Work in Progress: Qualitative methods for studying women's information experiences in engineering education

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Abstract

This work-in-progress paper outlines the methodology and initial findings of a doctoral study. The phenomenon investigated by the study is the information experiences (incorporating both information behaviour and information literacy) of women engineering undergraduates within their highly masculinised learning environment.

The study, for which a pilot phase was conducted from October to December 2024, takes a phenomenological approach. Qualitative data was collected using a combination of multimedia diaries and semi-structured interviewing. The qualitative approach was selected in part as a counter to the dominance of quantitative methodologies in the reviewed literature.

Preliminary results indicate that the gendered learning environment did play a role in the information experiences of all four pilot participants, although to differing extents. Common features of the information behaviour of the four participants included a preference for video learning and use of Google Scholar in preference to library databases. Interestingly, information sharing via shared Google or Word documents also emerged as a common behaviour.

Data collection for the study is underway from January to April 2025, with the pilot study having proved a successful test of the methodology.

Introduction

This work-in-progress paper outlines the methodology and preliminary findings of a phenomenological study into the information experiences of women engineering undergraduates at UK universities.

Women make up 20% of undergraduate engineering and technology students in the UK [1], and 24.8% in the US [2]. Being in a numerical minority of any kind can include negative experiences, and the effect is greater when the numerical minority also has less societal power; for example ethnic minorities in predominantly white spaces, or women in predominantly male spaces [3]. Much has been written on women's representation in science, technology, engineering and mathematics (STEM): for example, seven articles were published in the Journal of Engineering Education in 2023-24 with the keywords "women" or "gender" (see Appendix A for a list). However, to date few studies have addressed this question from a library and information science (LIS) perspective. LIS research offers a valuable perspective to the study of engineering education, as the ability to find and use appropriate information is a key expectation for graduate engineers [4]. Librarians play a central role in educating students in higher education on how to navigate the scholarly information relevant to their discipline [5].

This study takes a novel approach within the discipline of information science, combining the fields of information behaviour and information literacy through the lens of information experience. Information experience has been defined as "the way in which people experience or derive meaning from the way in which they engage with information and their lived worlds" [6, pp. 5–6]. It can be understood as both a research approach, and an object of study in itself [7].

Information experiences are highly contextual [8], and for students may be shaped by factors including norms and expectations of their disciplines [9], as well as social and affective needs [10], [11]. These may in turn be influenced by the learning culture, which impacts learner motivation, sense of belonging, and persistence [12]. Therefore this research will explore research questions related to the intersection of female engineering undergraduates' information experiences with their broader experiences in the engineering classroom.

The study explores the following research questions:

1. How does the lived experience of being a woman in an undergraduate engineering classroom shape the information behaviour of women students?
2. How does the gendered learning environment of an engineering classroom interact with women's information literacy development?
3. What are the aims and motivations of female engineering students when engaging with information?
4. What role does affect play in women engineering students' information experiences?
5. Is personal epistemology, specifically Women's Ways of Knowing [13], a useful lens through which to examine women engineering students' information experiences?

This paper will share preliminary data and reflections on the methodology from the pilot study, which was conducted between October and December 2024.

Literature review

To frame the context of this study, the literature reviewed in this paper focuses on research into the information behaviour and information literacy of engineering students. As little research in this area has focused specifically on women's information experiences, this review will discuss research into engineering students of all genders.

The information behaviour of engineers has been widely studied [14], [15], [16], [17], but there are fewer studies focusing on engineering students. In a scoping review, Mercer et al. [9] found that insufficient LIS research has focused on undergraduate engineering students, and what research does exist is piecemeal. The review identified key themes from the research to date, including: "Student information behavior mirrors that of professionals; Design thinking as a guiding force for information behavior; Design work requires the use of specialized information sources" [9, p. 3]. They also discuss the methods and theoretical approaches used in their reviewed papers.

Using Mercer et al.'s 2019 review [9] as a starting point, this section will review relevant literature since 2017, to include papers that may have been published while Mercer et al. wrote their review, plus any published since then. Some older papers may also be included where they provide useful context. The themes identified by Mercer et al. will be used as a framework for discussing the literature, along with the additional themes of measurement of information literacy, and gender balance and differences.

Student information behaviour mirrors that of professional engineers

Historically, LIS research into the information behaviour of engineering students has cast them into a deficit role, identifying their behaviours as inadequate when compared to information literacy standards [18]. Madden et al. [19] take a different view, arguing that students with a preference for "hard" disciplines such as engineering [20], [21] may engage in "sub-critical" or "surface-critical" information behaviours not through lack of competence, but because a critical approach was simply not needed or expected in their field. They propose the term "a-critical information behaviour" to describe this approach, to avoid the value judgement inherent in labelling a student's practice as "sub-critical." Dommermuth and Roberts [22] echo this view, discussing the social and surface information seeking of their student participants as appropriate for the norms within engineering, therefore representing a strength rather than a deficit.

Several articles have directly compared the information behaviour of student and professional engineers. For example, Phillips et al. [23] found that practising engineers spend more time gathering information than students, and use a greater variety of information source types, including human sources; however students rated their information seeking and identification skills more highly than professionals. This may indicate the unreliability of self-assessment as a measure of information literacy (see discussion under 'Information literacy interventions and measurement', below). Similarly, Kaufman et al. [24] found that practising engineers use a wide variety of information sources, including those considered "non-scholarly" such as technical documentation, product information, and standards. Studies into the workplace experiences of engineering students and recent graduates have found that professional engineers consider quickly locating and evaluating information as key skills for new engineers [4], and that students on work placements or internships often require guidance from their colleagues and supervisors on how to do so [25].

Engineering students are focused on the application of information rather than on the process of research, mirroring the requirements of practicing engineers [9], [26], and may take their cue on the importance of information literacy from academic staff. Unfortunately, engineering academics can be lukewarm on the necessity of information literacy for undergraduates, seeing it as either irrelevant to their courses [27], [28] or as valuable only in later years of study [18]. However, academics in some STEM disciplines do value information literacy instruction and collaboration with librarians [29], particularly if librarians can demonstrate a good understanding of how information is used in professional practice [30].

Design thinking as a guiding force for information behaviour

The basis of engineering education is learning mathematical and scientific principles and applying these to design practical solutions to problems [31]. Design is therefore a central component of engineering education.

Fosmire and Radcliffe [32] argue that information, and thus information literacy, is central to engineering design, and propose a model of "Information-rich Engineering Design" (IrED) to associate information seeking strategies with all stages of the design process. Fosmire [33] recommends IrED as a framework to incorporate principles of information literacy into the engineering classroom, to help students to understand the central role of good information practice in design work. Engineering education frequently includes practices such as design challenges and problem-based learning (PBL), which can present opportunities to embed information literacy instruction as part of the design process [34].

