frontiers | Frontiers in Education

TYPE Original Research
PUBLISHED 12 April 2024
DOI 10.3389/feduc.2024.1393183

OPEN ACCESS

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RECEIVED 28 February 2024
ACCEPTED 03 April 2024
PUBLISHED 12 April 2024

CITATION
Mori A (2024) Facilitating collaboration between Japanese high schools and universities: a qualitative exploration of the role of education outreach coordinators. *Front. Educ.* 9:1393183.
doi: 10.3389/feduc.2024.1393183

Facilitating collaboration between Japanese high schools and universities: a qualitative exploration of the role of education outreach coordinators

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Introduction: In recent years, universities have been expected to participate in Japanese high school education, especially in the "period for inquiry-based cross-disciplinary study." Despite various university faculties engaging in diverse educational practices, there is insufficient research on human resource development and the creation of mechanisms to ensure continuous development.

Methods: This study conducted semi-structured interviews from July to November 2023, with 15 educators from universities and high schools, among others, to explore the current state of educational collaborations between these institutions and identify potential solutions.

Results: A reflective thematic analysis of the interview identified two key themes: the significance of university involvement in high school education and conflict areas generated from this collaboration. The findings suggest that the success of these initiatives relies on the involvement of coordinators who possess a high level of expertise and competencies.

Discussion: These coordinators, who work in the "third space" in universities, are crucial for realizing the ideal outcomes of educational collaborations between universities and high schools in Japan's new educational environment.

KEYWORDS

qualitative research, STEAM education, school-university collaboration, coordinator, third space professionals, Japan

1 Introduction

In the Japanese education system, particularly at the high school level, there is an increasing expectation for more university involvement. This supposition arises from the national education guidelines, the Course of Study established by Japan's Ministry of Education, Culture, Sports, Science and Technology (MEXT). Despite this, university participation is voluntary, lacking uniform standards or mechanisms. Since April 2021, the author has led a cross-institutional project at a university research institute, focusing on creating educational opportunities to collaborate with high schools or local governments. In this capacity, the author serves as a coordinator.

This study explored the following two key research questions:

i. What are the significant outcomes and challenges associated with collaborative educational activities between universities and high schools?
ii. What approaches can be implemented to maximize the benefits and mitigate the challenges associated with educational collaboration between universities and high schools?

Then, this study provides an overview of Japan's high school education policy, reviews the relevant literature, and explains the practices the author implemented at the university and the author's role. The national school education curriculum guideline in Japan, the Course of Study, is revised approximately every 10 years by MEXT.

The "period for inquiry-based cross-disciplinary study" (*So-go-tekina-tankyu-no-jikan*) in high schools was introduced in 2021 in the Courses of Study. However, its origins can be traced back to the 1990s. During that time, Japan was grappling with the challenges brought about by globalization and advancements in technology. Japan simultaneously faced concerns over intense competition in entrance examinations and a decline in scientific and technological interest among younger generations (Ministry of Education, Culture, Sports, Science and Technology, 1995).

In response to these challenges, the report published in 1996 by the Central Council for Education proposed a departure from the traditional knowledge-driven approach to education that focused on fostering students' autonomy and creativity (Chukyoshin and Central Council for Education, 1996). The concept of the "zest for living," which was first used in this report (Matsuo, 2020), emerged as a significant phrase in Japan's educational reforms from the 1990s (Kitamura et al., 2019). The introduction of the "period for integrated studies" across elementary, junior high, and senior high schools was a prominent reform feature. Officially implemented in high schools with the Courses of Study in 1999, the objective was to cultivate problem-solving abilities, independent thinking, and self-directed learning through interdisciplinary studies and student-driven interests (MEXT, 1999).

In the 2009 Course of Study revision, there was an increased emphasis on promoting inquiry-based learning at the high school level. This included the expectation of the university's involvement in the "period for integrated studies," which was indicated in the "Explanation of the Course of Study" (Explanation), such as, "It is considered effective to promote high school–university cooperation, for example, by having high school students visit universities and conduct research under the guidance of university faculties, university students and postgraduate students" (MEXT, 2009).

The 2018 revision further emphasized the importance of inquiry-based activities, shifting from a "problem-solving" approach to a "problem-finding" approach that connects to students' own ways of being and living (MEXT, 2018b). As part of this emphasis, the "period for inquiry-based cross-disciplinary study" (*Tan-kyu*) was retained and continued to serve as a key component of Japan's educational framework (Chukyoshin, 2016). One of the standard activities in the *Tan-kyu* is the "Research Project." This activity centers on the inquiry process, which comprises "problem setting," "information collection," "organization and analysis," and "summary and expression" (MEXT, 2018b). The key components of *Tan-kyu*, which diverge from the conventional subject-based education and revolve around the student's agency, entail project-based learning akin to the research process in academia.

