

# Towards Scaling External Feedback for Early-Stage Researchers: A survey study

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**Abstract.** Feedback on research artefacts from people beyond local research groups, such as researchers in online research communities, has the potential to bring in additional support for early-stage researchers and complementary viewpoints to research projects. While current literature has focused primarily on early-stage research seeking or getting support for research skills development in general, less is known about, more specifically, empirical understanding of how early-stage researchers exchange feedback with external researchers. In this paper, we focus on understanding the critical types of external feedback that early-stage researchers desire and the prevalent challenges they face with exchanging feedback with external helpers. We report on a large-scale survey conducted with early-stage researchers of diverse backgrounds. Our findings lay the empirical foundation for informing the designing of socio-technical systems for research feedback exchange.

**Keywords:** Early-stage researcher · feedback · survey.

## 1 Introduction

Feedback on research activities is a critical element for improving research skills, such as feedback on research planning [23] and feedback on research papers [19]. The feedback is especially essential for Early-Stage Researchers (ESRs), who are typically PhD students [22]. However, most ESRs get limited feedback from a small circle of advisors, reviewers and peers [23]. This is a growing challenge as the number of research students is increasing, while dedicated on-demand feedback is hardly scalable – advisors have limited time and resources to provide timely and personalized feedback to multiple ESRs [23, 5].

Emergent literature and practices are starting to see the potentials of socio-technical affordances for exchanging feedback among people beyond local networks [19, 23]. Socio-technical systems are affording feedback exchange for academic skills development [15], professional development [8, 16], creative design [5] and creative writing [7, 2].

With socio-technical affordances, research students can engage in authentic research projects with online mentorship and get feedback during the projects [23, 19]. For example, agile research studios (ARSs) scale mentorship on both research planning and getting help on their research projects [23]. With ARSs, each advisor can mentor about twenty students within a traditional laboratory. As another example, Crowd Research [19] operates at a much larger scale and with more diverse participants focusing on providing open access to research experiences from seeding initial ideas to writing the final research paper. The majority of the participants were from universities lacking research training support. These efforts are attractive because they enable more people to get access to research experience and enable an advisor to coordinate students at a larger scale and with more diversity. They also provide access to distributed external feedback and expertise that were not traditionally available. However, they still rely on principal investigators and advisors scaling their efforts.

Thus, it is clear from literature (e.g., [1, 19, 23, 15]) that ESRs wish to have external feedback on their research projects, and socio-technical systems hold the potential to afford the feedback exchange process. However, quantitative empirical understandings of ESRs' desire for external feedback on various types of research artefacts is under-explored. Meanwhile, ESRs may face challenges when seeking or adopting external support [1]. For example, many ESRs concern the potentially vague or overly concise answers to inquiries, which may lead to misinterpretation. However, quantitative empirical researches on the challenges of seeking and adopting external feedback on research projects are lacking.

In this study, we build on literature about opportunities and challenges about seeking support on research skills development [1] and extend the literature with quantitative empirical understandings of how ESRs get external feedback. More specifically, we aim to identify, among all the challenges faced by ESRs with getting external support, the challenges that future systems on exchanging research feedback need to prioritize to solve. We also aim to prioritize the types of external feedback that future systems to focus on. These priorities may allow practitioners and researchers to reflect on, as well as design systems or conduct research studies with more evident objectives. Hence, we aim to answer the research questions:

**RQ1:** What types of external feedback ESRs most desire and why?

**RQ2:** What challenges about exchanging feedback with external researchers need to prioritize to solve?

To answer the questions, we performed an online survey study with ESRs of diverse fields of study, geographic locations and opportunities in terms of accessing research support. The goal was to obtain the most varied perspectives. The survey inquired ESRs about how useful they perceive various types of external feedback, how frequently they wish to have each type of external feedback, and their perceptions on the challenges of external feedback on their research projects.

This study revealed that the majority of ESRs perceive external feedback on research methods and paper drafts as being both very useful and frequently

desired. Most ESRs faced challenges with adopting external feedback, including concerns regarding the qualifications of helpers, quality of the feedback and timeliness. We also found that ESRs' background, including disciplines and access to local support, influence their desire for external feedback and the challenges they face with external feedback. Thus, the design of socio-technical affordances for research feedback exchange should consider the target users in prioritising needs and implementing collaboration models. Based on the findings in this study and related literature, we discuss how our results lead to design implications for scaling feedback on research artefacts. The findings lay the empirical foundation for informing future research and designing socio-technical systems for research feedback exchange.

## 2 Background and Related Work

We begin with an overview of how researchers are interacting within online communities. The emerging interactions in the communities bring numerous challenges.

