research by aligning goals and activities. Constructivism places students as responsible for their own learning by having instructors guide students to make connections and draw conclusions on their own by utilizing and developing their critical thinking skills (Hall et al. 2020; Savery and Duffy 1995). Students should be actively engaged in the research process in order to make it more visible to the students (Kilburn et al. 2014). Active learning strategies differ from traditional approaches in that, instead of utilizing lecture-based learning that is instructor-centred, active learning is interactive and student-centred (Michael 2006).

The perception of research as being difficult stems from its complexity, which requires students to incorporate different areas of knowledge to form complex thoughts on research processes (Balloo 2019). Students who enrol in research methods tend to have a sense of anxiety toward research (Papanastasiou 2005). Interestingly, students who view research as important for their future tend to have greater levels of anxiety toward research methods (Papanastasiou and Zembylas 2008). Students' self-perceptions also have an influence on their level of anxiety toward research methods courses (Papanastasiou and Zembylas 2008). When students are tasked with a research-based task, there is anxiety based on their fear of the unknown and taking their first step with their research topic (Balloo 2019). Similar to learning any new concept, research requires practice. Rather than instructors telling students about how to do research, students are to be encouraged to take part in conducting the research themselves (Kilburn et al. 2014; Savery and Duffy 1995). This approach gives students experience that is closely related to experiences that they may encounter in future research projects (Kilburn et al. 2014). The feedback and practice that students receive reduces the anxiety that is associated with research methods courses, enhances self-efficacy, and promotes self-regulated learning (Balloo 2019).

Measures of Research Self-Efficacy

Researchers have formally measured self-efficacy in as it pertains to research topics, but the primary focus for many years was apprehension to statistics and mathematics (Adams and Holcomb 1986; Onwuegbuzie 2004; Roberts 1980). In 2005 The Attitudes Toward Research (ATR) scale was created for the purpose of measuring research self-efficacy in students (Papanastasiou 2005). The ATR Scale uses a 7-point Likert scale to identify the attitudes of undergraduate students toward academic research. ATR is a five-factor structure, measuring students' subjective assessments of research usefulness, research anxiety, positive attitudes towards research, relevance to life, and research difficulty. While it is generally regarded as credible, the main concern of the researchers was the phrasing, stating that it "might overemphasize literally positive views" (Haaga and Kaufmann 2021, p. 9). The ATR scale is intentionally exclusive to undergraduate students, which exposes a limitation of the ATR Scale in terms of external validity.

The Revised Attitudes Toward Research (R-ATR) Scale was introduced by the author of the original ATR scale to address these concerns and adapt it into a broader, modern academic environment. In the corresponding article introducing the R-ATR Scale (Papanastasiou 2014), the author states the limitations of the ATR scale and the measures they took to update the scale. The R-ATR scale is focused on providing a holistic understanding of the self-efficacy of students in RM. The R-ATR scale differentiates itself from the original ATR scale by removing the questions focusing on statistics because of their irrelevance to attitudes toward research (Papanastasiou 2014, p. 148). The revision is a three-factor structure of research anxiety, research usefulness, and positive research predisposition, which is explained as a combination of interest and positive feelings.

Availability of research opportunities for IS students

In theory, no differences between preparing practitioners and researchers exist (Topi et al. 2017) though in practice there are clear focal points in delivered curricula. The common example to highlight the focal point difference is between business schools and technical programs, but this easy classification obfuscates the reality and nuances of offered programs worldwide.

To the extent that research training opportunities are available for IS students, it is better analogized as students' access to informal and formal institutions (Stiglitz 2000; Zenger et al. 2000). In an informal institutional experience, a mentor selects and sponsors mentees directly with projects on a smaller scale (e.g., research assistants; independent studies). Another way to expose students to research is within a formal institutional program, like Research Methods courses and seminars. Research as an institutional offering has the added benefit of being universal and inclusive, especially in the case where it is required for degree completion. Other research introduction models exist, such as elective courses instead of required courses or targeted research introduction programs. In the United States, the Council on Undergraduate Research works to increase independent student research opportunities as well as targeted mechanisms like National Science Foundation's Research Experience for Undergraduates funding. Such models share formal-informal characteristics, which is to say that they are formally institutionally driven, so more accessible and less subjective while maintaining a relatively small scale and thus a still exclusive make-up more similar to informal institutional programs.

To better understand the availability of formal foundational research courses, the research team performed a top-down internet resource search. We compiled five lists of the top 25 IS programs based on the US News and World Report (USNWR), QS World University Ranking, and the AIS Research Rankings. The Times Higher Education World Ranking subsumes IS into either Computer Science or Business/Economics and the Shanghai Ranking either Computer Science and Engineering or Library Science and Information and were thus excluded. From the USNWR, we included (1) Best MBA in MIS programs[1] and (2) Best Undergraduate Management Information Systems programs.[2] The QS World University Ranking (3) offers a combined Computer Science and Information Systems ranking.[3] From the AIS Research Rankings, the search criteria used the Basket of 8 for the past five years worldwide for (4) the top-ranked research universities as well as (5) the current academic base of the top-ranked individual researchers for the same search criteria.[4] These lists are near proxies for student-centred as well as researcher-centred definitions of top-level programs (though they are notably US-centric with the USNWR data).