In the context of university collaboration, the explanation emphasizes that to effectively engage in inquiry, it is "crucial to utilize a variety of educational resources" (MEXT, 2018a), including university researchers and postgraduate students. When the "period for integrated studies" was initiated in 1999, there was no reference to university involvement; however, in the 2008 Explanation for Integrated Studies, the word "university" was mentioned 12 times, and in the 2018 Explanation for *Tan-kyu*, the frequency of mentions rose to 33 times. This indicates an increasing significance of universities in high school education in educational policy.

A comparable phenomenon can be observed in STEAM education promotion in Japan; however, the present study specifically concentrates on *Tan-kyu*.

In recent years, collaboration between high schools and universities in *Tan-kyu* has received increasing attention in educational research. Harada (2021) emphasizes the pivotal role of universities in inquiry-based and problem-solving learning in modern Japan. Research in this field includes efforts to evaluate educational impacts (Shimizu and Arai, 2023) and explore support patterns in high school–university cooperation (Harada, 2021). Addressing challenges, Maeda (2023) discusses such issues as the prevalence of one-off initiatives. Osugi et al. (2021) examine the tendency for one-sided, university-to-high school support, while Sugioka (2022) proposes the use of coordinators to alleviate the excessive burden on high school teachers managing these collaborations.

The ongoing and direct engagement of universities in high school education, particularly for high school students, extends beyond the traditional scope of universities' education and research. However, there has been limited discussion thus far on how to address the expanded role expected of universities. Should universities undertake activities beyond their conventional roles, new frameworks, and mechanisms must be established to facilitate these efforts in a sustainable and progressive manner. This study aims to clarify this viewpoint.

In April 2021, the Advanced Education Outreach (AEO) lab was established at the Research Center for Advanced Science and Technology (RCAST) at the University of Tokyo. The AEO collaborates with researchers and students from various academic fields to conduct educational activities for junior and senior high school students. From 2021 to 2023, the AEO worked with 25 schools and educational organizations, including local governments. Some are ongoing interactions throughout the year, while others are collaborations for one-off projects once a year. These activities include: (1) providing guidance and advice during the "period for inquiry-based cross-disciplinary study" at schools; (2) supporting "high school researchers" who wish to advance their research initiated during this period; (3) conducting webinars to explain cutting-edge research in an easily understandable way; (4) organizing the RCAST Research Tour for school groups, which includes lectures, lab tours, and interactions with graduate students; and (5) hosting "after-school talk" events, at which female students can engage with diverse science role models. Every year, approximately 30 university faculty members and over 20 "student affiliates" (graduate and undergraduate students) from various disciplines collaborate in these initiatives (Mori and Student Affiliates, 2023). Student affiliates maintain a closer relationship with the high school students compared with the university faculty and

undertake multifaceted roles. They act as mentors to the high school students, implement the educational program, and fulfill a range of additional responsibilities. As the producer and coordinator, the author is responsible for conceptualizing, planning, and managing these activities. Since the job itself and the job title of this activity have not been established in Japan, the author's role was dubbed "education outreach coordinator" (EOC) in this study as a provisional job title. A significant aspect of this approach is "educational co-creation," which prioritizes dialog with schoolteachers, university faculty, and high school students to tailor and enhance programs based on their needs and feedback (Mori and Student Affiliates, 2023).

Student participation in these initiatives has yielded remarkable outcomes, such as the development of a cross-curricular perspective that integrates arts and sciences (Mori and Shimizu, 2023), the discovery of relevance to their school studies (Mori, 2022), and increased interest in science according to surveys of participants. These achievements highlight the AEO's model response to the educational policy expectations outlined above.

In Japanese universities, the role of an EOC is not yet clearly established. However, the author is attempting to pioneer this role by establishing the duties of a coordinator through action research. This effort could facilitate organic collaboration between high schools and universities. The present study is grounded in this approach.

The rest of the paper is structured as follows. The next section details the research methodology. Section 3 presents the findings of the thematic analysis of the semi-structured interviews. The final section discusses the study's limitations and future research directions.

Although the AEO's educational practices encompass interactions with students from various countries, this paper specifically concentrates on issues pertinent to educational practices involving Japanese students and schools.

2 Methods

2.1 Research design

This study used a qualitative approach to investigate and identify issues and provide future directions in educational collaboration between high schools and universities in Japan. The aim was to identify current challenges and thereby clarify the roles and quality competencies of an EOC, which have not yet been visualized.

In this study, semi-structured interviews were conducted with interviewees from July to November 2023. All the interviewees were involved in the AEO programs, which are described in Section 1, or engaged in similar activities. The interviewees were selected using convenience sampling and snowball sampling. To exceed the minimum size required and reach certain saturation, 15 people were selected as interview participants for this study (Morse, 2000; Guest et al., 2006); the study aimed to have an equivalent number of university faculties and school teachers, with one neutral party. This is because the author considered it important to hear opinions from both universities and schools, among others, to obtain a balanced insight into issues in the field.

The participants were divided into three main categories: (a) university teachers responsible for providing lectures, laboratory visits, and guidance to high school students, (b) high school teachers or local government school board employees who requested university cooperation, and (c) independent education activists. The demographics of the participants are shown in Table 1.