### 2.1 Researchers' Interaction with Online Communities

Previous literature studied what researchers desire from online communities. Some researchers use ResearchGate and Academia.edu for social networking purposes, such as building communities and following research news [21]. Jeng et al. [9] studied how researchers exchange information and resources with ResearchGate Q&A and found that researchers providing answers to questions and share resources (e.g., references and links). Some researchers also communicate with the general public using platforms such as Reddit [11]. Other examples include ResearchBlogging.org for scholarly blogging, Publons for open reviewing scientific papers [17], and Mendeley for creating profiles with publications, research interests, awards, and grants [9, 21]. Our previous work studied how ESRs leverage socio-technical affordances for external support [1]. We found that ESRs inquire online for other researchers' experience with research exploring process, explanations on concepts or theories, and brief introductions to research tools. Despite many studies showing that online communities and socio-technical affordances are enabling researchers to communicate with external researchers and general public, none of these studies focused on understanding ESRs exchanging feedback on research artefacts within online research communities. In this study, we further explore what are the prevalent types of external feedback that ESRs desire, as well as how ESRs' perceptions vary across disciplines and other demographic information.

### 2.2 Challenges Faced by Researchers when Seeking External Support

Studies have shown that researchers face challenges and barriers with seeking and adopting support and inputs from external communities. For example, al-

though researchers can gather contributions from millions of volunteers with the availability of citizen science platforms (e.g., Zooniverse, eBird), many researchers still hesitate to adopt the platforms for generating, processing or analyzing research data [13]. We also previously reported on an in-depth interview of how early-stage researchers faced challenges and concerns when seeking support from online research communities [1]. We discuss below some of the salient challenges reported in the literature during seeking support, interacting with external helpers and adopting support.

**Seeking support:** Researchers may hesitate to seek for external support for cultural, personal and project factors. For example, some researchers faced ethical issues that sensitive research data cannot be shared [13]. Van [21] found that some researchers are afraid that some online platforms would use the researchers’ information in ways that they are not comfortable with. Some researchers, especially early-stage researchers, were afraid to expose weakness or pose as incompetent with an online profile [1].

**Interacting with external helpers:** When interacting with external helpers for support, researchers also faced communication challenges. Examples include explaining their research projects and their need for support to external helpers; and getting instant replies that is productive.

**Adopting support:** When adopting external help, many researchers concerns of the qualification of the helpers and quality of feedback or inputs from the helpers. For example, many researchers hesitate to adopt citizen science platforms for generating, processing or analyzing research data [13]. Reasons include the involvement of unqualified crowds in tasks requiring subject matter knowledge, quality control in crowdsourcing and unintended consequences of poor quality-control methods (e.g., intellectual property and privacy risks; malicious attacks) [6]. These issues may impact the validity and quality of research findings [13].

While the prior work helps us identify the challenges that researchers face with external support, we do not have a good understanding of how prevalent are the challenges for ESRs. We also do not adequately understand how the challenges are differently faced by ESRs of various backgrounds. This study helps to further understand the challenges that warrant further investigation and derive design requirements for feedback exchange system design.

### 3 Method

The goal of the study is to increase the quantitative empirical knowledge on ESRs’ desires and challenges with seeking and adopting external feedback on research artefacts, with the purpose of identifying promising paths for future research and designs that scales feedback exchange on research artefacts. To

help realize this goal, we build on prior work which identified the how ESRs seek support online and the challenges they faced while seeking support with socio-technical systems. We designed and conducted a survey to prioritize the and the challenges to solve.

**Participants.** We conducted online surveys with ESRs of diverse fields of study, geographic locations and opportunities in terms of accessing research support. The goal was to obtain the most varied perspectives. Respondent recruitment was open to ESRs who were PhD students or recently completed PhD study. We focused on ESRs with recent research activities, as they would more accurately recall specific details about their experience with seeking feedback [18, 14]. The survey was distributed through various channels including mailing lists, snowball sampling, online discussion groups and social media platforms. Participation was voluntary. We distributed the same survey with different anonymous links for each channel to record which channel a respondent came from, in case of the potential noise in the responses. For any type of communication with respondents, we send individual emails or messages to protect their privacy and identity information.

**Survey design.** Our survey<sup>4</sup> followed several iterations of design and was based on literature on online feedback exchange (e.g., [2, 4, 7]) and our previous work [1, 10]. In the survey, we first inquired about the researchers’ demographics. Then, we inquired respondents about whether they wished to have external research feedback. Those who reported wishing to have external research feedback (either sometimes, often or always) were further inquired about what types of external feedback they desired and what are the most salient challenges seeking the feedback. More specifically, we inquired them how often they wished to have external feedback on a set of research activities, as well as how useful they perceive the feedback (N1-N5). For each type of external feedback, we asked respondents two questions: (i) *how often they wished to get the type of external feedback* (selecting from “never, rarely, sometimes, often and always”), and (ii) *how useful they perceive each type of external feedback* (selecting from “not at all, slightly, moderately, very and extremely”). We also asked whether they need other types of feedback that we did not consider.

We also aimed to understand the challenges that ESRs faced with external feedback on their research. Informed by the challenges with exchanging support with external helpers 2.2, we list the potential challenges with exchanging feedback on research artefacts with external helpers as in Table 1. We asked the respondents Likert-style questions on each of the challenges: how much they agree with the challenges, selecting from strongly disagree, somewhat disagree, neutral, somewhat agree and strongly agree. We further inquired open questions about any additional challenges they faced.

