

Perceptions of prospective biology teachers about collaboration in the prospective teacher training program

Ahmad Kamal Sudrajat^{a,b,1,*}, I. Ibrohim^{b,2}, Herawati Susilo^{b,3}, Dita Purwinda Anggrella^{c,4}

^a Department of Biology Education, Faculty of Mathematics and Natural Sciences, Universitas Negeri Yogyakarta, Jl. Colombo Yogyakarta No.1, Sleman, Daerah Istimewa Yogyakarta 55281, Indonesia

^b Department of Biology, Faculty of Mathematics and Natural Sciences, Universitas Negeri Malang, Jl. Cakrawala No.5, Malang, East Java 65145, Indonesia

^c Biology Education Study Program, Faculty of Education, Universitas Islam Negeri Raden Mas Said Surakarta, Jl. Pandawa, Dusun IV, Pucangan, Kec. Kartasura, Kabupaten Sukoharjo, Jawa Tengah 57168, Indonesia

¹kamalsudrajat@uny.ac.id*; ²ibrohim.fmipa@um.ac.id; ³herawati.susilo.fmipa@um.ac.id;

⁴dita.anggrella@staff.uinsaid.ac.id

***For correspondence:**

kamalsudrajat@uny.ac.id

Article history:

Received: 9 September 2023

Revised: 18 September 2023

Accepted: 4 October 2023

Published: 28 October 2023



10.22219/jpbi.v9i3.29097

© Copyright Sudrajat *et al.*

This article is distributed under the terms of the Creative Commons Attribution License



p-ISSN: 2442-3750

e-ISSN: 2537-6204

How to cite:

Sudrajat, A. K., Ibrohim, I., Susilo, H., & Anggrella, D. P. (2023). Perceptions of prospective biology teachers about collaboration in the prospective teacher training program. *JPBI (Jurnal Pendidikan Biologi Indonesia)*, 9(3), 394-401. <https://doi.org/10.22219/jpbi.v9i3.29097>

Abstract: Collaboration is an important skill for a teacher. Prospective teachers' perceptions about collaboration must be explored to discover their collaboration skills before becoming a teacher. This research aims to determine prospective biology teachers' perceptions regarding collaboration in their teacher preparation program. The study uses a mixed-method approach with an explanatory design. This research uses a survey instrument to obtain quantitative data and semi-structured interviews to obtain qualitative data. A total of 73 prospective biology teacher students were involved in this research. Data were analyzed using a mixed-method approach with explanatory design. The research results show that students have an expert level of collaboration. The gender factor does not significantly influence collaboration, but females have a higher overall score than males. Prospective biology teacher students have been able to define collaboration well, but their definition is not yet in-depth. Prospective biology teacher students have realized the importance of having collaboration skills to support their careers. The recommendation in this research is to develop an appropriate training model to train the collaboration skills of prospective biology teacher students.

Keywords: collaboration; prospective biology teacher; prospective teacher training

Introduction

Collaboration is a skill in the 21st Century and has been considered crucial for increasing innovation, growth, and productivity in various areas of human life (Ciulli et al., 2022; Nakamura & Chen, 2023). In everyday life, "Two heads are better than one" can be interpreted as solving a problem that will be more innovative if done together. Collaborative activities can greatly increase innovation (Li et al., 2022). Collaboration is not a solution to overcome problems (Świgoń, 2015) but is a driver for improving the quality of solutions. Currently, collaboration is considered an important qualification for an organization, including educational organizations (Diamond & Rush, 2012). Successful collaboration requires great effort. Individuals need to understand the meaning of collaboration and develop behaviors that support collaboration. Effective collaboration must embrace all relevant parties and create relationships that share

knowledge between team members (Nissen et al., 2014). From the world of education perspective, collaborative activities can improve the quality of learning, produce publications, disseminate research results, and even support career development and increase the reputation of academics (Patel & Ragsdell, 2011).

Various terminologies and conceptualizations of teacher collaboration have been researched in various literature (Vangrieken et al., 2015, 2017). Collaboration in the context of teachers is actually "doing something together." Teacher collaboration is carried out to carry out tasks related to their profession. When carrying out an activity together, it is important to carry out negotiation, discussion, and consider opinions from different points of view. The concept of collaboration is often differentiated from cooperation (Lai, 2011). Collaboration is not limited to activities when teachers divide their work and then combine it into a single unit to achieve a common goal. However, research also shows that implementing collaboration is not always sufficient in everyday classroom practice (Wullschlegel et al., 2023). Based on this, it is important to know student teachers' perceptions regarding collaboration, so that they can implement effective collaboration when they become teachers in the future.