The interviews were carried out with the participants' informed consent, following the provision of guidelines that detailed the interviews' objectives and structure, along with a written commitment concerning data collection, utilization, and storage.

The research plan received approval from the Expert Committee on Ethical Review of the University of Tokyo (review number 23–212).

2.2 Data collection

Data collection involved 15 participants from July to November 2023. The interviews involved one-on-one interactions, except in one instance wherein departmental colleagues (participants I and J) responded together. The interviews lasted approximately 1 h but ranged from 30 to 90 min. Participants were asked to provide detailed insights into their perceptions regarding university involvement in high school education, including examples of their personal practices, the challenges encountered, their views on the necessity for coordinators, the anticipated roles of these coordinators, and the competencies deemed important. It adhered to the principles of the Consolidated Standards on Reporting of Qualitative Research (COREQ) (Tong et al., 2007).

2.3 Data analysis

This study employs reflective thematic analysis (RTA), as defined by Braun and Clarke (2019, 2021a), for data analysis.

The analysis was conducted through the six phases of RTA. This study initially used an inductive approach with open coding to analyze the current condition. Adopting an experiential orientation, the study initially used an inductive coding approach with open coding for the segments addressing current challenges. Moreover, for the analysis concerning the skills and competencies of EOC, a deductive method was also applied. The coding process, along with the development of themes and sub-themes, was carried out independently by the EOC.

During the phase of theme and subtheme development, the author consulted with Associate Professor Shinichiro Kumagai, who provided valuable insights and advice. After this consultation, the analysis underwent further reviews to refine the findings.

The analysis drew upon the foundational works of Braun and Clarke (2019, 2021a,b), complemented by insights from Byrne (2022) and Oka et al. (2022).

3 Results

First, two main themes were generated: the significance of university involvement in high school education (referred to as the "ultimate goal") and the points of conflict that arise during collaboration between high school and university collaboration. These themes are further elaborated in Figure 1, with supporting participant quotes provided in Table 1 (participant codes are referenced here).

TABLE 1 Attributes of qualitative study participants.

Occupational categories		Participant	Interview date	Position
(a)	University faculty (excluding RCAST members)	A	24-Jul-2023	Associate Professor (Vice Chancellor)
		H	5-Sep-2023	Professor (Vice Chancellor)
		E	22-Aug-2023	Professor (overseas university, Japanese)
		I	19-Sep-2023	Professor
		J	19-Sep-2023	Project Assistant Professor
	University faculty (RCAST members)	L	1-Nov-2023	Associate Professor
		O	14-Nov-2023	Project Associate Professor
(b)	School teacher	B	31-Jul-2023	Public school in the metropolitan area
		C	9-Aug-2023	Public school outside the metropolitan area
		K	24-Oct-2023	Former principal of a public school in the metropolitan area
		M	7-Nov-2023	Public school in the metropolitan area
		N	14-Nov-2023	Principal of a public school in the metropolitan area
	Educational administrator (ex-school teacher)	D	9-Aug-2023	Office of the Board of Education in the metropolitan area
		F	29-Aug-2023	Office of the Board of Education outside the metropolitan area
(c)	Educator	G	30-Aug-2023	Founder of an educational association

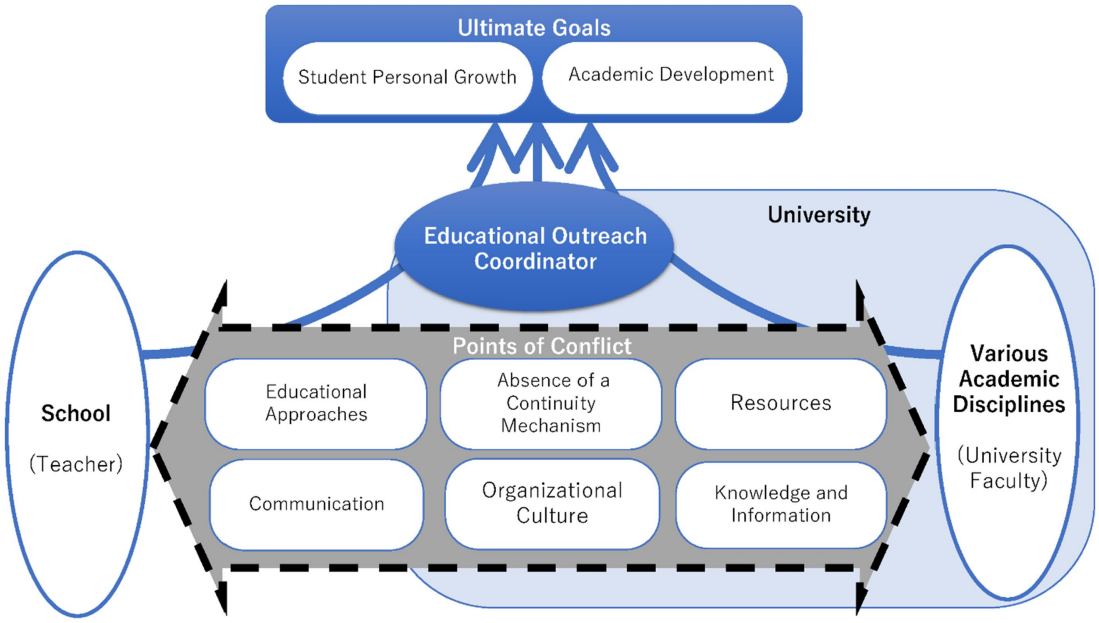

FIGURE 1
Common goals and points of conflict in school-university collaboration.