Respondents who never or rarely desired external research feedback skipped the questions about seeking external feedback. We inquired them about their

<sup>4</sup> The full survey is available at <https://bit.ly/3bOkwzX>

Table 1: Potential Challenges Faced by ESRs with External Feedback on Their Research

Requesting Feedback	C1	I feel suspicious of online helpers' intentions to give feedback.
	C2	I am afraid to expose weakness or pose as incompetent with a (public available) profile.
	C3	I may feel disappointed and frustrated when getting no responses after asking for feedback and thus drawing me back from asking for further feedback.
	C4	I am afraid that sharing pieces of my research online before publishing might introduce confidentiality / privacy / IP conflict problems, or compromise my research.
Interacting with external helpers	C5	I might not get an instant reply while discussing on my research artifacts. Thus the conversation on the feedback is not productive and fruitful.
	C6	The mostly text-based interaction in online communities pose limitations in properly explaining my inquiries and understanding helpers' feedback.
Adopting Feedback	C7	The ambiguity of the helpers' authority and qualification to answer my inquiry.
	C8	Quality of feedback not up to the standard for scientific use (e.g., no references given).
	C9	Online help failing to provide precise and complete answers to your research inquiries (e.g., no rationale).
	C10	Feedback not timely for my deadlines.

experience and perceptions about providing feedback to other researchers as helpers. More specifically, we asked them their perception on their capability to offer feedback on other' research, the frequency that they offer feedback to other, and what motivated them to give feedback and prevented them from providing feedback to others.

By the end of the survey, we asked respondents to share their positive and negative experience with external research feedback. We describe our analysis approach and the limitations as we present results to each research question.

## 4 Results

We collected 120 responses from ESRs of diverse demographic information<sup>5</sup> in terms of gender (female 49.2%, male 46%, NA 4.1%), geographic location (Oceania 49.2%, Europe 21.3%, Asia 13.9%, Latin America 8.2%, Africa 6.6%, Canada and USA 0.8%) and research experience (years since starting PhD, 1- 5+ years). In terms of field of study, they were generally grouped into Science, Technology, Engineering and Mathematics (STEM) (58%) and Humanities, Arts and Social

<sup>5</sup> Full demographic information at <https://bit.ly/2MVgPP8>

Science (HASS) & Interdisciplinary (42%). 94 respondents(78%) reported wishing to have external feedback either sometimes, often or always, while the rest 26(22%) reported never or rarely needed external research feedback. In the following sections, we present the results from our analysis of the survey responses to answer our research questions.

### 4.1 ESRs’ Most Desired Types of External Feedback

Our first research question (**RQ1**) inquires about what types of external feedback are essential to ESRs. For each type of feedback that we listed (N1-N5), respondents who reported wishing external feedback indicated how often they want to have the input and how useful they perceive the feedback from external helpers. We also asked respondents for their comments on the types of feedback and asked them to add other types of feedback they wish to have.

To identify the most important types of external feedback in overall, we draw an impact matrix with (*Frequency*) and (*Usefulness*) of each type of external feedback (N1-N5). The *Frequency* is demonstrated by the percentage of respondents who sometimes, often or always wished to have external feedback on their research (%). The *Usefulness* is demonstrated by the percentage of respondents who perceived external feedback on their research to be moderately, very or extremely useful (%). The resulting matrix, as captured in Figure 1, highlights external feedback on *research methods* (N4) and *paper drafts* (N5) as being both very useful and frequently desired in overall.

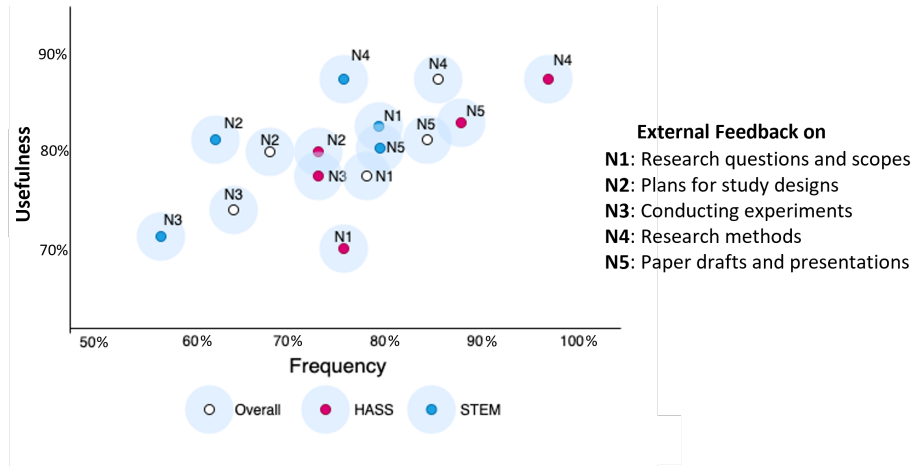


Fig. 1: The impact matrix.

**Frequency of desire for external feedback.** The results indicate that there is a frequent desire for external feedback on the five artefacts (N1-N5). Respondents reported desiring external feedback support (sometimes, often or always) especially for research methods (N4, 86% of respondents) and paper drafts and presentations (N5, 84%). These artefacts are followed by research questions (N1, 68%), plans for studies (N2, 68%) and, lastly, support for conducting experiments (N3, 66%).