Use of specialised information sources

The information landscape for engineering students is composed of mostly centralised resources such as reputable journal and standards databases, which they are often reliant on their lecturers and supervisors to guide them through [5]. It has also been suggested that learners in STEM disciplines may require less information to aid understanding of their course content than those in social sciences and humanities, as the concepts in STEM are less abstract [35].

Some studies have identified that engineering students can struggle to identify their information needs, rely heavily on popular and non-scholarly sources such as YouTube and Wikipedia, and are often unaware of the range of scholarly resources available via their university library [36], [37]. This reliance on non-scholarly sources may lead them to neglect the information-gathering stage of a project [33].

Information seeking, gathering, evaluation and use tends to become more complex and sophisticated as students advance through undergraduate and postgraduate level studies [38], [39], [40]. However final year (senior) undergraduates and graduate students (i.e. Masters and doctoral students) still make use of predominantly free, online materials and web search engines, as well as social information seeking strategies such as asking colleagues and classmates [41], [42], [43].

Methodological and theoretical approaches

Consistent with Mercer et al.'s 2019 scoping review findings [9], the more recent LIS literature concerning engineering students is still dominated by quantitative approaches and frequently lacks a stated theoretical perspective. Most of the papers in this review are small-scale studies. Sample sizes of the qualitative studies range from 10-17 participants, and most of the quantitative studies range from 35 to 400, with four outliers having more than 1,000 participants. The most common qualitative methods used were semi-structured interviews, reflections, literature reviews, and focus groups. The most common quantitative methods were questionnaire surveys, self-assessment surveys, and assessment measures such as tests

or grade comparisons before and after an IL intervention. See Appendix B for a table listing the methods used in the reviewed papers.

Information literacy interventions and measurement

As "information experience" is a relatively new approach, many of the papers in this review focus on information literacy. There is a paucity of literature focused on the information literacy of female engineering students specifically, therefore the papers reviewed here include engineering students of all genders.

Many of the reviewed papers are practice-based papers which detail or evaluate specific information literacy interventions for engineering students, primarily in universities. These papers often describe teaching strategies including embedding information literacy classes regularly throughout engineering courses [30], [40], [44], collaborating with academic staff to create exercises and assessments [45], [46], using problem-based learning [34], [45], flipped classroom approaches [47], one-shot[1] library classes [48], [49], [50], [51], [52], [53], [54], and using standards such as the ACRL Framework for Information Literacy [46], [55], [56].

Some of these papers are descriptive or reflective, however the majority include some attempt to evaluate the success of the information literacy teaching. This may reflect the pressures felt by librarians to justify the time spent on information literacy, as this may be seen by some academics as taking time away from their "core" subject teaching: engineering lecturers are less likely than academics in other disciplines to consider information literacy as important for their students [57], [58].

Information literacy is notoriously difficult to measure and evaluate [59]. Common methods used in this review for evaluating information literacy teaching included tests before and after the intervention [44], [45], [51], [60]; grade comparisons [49]; analysis of citations in student work [47], [50], [52]; and self-assessment surveys [53], [61]. Most articles found an improvement in either academic performance [40], [47], [49] or information literacy confidence and/or competence [44], [50], [51], [53], [56]. Only one paper noted no correlation between information literacy interventions and improvements in student work [52]. However, these were all small-scale studies and may not be generalisable to other contexts. In a systematic literature review of information literacy teaching methods, Phillips et al. [62] concluded that most of the research in this area lacked methodological rigour, and it was therefore not possible to identify the most effective method(s) from their literature sample, but noted that the main indicator of success for any information literacy intervention appeared to be collaboration with academic staff.

Quantitative measures of self-reported behaviour, for example through questionnaire surveys, are commonly used and can be helpful for uncovering patterns of behaviour. However, self-assessment surveys that invite participant to rate their information literacy on a quantitative scale are likely to be less useful. Several studies have found that on self-assessment surveys,

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[1] The term 'one-shot', commonly used in the LIS literature, refers to provision of a single lecture or class in the academic year rather than an ongoing program of instruction.

engineering students frequently rate their information literacy highly, however these ratings are not always compared with actual capability [61], [63], [64]. Other studies using a comparison measure, such as awareness of information sources and searching techniques, find low or no correlation between self-assessment and information literacy [23], [43].

Significant work into the validity of self-assessment in measuring the information literacy of engineering students has been conducted by researchers at Purdue University. In 2011 the team developed the Self-Assessment of Problem-Solving Strategies (SAPSS) [65] as an instrument to measure student confidence in information tasks, however the findings indicated that high self-assessment ratings did not correlate with performance, and a later test of the same instrument found no difference between self-assessed ratings of students in their first and third years [66]. The authors conclude that self-assessment may not be a helpful measure for assessing the information literacy of engineering students.

The focus on quantitative measures in information literacy is probably reflective of the broader bias towards positivist research paradigms in LIS research [67]. Using qualitative measures such as interviewing may allow a deeper exploration of students' own understanding of their information practices [68].

Gender balance and differences

Most of the approximately 48 papers in this review do not mention the gender balance of participants. Of the 12 that do, proportions of women in the studies are usually low, ranging from 3% [23], [44] to 45% [57]. In the quantitative papers the numbers of women included are usually too low to allow for any statistical analysis, so gender differences are either not considered, or are only briefly mentioned.

Two all-female studies were identified. One paper evaluated a one-shot information literacy class given specifically for a women's group [53], finding that scores on a self-assessment survey for the class of 75 first-year students improved slightly after the session. The other investigated the ways in which undergraduate women in STEM subjects used the academic library [69], using a series of focus groups and interviews with 14 female undergraduates. The study found that the women in the study saw the university library primarily as a safe, quiet space to study, but did not associate it with providing access to academic literature, which they saw as being provided by their lecturers.

Where gender was included as a variable, often some attempt was made to look for differences between women and men. However, only two papers in this review found any such differences. The first was based on self-assessment of information literacy, and found that female undergraduates rated themselves as more competent in information literacy than their male peers [64]. This contradicted earlier findings from a similar self-assessment study based on different but comparable IL criteria, which found that women undergraduates rated themselves as less competent than male undergraduates [70].

The second paper was based on citation analysis of student work [71]. This study evaluated an information literacy intervention among engineering undergraduates, by analysing the

bibliographies from a random sample of assignments before and after the students had experienced an information literacy class. The 28 female students in the study (22% of the total sample of 127) showed more improvement than the male students in the quality and relevance of citations used in their assignments following the class, although the difference was not statistically significant.

From this small analysis, two conclusions can be drawn: women are underrepresented in studies on the information literacy and behaviour of engineering students; and findings regarding women engineering students' information literacy are inconclusive.

Methodology

As a counter to the dominance of the quantitative approach in the existing literature on the subject, this study takes a qualitative, phenomenological approach. A qualitative approach was chosen as it enables meaningful insight into the lived worlds of participants. A particularly appropriate methodology for this purpose is phenomenology, which "stresses the importance of being able to strip away the layers of social meanings attached to experiences so that it becomes possible to get a clear picture of things as directly experienced by people" [72, p. 131].