3.1 Ultimate goals

Both university and high school educators viewed the collaboration between universities and high schools positively. All 15 participants recognized the significance of such cooperative efforts in improving the educational experiences of high school students, with none expressing any negative views. The analysis revealed two primary perspectives, from which two sub-themes emerged: contributions to student personal growth and academic development.

High school educators highlighted an urgent requirement for collaboration with universities, notably to enrich *Tan-kyu*.

> *I feel that collaboration with universities, or having university staff visit or come to high schools, will become more active, and I think that this is what is required. In particular, there is a trend in high schools in which I am involved where there is an increasing emphasis on exploratory activities, so it is difficult to put such things into practice in the high schools alone. I feel that it is very important to*

> *have opportunities for students and teachers to learn from university professors and their knowledge. (F)*

Reflecting on their own childhood and various experiences, several university educators shared views grounded in a desire for social contribution. They expressed wishes for a system in their youth that would have connected them to universities and a keen interest in providing motivated students with the opportunity to engage with higher education. These sentiments stem from a commitment to offering a meaningful educational experience to each student.

Conversely, there were opinions that emerged from the anticipation of contributing to the advancement of academic fields.

> *For me, I feel there is a rising necessity and importance (of cooperating in education for high school students). First, I realize that there are not many people doing research, especially in our field. If there were more researchers, research could develop further, and we could provide useful technology to the world. In that sense, we would be very happy if we could get excellent students to take on our research. This is a request from a researcher, but from our point of view, we do feel the increasing necessity and importance of fostering the next generation. (O)*

School teachers have expressed a keen interest in providing students with exposure to researchers across diverse academic disciplines. This approach is a "contribution to the students," rooted in the aspiration to expand their opportunities and horizons, thereby fostering academic development.

3.2 Conflicts

Despite the consensus on the significance of collaboration between universities and high schools, as discussed in Subsection 3.1, the interviews revealed that university and high school teachers encounter distinct challenges and discrepancies.

3.2.1 Educational approaches

Inquiry-based learning in high school education does not always match university research, which assumes a vast array of knowledge skills. This can be perplexing to university teachers.

> *When high school students are asked to think based on a certain number of facts, rather than being taught various facts in depth at the high school stage, they may go in a variety of extremely liberal directions. University teachers feel a sense of crisis about this. In fact, we can see a glimpse of how it would be better to teach them solid facts. To put it more politely, if, in the end, students are allowed to think and discuss freely based on a certain number of facts at the high school level, and if they are allowed to think and discuss freely, which is a strange thing to say but if they are actively encouraged to do so, what is left out is actually the ability to connect various facts together and interpret them as history. In fact, what is left out is the interpretation of history by connecting various facts, and interpretation is also based on a great deal of accumulation so-called history of research, or academic theories. In a sense, they skip over the accumulation of academic theories and go in various directions. (A)*

High school teachers, meanwhile, may feel frustrated because they do not always get along with university teachers or because university teachers do not consider the realities of high school education.

> *The university content was communicated to the science and mathematics teachers. (Omitted) We also held online meetings. Even so, when we actually tried it, the results were not what we expected. We felt that we were in trouble. It's like it's too difficult, but the university content is also quite limited to those who are interested in the field, and it seems difficult for the students to keep up. (M)*

While it is crucial to present university research in an accessible manner to high school students, research remains highly specialized and distinct from the curriculum typically encountered in high school education. Depending on the discipline, crafting lectures that universally engage all students presents challenges, and researchers who irregularly interact with high school students may find it particularly challenging to gauge the appropriate level of complexity expected of them.

3.2.2 Absence of a continuity mechanism

In the interviews conducted, six out of the seven high school teachers mentioned their reliance on personal connections to facilitate collaborative activities with universities. In this context, the teachers conveyed a sense of reassurance in having direct communication with a known counterpart and expressed satisfaction in executing these activities through their own efforts and skills. However, several teachers also raised concerns about the sustainability of such educational initiatives. They noted that if either teacher were transferred or otherwise unavailable, it would undermine the continuation of these activities.

The participants expressed several concerns. For example, the reliance on personal relationships may bias the fields of study that high school students encounter. Staffing instability was also an issue raised by university teachers working on a voluntary basis. Participants mentioned that initiatives are not shared and information only reaches those who are interested and involved. Finally, organizational mechanisms are required to transform activities that depend on connections between individuals into permanent and universal initiatives.

3.2.3 Resources

Both teachers highlighted the constraints of time and human resources when planning and executing collaborative educational activities.