Existing research shows that various complex factors influence collaboration (Q. Cheng & Chang, 2020; Sepuru et al., 2021). Personal (gender, motivation, self-efficacy), professional, social/cognitive, and organizational factors influence the effectiveness of team-based collaboration. Gender is an interesting study in studying collaboration in depth. For example, in some research, there are differences in the treatment of gender in collaboration activities (Cottrell & Parpart, 2006). Gender has the possibility of being taken into consideration when seeking or being sought in collaborative activities. In collaborative activities, females can send more ties than males, but males receive more ties than females (Moolenaar et al., 2014). Studies show that attitudes towards collaboration differ for males and females (Feng et al., 2023). A positive attitude towards collaboration has an important role in the collaboration process, which increases the possibility of exchanging information or knowledge (Schuster et al., 2021). Positive attitudes like trust are key to collaboration because the willingness to implement innovation will increase if individuals in the collaboration group trust each other (Moolenaar & Slegers, 2010). A high level of trust leads to more effective forms of collaboration to improve the group (Brown et al., 2016).

So far, studies on concepts and perspectives on collaboration have been carried out in the context of groups of teachers in schools (Nguyen & Ng, 2020; Tichenor & Tichenor, 2018), students (Hussein, 2021), and other organizations (F. Cheng et al., 2020; Melnychuk et al., 2021; Tolstykh et al., 2023). There are still few studies that discuss the perspective of collaboration in prospective teachers, so this research is important to carry out. This research was conducted to answer three main questions: 1) what is the profile of prospective teacher student collaboration; 2) what is the understanding of prospective biology teacher students about collaboration, and 3) what is the student's perception of the importance of collaboration in prospective teacher education. With this research, universities, as the main training places for prospective biology teachers, can use the research results to evaluate the effectiveness of developing collaboration skills in their training program. Universities can also use the results of this research as a reference for developing training curricula for their prospective biology teachers.

Method

Research design

This research uses a mixed-method approach with an explanatory design to investigate prospective teachers' perceptions when involved in collaborative teams (Cohen et al., 2018). The survey was conducted to obtain quantitative data about prospective teachers' perceptions of their group's collaborative activities during training. Next, interviews were conducted with four respondents to strengthen the survey results (two male and two female).

Setting

This research was conducted at a high-level educational university in Indonesia with around 43,000 students. This university is a public university with quite good national and international rankings.

Participants

Purposive sampling was carried out to select participants involved in this research. The selected participants were final-semester students (The total number of students is 114) who had taken all pedagogical and content courses. Participants were selected because they had gone through a long collaborative process while involved in the prospective teacher education process (Creswell, 2012). Once potential participants were identified, consideration was given to gender mix to gain more perspectives. A total of 73 prospective biology teacher students, fourteen male, and fifty-nine female, participated in this research.

Research instruments

The instrument was developed based on a previous survey by [Woodland et al. \(2013\)](#). The instrument consists of four main indicators: exploration, communication, using the internet for collaborative practice, and action for the community. Before the survey instrument was used, we carried out validity and reliability tests. The instrument's validity is measured using the corrected item discrimination (r) value. The r value ranges from 0.63 to 0.81, with a p -value < 0.05 , so all items are valid. Reliability analysis was carried out using Cronbach's alpha (α). Cronbach alpha is used because it is the most appropriate test to measure the instrument's reliability ([Schmid et al., 2020](#)). The instrument is reliable if the score exceeds 0.08 ([Schmid et al., 2020](#)). The results of the test instrument reliability were as follows: exploration ($\alpha = 0.81$), communication ($\alpha = 0.81$), using the internet ($\alpha = 0.86$), action for the community ($\alpha = 0.88$), and the whole instrument ($\alpha = 0.82$).

Semi-structured interviews were conducted to obtain more descriptions of participants' experiences and perceptions of collaborating while they were involved in the training ([Cohen et al., 2018](#)). Semi-structured interviews were developed based on instruments [Newell and Bain \(2020\)](#).