Breaking down the analysis by field of study we can see some differences (Figure 2). Overall, we observed a higher number of responses expressing needing external feedback among HASS (80%) compared to STEM (73%) ESRs. In terms of specific artefacts, HASS students follow the general trend, reporting a higher need for external support on research methods (N4, 95%) and paper drafts and presentations (N5, 87%). For STEM students, instead, expressed higher need for external support on research questions and scope of their research (N1, 81%) along with paper drafts and presentations (N5, 81%). This suggests that the need for support, as well as the preference might change according to the field of study and community.

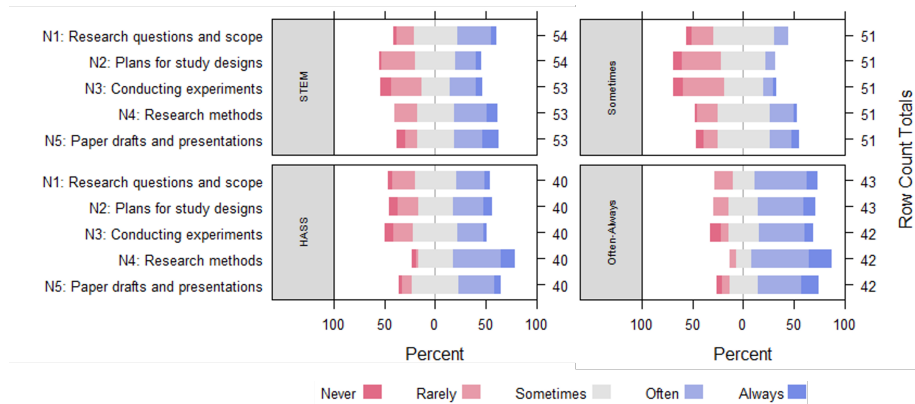


Fig. 2: Divergence analysis of frequency of desire for feedback by type of artefact, field of study and need for support.

We also wanted to get insights on whether the availability of resources also influenced the desire of different types of external feedback. For this, we took the self-reported wish for external feedback, indicated at the start of the survey, as a proxy for the feedback available to the ESR.<sup>6</sup> Those who expressed wishing external feedback often and always were considered as being in higher demand for feedback (potentially low support available), while those who only wished for

<sup>6</sup> We did not consider geographical location due to the distribution of responses, and for not being a reliable indicator of the individual circumstances of the ESRs.



feedback sometimes as being in lower demand (potentially higher support available). We found that those who occasionally require external feedback mainly wanted feedback on N5 (80%) and N4 (78%), which are more about feedback on research methods and papers. This group of ESRs may find external feedback to be useful for some alternative viewpoints or validation on their research activities. For example, four respondents mentioned that they wish to get external feedback on whether they considered all important related work in their papers. As one respondent explained that “*I hope I can get some advice about related work on a research topic, so that I may not omit possible related works*”. Another ESR asked his peers to “*read short extracts of my work to see if it makes sense to them*”. On the other hand, those who wanted external feedback more often expressed their desire for external feedback on all aspects through out a research life-cycle. Indeed, besides the higher need for feedback on research methods (N4, 95%), all other types of feedback were on a narrow range (83%-88%).

We also investigated if there were any relationship between the level of desire for external feedback and the ESRs’ gender and research experience. We found that, among those who desired external feedback often or always, 21 were female ESRs and 18 were male ESRs, which demonstrates relatively balanced gender distribution. As for the relationship between years of research experience and desires for external feedback, we found that ESRs desire external feedback regardless of the research experience they have.

What the above suggests is that the need for external feedback can be influenced by the discipline and available resources. The design of socio-technical affordances for research feedback exchange should consider the target users in prioritising needs and implementing collaboration models.

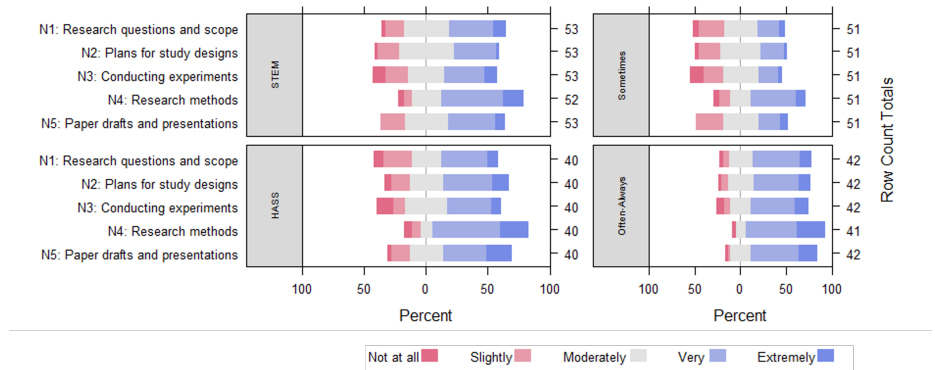


Fig. 3: Divergence analysis of perceived usefulness for external feedback by type of artefact, field of study and need for support.