Some high schools have set up school departments, such as an "Inquiry Department" within the school, where the teacher assigned to the department is responsible for planning and coordination of *Tan-kyu*, but even in such schools, there are still challenges.

> *As teachers, they are required to do the same work as other teachers, so it is difficult for them to specialize in coordinator work in terms of time. So, of course, they have to do that, but they also have to work the same number of hours as other teachers, for example, four hours a day, and they also have to supervise club activities. (K)*

University faculty members understand the challenges they face.

> *It's the lack of people, isn't it? There is a huge shortage of people in relation to demand. This may be a problem for the universities. (J)*

3.2.4 Communication

High school teachers encounter difficulties in effectively communicating with university faculty, resulting in unmet educational objectives:

> *First, it would be easier for us if you showed us what you can do, as you tell us by e-mail. It's a bit awkward or scary for me to ask them if they can do something like this, maybe they are too busy. (C)*

As highlighted in Subsection 3.2.1, although the pedagogical approaches of high schools and universities differ, the challenges associated with integrating university-led activities into the high school curriculum cannot be easily dismissed. These activities, which may not pose issues when conducted outside the high school curriculum, become more conspicuous and potentially problematic when incorporated within it.

Furthermore, high school teachers and local government officials often find themselves in a position in which specifying the details of these activities and freely expressing their opinions to university faculty can be challenging. This situation may arise because university participation in high school education is voluntary and not mandated to align with high school curricular content. Consequently, making excessive demands is difficult, and there is a natural tendency to respect the expertise of university personnel.

3.2.5 Organizational culture

Even within the same country or region and across identical educational fields, notable disparities in approaches and values exist between high school and university educators. Engaging in interactions without acknowledging these distinctions can precipitate discomfort.

> *But the high school side is really lacking in manners (…) If the high school students want to do it themselves, that's fine, but in the case of the A's the other day, there were cases in which the high school was asking them to do it, and they wrote on a piece of paper saying something like "please do my request," attached it, and sent it widely to university teachers and business people, probably without any regard. I think it's a little bit that when high schools are doing it. (J)*

> *University researchers with a high degree of expertise have a good sense of commitment and pride in their own specialization. But the education field and the general public sometimes use language that is offensive and rude to researchers. I think it's necessary for both sides to work comfortably so that (coordinators) can come in between and make sure there is no rudeness on both sides. (G)*

At first glance, such issues might seem to be attributed solely to individual communication competencies. Upon deeper examination, however, it is posited that these discrepancies stem from divergences in organizational culture between high schools and universities. This phenomenon aligns with what Schein (1990) described as "basic underlying assumptions." Therefore, these opinions were classified under a distinct subtheme separate from Subsection 3.2.4.

3.2.6 Knowledge and information

School teachers lack sufficient knowledge about university disciplines and researchers, which hinders effective collaboration:

> *Right. There are still cases where we don't know [about academic fields or researchers]. If we are introduced to someone, or if we tell them that we want to do a project like this and they co-ordinate it with us, it can lead to people we didn't know at all getting involved in a good way, which is how we felt this time when we asked the AEO, and also when we asked the medical school. (F)*

> *First, I don't have any expertise on my side, so I talked to the contact professor at U of N, for example, about wanting to do this kind of course, and the other day, I talked with the committee members about wanting to do a project on engineering because engineering is not in our STEAM, but that concept of engineering is not in my side (…). When I have to tell them as a representative, if I don't know what they are talking about, I can't negotiate with them from the beginning. (M)*

Moreover, university teachers also deal with the situation in a hands-on way, as they have no means of knowing the actual situation in schools.

3.3 The need for a coordinator

The "final goal" and "points of conflict" are delineated in Subsections 3.1 and 3.2, respectively. Regarding the final goal, it is noteworthy that school personnel and university faculty members recognize the significance of university support for high school students and their involvement. This recognition holds promise for the development of more enriching educational opportunities.

However, the study identified a broad spectrum of conflicts, including differences in educational approaches, the absence of a structured ongoing relationship, resource limitations, communication hurdles, cultural disparities, and a deficiency in knowledge and information. These conflicts are not isolated; they are interconnected and can lead to complex challenges and unsatisfactory outcomes. Furthermore, these conflicts vary depending on the specific school, its faculty, the academic discipline, and the university faculty involved.

A potential source of these conflicts is the weak relationships between institutions. Upon deeper analysis, another contributing factor might be the fundamental differences in roles and responsibilities. High school teachers are tasked with the education of high school students—a responsibility not shared by university faculty, whose primary focus is on research and higher education. The extent to which university faculty engage with requests from schools is largely left to their discretion. Since the 2000s, the stagnation in the growth of academic publications in Japan, compared to other countries, is a concern to those working in science and technology policy. A reduction in research time is a key issue (Aoki and Kimura, 2016). Given the pressure to allocate more time to research, significantly increasing the time and effort devoted to educational activities outside their primary responsibilities may not be feasible for university faculty, despite potential willingness.