Data analysis

The analysis was carried out descriptively to determine the level of student collaboration. Apart from that, the Mann-Whitney test was also carried out to determine differences in collaboration skills between different genders. The first author transcribed the interviews. Qualitative data analysis was done manually because the sample size was relatively small. Qualitative data analysis uses a thematic approach. First, the data were coded based on the literature definition of collaboration, reflected in the interview questions and survey items. Each theme was then analyzed and organized based on subcategories that emerged from the data. This subcategory relates to the elements and factors of collaboration identified by student teachers.

Results and Discussion

Profile of collaboration skills of prospective biology teacher students

Collaborative activities have been practiced in various learning activities undertaken by prospective biology teacher students since they were in their first semester. The results of surveys filled out independently by students show that, overall, females have higher collaboration scores than males. Females score higher than males on almost all indicators except the decision-making indicator. More clearly, the survey results are shown in [Figure 1](#).

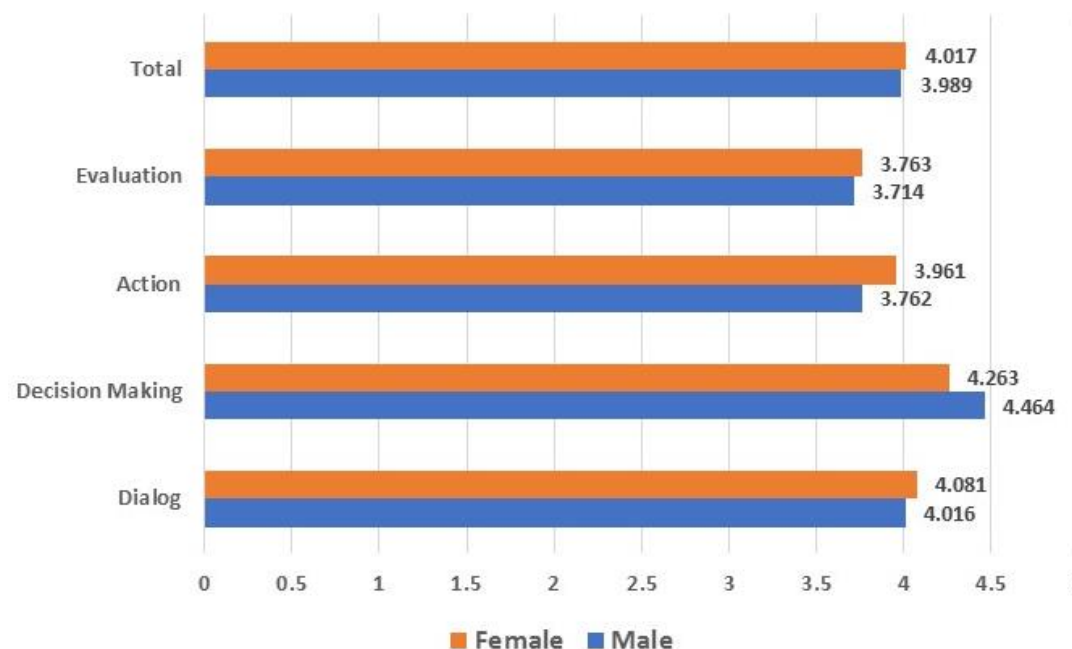


Figure 1. Collaboration skills profile of prospective biology teacher students

Next, inferential analysis was carried out using the Mann-Whitney Test. Based on the results of the Mann-Whitney test, although the means between males and females are different, after carrying out the test, it turns out that the difference is not significant (Sig. > 0.05). The results of the Mann-Whitney test are shown in [Table 1](#).

Table 1. Mann-Whitney Test analysis results

	Dialog	Decision Making	Action	Evaluation	Total
Z	-.267	-1.365	-1.170	-.298	-.631
Asymp. Sig. (2-tailed)	.789	.172	.242	.766	.528