**Perceived usefulness of external feedback.** In addition to the frequency of desiring external feedback, we also studied ESRs’ perceived usefulness of external feedback. The resulting Likert-scale analysis as in Figure 3 revealed that the differences in perceived usefulness follows the same trends as observed before. People who only occasionally need support find it less useful and those in more need find it more useful. Furthermore, as shown in Figure 1, comparing with HASS respondents, STEM respondents reported experiencing the need for external feedback relatively less often, but considering the feedback as more useful. Meanwhile, nine respondents reinforced, in their open-ended text responses, the usefulness of insights on the overall research scope (N1) from industry practitioners and researchers not in the same research domain as the ESRs. They wished to get feedback on how their research can contribute to other related research fields and related industry practices, as well as how they can build on knowledge from other research domains and industry practices. For example, respondents mentioned that they wish to get feedback on how to “*position better my research to current challenges in the industry*” and “*What other domain knowledge may improve my work?*”. We note that ESRs’ perceptions of usefulness may be biased by previous experiences and challenges faced when requesting and adoption external feedback. We investigate the challenges they faced before about external feedback in the next section.

**Additional artefacts.** Some respondents shared other types of feedback that they wish to get from external helpers, which are not directly related to a research project but is important to them as a researcher. Examples of such activities that ESRs wish external feedback on include “*grant and scholarship application*”, “*relationship management with research stakeholders*” and “*research networking opportunities*”.

## 4.2 The Challenges ESRs Face When Seeking External Feedback

Although the vast majority of respondents expressed that they wish to have options to connect with more people with expertise in the research area besides supervisors, our study revealed that they also face many challenges to seek, communicate on, and adopt the feedback. In this section, we discuss the findings to **RQ2** to explore the prevalent challenges faced by ESRs in overall, and explore how the challenges ESRs face vary across disciplines and their overall need for external feedback. We also discuss the additional challenges raised by survey respondents.

**How prevalent the challenges are for ESRs in overall.** To understand how prevalent are the challenges, for each challenge, we analyzed the percentage of survey respondents agreeing with the challenge. The results are shown in Table 2. Beyond indicating their agreement to the challenges, 29 respondents provided further comments either elaborating on those challenges or describing other challenges they experienced. In the following, we provide representative

respondent quotes, which is shown in italics. In the presentation of the challenges, we rely heavily on the ESRs’ own words to bring credibility to our findings.

We found that, for respondents in overall, the challenges (C1-C10) are widespread and faced by the majority of the respondents. However, challenges about adoption are mostly agreed by respondents that over 80% survey respondents had challenges with adopting external feedback. Among challenges with adoption, the ambiguity of the helpers’ authority (C7) is the most imposing challenge. As explained by some respondents in their open-ended text comments, qualified external helpers that ESRs wish to seek feedback from need to be expert in the research field or have successfully helped ESRs before: *“Whether I will seek help from others (especially for online forums) depends mainly on their authority and qualifications, or the number of people they have successfully helped (suggestions are accepted) before”*.

The second most prevalent challenge is about concerns around confidentiality and intellectual property (C4), which is the most salient challenge in requesting external feedback. An interesting theme emerged in respondents’ comments is that they concern less about disclosing ideas before publication when they are more experienced researchers: *“I (3rd Year PhD) have less concern about my niche and ‘originality’ now than in Yr 1. Hence more open to the idea of going to an online community for help.”*

Following is the concern of getting no responses, which echos previous research on feedback exchange in creative design communities that designers also hesitate to ask for feedback due to afraid of no response [5]. On the other hand, less of an obstacle, overall, is fear of exposing oneself online (C2) or suspicious about helpers intentions (C1). Interaction issues are present (C5, C6), though with less prominence as in requesting and adopting external feedback.

Table 2: Challenges Faced by ESRs with External Feedback on Their Research

		All (%)	Some -times (%)	Often- Always (%)	STEM (%)	HASS (%)
Requesting	C1	56	41	73	46	66
	C2	55	47	63	44	67
	C3	67	55	78	76	55
	C4	84	76	92	85	82
Interacting	C5	65	56	73	71	55
	C6	64	63	65	62	67
Adopting	C7	87	86	87	84	90
	C8	82	82	82	85	78
	C9	80	83	78	82	78
	C10	82	86	78	87	76

**Differences in challenges faced by ESRs of various backgrounds.** Besides analyzing the overall agreement with the challenges among all respondents, we also compare the prevalent of the challenges faced by ESRs sometimes desire external feedback and those who often or always desires external feedback; and compare the prevalent of the challenges faced by STEM ESRs and HASS ESRs. The results are shown in Table 2. We highlight some of the differences below.

Regarding overall need for external feedback, we found that respondents who occasionally desires external feedback faced challenges mainly with *adopting* the feedback. They concern about the timely and quality of external feedback, as well as how qualified are the helpers. Respondents who often or always want external feedback, instead, faced challenges distributing between requesting and adopting feedback. The most salient challenge they faced was concerning about getting their work stolen.