Of a possible 125 options, the list review resulted in 76 unique programs (a ~60% overlap). Each of the 76 degree program websites were then searched for a recommended course sequence/curriculum in the IS degree. Programs which (1) have an active IS degree or near equivalent (see (Topi et al. 2010, pp. 12–13) for a list of program synonyms); (2) have a listed course sequence on their public website; and (3) were in English or were discernibly translated by the Google Chrome browser extension (version 2021) were included in the final analysis (n=50).[5] The home institutions of the research team are also included in the comparison (4). This resulted in a list of 52 programs across three continents (Table 1). 40% of the identified programs are housed in business schools. A summary of data from the identified programs is below:

- 15% of the identified programs are fully taught programs and require neither a Capstone or Thesis exit option.
- 23% and 29% have exit options with only a Capstone or Thesis respectively, and 33% of the programs offer either a Capstone or a Thesis exit option.
- Considering all identified programs with a Thesis exit option, nearly three-quarters (73%) offer Research Methods as an elective or required course.
- Only 41% of programs with a Thesis option require Research Methods as a graduation requirement. Looking only at business schools with a Thesis exit option that require Research Methods, that number drops to 19%.

These numbers offer some first indications. It is evident that formal research courses are not uniformly offered, though they are more common in technically-oriented programs. Of programs where a Thesis is an option, most programs offer RM, though many (59%) do not require it when a Thesis is the required exit option. This indicates a potential mismatch in skills and output.

[1] https://www.usnews.com/best-graduate-schools/top-business-schools/information-systems-rankings

[2] https://www.usnews.com/best-colleges/rankings/business-management-information-systems

[3] https://www.topuniversities.com/university-rankings/university-subject-rankings/2021/computer-science-information-systems

[4] https://www.aisresearchrankings.org/rankings/

[5] From the excluded programs, 13 are in North America; 4 are in Europe; and 7 are in the Asia-Pacific region.

North America			
Arkansas	ASU	U of Arizona	Bentley
Boston College	Brigham Young	UBC	U of California Berkeley
Carnegie Mellon	Columbia	Cornell	U of Florida
Florida State	U of Georgia	Georgia State	Georgia Tech
U of Illinois	U of Indiana Bloomington	Loyola	U of Maryland
McGill	MIT	U of Michigan	U of Minnesota Twin Cities
U of Nebraska	NYU	U of Nevada Las Vegas	U Penn
Penn State	Princeton	Purdue	Southern Florida
Temple	Texas A&M	U of Texas Austin	U of Texas Houston
Toronto	Virginia Tech	Waterloo	

Europe	
Darmstadt	UCL
Edinburgh	EPFL
Hamburg	UCLU of Liechtenstein
U of Rotterdam	WU Wien

Asia	
City U Hong Kong	Hong Kong S&T
KAIST	NTU
NU Singapore	

Table 1. Identified IS Programs Considering Research Methods Offerings

The summary also shows that the informal institutional practices of directed mentorships in small groups are likely still driving most students' first exposure to research. It is likely that the concept of *'fit'* between mentor and mentee plays an outsized role in the invitation to and evaluation of the informal research experience. Fit is simultaneously critically important for a successful experience (Grover 2007; Pyhältö et al. 2015) but hard to define in terms that are neither nebulous nor exclusionary (Posselt 2014). While fit has been established be determinative of experience and successful outcomes in graduate school (Gardner 2009; Gazley et al. 2014; Jones 2013), overly strict assessments of fit or undue weighting of this fully subjective factor can lead to undesirable outcomes like less diverse student cohorts (Posselt 2014; Purdie-Vaughns et al. 2008).

Offering and requiring a formal course as an entry point to research that addresses the design and evaluation of research specific to IS would seem to be a solution to better exposing a diverse group of students to IS research. The uniform access point becomes a critical factor to balancing the subjective aspects of fit as interest and readiness can be evaluated more uniformly. It is yet unknown if formal training is a sufficient condition for increasing diversity in IS, though broader and wider exposure would appear to be a necessary condition for diversifying the pool of potential researchers.

Case Study: Demystifying Research with Epistemic Design

This case study proposes the design of a 3-credit RM course. The course has been delivered to graduate students at two institutions located in the European Union and the United States in six semesters. The goal of *Digital Research Foundation* is to introduce students to basic and applied research approaches which can be applied to their Capstone or Thesis. It has historically been a required course. We validate the approach using the Revised Attitudes Towards Research scale (2014).