Several kinds of literature that examine collaboration have the same results as this research ([Bush & Grotjohann, 2020](#); [Cole et al., 2018](#); [Sobko et al., 2020](#)). Based on research by [Bush and Grotjohann \(2020\)](#), Female have higher collaboration in almost all aspects except performance. Performance has similarities with the decision-making aspect in our study because both indicators relate to decision-making during performance. Previous research also shows that female teachers collaborate more than male teachers ([Killion, 2015](#)). In collaborative activities requiring high costs, more females are involved than males ([Ronfeldt et al., 2015](#)). If examined from another perspective, the gender composition in a collaborative team has a different influence on the process and results of the collaborative activity. The collaboration skills teachers possess to determine the quality of the learning process and the development of students' skills. Based on research by [Wullschleger et al. \(2023\)](#), there is an increase in the quality of learning carried out by teachers involved in a collaborative team. Teachers' self-efficacy will also increase if they are used to working collaboratively ([Goddard & Kim, 2018](#)). Collaborative activities also create opportunities for creating learning innovations in the classroom. Teacher collaboration is not only limited to implementing learning but can also be done in designing evaluations of their learning. Improving the quality of learning and learning innovations implemented by teachers in their classes will certainly increase student learning outcomes academically and in skills ([Heaysman & Tubin, 2019](#); [Vlachhou, 2015](#)). Several studies show that learning innovation can increase student collaboration ([Ernawati & Sari, 2022](#); [Ilma et al., 2022](#); [Nurwidodo et al., 2023](#)).

Prospective biology teacher students' understanding of collaboration

The second research question asked participants about their understanding of collaboration and their barriers. Open questions were asked to participants, and no keywords were explicitly given to interview participants. The interview results generally show that prospective biology teacher students do not yet deeply understand collaborative activities. After the identification process from the interview transcripts, several keywords describe prospective teachers' understanding of collaboration. These words are working together, volunteering, common goals, and sharing. All participants said the word "cooperation" when explaining what collaboration is. The following is one answer from a prospective teacher student.

"I collaborate when I can work together with my group of friends...." (P2)

However, other participants provided more detailed explanations about collaboration. The participant said the words "voluntary" and "common goal." The following is the respondent's statement:

"...In my opinion, collaboration is not enough to work together. Volunteerism is needed so that the collaboration can immediately produce an output...members in the collaboration must also have the same goal so that the collaboration can run effectively." (P3)

An interesting thing we found from the last participant, this participant used the word "sharing" in his definition of collaboration.

"...Collaboration also means sharing. This process does not prioritize the interests and egos of each individual. All members in the collaboration must be in line in working together without hiding anything."

Regarding barriers to collaboration, we found two keywords mentioned by the participants: time and frustration. The following are examples presented by participants.

"Collaboration members consist of several people, so it is difficult for us to determine the right time to discuss" (P1)

"...Sometimes the discussion takes too long, and results have not been found. I feel frustrated at this condition..." (P2)

There is a large amount of research that discusses collaboration. According to [Vangrieken et al. \(2017\)](#), Collaboration is "joint interaction in a group on all activities necessary to carry out a joint task." Other researchers define collaboration as "a situation in which two or more people learn or try to learn something together and more specifically as joint problem solving" ([Dillenbourg et al., 1996](#)). Based on several of these definitions and the results of interviews with prospective teachers, we define collaboration in the context of prospective teacher training as "a collaborative activity carried out by two people voluntarily to share knowledge to solve a problem or achieve a common goal."

The importance of collaboration in the prospective teachers' training

The third research question asked participants about the importance of collaboration in their teacher education process. This question is not limited to the characteristics of the courses they take during the teacher education process. All interview participants stated that collaborative activities were important in their educational process. Some keywords that interview participants said were important, very important, valuable, and necessary.

When asked for the main reason, they generally answered that collaborative activities could increase their knowledge and skills to become teachers. Collaboration is also considered a way to reduce their limitations during the learning process.

"I think collaboration is essential in the teacher education process, I can learn from friends if I don't understand something..." (P1)

"...In collaborative activities, I get valuable things, especially in evaluating the learning practices that I do" (P4)

Collaboration is essential in the teacher education process. Collaboration can be a forum for sharing knowledge and experiences ([Chedid et al., 2020](#); [Savolainen, 2017](#)). Prospective teachers' correct perceptions of collaboration can also improve their skills ([Sudrajat et al., 2020](#)). Teacher collaboration has been proven to improve the practical quality of teacher learning ([Xie et al., 2023](#)). Teacher collaboration is generally considered a positive condition for teacher learning. Teachers state that collaboration with other teachers is a powerful learning platform ([Jong et al., 2022](#)). In a collaborative climate, teachers can exchange ideas or experiences in learning, discuss learning content, get feedback from other colleagues, and support each other in their work ([Johnston & Tsai, 2018](#); [Le et al., 2018](#)).