If the collaboration with universities is to extend beyond serving as a resource for high school education to being integrated within the

high school curriculum itself, a clear need emerges for individuals who can bridge the gap between the two sectors. These individuals must understand the needs of both and foster improved educational opportunities. In this study, such individuals are designated as EOCs.

The findings from Subsection 3.2, detailing the various challenges faced by participants, also point to the necessity of a coordinator role. Additionally, there were indications of the need for coordinators to address issues not yet explicitly recognized as coordination challenges.

> *No, I mean [university education and high school education] are getting closer, but they are not completely close because there is still a gap. So, I think that when we were able to recognize that they were completely different, it was easier to co-ordinate. In a sense, the directions are the same, but they are not completely parallel, nor do they intersect, so it can be like a twisted position. So, I think that's why there is now a need for coordination to make connections. (A)*

The following remarks indicate confusion among university teachers regarding their relationship with high school students for whom they have no direct educational responsibility. They also refer to the importance of the role of the coordinator, either as a point of responsibility or from the perspective of ensuring transparency in their activities.

> *High school students are not in a position to receive higher education, so in that sense, it is fine for them to ask questions and seek advice when they are in high school, but it is not always possible for us to go into greater depth, for example. In those situations, for example, if there is a coordinator, I think it would be possible to ask them to control the situation. For example, if we go deeper and deeper, of course, we may have problems securing the time to do so, so I think that would also be a problem. And another thing is that I don't think we can publish articles or papers on our own with the high school students. In that sense, I think it is necessary to have some kind of follow-up in terms of control over that area. (O)*

Some of the challenges identified in the realm of collaboration between high schools and universities could be mitigated by creating opportunities for each party to learn about the other and by disseminating information. Nevertheless, as long as both parties continue to operate under the assumption that activities involving high school–university cooperation are not their primary responsibility or that they are burdened with numerous other tasks, it becomes crucial to involve individuals who specialize in this area of collaboration.

As delineated in Section 1, the author serves as an EOC within the AEO. This role primarily involves bridging the educational and collaborative divide between universities and secondary education institutions. The author has been instrumental in facilitating educational collaborations across a diverse spectrum of university faculties and academic disciplines with schools. For instance, in Fiscal Year (FY) 2022, the initiative led by the author successfully engaged 30 university faculty members from varied research domains—ranging from energy systems and nutriomics to mobility science, insect-controlled space design, art and design, rule-making strategies, and political science research—in the educational advancement of high school students. This initiative resulted in the enrollment of 1,300 students from 93 schools and organizations across Japan in these educational programs (Advanced Education Outreach Lab, 2023).

Furthermore, during FY2022, a total of 26 students, encompassing doctoral, master's, and undergraduate students from various research fields, registered as "student affiliates" at AEO to support secondary school students. These affiliates acted as tangible role models and mentors for high school students, guiding them through inquiry-based research projects and other educational activities (Advanced Education Outreach Lab, 2023).

In the capacity of an EOC, the author identified the characteristics of these student affiliates, strategically positioning them to leverage their strengths and foster the development of new skills. The contributions of these student affiliates were highly regarded, with three affiliates securing assistant professor positions at universities, where they continue to engage in outreach activities.

The initiatives of the EOC have been appreciated by educators at both the university and high school levels. For example, one university faculty member, directly involved in the initiatives spearheaded by the author as an EOC, remarked:

> *Prior to this initiative, I have rarely had junior high or high school students visit my laboratory. Unfortunately, there is currently a disconnect between elementary and secondary education and university education and research in Japan. Since FY2021, I have had the opportunity to actually meet middle and high school students through AEO, and (..) it is always a new learning experience for me as well. (MORI and Student Affiliate Team, 2022)*

School educators and local government officials have acknowledged the pivotal role of the EOC in bridging the gap to university research fields and researchers previously inaccessible to them. This sentiment is exemplified in the statement by Interviewee F, as cited in Subsection 3.2.6.

Thus, the EOC plays a crucial role in facilitating a multifaceted educational exchange between schools and universities, yielding outcomes that would be challenging to achieve through direct bilateral efforts between educators and university faculty alone.

The engagement of universities in providing educational opportunities to students below high school age, as well as the collaboration between universities and schools, can be observed merely beyond the objective of student recruitment by universities and is not an exclusively Japanese phenomenon. For example, such institutions as the University of Queensland in Australia and the University of Auckland in New Zealand have implemented school engagement activities aimed at high school students. Some of these initiatives are accessible on their official websites (University of Auckland, n.d., University of Queensland, n.d.). The demand for such coordinators is not confined to Japan but is also a significant aspect of the educational landscape internationally.

In these collaborative efforts, the role of coordinators should be pivotal. These individuals facilitate activities that surpass the conventional scope of individual researchers, encompassing university-wide initiatives or collaborations involving multiple researchers. This suggests the universal need for effective collaboration between universities and schools, highlighting the critical role coordinators play in this context.