Course Design

Epistemological and Science of Science perspectives were chosen due to the rather complex nature of satisfying the needs of diverse student audiences. Epistemic design treats the course as an opportunity to understand the creation of new knowledge via the practice of science and application of the research enterprise. Such courses focus on increasing knowledge and certainty and decreasing ignorance or unfamiliarity of the subject matter. To decrease unfamiliarity/ignorance, course content is decomposed into subproblems of how to perform research that become the overarching module structure. The subproblems are listed below in order of delivery:

- How basic and applied research produce technological innovation
- The use of abstraction and models in creating new knowledge
- Finding a research gap
- Using levels of measurement to form research questions and apply (statistical) evaluations
    - Qualitative, qualitative, and mixed methods
- Defining Ethics and Critical Theory in the IS research context.

The explicit focus on the basic-applied research nexus allows students to place content into their real environments (Sizemore and Lewandowski 2009). This supports increasing knowledge of the research process. Not all students who are exposed to research can be expected to pursue a research career, but all students can use RM to better understand how research influences their field of interest.

There are 20 content modules, each covering remedial, developmental, or transferable content. Areas of remediation are discovered with the use of a timed pre-test taken in the first week that covers common research vocabulary (*hypothesis, robustness, citation*). On this basis, trends in students' foundational knowledge are inferred and addressed. Remedial training is enveloped in reading and writing tasks in order to support transfer learning throughout the term. Remedial training is the primary place where students' misconceptions about research are addressed, increasing students' topical certainty.

Developmental and transferable content and tasks are introduced in two ways: research milestone assignments and student-led discussions on specific methodologies. The parts are supportive of one another. The methodologies discussion allowed students to consider and reflect on approaches for their own research. The milestone structure of assignments is a breakdown of typical steps in a research process. In order, the milestones corresponding to assessment items are:

- Begin literature review
- Propose research question or hypothesis
- Name and map (expected) research variable relationships
- Propose methodology
- Proposal revisioning
- Final proposal

Breaking down the steps allows for interactive feedback loops between instructor, student, and the student cohort and is in-line with current literature on goal setting and subtasking (Margulieux et al. 2020).

Reading

Reading is the core self-study component of the class. Reading is broken into five different classifications: Reading to *Understand, Discuss, Critique, Appreciate,* and *Write*. Differentiating signals that the core task and thus approach require new, more expansive skills. Students are assigned readings throughout the semester from a textbook *(c.f.* (Ghezzi 2020; Zobel 2014)) and a collection of scholarly journal articles that are assembled by the instructor.

Students assess each assigned reading utilizing the skills acquired from the remedial training on understanding academic writing covered during the first three weeks of the course. A unified prompt for note-taking is in use to level-set across students.

- What kind of article is it (for example does it present data or does it present purely theoretical arguments)?
- What are the main issues raised by the author to justify the relevance of the science?
- What questions are raised?
- How well are these questions addressed?
- What are the stated limitations?

In subsequent discussions students should be able to express the readings that they thought were well written, or the ones that they enjoyed reading and why. They should recognize the elements that made that paper attractive to them. These specific readings that they appreciate are later used to serve as models for on how they could construct their research proposal and gives them a foundation for writing in the future.

Reading for Writing

Writing an academic manuscript requires different skills than are typically taught in formative language training. Yet, formal guidance is typically only available at the doctoral level. Earlier training is one way to better spot and engage with talented students to 'hook' them early (Lewthwaite and Nind 2016).

Within the overview modules of the course, two or three class sessions should be devoted to understanding the structure and style of academic writing (depending on remedial needs of the group). This is an exercise completed with the entire class and led by the instructor. One article representing strong academic writing inside of the respective discipline is presented and reviewed collectively for structure instead of content. To do this, the instructor walks through the abstract, introduction, and specific, pre-named subsections. With each paragraph/section, the following questions are be discussed:

- How much information is in the first sentence? And in the second sentence?
- How many sentences are in the paragraph/ each paragraph?"
- How much information is in the final sentence per paragraph?
- What is this paragraph about?
- How many citations are in each paragraph on average?
- What is the main point of this section?

It would seem repetitious, but the activity is typically more difficult than it seems as most students will not have experience with analysing structure, nor with interpretation at the sentence level. As they grow more confident the process speeds up. It is recommended to include at least one section with equations as this is quite commonly an area requiring remediation. This guided discussion utilizes a constructivist framework by helping students to collaboratively share their observations and gain knowledge through each other rather than the instructor explicitly telling students what is important in the paper.