Conclusion

The collaboration between prospective biology teacher students shows that it is at a high level, but still needs improvement. There are obstacles in their collaboration activities, so attention needs to be given to improving the quality of their collaboration. Regarding the gender factor, gender does not have a significant influence on the collaboration process, but the female has a higher score overall, as well as on every indicator except the decision-making indicator. Prospective teachers' understanding of collaboration is quite good, but they have not provided an in-depth explanation of collaboration in their teacher education process. Prospective biology teacher students have the awareness to collaborate in their teacher education process. Prospective biology teacher students consider collaboration important in improving their skills and knowledge to become professional teachers. The results of this research recommend the importance of developing training models or methods for prospective biology teachers, especially to develop their collaboration skills.

Conflicts of Interest

The authors declare that there is no conflict of interest regarding the publication of this paper.

Author Contributions

A. K. Sudrajat: conducting the research, collecting data, writing original article, **I. Ibrohim**: methodology & review; **H. Susilo**: review, and **D. P. Anggrella**: analysis data & formatting

References

- Brown, C., Daly, A., & Liou, Y.-H. (2016). Improving trust, improving schools. *Journal of Professional Capital and Community*, 1(1), 69–91. <https://doi.org/10.1108/JPC-09-2015-0004>
- Bush, A., & Grotjohann, N. (2020). Collaboration in teacher education: A cross-sectional study on future teachers' attitudes towards collaboration, their intentions to collaborate and their performance of collaboration. *Teaching and Teacher Education*, 88, 102968. <https://doi.org/10.1016/j.tate.2019.102968>
- Chedid, M., Caldeira, A., Alvelos, H., & Teixeira, L. (2020). Knowledge-sharing and collaborative behaviour: An empirical study on a Portuguese higher education institution. *Journal of Information Science*, 46(5), 630–647. <https://doi.org/10.1177/0165551519860464>
- Cheng, F., Ma, Y., Uzzi, B., & Loscalzo, J. (2020). Importance of scientific collaboration in contemporary drug discovery and development: a detailed network analysis. *BMC Biology*, 18(1), 1–9. <https://doi.org/10.1186/s12915-020-00868-3>
- Cheng, Q., & Chang, Y. (2020). Influencing factors of knowledge collaboration effects in knowledge alliances. *Knowledge Management Research and Practice*, 18(4), 380–393. <https://doi.org/10.1080/14778238.2019.1678412>
- Ciulli, F., Kolk, A., Bidmon, C. M., Sprong, N., & Hekkert, M. P. (2022). Sustainable business model innovation and scaling through collaboration. *Environmental Innovation and Societal Transitions*, 45, 289–301. <https://doi.org/10.1016/j.eist.2022.11.003>
- Cohen, L., Manion, L., & Morrison, K. (2018). *Research methods in education* (8th ed.). Routledge. <https://scirp.org/reference/referencespapers.aspx?referenceid=3026028>
- Cole, M. L., Cox, J. D., & Stavros, J. M. (2018). SOAR as a mediator of the relationship between emotional intelligence and collaboration among professionals working in teams: Implications for entrepreneurial teams. *SAGE Open*, 8(2). <https://doi.org/10.1177/2158244018779109>
- Cottrell, B., & Parpart, J. L. (2006). Academic-community collaboration, gender research, and development: pitfalls and possibilities. *Development in Practice*, 16(1), 15–26. <https://doi.org/10.1080/09614520500450768>
- Creswell, J. W. (2012). *Educational research: Planning, Conducting, and evaluating quantitative and qualitative research* (4th ed.). Pearson. https://books.google.co.id/books/about/Educational_Research.html?hl=id&id=4PywcQAACAAJ&edir_esc=y
- Diamond, J., & Rush, L. (2012). Intra-organisational collaboration in one UK university: potential for change or missed opportunity. *International Journal of Public Sector Management*, 25(4), 287–300. <https://doi.org/10.1108/09513551211244115>
- Dillenbourg, P., Baker, M., Blaye, A., & O'Malley, C. (1996). The evolution of research on collaborative learning. In *Learning in Humans and Machine: Towards an interdisciplinary learning science* (pp. 189–221). Elsevier. <https://tecfa.unige.ch/tecfa/publicat/dil-papers-2/Dil.7.1.10.pdf>
- Ernawati, E., & Sari, T. M. (2022). Implementation of free inquiry approach based on blended learning on creative thinking and student collaboration skills. *JPBI (Jurnal Pendidikan Biologi Indonesia)*, 8(3), 216–225. <https://doi.org/10.22219/jpbi.v8i3.22254>
- Feng, Q., Luo, H., Li, W., Chen, T., & Song, N. (2023). Effects of gender diversity on college students' collaborative learning: From individual gender to gender pairing. *Heliyon*, 9(6). <https://doi.org/10.1016/j.heliyon.2023.e16237>
- Goddard, Y., & Kim, M. (2018). Examining connections between teacher perceptions of collaboration, differentiated instruction, and teacher efficacy. *Teachers College Record*, 120(1), 1–24. <https://doi.org/10.1177/016146811812000102>
- Heaysman, O., & Tubin, D. (2019). Content teaching: Innovative and traditional practices. *Educational Studies*, 45(3), 342–356. <https://doi.org/10.1080/03055698.2018.1446334>
- Hussein, B. (2021). Addressing collaboration challenges in project-based learning: the student's perspective. In *Education Sciences* (Vol. 11, Issue 8). <https://doi.org/10.3390/educsci11080434>
- Ilma, S., Al-Muhdhar, M. H. I., Rohman, F., & Saptasari, M. (2022). Promote collaboration skills during the COVID-19 pandemic through Predict-Observe-Explain-based Project (POEP) learning. *JPBI (Jurnal Pendidikan Biologi Indonesia)*, 8(1), 32–39. <https://doi.org/10.22219/jpbi.v8i1.17622>
- Johnston, W., & Tsai, T. (2018). The prevalence of collaboration among American teachers: national findings from the American teacher panel. *The Prevalence of Collaboration Among American Teachers: National Findings from the American Teacher Panel*. <https://doi.org/10.7249/rr2217>
- Jong, L. De, Meirink, J., & Admiraal, W. (2022). School-based collaboration as a learning context for teachers: A systematic review. *International Journal of Educational Research*, 112(January), 101927. <https://doi.org/10.1016/j.ijer.2022.101927>
- Killion, J. (2015). High-quality collaboration benefits teachers and students. *Journal of Staff Development*, 36(5), 62–64. <https://eric.ed.gov/?id=EJ1082768>
- Lai, E. R. (2011). *Collaboration: A literature review*.