3.4 Competencies (skills and competencies) required by EOCs

What competencies are essential for EOCs to address the conflicts identified in Subsection 3.2? This study considers that a distinct level of professional competence, diverging from the conventional roles of university faculty and staff, is required. This competence arguably belongs to a "third domain" of operation (Whitchurch, 2008, 2013), a realm already familiar in Japanese universities through the role of the university research administrator (URA). The skill standards for URAs, developed by the University of Tokyo under a project commissioned by the Ministry of Education, Culture, Sports, Science, and Technology (The University of Tokyo, 2014), outline "work performance indicators" across such categories as "business (mission understanding)," "knowledge," "practice," "language," and "interpersonal," each was further divided into sub-items. Analyzing the interview content with reference to these URA skill standards yielded five themes: "knowledge," "holistic perspective," "practical work," "interpersonal," and "education." Each theme represents both independent skills and competencies and is interrelated with the others.

3.4.1 Knowledge

"Knowledge" encompasses a broad spectrum, including specifics of school education and university research, diverse fields, and the organizational cultures of schools and universities. This addresses the conflicts between "differences in educational approaches" and "lack of knowledge and information" identified in Subsection 3.2. With this extensive "knowledge," EOCs are expected to facilitate the planning of more appropriate educational programs for high school students. These programs should consider university research and provide consultations to both school and university teachers.

University and high school teachers can consult with the EOC, who acts as an intermediary on matters difficult to address directly, enabling smoother cooperation.

3.4.2 Holistic perspective

The "holistic perspective" skill involves the ability to plan and envision both university research and high school education from a holistic perspective, identifying potential connections between academic disciplines and educational needs without bias.

The inherent value of an EOC lies in its ability to matchmake beyond specific academic fields or laboratories, facilitating activities that might otherwise be constrained by limited perspectives or resources.

3.4.3 Practical work

"Practical work" includes decision-making, management, financing, and analyzing results, beyond mere administrative tasks. This addresses the "resource constraints" conflict.

3.4.4 Interpersonal skills

"Interpersonal" skills primarily involve verbal and non-verbal communication, which is crucial for overcoming "cultural differences" and "communication barriers," and pivotal for resolving all identified conflicts.

3.4.5 Teaching and mentoring skills

"Teaching skills" entail the ability to engage high school students, facilitate discussions, and teach about university research in an accessible manner, addressing "differences in educational approaches" and alleviating "resource constraints."

The crux of the EOC's role extends beyond merely imparting expertise. Rather, its essential function lies in its capacity to forge close connections with high school students to unlock their potential and bolster their self-confidence. This approach might be particularly effective due to the EOCs' comprehensive overview of the university's diverse academic disciplines and their distinct position from that of high school teachers, who teach at school on a daily basis. The EOC staff fosters maximum psychological safety for the students, embracing and welcoming them with open arms, akin to a familial setting. This environment necessitates proficient mentoring and coaching skills. The primary mentor for the high school student is often an undergraduate or graduate student who assumes this pivotal role. Concurrently, the EOC also undertakes a mentoring responsibility, acting either as a mentor to the mentor or in the interests of inclusivity. This arrangement mirrors the "closed triad" model discussed by Montgomery and Page (2018).

The ability of the EOC to unlock students' latent talents, incite intellectual curiosity beyond what is catered for in the school curriculum, and forge avenues for high school students to manifest their competencies further affirm the significant inherent value of the EOC's activities.

EOCs must integrate extensive "knowledge" with a "holistic perspective," "practical skills" for implementation, and "interpersonal" skills for effective communication, potentially taking on educational roles to ease the burden on university faculty and foster broader cooperation.

4 Discussion

This study provides a comprehensive analysis of the perceived objectives and conflicts inherent in educational collaborations between universities and high schools in Japan, emphasizing the crucial role of EOCs in mitigating these challenges and outlining the requisite skills and competencies for such roles. This study explores areas that have received scant attention in existing literature, thereby making significant contributions to understanding these collaborations.

As Section 1 indicates, the importance of universities in facilitating inquiry-based and problem-solving learning is well documented in recent Japanese educational discourse (MEXT, 2018b; Harada, 2021). These educational practices are implemented through diverse methodologies, often characterized by experimentation and iterative refinement. To transcend the limitations of *ad-hoc* and generational initiatives by pioneering entities and to foster a sustainable and evolutionary approach to educational collaboration, it is imperative to establish a framework that seamlessly integrates the distinct roles and values of schools and universities. This study delves into the intricacies of such integration, highlighting the discrepancies between educational institutions, as detailed in Subsection 3.2.

The need for coordinators as a linchpin between schools and universities forms a central thesis of this study. While previous research (Sugioka, 2022) has touched on the potential utility of

coordinators, there remains a lack of detailed discourse on the specific responsibilities these roles entail, the skills and competencies required, and the nature of expertise coordinators should possess.

In discussions about the collaboration between high schools and local communities, MEXT also emphasizes the importance of coordinators (MEXT, 2020). This indicates that the Japanese educational policy recognizes the need for intermediaries when schools collaborate with external organizations or individuals. However, the discussions at MEXT primarily focus on coordinators placed in high schools, and do not address the unique and essential challenges of collaboration with universities, nor the need for universities to adapt to new roles as discussed in this study. This study advocates for the necessity of coordinators in universities, as incubators for creating new educational opportunities through collaboration with schools.