Reading for Discussion

Graded, student-led discussions replace the classic methodologies section in this course design. Two typical modalities for teaching methodologies exist: deep dives and methods surveys. Deep dives more often than not concentrate on a small number of methods to deeply probe them. Given both the diversity of methods in IS as well as the diversity of students in the actual course, this was deemed an inappropriate choice. Methods survey covers more approaches but does so at a higher, more superficial level. The compromise reached for *Digital Research Foundations* is to maintain the methods survey design and charge individual students to lead the presentation and discussion of one method as a graded component. Like this, students are introduced to many commonly used approaches but still have deeper expertise in a specific methodological approach. Historically students have been required to choose their method of interest on which to lead the discussion session. There are typically more students than pre-selected methods, meaning there will be more than one student in charge of preparing the materials for the session.

Student-facilitated discussion is a vital component to the development of critical thinking and communication skills. It enhances students' ability to think independently by allowing them to contrast the implications of various theories and methods, among other aspects of research. It also allows them to build patterns of what they enjoy and dislike about research. Student-lead discussions account for 15% of the graded evaluation. Students are graded on their preparation before the discussion, their performance in facilitating the discussion, and the quality of their synthesis of the paper. It is recommended that the instruction team meet with each student one-on-one shortly before their discussion facilitation. The student-led discussions focus on a specific topic within research methods, including the list found above, data preparation and analysis, and research ethics. Within each approach, the instructor should choose one to three representative articles for the domain. These papers can be inside or outside of IS and IT, but they should utilize the same approach.

Students choose the article which they would like to lead assuring autonomy in their learning and help to cater lessons to their individual interests. In preparation for the in-depth paper review with the instruction team, students prepare answers to questions such as:

(a) What is the purpose/aim of this text? How do you know? How might this influence the way it is written?
(b) What are the major research justifications that were made in this article? OR Can you see any justification (direct or implied) for the research decisions? Do the justifications seem reasonable?

(c) Do these assumptions seem reasonable in this context? Why or why not?
(d) Are any generalisations being made? Are these generalisations reasonable here?
(e) Is there anything problematic?
(f) What would the implications be if we were to take the claims seriously? i.e. What should happen next?

Between the notes and the paper review with the instruction team, students are typically prepared to lead a discussion with their classmates. The instructor is recommended to only become involved in the discussion if there is a conflict or other technical issue occurs lest the student lose ownership of the content.

As there are typically less articles than students to lead discussions, it is common that more than one discussion happens per lecture unit. While harder to evaluate this is a good outcome, as it means students can be broken into smaller subgroups, which increases their chances of directly participating. Participants are instructed to have reviewed the articles to the extent that they would be able to discuss the overall methods and conclusions of the paper. The purpose of the review is not to have an expert level understanding of the papers' contributions but more of understanding why they chose the methods they did, if their processes matched the method, and any flaws that they had in their research design or conclusions. The discussions give the students the opportunity to address any misunderstandings that they had or important components of the paper that they think is relevant to address with their peers.

Throughout the course each student will lead one academic article (the one they discussed) in depth and have reviewed approximately 15 other articles. This consistent pattern of reading and discussing gives students the opportunity to continuously practice their academic reading skills for improvement. The academic articles assigned to students fall into a range of difficulty levels and methodologies found inside of and adjacent to IS and IT. This exposes students to different academic writing styles and approaches in IS and IT research.

Intended Outcomes and Pedagogical Tools

Epistemological context is a powerful tool in the demystification of research. A typical RM will primarily rely on the *what, when,* and *who* aspects of performing and interpreting research while epistemic design concentrates heavily on the *why* and *how*. The value is experienced across the spectrum of students intending careers in industry, research, or who are still exploring. A classic pedagogical example of learning to learn, it can also be a tricky needle to thread. To some degree epistemic courses require divorce from application. However, one of the major hurdles to research methods in IS is content transferability. *Digital Research Foundations* relies on the constructivist model found in (Hall 2018; Savery and Duffy 1995) in order to assure the student learning outcomes are met at their intended level corresponding to Bloom's taxonomy (Anderson and Krathwohl 2001) (Table 2).

Specifically in terms of the eight-point model Savery and Duffy proposed (1995), *Digital Research Foundations* utilizes *discussions* and *self-monitoring* processes in order to support students to develop ownership of their tasks and corresponding outputs. The taught lectures frequently upcycled slides from previous modules in order to build out and build upon new learning materials. This allows learners to authentically connect and transfer content across academic, professional, and personal contexts. Reuse of the same materials also allowed the students to implicitly build on complexity and abstraction as applied to the process of creating new knowledge.