The study uses the Reflective Lifeworld Research (RLR) approach [73]. RLR, developed by Karin and Helena Dahlberg, is an approach to research that draws together the philosophical traditions of descriptive phenomenology and interpretive, or hermeneutic, phenomenology, using the "lifeworld" as a unifying concept. The lifeworld is defined as "the complex, qualitative and lived reality that is there for us whatever we do" [73, p. 38]. The lifeworld is a concept that has occasionally been used in the LIS literature, and has been recognised as having further potential for exploring information experience [74], [75]. Gorichanaz et al. [76] suggest that adopting the lifeworld as a unit of analysis would enable researchers to uncover facets of information experience that were previously unexpressed.

The aim of RLR is to "make the phenomena of study appear and to describe them in a clear and comprehensible way" [73, p. 49]. RLR is not a step-by-step method, but an open approach to research that encompasses some key features including [73]:

- Openness to meaning: "to have the patience to wait for the phenomenon to reveal its own complexity rather than imposing an external structure on it" (p. 112).
- Attention to the relationship between researcher and participant.
- Researcher self-reflection and self-awareness, to "bridle" one's own pre-understanding of a phenomenon so it does not overshadow the phenomenon from the participant's perspective.
- Use of qualitative data collection methods, particularly diaries, interviews, and observations.
- Small sample sizes.
- Aiming for rich variation in data, rather than data saturation.

This research adopts a reflective lifeworld perspective to explore how the participants' life experiences, status as a gender minority, and their dual identities as both women and as novice engineers, impact their information behaviour within the masculine culture of the engineering classroom. These may be aspects of their lifeworlds that are invisible to the participants themselves, so the research aims to bring these into focus.

Study design

The study consists of two stages of data collection: a pilot study, conducted at a single university during October to December 2024; and a main study, which will recruit undergraduate students from up to four UK universities of varying size, type, and demographics, from January to April 2025. At time of writing, recruitment has just begun for the main study, so this paper focuses on the pilot study. Ethical approval was received from the University of Sheffield in February 2024, ethics approval number 050635.

The study aims to recruit up to 20 female engineering undergraduates in total, including those who participated in the pilot study. The overall research design for the main study is the same as for the pilot study, with minor amendments as listed in the discussion section of this paper. The pilot study design is detailed below.

Participants were asked to keep a diary recording their information experiences over 2-4 weeks, as they worked on university assignments. Following this, participants were invited to semi-structured interviews, using the diary narratives as a starting point for discussion. The interview schedule began with a discussion around the diary entries, followed by a series of questions around various aspects of information experience.

Diary methods, including written diaries, audio recordings, photos and videos, have been used in LIS research to enable authentic, in-the-moment reflection on information encounters, without relying on the participants' memories of events [77]. Visual diary methods such as photovoice [78] can be particularly valuable in LIS research as they enable participants to depict "the intangible aspects of their information literacy and learning practices" [79, p. 231], which participants may struggle to verbalise or researchers may not know to ask about.

Participants were given free choice of medium to record their diary entries: photos/images, text, videos, sound recordings, or a combination. Enabling participants to choose a recording medium that suits their own preferences allows participants to express themselves freely without being constrained by a specific medium, consistent with the lifeworld approach. The diaries collected by participants are a reflective tool to support them to remember their information practices and discuss them in the interviews. The qualitative analysis then focuses on the interview transcripts. As the diaries are not the primary data source, differences in diary format and medium do not affect the analysis.

Analysis of the interview transcripts will aim to produce a detailed description of how information is experienced in the lifeworlds of the research participants. The analysis will use

Karin and Helena Dahlberg's suggested two-stage process of analysis for reflective lifeworld research [80]:

1. The first phase of analysis focuses solely on empirical data (for example, interview transcripts, or documents relating to the experiences under study), to gain a view of the phenomenon without reference to external sources or theory.
2. A second, optional phase of analysis brings in external sources, such as relevant theory or findings of previous research, to illuminate the phenomenon and contextualise it.

The ultimate goal of the analysis is to produce a rich description of the "essence of the phenomenon and its constituents, the meanings that constitute the actual essence" [73, p. 255]. As RLR provides little guidance on the practicalities of data analysis, Braun and Clarke's thematic analysis approach [77] will be used an interim step. Reflexive thematic analysis has been selected as it is a flexible approach, emphasising reflexivity and researcher subjectivity, and is therefore consistent with reflective lifeworld research. Typically, reflexive thematic analysis consists of progressive and recursive phases of dataset familiarisation, coding, theme generation, and theme development and refinement. These phases will be used to provide an initial thematic framework from which to develop a rich description of the phenomenon.

Pilot study

The pilot study was conducted from October to December 2024, with students from one university. The aim of the pilot was to test the instructions given for the diary stage and the questions used in the semi-structured interviews (see appendices C and D).

The pilot institution was selected because the lead researcher was formerly employed there and knows the department well. The lead researcher's connections with the institution potentially presented an ethical challenge, as it was possible that students in later years of study may have known her in her professional role at the university. She could therefore be seen as an authority figure, which could impact informed consent. Participants also may have been aware that she knew the academic staff at the institution, and may have been concerned that any comments they made regarding the content or teaching of their courses could be reported to their lecturers. This was addressed in the ethics review, and it was made clear in the consent process that anything participants disclosed would be treated in confidence and only shared anonymously, without identifying which institution they were from.

To recruit participants, a targeted email was circulated to female students in the department. The text of the email gave brief details of the study, including that participants would be paid £30 each for their time, and included links to the participant information sheet and a demographic screening form. The form asked for contact details, and basic demographic information including age, gender identity, ethnic background, nationality, and first language. This form was used as an initial screen of participants, in case more volunteers came forward than were needed for the pilot study. The intention was to use the demographic screening to ensure variation among participants. Although reflective lifeworld research does not require

representative sampling, it is important when recruiting to aim for "rich variation in data" [73, p. 175], such as including a range of ages, backgrounds and life experiences.

Seven volunteers from the target institution completed the demographic screening form. All were invited to attend an individual, online meeting to discuss instructions for the study and confirm they were willing to participate. Four responded to this invitation and progressed to the first stage of the study. See table below for demographic characteristics of the volunteers. The four who ultimately participated in the study are referred to by their pseudonyms, while the other three are identified by respondent number only. Three characteristics have been omitted from the table as they were the same for all respondents: all identified as women, all were aged 18-24, and none identified themselves as having a disability.

ID	Year of study	Engineering discipline	Ethnicity	Nationality	First language
Yasmin	1	Mechanical	Asian / Persian	British	English
Emma	1	Mechanical	White	British	English
Holly	2	Mechanical	White	British	English
4	2	Mechatronic	Asian	Indian	Malayalam
Rose	Foundation[2]	General	White / Southeast Asian	British	English
6	1	Electrical	Chinese	Chinese	Chinese
7	Placement[3]	Mechatronic	White	British	English

Table 1: Demographic screening form responses.