In the context of Japanese society, the term "coordinator" typically denotes roles focused on logistical support, such as matching people and scheduling. This study, however, posits that coordinators in educational collaborations should transcend logistical functions to act as vital agents of change, fostering optimal educational opportunities through advanced professional skills. This necessitates a re-evaluation of the conventional understanding of coordinators, as highlighted by feedback from interviewees questioning the appropriateness of the term and suggesting a more supervisory capacity.

Effective collaboration between schools and universities requires coordinators who not only possess specialized skills but also embody a broad spectrum of competencies, as outlined in Subsection 3.4. Given the practical challenges of employing numerous specialists within a single organization, department, or team, the study advocates for individuals who can amalgamate various qualities and competencies, thereby ensuring the cohesive coordination of educational efforts.

Prospective coordinators are envisaged to have a foundational level of expertise, further enhanced by targeted training programs and practical experience. Potential candidates for this role include educators and educational administrators with a deep understanding of school education, as well as PhD holders with insights into university education and research, the latter being particularly well-suited given the ongoing discourse on career development for PhD holders in Japan (MEXT, 2023).

The Sixth Science and Technology Basic Plan (Cabinet Office, 2021) underscores the need for diversified career paths for doctoral graduates, a sentiment echoed by MEXT's initiatives to promote doctoral students' engagement across various societal sectors, including such roles as research administrators in universities. This study's proposal for coordinators as advanced professionals not only aims to enhance secondary education but also addresses broader societal challenges related to doctoral career development.

The research of this study offers valuable insights into the dynamics of collaboration between college and high school faculty. However, it is important to note that these findings are derived from a relatively small participant pool and predominantly reflect the perspectives of individuals already engaged in such collaborations. This limitation suggests that the conclusions drawn might not comprehensively represent the broader spectrum of faculty members across educational institutions.

Moreover, the scarcity of examples of university coordinators in Japan underscores the need to extend the scope of investigation to international precedents. A thorough examination is needed of the practices employed by universities and schools abroad in fostering cooperation, including the roles of professionals who facilitate these partnerships and the strategies implemented to secure personnel and operational funding. Such an analysis would significantly contribute to a more nuanced understanding of the coordinator profession and its critical functions within the educational sector.

Another limitation of this study and the presumed practices in AEO education is the absence of participants who were students with special needs, alongside the lack of teachers from schools specifically attending to such students. Although the interviewees from university faculties included a participant with special needs, the interview did not specifically focus on such students. Consequently, the findings of this study do not reflect experiences with inclusive responses. Conversely, the RCAST, where the AEO is situated, is a research institution renowned for its expertise in inclusive design and barrier-free access. It is pivotal to explore how the EOC can facilitate inclusive responses moving forward.

Additionally, this study highlights the need to devise specific strategies for cultivating the qualities and capabilities of coordinators. Developing these competencies is pivotal for enhancing the effectiveness of educational collaborations and ensuring their success.

Another key aspect of this research is the organizational placement of coordinators. Unlike positions tied to specific laboratories or departments, the coordinators discussed herein are envisaged to be employed by the educational institution at large. This broader organizational role necessitates a detailed exploration of whether the demand for coordinators, as evidenced by this study, justifies the encouragement of institutional hiring practices. It is imperative to determine the extent of this need, identify desired outcomes, and advocate for the establishment of roles that align with organizational objectives.

Furthermore, the study underscores the critical issue of funding for personnel costs. A comprehensive examination of potential mechanisms for financing these expenses is crucial for the sustainable implementation of coordinator roles. Addressing this challenge requires innovative approaches and careful consideration of various funding models.

In conclusion, the findings of this study serve as a preliminary step toward the development of improved educational practices and the creation of new models for collaboration between educational institutions. Continued practice and research are essential for refining these approaches and achieving meaningful advancements in the field of education.

Data availability statement

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author/s.

Ethics statement

The studies involving humans were approved by the University of Tokyo's Ethics Review Committee. The studies were conducted in accordance with the local legislation and institutional requirements.

The participants provided their written informed consent to participate in this study.

Author contributions

AM: Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration, Resources, Software, Supervision, Validation, Visualization, Writing – original draft, Writing – review & editing.

Funding

The author(s) declare that financial support was received for the research, authorship, and/or publication of this article. This study was partly funded by the Year 2023 Research Grant Program of the Japan Securities Scholarship Foundation.

Acknowledgments

The author is grateful to the interview participants who generously gave of their time to participate in this research. The author would like to thank MD. Shinichiro Kumagaya and Dr. Yuto Kitamura of the University of Tokyo and Dr. Natalia Veles of the James Cook University for their advice on this research. The author also thanks Dr. Masakazu Sugiyama, Dr. Takashi Kondo, and other professors of the Research Center for Advanced Science and Technology, The University of Tokyo for their various forms of support in the activities of the Advanced Education Outreach lab.

Conflict of interest

The author declares that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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