Regarding disciplines, we found that challenges with adoption is still the main barrier no matter the discipline groups. C10 is also the highest pain-point different between HASS and STEM respondents. The most salient challenge for STEM respondents is the timeliness of getting external feedback (C10). One respondent suggested “*introducing a deadline*” so that “*you know you get your feedback in time or also you know that the feedback you provide to others is still helpful*”. However, for HASS respondents, it is less of an obstacle not getting instant reply (C10) or even not receiving responses (C3). On the other hand, the most salient challenge for HASS respondents is the ambiguity of the helpers’ authority (C7). We also found that either exposing weakness online (C2) or suspicious of external helpers’ intentions (C1) is less of an obstacle for STEM respondents.

**Additional challenges.** Two other challenges emerged in the open-ended text responses. First, Some respondents raised the challenge with interpreting diverse viewpoints or balancing with difficulty the viewpoints in external feedback: “*There will be a lot of chances that the supervisors and others have quite a different world view and the PhD researcher will be like facing two different opposing forces*”. Meanwhile, receiving feedback from a different viewpoint is appreciated by many other respondents as a valuable learning opportunities: “*It’s help to get a different angle of observation because my supervisor, colleagues and me, we can have the same opinion or the opinion can be biased so it will be preferable to ask people outside the team for feedback.*” Then, another challenge raised was about formulating requests for external feedback. some respondents found it challenging to explain their research artefacts, such as a research plan, to the external helpers who are not familiar with the research project: “*One reason not to ask for help could be the effort it takes to prepare my questions in an understandable way. I would have to provide sufficient background which might take a lot of time (depending on how close the helper is to my topic and how specific my question is)*”.

### 4.3 ESRs' perception toward providing external feedback

We are also interested in ESRs' perception as helpers. In our survey, 26 respondents shared their experience and perceptions towards providing feedback as external helpers. 19 of the respondents (73%) thought that they were either moderately, very, or extremely capable of providing feedback to others or less-experienced researchers. However, 9 indicated that they sometimes provide feedback to others and 2 respondents often provide feedback to others. This gap implies that, in overall, ESRs help less than they are in principle able to do.

**Barriers to providing feedback to external researchers.** The respondents shared the barriers that prevented them from offering feedback on others' research more often. We grouped the barriers into three types, which are lack of feedback exchange opportunities, lack of time to contribute feedback and lack of support on providing feedback. First, some respondents mentioned that they did not see much opportunity to offer feedback on others' research. Two respondents explained that they were "*not being asked for such a feedback often*" or had "*not so much contact to other(s)*". Second, some respondents mentioned that prefer to spend time and effort on working on their own research project while not much time available to support each other in a research community: "*I work, study, and am trying to publish...there really is no time left for me to be part of this kind of community*". Third, some respondents were not confident enough to offer feedback on others' research. This barrier can be either lack of confidence in others' research fields, e.g., "*I don't know enough about their fields to really help*" or lack of confidence in offering feedback, e.g., "*not so experienced with giving feedback*".

**Motivations to providing feedback to external researchers.** Some respondents shared their motivations to provide feedback as an external helper, which we grouped into three types. First, some respondents wished to learn from other researchers. As explained by one respondent, he/she give feedback to others' research "*to help myself learn more and get response to my observation and finally enrich research*". Second, some respondents wished to build a better research community. One respondent explained that "*research is meant to help push the boundary of science and to ultimately benefit the society. I contribute if and when I have ideas that can help improve the quality of others' research*". Another respondent added that "*we are a community of learners, and I feel we have a duty to help each other out*". Third, many respondents provide feedback as a "*part of journal/conference peer review*" process.

Note that we did not aim to have a comprehensive understanding of all types of barriers and motivations. Other types of barriers and challenges may exist and need further investigation.

## 5 Discussion

In summary, we identified the most salient challenges that ESRs faced when exchanging feedback on research artefacts with external online research communities. The quantitative understanding of the challenges validate and extend the literature about challenges in obtaining external support for research skills. In addition, the findings about challenges also adds insights about the feedback providers' points of view. We discuss design requirements for future systems that aim at feedback exchange for research artefacts at scale.

### 5.1 Prioritized Desires for External Feedback

First of all, we found that, even for ESRs who already have access to resources within institutional frameworks, 78% of the respondents reported wishing to have external feedback in addition to the feedback from their supervisory teams. This finding reinforced and extend the argument about the need to provide open access to research training [19, 20, 23].

As we mentioned before, some research initiatives and systems have explored scaling research skills training opportunities, such as agile research studios (ARS) [23] and Crowd Research [19]. However, both ARS and Crowd Research still rely on advisors or principal investigators to lead the research projects. Furthermore, both of the systems focus on providing research projects and support throughout a full life-cycle of the projects. Thus, these systems are less attractive to those who already enrolled in a research program in research institutes and have supervisory teams. We found that research students who have support from research groups mainly desire alternative and complementary feedback from external helpers. Furthermore, the external feedback on research papers is perceived as important and useful for the majority of ESRs (more than 80%). Future research may prioritize to design systems that focus on providing external feedback on research papers.

In addition to feedback from experts in same research domains, some ESRs also wish to have feedback from industry practitioners and researchers from different but related research domains. They wish to have feedback on how their research can contribute to other research domains and industry practices, as well as how their research can build on other research domains and industry practices. This finding echos an aim of interdisciplinary research that brings researchers together to contribute their own disciplinary knowledge to a collective research project to produce greater insight into the subject and not to exclude certain bodies of knowledge [3]. Meanwhile, none of the respondents that expressed this wish self-identified as working on interdisciplinary projects. Future research can explore how to facilitate an online community that allow researchers to build the network and get access to external feedback.