Bloom's Taxonomy reflected item	Student learning outcomes	Assessment item
Understand	* Acquire and demonstrate fundamental knowledge of the key concepts of basic and applied research methodologies	Discussion Leadership
Apply	* Select a method for answering research question * Apply key research methods for given problems	Proposal Milestones Proposal Discussion Participation

Evaluate	* Be able to interpret the results of research method * Draw the appropriate conclusions from results	Proposal Milestones Proposal Discussion Participation
Create	* Define a relevant research question	Proposal Milestones Proposal Discussion Leadership

Table 2. Mapping Blooms Taxonomy, Student Learning Outcomes, and Assignments

The concept of "learning by doing" is generally held up as a model standard for active learning classrooms (Robinson and Hall 2018). This typically takes the form of a mini-project in RM courses. Some challenges exist in the production of an entire project inside of a semester term, especially in the case of novices. Chief among these is a hidden assumption that students will have pre-assessed potential research questions or hypotheses before the course starts. Another is students' ability to authentically experience how research is done (well) before it has been thoroughly introduced. Especially in the very common scenario that research is misunderstood, it is easy to understand how and why RM can produce anxiety and negative experiences in students, as well as is seen as irrelevant to career prospects. To still support active learning, but not overwhelm students, *Digital Research Foundations* requires a research proposal as the semester project. The proposed structure and length are:

- Introduction (between half and 3/4 page)
- Literature Review (~2 pages)
- Research Questions/Hypotheses (~quarter page)
- Research Model (between quarter and half page)
- Proposed Research Method (~1 page)
- Expected Contributions (rest of document)
- References (no limit)

Writing

The main deliverable is the research proposal (35% of evaluation). It is recommended to leave the topic of research open to the students in order to give them control of their own research in a domain that they are interested in, especially to the extent that the degree program offers both Capstone and Thesis exit options. By choosing topics that students are interested in they will be more invested in their project and learning.

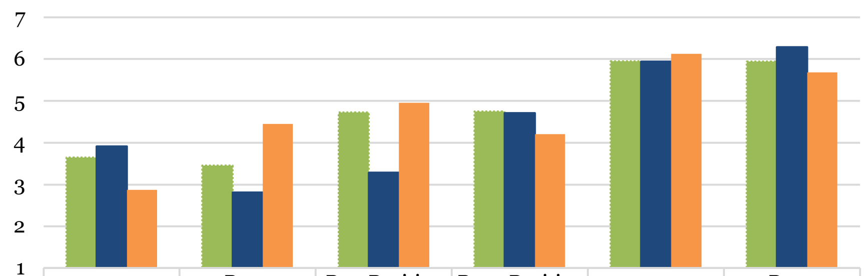
Milestones (see *Course Design*) are used to demonstrate that they can identify a research question and accurately determine the appropriate methodologies to execute a research project and understand the expected contributions and implications of the proposed work (25% of evaluation). The milestone structure is a method of evaluation that helps the instructor to address students' misconceptions or address parts of a milestone assignment that could be problematic in the final project proposal. These checkpoint assignments force students to focus on specific sections of the final project proposal in a stepwise manner. This spreads the workload of the writing process throughout the semester and prevents students from procrastinating until the end of the course, only thinking through the assignment all at once. Students should receive feedback from the instructor after each checkpoint submission. Students gain experience from the iterative nature of submission and feedback. Here we note that the creation and use of expansive rubrics in advance will lessen the grading overhead. Granular rubrics that present expectations can lower the level of personalized feedback required; the exchange basis becomes more focussed on coaching than writing individual reviews per assignment.

Students are expected to use the milestones that they submit throughout the course to construct their final research proposal. Students are encouraged to use the milestones in a formative way, making the necessary revisions to the final proposal based on instructor and cohort feedback from their milestones. The final research proposal is short (five pages) and in-line with expectations of a Capstone or Thesis proposal or student research grant proposal. This forces students to be concise in their writing and articulation. This is also recommended to put the students' focus on the research components rather than the length of information that they need to produce. The effects of this length should produce quality over quantity. The milestone system also reduces end of semester grading for the instruction team.

Validating the Approach

In its sixth iteration a pre- and posttest using the R-ATR scale (2014) was utilized (n=29). The survey was given in tandem with the vocabulary test during the first and last week of class. We focus on the R-ATR survey in this evaluation. We find a bimodal deviation: those for which there is improvement, and those for whom the course did not improve their impression of research. Figure 1 visualises the mean responses of the pre- and posttest across each construct overall and improved-attitudes and worsened-attitudes outcome groups. Table 3 summarizes the results of between and within group tests including effect size. As the data are not normally distributed Mann Whitney U and paired Wilcoxon signed-rank tests are implemented and effect sizes are estimated using *r* values (Valentine and Cooper 2003).

In 17 cases (5 female; 12 male) the pre-/posttest difference showed improved outcomes and in 12 cases (5 female; 7 male) the pre-/posttest difference showed worsened attitudes towards research. Research Usefulness means functionally swapped between the improved-attitudes and worsened-attitudes outcome groups (Pre: 5.94/6.13; Post: 6.28/5.68). The overall pretest data has high starting values, meaning that the improved students upwards adjusted their attitude from high Research Usefulness to very high Research Usefulness scores while the worsened-attitudes outcome group maintained high Research Usefulness attitudes. The differences between and within groups are not statistically significant (Table 3). Because of the course being a program requirement instead of an elective, this was unexpected.