For the first stage of the study a period of approximately two weeks was agreed with each participant to accommodate their current assignments and deadlines. During this time, they were asked to record any information experiences related to their university studies. The definition of "information" was kept intentionally broad, to enable participants to identify for themselves what they found informative, rather than being led by the researcher's assumptions [7]. See Appendix C for the instructions provided to participants for the diary task, including definitions of both "information" and "information experience".

Participants were each given access to their own Google Drive folder, shared only with the lead researcher, in which to upload their diary entries. They were told they could record their

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[2] In the UK, many universities offer a one-year, pre-degree course known as a "Foundation year" to enable students to develop the base level knowledge required to begin a degree qualification in a particular subject. These are popular with students who are returning after a break from studies, pursuing a new-to-them subject area, or who did not achieve the required grades for acceptance onto a degree course.
[3] A placement year is a year in paid employment, similar to an internship, during which the student is still enrolled in their course and expected to maintain contact with the university. Usually a placement year is in between the second and final years of the course.

diaries in whatever format they chose, e.g. written entries, voice recordings, photos, videos, drawings, etc. The lead researcher had kept her own information diary for a few weeks prior to recruitment and made her entries available to participants as examples. This proved useful, as three of the four participants asked unprompted in the initial meeting if they could see examples of the kinds of diary entries that would be expected.

During the diary periods, the lead researcher sent participants a weekly email to stay in touch. At the end of each diary period, participants were contacted again to set up a date and time for the interviews. Participants were offered the choice of doing the interviews either face-to-face or online. All interviews were conducted face-to-face in a room in the library of the target institution and each lasted approximately one hour.

Prior to the interviews, the lead researcher read through each participants' diary entries, noting areas where clarification would be useful as well as points that could relate to the research questions. This process was used to expand the interview protocols, so each interview began with a discussion of the diary entries before moving onto the pre-planned questions. This enabled an organic discussion of the participants' information experiences, rooted in their lifeworlds rather than imposing a structure decided upon in advance by the researcher. It also facilitated analysis of the diaries and interviews together. A digital audio recorder was used to record the interviews, and they were transcribed verbatim afterwards, enabling capture of both the interviews and discussed points from the diaries.

When transcribing, all names were replaced with pseudonyms. Naming of participants has been identified as a "micro-ethical" issue, with the common practice of assigning alphanumeric codes potentially obscuring the personhood of participants [81]. This would conflict with the lifeworld approach used in this study, therefore the use of pseudonyms was felt to be more appropriate. In line with inclusive practice in qualitative research, participants were offered the opportunity to select their own pseudonym. If they chose not to do this, a name was selected at random for them. Choosing pseudonyms for research participants can be ethically fraught, as names carry significant societal meaning, often indicating characteristics such as age, ethnicity and social class [82]. To mitigate this, as each of the participants was British and of a similar age, a list of the 100 most frequent baby girls' names in the UK from 2004 was consulted, and a random number generator used to select a name for each participant from the list. The only exception was Yasmin: as she had indicated her ethnic background as Persian, and her original name was of Persian origin, the name Yasmin was deliberately selected as it comes from the same ethnolinguistic background. This was felt to be preferable to selecting a name from the list of UK baby names, as that list contained mostly English names and no names of Persian origin. Allocating English names to participants from other ethnolinguistic backgrounds has been highlighted as a "form of linguistic imperialism" [81, p. 7], and also risks misleading readers of the study as to the backgrounds and characteristics of participants [83]. All participants were informed of their selected pseudonyms after the interviews, and given the opportunity to choose different names if they would prefer. None chose to amend their pseudonyms.

At time of writing, analysis is underway. The focus of the analysis is on the interview transcripts, with diary entries referred to as needed to clarify points of discussion. As recommended by Karin and Helena Dahlberg's RLR approach, analysis begins with a process of familiarisation through repeated close readings of the transcripts [80]. As RLR does not provide detailed instructions on how to analyse qualitative data, a combination of techniques for qualitative data analysis has been chosen, consistent with the goal of producing a rich description of the phenomenon [73]. This includes memo-writing to document initial impressions [84], followed by a process of thematic coding to identify and group themes across interviews [77].

Preliminary results

Analysis of the pilot study data is in progress, so no firm conclusions have yet been drawn. In the interests of sharing the work in progress, this section will present a short vignette of each participant, drawn from the interview transcripts, as recommended by Seidman [85]. Using participants' own words to construct a narrative is consistent with the reflective lifeworld approach. As per the research questions, the vignettes will discuss the participants' lived experiences as women in an engineering classroom, and how this gendered learning environment interacts with and shapes their information experiences. Following the vignettes, emerging insights will be discussed.

Holly, who is in her second year of a Mechanical Engineering degree, spoke at length about her experiences working as part of a team. The engineering courses at the pilot institution make frequent use of problem-based learning (PBL), structuring their courses around a series of team projects, meaning that the learning context for Holly's engagement with information was largely based on group work. Teams are allocated randomly at the start of the year, and each consists of 8-9 people. Each group is instructed to appoint a chair and a scribe, plus other roles as needed for specific projects, with the expectation that they rotate roles for each new project.

In her first year, Holly was the only woman on her team. She found this isolating, and described a sense that her teammates doubted her capability, even rewriting some of her work on occasion. Now in her second year, her new team has one other female member, who Holly has become friendly with and who she collaborates closely with on their team projects. Although she prefers having another woman on the team, she feels that her first-year team was more "efficient," which she attributes to one team member chairing all projects and taking charge of allocating work among the team. She feels this was done fairly, according to ability, but describes an occasion in which a male lecturer had intervened to stop her male teammates from assigning her only the non-technical tasks in the team. He insisted that she take on some coding instead, which she was subsequently proud of completing successfully.

In her second-year team, for the first two projects Holly has taken the role of chair, while the other woman on her team has taken the role of scribe. Holly notes that she did not initially want to chair, but that one of her male teammates told her to do it as no one else wanted to. She thinks her female teammate may have taken the role of scribe in a similarly accidental

fashion. However, she thinks taking these roles has worked well for them, as this enables them to take control of information sharing in the project. At the time of the interview, Holly's team was just beginning a new project, for which the output was to be a poster. Holly described being told by one of her male teammates that she and the other female member should take responsibility for the poster, so they could "make it look pretty." Although this should mean that other group members take charge of doing background research to include in the poster, Holly and her female teammate are doing this task as well as they do not trust that their male teammates will provide the information they need for the poster in time.