## 5.2 Design Implications for Systems that Scale Feedback Exchange on Research Artefacts

In this paper, we explored and prioritized the challenges that ESRs faced with exchanging feedback on research artefacts with external online research communities. Based on the findings and related literature (e.g., [9]), we derived design implications for systems on scaling feedback exchange on research artefacts.

**Support researchers to collaboratively contribute feedback.** Through studying how ESRs perceive providing feedback to external researchers, we identified a gap between their self-identified ability to provide feedback and their actual efforts taken to provide feedback. Most ESRs are not providing feedback to external researchers. One of the reasons that our respondents provided was the lack of time to help others, since providing comprehensive feedback takes time and effort. Instead of each research providing formal comprehensive reviews, future systems may support a community of researchers to collaboratively contribute feedback. For example, crowdsourcing techniques have shown to be useful in distributing the effort of providing support and feedback to a community of helpers [2, 7, 10].

### **Guide and support reviewers to provide feedback on research artefacts**

As found in the study, another reason for researchers hesitating to provide feedback to other researchers is because they are not confident enough about their knowledge and experience in providing feedback. Future research may explore how to guide inexperienced reviewers to provide feedback on research papers and learn skills about reviewing research papers.

### **Help feedback requesters to interpret and reflect on the feedback**

As found in the study, the challenges of adopting external feedback are the most prevalent and faced by the majority of respondents. The top prioritized challenges are about identifying useful feedback and feedback that they can trust. Some respondents also added the challenge about balancing the viewpoints in feedback. In addition, we found in [1] that ESRs wish to have an overall understanding of the potentially large amount of feedback. Future systems can help ESRs interpret the feedback by summarizing all the feedback. Other potential ways to help identify useful feedback and reflect on feedback include collecting ratings on the feedback and discussing with experts on the feedback.

### **Support and guide ESRs to request external feedback**

In this study, we found that although the majority of respondents wish to get external feedback on their research artefacts, more than 50% of the respondents also hesitated to seek external feedback. First, the most salient challenge for STEM respondents is the timeliness of getting external feedback. Future systems may support feedback seekers to include a feedback deadline when they request feedback. Then,

respondents who have less local support on research skills training are concerned most about confidentiality and intellectual property issues. Future systems may support feedback seekers to seek feedback from selected groups or individuals of helpers that the requesters trust.

### 5.3 Limitations.

We mentioned some of the limitations during presenting the findings. First, ESRs' perceptions of usefulness may be biased by previous experiences and challenges faced when requesting and adoption external feedback. Second, as for ESRs' perceptions on providing feedback to external researchers, we identified some of the motivations and barriers to help. However, we did not aim to have a comprehensive understanding of all types of barriers and motivations. Other types of barriers and challenges may exist and need further investigation. As for the generalizability of the results, we conducted this study with 120 ESRs from diverse backgrounds, with various geographical locations, academic disciplines, years of doing research and balanced gender distribution. However, we only collected responses from ESRs who understood English. ESRs from less developed areas and with less access to research training might be benefit even more from external feedback than those privileged few at select universities [19, 12]. Furthermore, those ESRs may face other challenges when seeking external feedback and need other types of feedback that were not included in the findings of this study.

## 6 Conclusion & Future Work

This work contributes to the quantitative understanding of crowdsourcing support for research skills training. In particular, the results highlight the potential and need for tools to exchange feedback on research drafts within online research communities. Furthermore, the study showed that the desire for external feedback could be influenced by the discipline and available resources. The design of socio-technical affordances for research feedback exchange should consider the target users in prioritising needs and implementing collaboration models. Besides, the results also provide clear directions and priorities for further studies on scaling research training with crowdsourced support.

## References

1. Anonymous: The opportunities and challenges of using socio-technical systems to learn research skills from external communities (2021), unpublished
2. Campbell, J., Aragon, C., Davis, K., Evans, S., Evans, A., Randall, D.: Thousands of positive reviews: Distributed mentoring in online fan communities. In: Proceedings of the 19th ACM Conference on Computer-Supported Cooperative Work & Social Computing. pp. 691–704. CSCW '16, ACM, New York, NY, USA (2016)