	Pre: Research Anxiety	Post: Research Anxiety	Pre: Positive Research Pre-disposition	Post: Positive Research Pre-disposition	Pre: Research Usefulness	Post: Research Usefulness
Overall	3,65	3,45	4,73	4,75	5,95	5,95
Improved Outcomes Group	3,92	2,81	3,29	4,71	5,94	6,28
Worsened Outcomes Group	2,87	4,45	4,96	4,21	6,13	5,68

Figure 1. Pre- and Posttest Scores of All Students, and Improved-attitudes and Worsened-attitudes Groups.

Positive Research Predisposition (PRP), a construct reflecting interest in and positive experiences with research, shows no significant differences between improved-attitudes and worsened-attitudes outcome groups in the pre- and posttests. There are significant within-group differences. Students' PRP scores increased by 1.43 points for the improved-attitudes group, a 43% increase which is statistically significant (Z=-2.310, *p*=0.020, *r*=-0.576) whereas the worsened-attitudes group showed a -15% decrease from pre- to posttest (.75 points). This is also a significant decrease (Z=-2.139, *p*=0.032, *r*=0.665).

Research Anxiety showed the most drastic changes over the semester and within the groups themselves. There were no significant differences between groups in the pretest (Z=-1.042, p=0.296, *r*=-0.198). At the end of the semester the improved outcomes group showed an improvement in Research Anxiety by a factor of 1.11 over pretest (a 28% decrease; Z=-3.392, *p*=0.000, *r*=0.829) and a factor of 1.64 over the worsened-attitudes group in the posttest (Z=-2.713, *p*=0.006, *r*=0.508). The worsened-attitudes group reports an increase in research-related anxiety of 1.58 points (a 55% increase; Z=-2.472, *p*=0.013, *r*=-0.725).

			Z-statistic	p-value	Effect Size
RA	Between	Improved vs worsened in Pretest	-1.043	0.296	-0.198
		Improved vs worsened in Posttest	-2.713	**0.006*** **	0.508
	Within	Improved group, Pre-posttest	-3.392	**0.000*** **	0.829
		Worsened group, Pre-posttest	-2.472	**0.013***	-0.725
PRP	Between	Improved vs worsened in Pretest	-10.445	0.296	0.198
		Improved vs worsened in Posttest	-0.956	0.338	-0.182
	Within	Improved group, Pre-posttest	-2.310	**0.020***	-0.576
		Worsened group, Pre-posttest	-2.139	**0.032***	0.665
RU	Between	Improved vs worsened in Pretest	-0.067	0.946	-0.016
		Improved vs worsened in Posttest	-1.095	0.273	-0.208
	Within	Improved group, Pre-posttest	-1.335	0.181	-0.325
		Worsened group, Pre-posttest	-0.971	0.331	0.273
Significance: 0.05*, 0.01**, 0.001***					
Effect Size *r*: < 0.3: Small, >= 0.3 and < 0.5: Medium, >= 0.5: Large					

Table 3. Results of Mann Whitney U (Between Groups) and Paired Wilcoxon Sign-rank (Within Groups) Hypotheses Tests

More interesting than the fact that there are differences are the drivers of these differences. In the pretest the worsened-attitudes group has lower Research Anxiety and higher Research Usefulness and Positive Predisposition than the overall group average and the improved outcomes group. If the course fails on its goals, contains mismatches between stated goals, materials, activities, or contains unclear outcomes, we should expect to see lower overall variance in the constructs and a worsened overall score; instead, we see higher variance paired with a lower average. Figures 2 and 3 display the variance of the pre- and posttest data for the two outcome groups. The variance differences between and within improved and worsened-attitudes groups is most obvious for Research Anxiety, where the variance for the worsened-attitudes group expands considerably. We can infer a mixed experience in the course for those in the worsened-attitudes group. While they learned the content, they also learned that they did not like the research endeavour.

This inference is also supported by qualitative data. Students were given the option to add free text feedback in the pre- and posttest in response to the question '*Is there anything else that you want me to know? This response will not be shared with the class; it is for me to better calibrate the semester.*' A representative sample of the worsened-attitudes group from the posttest is below.