Holly mentions "doing research" a few times throughout her interview but is vague about what this entails. When pushed for details, she describes relying primarily on Google and Google Scholar. She sees Google as most helpful for finding what she terms as "hard facts," such as how an air-based cooling system works. She uses Google Scholar to find more scholarly sources to supplement her work, but finds that the language is often "very scientific" and difficult to understand. She also mentions using ChatGPT to help explain things in simpler terms if her tutor is not available to answer questions. She seems generally happy to ask questions of her lecturers and her classmates, but is reluctant to admit she doesn't know something in front of people she doesn't know well. In those cases, she is more likely to turn to Google or ChatGPT so she can find out for herself rather than having to ask someone.

Rose is studying on a foundation year. The Engineering Foundation program at the pilot university aims to introduce students to a broad range of engineering related concepts. Students who successfully pass this year are automatically accepted onto any of the university's engineering degree courses or may choose to apply to different universities. This was initially Rose's plan: she had hoped to study at a different university (which she described as her "dream university"), but had been told that she would need to complete a foundation year first, which her dream university did not offer. She therefore planned to complete her foundation year at the pilot institution in order to reapply to her dream university. However, her few months of experience on the foundation course had led her to the realisation that she did not enjoy the applied work of engineering, and would prefer to study physics or maths instead.

Rose presented herself in an explicitly feminine way, through her clothing, makeup and hair style. She commented on this during the interview, saying that one of the ways she sees her course as having a masculine environment is that the few other women on the course are mostly "tomboys". Rose shared that although when she was younger she had presented herself in a "tomboyish" style, she now takes pride in expressing her femininity. She believes that there is pressure on women in male-dominated fields to present in more masculine ways, as femininity is seen as a weakness, but as a feminist she enjoys countering those expectations.

Rose discussed her own feminism a few times throughout the interview, which she attributes to her upbringing and the influence of her older sister, who is a biologist with a PhD. Rose's family members are important influences in her life: she mentions relying on her mother, a

teacher, for grammar checking her work; her sister, for general study advice; and her aunt and uncle, who are both scientists and a source of inspiration for her. Since beginning her course, she has been sharing interesting information she has come across with her parents. She has particularly valued sharing information with her father, who she says is "quite clever, but he was never really given the opportunities when he was younger." While she is comfortable asking for help from her family and close friends, in the context of her course she prefers to try to find information alone before asking others. She says she would prefer that other people, "especially boys," not know that she doesn't know something.

Since beginning the course, Rose has completed both an individual assignment and a group report and presentation (at the time of the interview, the individual report had been submitted but the group report and presentation were still a few days away from the deadline). Rose has always been academically high achieving, describing herself as "naturally smart," and has extremely high standards for herself. She was also diagnosed aged 18 with ADHD, which she believes contributes to her over-preparing for her work. For her individual assignment, a short research report on a topic of her choosing, she prepared by exhaustively researching all aspects of the topic and writing a five-page plan before beginning the actual report. She describes this as being a typical process for her and feels it usually serves her well, although she did express frustration at having researched a lot of information that turned out not to be relevant for her report. Rose prefers video as an information source as she struggles to internalise information just by reading or hearing it – she believes this may also be related to her ADHD. She does also read books and make use of lecture notes but tends to find videos easier to understand. She primarily uses Google for searching, although she has used Google Scholar in the past, but finds it frustrating as full-text content is not always available. When searching for information online she is careful in her selection of sources, looking for reputable organisations' websites and official YouTube channels.

The group project has been a significant source of frustration for Rose. She was randomly allocated to a group of three and is the only woman in the group. She feels strongly that if there were another woman in her group the work would have been better. She believes that women work harder, especially in STEM subjects, where they often feel a need to prove themselves. She took an immediate lead on the group project, contacting the other group members to introduce herself and setting up a shared Google document so they could all contribute to it. At the time of the interview, she had received very little communication from her group members and no one else has contributed to the Google document. She seemed resigned to completing the work almost by herself as she felt it was important to her to do well, so she had accepted that this meant others would benefit from her work without contributing themselves. She had not yet met her group members in person, but had realised who they were when she overheard them discussing her in a lecture theatre, saying that they were going to let her do most of the work as she "seems like she's got loads of time."

Yasmin and **Emma** are both in their first year of the Mechanical Engineering degree, and are friends and frequent collaborators on their course. Each was aware that the other was participating in this research and brought this up unprompted in their interviews. Both are

members of the university's Formula Student team.[4] Like Holly, Yasmin and Emma are both in project teams on their course for a series of PBL assignments throughout the year. They are not on the same team.

Yasmin has a very pragmatic approach to her studies. She is motivated by wanting to succeed in her degree and get a good job at the end of it, possibly in motorsports. Ultimately she thinks this will depend on what jobs are available when she graduates. She has a little more experience with academic information seeking than some of her peers. For example, she already knew how to use Google Scholar to find journal articles, and how to reference in APA 7th edition style. She credits this to having completed an Extended Project Qualification (EPQ)[5] prior to starting university. She was able to share her knowledge of how to produce APA 7th edition references with friends on her course who had not yet been taught how to do this. First year students at this university will usually receive a one-shot class from the subject librarian for their course on how to cite reference materials, as well as how to use library databases. This had not yet taken place at the time of the interview, so Yasmin was unaware of the range of library resources available. She states that she uses Google Scholar as she considers it "more reliable" than Google, however she does also use Google for finding fact-based information such as 3D printing techniques and materials. For her own learning and revision, she prefers using videos and problem worksheets provided by her lecturers. Some of the material covered in the first year of the degree is already familiar to Yasmin from her A levels in maths and physics, but she appreciates the opportunity to refresh her knowledge. She is aware that others on her course do not have her level of prior knowledge, but does not recall having been asked for help by her classmates on the topics she is already familiar with.

In her PBL group, Yasmin is one of two women. She feels that the group work well and allocate work efficiently. Where there are group decisions to be made, such as which design to prototype, she feels these are made fairly, based on the available data. She is less convinced of the fairness of the more subjective assessment criteria. For example, the projects include peer assessment, where team members rate each other anonymously based on their contributions. She is concerned about how this will be done fairly when some team members have not always been present to see what everyone is contributing.

In her role with the Formula Student team, Yasmin has experienced some information sharing in a way that seemed new to her. The team is split into "departments," each focusing on a different aspect of the prototype design and build. At a weekly meeting, the department leaders (all final year undergraduates or Masters students) present to the rest of the team about what they have worked on over the previous week. Yasmin finds this useful to "bring everyone to knowledge."

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[4] Formula Student is an initiative of the Institution of Mechanical Engineers (IMechE). It is an annual engineering challenge in which student teams from universities across Europe compete to design, build and test a race car prototype.
[5] EPQ is an optional qualification taken by some students in England and Wales during their Further Education (between school and university, usually aged 16-18). It takes the form of an extended research report, usually around 5,000 words, on a topic of their choosing.