3. Castán Broto, V., Gislason, M., Ehlers, M.H.: Practising interdisciplinarity in the interplay between disciplines: experiences of established researchers. *Environmental Science Policy* **12**(7), 922–933 (2009)
4. Chen, Y., Lee, S.W., Xie, Y., Yang, Y., Lasecki, W.S., Oney, S.: Codeon: On-demand software development assistance. In: *Proceedings of the 2017 CHI Conference on Human Factors in Computing Systems*. pp. 6220–6231. CHI '17, ACM, New York, USA (2017)
5. Cheng, R., Zeng, Z., Liu, M., Dow, S.: Critique me: Exploring how creators publicly request feedback in an online critique community. *Proceedings of the ACM on Human-Computer Interaction* **4**(CSCW2), 1–24 (2020)
6. Daniel, F., Kucherbaev, P., Cappiello, C., Benatallah, B., Allahbakhsh, M.: Quality control in crowdsourcing: A survey of quality attributes, assessment techniques, and assurance actions. *ACM Comput. Surv.* **51**(1), 7:1–7:40 (Jan 2018)
7. Evans, S., Davis, K., Evans, A., Campbell, J.A., Randall, D.P., Yin, K., Aragon, C.: More than peer production: Fanfiction communities as sites of distributed mentoring. In: *Proceedings of the 2017 ACM Conference on Computer Supported Cooperative Work and Social Computing*. pp. 259–272. CSCW '17, ACM, New York, NY, USA (2017)
8. Hui, J.S., Easterday, M.W., Gerber, E.M.: Distributed apprenticeship in online communities. *Human-Computer Interaction* **34**(4), 328–378 (2019)
9. Jeng, W., DesAutels, S., He, D., Li, L.: Information exchange on an academic social networking site: a multidiscipline comparison on researchgate q&a. *Journal of the Association for Information Science and Technology* **68**(3), 638–652 (2017)
10. Jiang, Y., Schlagwein, D., Benatallah, B.: A review on crowdsourcing for education: State of the art of literature and practice. In: *Proceedings of the 22nd Pacific Asia Conference on Information Systems*. p. 180. PACIS '18, AISEL, Japan (2018)
11. Jones, R., Colusso, L., Reinecke, K., Hsieh, G.: R/science: Challenges and opportunities in online science communication. In: *Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems*. pp. 1–14. CHI '19, ACM (2019). <https://doi.org/10.1145/3290605.3300383>
12. Kizilcec, R.F., Halawa, S.: Attrition and achievement gaps in online learning. In: *Proceedings of the Second (2015) ACM Conference on Learning @ Scale*. p. 57–66. L@S '15, Association for Computing Machinery, New York, NY, USA (2015)
13. Law, E., Gajos, K.Z., Wiggins, A., Gray, M.L., Williams, A.: Crowdsourcing as a tool for research: Implications of uncertainty. In: *Proceedings of the 2017 ACM Conference on Computer Supported Cooperative Work and Social Computing*. pp. 1544–1561. CSCW '17, ACM, New York, NY, USA (2017)
14. Marlow, J., Dabbish, L.: From rookie to all-star: Professional development in a graphic design social networking site. In: *Proceedings of the 17th ACM Conference on Computer Supported Cooperative Work Social Computing*. pp. 922–933. CSCW '14, Association for Computing Machinery, New York, NY, USA (2014). <https://doi.org/10.1145/2531602.2531651>, <https://doi.org/10.1145/2531602.2531651>
15. Motahar, T., Jasim, M., Ahmed, S.I., Mahyar, N.: Exploring how international graduate students in the us seek support. In: *Extended Abstracts of the 2020 CHI Conference on Human Factors in Computing Systems*. pp. 1–8 (2020)
16. Storey, M.A., Zagalsky, A., Figueira Filho, F., Singer, L., German, D.M.: How social and communication channels shape and challenge a participatory culture in software development. *IEEE Transactions on Software Engineering* **43**(2), 185–204 (Feb 2017)

17. Sugimoto, C.R., Work, S., Lariviere, V., Haustein, S.: Scholarly use of social media and altmetrics: A review of the literature. *Journal of the Association for Information Science and Technology* **68**(9), 2037–2062 (2017)
18. Torrey, C., McDonald, D.W., Schilit, B.N., Bly, S.: How-to pages: Informal systems of expertise sharing. In: Bannon, L.J., Wagner, I., Gutwin, C., Harper, R.H.R., Schmidt, K. (eds.) *ECSCW 2007*. pp. 391–410. Springer London, London (2007)
19. Vaish, R., Gaikwad, S.N.S., Kovacs, G., Veit, A., Krishna, R., Arrieta Ibarra, I., Simoiu, C., Wilber, M., Belongie, S., Goel, S., Davis, J., Bernstein, M.S.: Crowd research: Open and scalable university laboratories. In: *Proceedings of the 30th Annual ACM Symposium on User Interface Software and Technology*. p. 829–843. *UIST '17*, Association for Computing Machinery, New York, NY, USA (2017)
20. Vaish, R., Goyal, S., Saberi, A., Goel, S.: Creating crowdsourced research talks at scale. In: *Proceedings of the 2018 World Wide Web Conference*. pp. 1–11 (2018)
21. Van Noorden, R.: Online collaboration: Scientists and the social network. *Nature News* **512**(7513), 126 (2014)
22. Wang, T., Li, L.Y.: ‘tell me what to do’ vs. ‘guide me through it’: Feedback experiences of international doctoral students. *Active Learning in Higher Education* **12**(2), 101–112 (2011)
23. Zhang, H., Easterday, M.W., Gerber, E.M., Lewis, D.R., Maliakal, L.: Agile research studios: Orchestrating communities of practice to advance research training. In: *Companion of the 2017 ACM Conference on Computer Supported Cooperative Work and Social Computing*. pp. 45–48. *CSCW '17 Companion*, ACM, New York, NY, USA (2017)