- (Male IT Innovation major) "The course helped me understand that even though I'm capable of doing research it is not something I enjoy or want to do in the future as a career."
- (Male Data Science major) "I want you to know that I enjoyed this course more than I thought I would. The research in itself is still very difficult for me and still scares me, but I understand and enjoy it more. The group discussions and the chance for people to get out of their comfort zone and lead a discussion is a valuable thing to give a student. I'm by far not your best student and I've struggled in concepts and topics for your class by my own doing, but you've provided a good support still. As I'm very early in my journey for my Graduate program, you're (*sic*) class has definitely push me where I need to be pushed and come to the realization of what academics is all about again. The class has been an invaluable asset to me as I felt I've struggled pretty hard, but still accomplished a list of things."
- (Female Data Science major) "This class was challenging. I feel like I have said so many times - "this or that should be studied," but it turns out I have no idea how science works. So this class taught me how ignorant I am about the scientific method and research. It's fine, I'm fine, I did learn *something* even if it's not an expected learning outcome for the course. At least now I know more about what I don't know."

At first blush such feedback can seem disheartening. However, especially the final free text response adds a level of nuance to the worsened-attitudes data. In line with (Kruger and Dunning 1999), students in the worsened-attitudes outcomes group self-assessed to be stronger in their appreciation of research likely due to their lack of foundational knowledge. Once exposed to the requirements and practices that make up scientific research, these same students self-corrected their assumptions about their relationship with research. Holistically, this isn't a subjectively worse outcome with respect to the course and its outcomes but rather a type of level-setting of experience and interests.

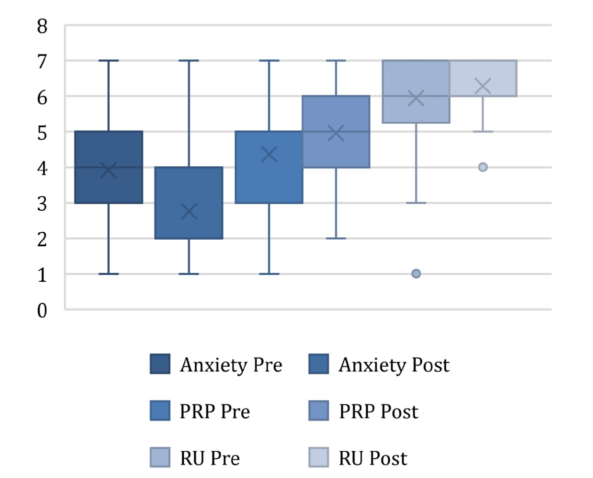


Figure 2. Pre- and Posttest Scores of Improved-attitudes Groups

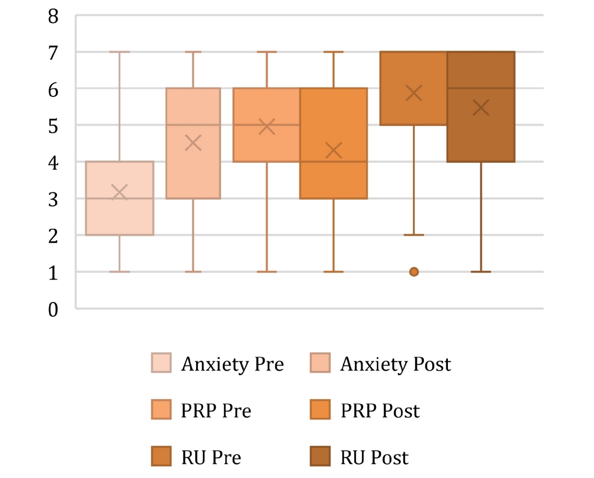


Figure 3. Pre- and Posttest Scores of Worsened-attitudes Groups

Discussion and Conclusion

Recalling the high-level research question, "How does epistemic design affect student research anxiety, research predisposition, and perception of research usefulness?" we respond with the following observations. Research (Methods) can be demystified for students. Expanding Research Methods as a feature of IT and IS curricula can be a net positive for students regardless of their applied or theoretical focus. Introducing 'learning to learn' skills rather than deep dives into specific methods or large methodological surveys facilitates the success of students regardless of their planned exit option and aligns with both current educational literature and the current IS and IT curricular guidelines (Agarwal and Ahmed 2017; Topi et al. 2017; De Veaux et al. 2017).

Subjective valuation for the usefulness of research started and remained high, which is an unexpected result. Moreover, the epistemic approach tends to lower anxiety of students by increasing knowledge and decreasing unfamiliarity. In the case that students experience worsened-attitudes, is it less likely linked to a poor experience than it is that they had started the course with a wrong baseline understanding of the research enterprise (Kruger and Dunning 1999; Sizemore and Lewandowski 2009). It is worth noting that the course is well-evaluated by students (4.48 out of 5 for 'Course Overall' averaged over the last three teaching evaluations). Using the core components of Nunamaker and colleagues' proof-of-value propositions (2015), we summarize our contributions and raise points for future consideration (Table 4).