Yasmin occasionally finds being one of very few women on the course isolating. In her prior education she had attended an all-girls secondary school, followed by a mixed-gender Further Education college, where she was one of only a handful of girls in her maths and physics classes. She found this experience "completely different" and "weird," having been used to all-female environments. During her time at the Further Education college she had attended a day of talks and workshops for women in STEM, aimed at encouraging girls aged 16-19 to pursue careers in STEM fields. She found this made STEM careers feel more "relatable" to her. At university, she has no female lecturers. The only female academic she has encountered is the woman who leads the Formula Student team, who has acknowledged that Yasmin and Emma are the only women on the team and encouraged them to come to her if they feel isolated. Yasmin believes that if there were more female academics in the department, it would feel "encouraging, like that more women are able to do it."

Yasmin prefers to seek out information herself rather than ask others. She recently arranged an appointment with a tutor to go over some material she was struggling to understand. This was the first time she had done this, and she says she would not have been brave enough to do so if she weren't studying with Emma, who was struggling with the same material. Having asked for help once, she now feels more confident in doing so again, but would still prefer not to do so in front of her classmates. She is very concerned with not being seen as "less knowledgeable." In her PBL group, the men in the group often discuss "male-dominated interests" such as building PCs. She is also interested in these hobbies, but feels she can't join the conversation as she assumes the men know more about them than she does.

Emma is one of several engineers in her family. She has two male relatives, both on the same course at the same university with her, and her grandfather is also an engineer. She initially planned to study maths, but the mathematics degree at the pilot institution was discontinued after she had applied so she accepted a place on the engineering degree instead. She is highly motivated to seek a good career after university and chooses her activities on the basis of what might look good on her CV and possibly lead to a good job. This was her motivation for joining the Formula Student team, and for attending an Advanced Engineering Exhibition aimed at second and final year undergraduates.

In her PBL group, Emma is one of two women. Emma volunteered as scribe for the first project, then felt she was expected to continue in the same role for the second. She did not want to get "stuck" in this role, so has volunteered as chair for the third, which was just starting at the time of the interview. As chair, she has suggested that the team roles are rotated more often, rather than the same people taking the same tasks each time. She feels this may have disappointed one group member who is already experienced with computer-aided design (CAD) and had expected that he would continue to do the bulk of the design work. Emma feels that it is important that "everyone gets a chance" to work on each aspect of the projects, although she recognises that, in practice, people who are initially less skilled in certain areas such as CAD get "nudged out" by those with higher skills.

Emma finds corporeal, embodied information (such as information perceived through activities such as handling materials and conducting tests) particularly useful for learning.

She describes handling materials in a lecture to learn their properties through tactile feedback, and splitting open a prototype gear during testing to see why it had failed. In her diary, she also shared videos of the gear tests in process. When asked about why these videos had been informative, she discussed two aspects. The first was a form of information sharing with her teammates who had not been present for the tests, as she believed that showing them what had happened to the gears would be more helpful than simply reporting the results. The second was the capability of the video itself: one of the gears had broken too quickly to see in real time what had happened, so by slowing the video down, she was able to identify the point of failure.

Like Yasmin, Emma prefers to try to find information for herself before asking others. However while Yasmin seemed motivated by wanting to appear knowledgeable, Emma seemed more concerned with not wanting to "put someone out." She is comfortable asking questions in a classroom setting, but less so in a lecture where she would be asking "in front of everyone." She notes that the men on her course tend to be "shy" and less likely to ask questions, which she identifies as one of the aspects of a masculine environment. In her PBL group, she has asked others to contribute the background research each has completed to a shared document, however she notes that most seem reluctant to do so. She suspects this may be to mask the fact that most are researching their allocated areas at the last minute.

Emma does not think she has experienced any sexism on her course. She had anticipated that this might occur, due to her understanding of issues around "women in STEM," and from her male relatives' reported experiences at an engineering college, where women were even scarcer than on her university course and she had heard anecdotes of sexist behaviour. She does feel that the course is taught in a masculine way: she recalls discussing in her prior education some ways in which women and men are thought to learn differently, and she believes that the lectures are delivered in a teaching style that suits men.

Discussion

Although analysis of the pilot interviews is at an early stage, some themes concerning the information experiences of the four women in the pilot study have begun to emerge.

The gendered environment seemed to play a role in the learning experiences of all four participants, although they varied in the extent to which each believed this to be the case. Rose was the only participant who explicitly acknowledged the gender dynamics throughout her interview, as well as in her diary entries. She attributed her difficulties with her group work to being the only woman in the group, and openly expressed a belief that "girls do work a lot harder than boys." Although she had male friends on the course, she wished there were more women on her course that she could get to know and collaborate with. Yasmin also wished for more female representation, particularly among the academic staff. Her friendship with Emma and with other women on the course helped her increase her confidence, which sometimes suffered when she was in otherwise all-male groups. Emma, by contrast, did not see the gender balance on her course as having much of an effect on her learning, and had been pleasantly surprised by not encountering the sexist attitudes she had been led to expect.

Holly did not think that being a woman on an engineering course had impacted her, answering "Not really, not too badly anyway" when asked directly about this. However, throughout her interview she alludes to experiences that could be understood as sexist microaggressions, such as having male teammates rewrite her work, attempt to assign her only administrative tasks, or tell her to make the group poster "look pretty."

Although determining the information behaviour of participants was not an explicit research question of the study, some common features of their information behaviour have become apparent. All four participants were heavy users of Google (and to a lesser extent, Google Scholar) for their information seeking, and none mentioned using library databases. This could have been due to all participants being at fairly early stages in their studies. As noted in prior research, many engineering students do not make use of more complex, scholarly information until the latter years of their degrees [39], [40]. Use of explanatory videos was also popular, which supports earlier findings that engineering students often prefer video sources such as YouTube [36], [37].

The masculine learning environment could have shaped the participants' information behaviour through the use of shared documents. Holly, Rose and Emma all discussed creating shared documents to enable collaborative information sharing, and as a way of taking control of the work in the absence of input from their male teammates. In Emma's case, she explicitly described the shared document as a method of accountability with her teammates, and as a form of collaborative behaviour that she expected would be required in professional practice. Coordinating information sharing as part of a design project is one of the recommendations of Fosmire and Radcliffe's Information-rich Engineering Design model [32], and is often neglected in engineering student work [33], so it is interesting to see the women in this study leading on this form of knowledge management.

The influence of affective needs such as social belonging and self-confidence can be seen in the participants' use of non-human sources. All four participants indicated they preferred to search for information on their own before asking others, though motivations for this varied. In Emma's case, she put this down to not wanting to "bother" other people without having put in some effort herself to begin with. Rose discusses not wanting others to know that she doesn't know something, but attributes this to her competitive nature rather than a lack of confidence. Holly's preference for searching for information alone rather than asking others may be related to her negative opinion of the knowledge and skills of her classmates. Yasmin is highly concerned with appearing knowledgeable, so is reluctant to ask others for information in case this exposes her lack of knowledge. It was only studying alongside Emma, and realising that she was also struggling with the same topics, that gave Yasmin the courage to ask a lecturer for more detailed guidance. It is perhaps relevant that Yasmin was the only visible woman of colour in the pilot, so this compounding marginalisation could potentially contribute to her sense of needing to prove her knowledgeability.