Expanding RM availability when it is a net positive for student experience can reasonably support the diversification of the junior researcher applicant pool. Formalizing access to research within the institutions' degree programs will reduce barriers to research caused by an ad-hoc or informal approach. In the free text data nine students indicated that they plan to change to a Thesis exit option or will apply to Ph.D. programs in the near future. 55% are female; other intersectional aspects of diverse experience and ideology are present but cannot be evaluated due to the small sample size. Increasing access to and knowledge about the research enterprise supports unifying and standardizing the evaluation of 'fit' and can increase the diversity of the students who will become interested in research as a career option.

Goal	Description
Deepen understanding of problem space and potential solutions	• Understanding the research endeavour is critically important. Research Methods courses are the typical educational vehicle but the courses (1) cause students anxiety and negative experiences and (2) are not uniformly offered. • Future researchers are recruited and trained in an ad hoc manner which may contribute to a lack of experiential and ideological diversity.
Degree to which solution is generalizable	• Epistemic courses are appropriate for managerial and technical IS and IT training because the abstraction level supports understanding of how and why research is conceived, implemented, and evaluated. • Epistemic design and active learning, including student self-monitoring and frequent discussions, are natural partners in RM courses.
Improve functional quality of solution	• All students maintain a high valuation of the usefulness of research for the duration of the semester. • Students' content enjoyment of research methods delivered in an epistemic course significantly increases and anxiety significantly decreases for students who entered the course with poor attitudes towards research. • As much of IS is considered interdisciplinary (Sarker et al. 2019), epistemic RM courses may aid in clearing up students' misconceptions of its scope.
Discover and describe unintended consequences	• Highly (or overly) confident students experience statistically significant increases in anxiety and decreases in interest and experience over the semester in an epistemic research methods course.
Document value creation	• 31% (5 female, 4 male) of the student cohort plans to pursue independent research in some form, promising a successful medium-term outcome.
Understand feasibility of solutions' deployment	• *Technical feasibility*: Ongoing and increasing trends towards remote courses may require computer-mediated delivery. This is turn can impact the use of active learning for un(der)trained instructors/instruction teams. • *Economic feasibility*: Given an implicit expertise of faculty members with research, no additional institution resources should be anticipated in creating and offering such a course. • *Operational feasibility*: A why/how abstraction of the research endeavour allows for general or area of interest or domain-specific foci (i.e., RM for Health Information Systems; RM for IT Managers) to be delivered without reducing the effectiveness of the outcomes.

Table 4. Documentation of Proof-of-value of Epistemic Design in RM Courses

Implications for Students

We are all worse off if students have poor attitudes towards research. Moreover, a strong command of research pays dividends in professional scenarios outside of research (Earley 2014; Patten and Newhart 2017). RM courses have the goal of preparing students to understand research as a component of their career but have traditionally failed to meet their objectives. This case study shows that epistemic RM courses not only teach students how to become acquainted with the logic of scientific research but also provides a holistic understanding of the research enterprise regardless of their intended exit option and/or career plans. Epistemic design of Research Methods benefits students entering with poor attitudes by decreasing their anxiety and increasing their enjoyment of the content. Epistemic design also benefits those who enter with inflated self-concepts of research knowledge and ability by allowing them to achieve a more realistic understanding of research. All students benefit via the process of self-adjusting their knowledge and familiarity of research due to a tight coupling of theoretical (*why*) and practical (*how*) knowledge.

Implications for the Discipline

This case study is designed to foster uncomplicated adoption of RM into other IS programs. The difference in epistemic design compared to traditional courses is the focus on *why* and *how* as opposed to *what, when*, and *who*. This implies that the efforts required to implement such a course are conceptual and (re-)design oriented more than resource-directed. Integrating epistemically designed RM into the degree program is both plausible and possible and fits will with the objectives of standard IS curricula.

RM could be the bridge to reaching and retaining more students regardless of prior experience. Recruiting based on performance and interest rather than opportunity is a more egalitarian approach, and may broaden participation in IS research. Diversifying the pool of (junior) researchers is a net win for IS as a field, particularly as scholars recognize the increasingly relevant bright and dark sides of technological systems in industrial and societal institutions.

Limitations and Future Work

The presented case study recognizes its limitations. Though the presented course has been delivered six times, evaluation data only exists for one iteration. Future iterations will maintain the pre- and posttests. Linked to this: the R-ATR mechanism is cross-sectional, so hard data on medium term effectiveness of the course in changing attitudes towards research is out of scope. Finally, it is difficult to split the impact of a course from the instructor/team leading it. The experience of being in a class with a cohort of students and specific instructor is idiosyncratic and that will have unmeasurable effects on any subjective data.

We propose as future work expanding the review of Research Methods in IS curriculum. Our analysis of top-ranked programs gives tendencies and indications but is not representative. The data may also be interpreted as preferential, though this is not the intent. A more comprehensive picture is necessary to diagnose common pain points and improve the staff and student experience. Realized in its full breadth and scope, an international comparative survey completed at the department level will empower IS curriculum designers and program administrators to re-imagine the research introduction process.

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