Conclusions

The pilot study was a successful test of the research instruments, confirming that the study design is feasible and appropriate for addressing the research questions.

The diary instructions did not present any difficulties for participants to follow. All four participants provided written entries and photos, and one also included videos. The amount of material varied considerably: one participant included only half a page of bullet points and three screenshots, while another produced a 13-page document including detailed written entries and photos, along with a folder of video recordings. However, despite the variation in breadth and depth of the diary material, all four interviews were lengthy and productive. There did not appear to be a correlation between the detail of the diary entries, and the richness of the interview data. There was a small concern that providing the lead researcher's diary entries as an example may have led all participants to produce very similar diaries, however this did not occur. As three of the four participants asked for examples before keeping their own diaries, and all four seemed to find having an example reassuring without feeling the need to copy the format exactly, this will be continued for the full study.

Some minor amendments are being considered for the main stage data collection, based on the experience from the pilot study. This will include revisions to the recruitment process, the structure of the interviews, and the interview questions.

At the recruitment stage, it was notable that of the seven potential participants who initially expressed interest, the four who ultimately joined the study were all British and English-speaking. The two overseas students who did not speak English as a first language did not respond to the invitation to the initial meeting. From such a small sample, it is possible that this was just random chance. However, to ensure inclusive recruitment, it is important to reflect on if there was anything in the study design and invitation emails that may have discouraged non-native English speakers from joining the study. Several amendments are being considered to encourage participation from overseas students who may not have English as a first language. This will include offering the option to submit their diary entries in their first language and/or in non-written formats such as images or voice recordings, providing interview questions in advance, and offering alternatives to a verbal interview if the participant is not confident in their spoken English. It is possible that a simple reassurance in the invitation email that 'perfect' English is not expected may help encourage participation.

The interviews themselves relied more heavily on the diary entries than had been anticipated. The bulk of the time in each interview was spent discussing the diaries, asking clarifying and follow-up questions. In Emma's interview, we ran out of time for the remaining questions so skipped most of these. One simple amendment that will be made for the main study is to expand the time for the interviews. For the pilot, participants were told that interviews would take approximately one hour. While this was just enough for three of the interviews, the fourth would have benefitted from more time. For the main stage data collection, participants will be asked to attend interviews for 60-90 minutes. The additional half hour may not always

be required, but it is felt to be better for participants if the interviews take less time than they expected than more.

The interview questions will also be amended based on experience from the pilot study. During the pilot interviews, the discussion of the diaries yielded far richer conversation than the scripted questions. When the scripted questions were reached, they often felt repetitive, as they covered ground that had already been discussed through the diary conversation. For the main stage data collection, rather than using these scripted questions, the whole interview will be based around the diary entries. Most of the scripted questions will be rephrased as prompts to use at relevant points in the diary discussions, based on the lead researcher's examination of the diaries prior to the interviews. They will still be retained as back-up questions, in case any participant either does not complete their diary, or the conversation around the diary is shorter than expected.

However, the scripted questions that ask specifically about the participants' experiences as women on male-dominated courses and about the masculine environment of engineering courses will be retained. These questions were deliberately placed at the end of the interview schedule to determine if and how participants discussed their gendered experience without prompting. Rose was the only one of the four pilot study participants who brought up gender-related experiences unprompted, but all four had interesting comments to make on this topic once explicitly asked about it.

The scripted questions also included some example statements taken from Women's Ways of Knowing [13] (see question 9, a-d, Appendix D). This was a seminal study published in 1986 that aimed to include women in the then nascent field of personal epistemology, which up to that point had been based almost exclusively on the study of male subjects. These questions aimed to address research question five: "Is personal epistemology, specifically Women's Ways of Knowing, a useful lens through which to examine women engineering students' information experiences?" However, the research participants all appeared nonplussed by these statements, and the conversation around them yielded little illuminating data beyond what had already been discussed. These statements will therefore be removed for the main stage data collection, although Women's Ways of Knowing will still be used as a sensitising lens during the analysis.

Data collection will continue from January to April 2025. At time of writing, recruitment has begun for this main phase of data collection. Contact has been made with three other UK universities, selected for their contrasts in size, location, and student demographics, with each other and with the pilot institution. Analysis of the data from the pilot will continue alongside the main stage data collection. Reflections and insights from this process will continue to inform data collection on an ongoing basis.

Women engineering students are an under-studied group in LIS literature. Preliminary results from the pilot study indicate some findings that are consistent with previous literature about engineering students, such as the preference for web-based and non-scholarly sources; while others may indicate a departure from previous research, such as the leading role the women in

the pilot study take in collaborative information sharing. It is hoped that the findings of this study, once complete, will help librarians and engineering faculty to better understand the specific information experiences of this under-represented group.

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Appendix A: Articles published in the Journal of Engineering Education in 2023-24 with the keywords "women" or "gender"

Beagon, U., & Bowe, B. (2023). Understanding professional skills in engineering education: A phenomenographic study of faculty conceptions. *Journal of Engineering Education*, *112*(4), 1109-1144. https://doi.org/https://doi.org/10.1002/jee.20556

Chen, X.-Y., Usher, E. L., Roeder, M., Johnson, A. R., Kennedy, M. S., & Mamaril, N. A. (2023). Mastery, models, messengers, and mixed emotions: Examining the development of engineering self-efficacy by gender. *Journal of Engineering Education*, *112*(1), 64-89. https://doi.org/https://doi.org/10.1002/jee.20494

Dickerson, D. A., Masta, S., Ohland, M. W., & Pawley, A. L. (2024). Is Carla grumpy? Analysis of peer evaluations to explore microaggressions and other marginalizing behaviors in engineering student teams. *Journal of Engineering Education*, *113*(3), 603-634. https://doi.org/https://doi.org/10.1002/jee.20606

Halkiyo, A. B., & Hailu, M. F. (2023). Black women's placemaking in undergraduate engineering. *Journal of Engineering Education*, *112*(4), 918-937. https://doi.org/https://doi.org/10.1002/jee.20545

McIntyre, B. B., Scalaro, K., Godwin, A., Kirn, A., & Verdín, D. (2024). Exploring experiences that foster recognition in engineering across race and gender. *Journal of Engineering Education*, *113*(4), 1265-1286. https://doi.org/https://doi.org/10.1002/jee.20587

Patrick, A., Andrews, M., Riegle-Crumb, C., Kendall, M. R., Bachman, J., & Subbian, V. (2023). Sense of belonging in engineering and identity centrality among undergraduate students at Hispanic-Serving Institutions. *Journal of Engineering Education*, *112*(2), 316-336. https://doi.org/https://doi.org/10.1002/jee.20510

Schonning, A., & Perez, S. M. (2024). Impact of an immersive engineering program on children's understanding of and interest in engineering: Addressing gender stereotypes. *Journal of Engineering Education*, *113*(4), 1226-1244. https://doi.org/https://doi.org/10.1002/jee.20617

Appendix B: Methods used in reviewed papers

Method	No. of papers	Paper citations
Quantitative methods		
Questionnaire surveys	15	[18], [19], [24], [25], [27], [28], [34], [36], [38], [39], [41], [42], [57], [58]
Self-assessment surveys	9	[23], [43], [53], [61], [63], [64], [65], [66], [72]
Pre- and post-test	4	[44], [45], [51], [60]
Citation analysis	3	[47], [52], [73]
Grade comparison	2	[40], [49]
Multiple choice test	2	[64], [65]
Qualitative methods		
Semi-structured interviews	8	[4], [19], [22], [36], [41], [42], [68], [69]
Reflections	6	[30], [48], [50], [54], [55], [56]
Literature review	4	[9], [29], [33], [62]
Focus group	3	[19], [43], [69]

Appendix C: Pilot diary instructions

Thank you for taking part in this research project. For this first stage of the project, I would like you to keep a diary of your **information experiences** over the next few weeks. I will then interview you, using these diary entries as a starting point.

What is information?

For the purpose of this study, "information" means anything that *informs* you. As in, anything that you learn from, or that helps you understand, in the context of your current course. This could mean any of the following:

- lecture slides and notes
- conversations with your lecturers or classmates
- books or articles from your reading list
- websites, YouTube videos or podcasts
- data generated from lab experiments
- and much more.

The above are just some examples, but many more things could be considered as information. Basically, if you feel like you learned something from it, it is information!

What is an "information experience"?

Information experience refers to any time you engage with information. This may include any of the following, although note this is not an exhaustive list:

- Seeking out information, e.g. searching online or talking to someone.
- Encountering information accidentally, e.g. seeing or hearing something useful when you weren't actively looking for it.
- Searching for information, e.g. via a search engine or online library systems.
- Browsing information, e.g. scrolling TikTok or wandering along the library shelves.

What do I need to record?

Please make a note of any ways that you engage with information, as defined above, while you are working on assignments for your course over the next few weeks. Ideally, please record these as they happen or shortly after, so the experience is fresh in your mind. However you can also record things retrospectively, for example if you only realise later that something you experienced was informative.

You can record in any format you prefer. This may include for example short written entries, voice recordings, photos, video clips, drawings, mind maps, or any mix of these. Entries can be as long or as short as you prefer.

Please feel free to look at my own diary entries [link] for an example, but please interpret this diary task however you choose.

How many diary entries do I need to submit?

That is up to you, it depends on how much you want to share! As a guide, I would hope to see at least one entry per week over the period you are keeping this diary.

How do I submit my diary entries?

You will be provided with a Google folder, to upload your entries in whatever format. It would help if you put the date in the file name, e.g. 24Oct2024.jpg.

If you have any trouble uploading files to the Google folder, please let me know.

Is there anything I shouldn't record?

Please be aware of other people's privacy when making your diary entries. Particularly if you are submitting photos or videos, please do not include identifiable individuals in these. If you do include people in photos or videos, please obscure their faces. Most smartphone camera apps will allow you to blur or hide faces, and there are several free apps for iOS and Android that will blur faces in videos, but please contact me if you are unsure of how to do this.

What if I have other questions?

If you have any questions at all, please contact me on [email address redacted]. I will also stay in touch with you throughout the diary period with a weekly reminder to upload your diary entries.

Appendix D: Pilot interview protocol

Preamble

Thank you for agreeing to participate in this research. I'm going to ask you some questions, both about the diary you have been keeping and also about your general experiences as a student. I may ask follow-up questions to go into further detail on some of your answers. Please do share anything you think of - anything you choose to say in this interview is relevant for my research.

If at any point you wish to stop the interview, please just let me know and we can stop immediately. You do not need to give a reason for this, and you will still be paid for your time.

In case this discussion brings up any memories or experiences that were unpleasant or distressing to you, I've put together a list of resources to go to for further support if needed. [Hand over resource list].

To help me analyse this interview, I'm going to record this [audio/video, depending on if in person or online]. Is it ok with you if I start the recording now?

Interview questions

1. I'm interested in how you use information to learn on your course, so thank you for keeping this diary of your information experiences. Please can you talk me through these entries/photos/etc?

Insert here clarifying/prompting questions about the participant's diary.

2. If you don't know something, how do you approach this?
   a. *Clarification if needed: for example, do you prefer to ask other people or to try to work it out yourself?*
3. Think about a time when you were struggling to understand something on your course. What did you do to help you understand it?
   a. *Could offer clarification/examples if needed, e.g. ask someone, search online, review your notes.*
4. Still thinking about a time when you were struggling to understand something. Can you remember how it made you feel?
5. Think about a time when you successfully found some information that helped you understand something. How did you go about this?
6. Still thinking about when you successfully found some information. Can you remember how it made you feel?
7. Can you think of any occasions when you shared information with others on your course, or others shared information with you? Could you describe this?
   a. *Possible follow ups: how did others respond to you sharing information, do certain people on the course share more than others, how is information shared in group work?*

8. Can you tell me about the practical work you have done, for example in labs? For example, have you had the opportunity to use hands-on equipment in labs, or observe others doing so?
    a. *Possible follow-up question: would you consider your lab experiences as a useful form of information?*
9. I'm going to share some statements with you. For each one, I would like to know whether you agree or disagree. There are no right or wrong answers, I'm interested in your opinion.
    a. I can trust that what my lecturers say is correct, because they have access to all the facts. Whereas other students might be sharing their opinions, but they might not be correct.
    b. There are some areas, like maths and science, where the answers are definite and you just need to learn the facts. But in other subjects, like arts and literature, I think anybody's opinion is as good as another.
    c. If someone says something I disagree with, I like arguing the opposite, thinking of exceptions to what they've said, or thinking of a different train of logic to decide what's right.
    d. If someone says something I disagree with, I'll usually try to look at it from that person's point of view, to understand why they might think that.
10. Do you think your experience of being a woman in an engineering class has impacted your learning?
11. Engineering courses have sometimes been described as having masculine environments. Would you agree or disagree with that? Why/why not?
12. Is there anything else I haven't asked about that you would like to share?

Closing

Thank you for your time today, and for keeping your diary prior to the interview. I'm going to stop the recording now.

As I mentioned at the start, if anything we discussed today has been upsetting for you, or if you feel upset later, please use the list of support resources I gave you at the start.

After we've met today, I'm going to transcribe this interview verbatim. No one other than me will see/hear the recording, but your anonymised transcript may be made available to other researchers. I will share the anonymised transcript with you beforehand, and you can opt to remove this from any shared datasets if you prefer.

I will analyse this interview along with others I am conducting for this study, and the results will be used in my PhD thesis. If you are interested in what other participants have said in this study, I am happy to share a summary of my findings with you.