- <https://www.semanticscholar.org/paper/Collaboration%3A-A-Literature-Review-Lai/85daa93241a0a7f307e4d5aa742ce238d5e31b8f>
- Le, H., Janssen, J., & Wubbels, T. (2018). Collaborative learning practices: teacher and student perceived obstacles to effective student collaboration. *Cambridge Journal of Education*, 48(1), 103–122. <https://doi.org/10.1080/0305764X.2016.1259389>
- Li, L., Zhu, W., Wei, L., & Yang, S. (2022). How can digital collaboration capability boost service innovation? Evidence from the information technology industry. *Technological Forecasting and Social Change*, 182, 121830. <https://doi.org/10.1016/j.techfore.2022.121830>
- Melnychuk, T., Schultz, C., & Wirsich, A. (2021). The effects of university–industry collaboration in preclinical research on pharmaceutical firms' R&D performance: Absorptive capacity's role. *Journal of Product Innovation Management*, 38(3), 355–378. <https://doi.org/10.1111/jpim.12572>
- Moolenaar, N. M., Daly, A. J., Cornelissen, F., Liou, Y.-H., Caillier, S., Riordan, R., Wilson, K., & Cohen, N. A. (2014). Linked to innovation: Shaping an innovative climate through network intentionality and educators' social network position. *Journal of Educational Change*, 15(2), 99–123. <https://doi.org/10.1007/s10833-014-9230-4>
- Moolenaar, N. M., & Slegers, P. J. C. (2010). Social networks, trust, and innovation. How social relationships support trust and innovative climates in Dutch Schools. *Social Network Theory and Educational Change*, 97–114. <https://research.utwente.nl/en/publications/social-networks-trust-and-innovation-how-social-relationships-sup>
- Nakamura, H., & Chen, W.-L. (2023). Dialogue and collaboration for sustainable development in Japan and Taiwan: Epistemic foundation of partnership toward Sustainable Development Goals. *Environmental Science & Policy*, 145, 238–249. <https://doi.org/https://doi.org/10.1016/j.envsci.2023.04.017>
- Newell, C., & Bain, A. (2020). Academics' perceptions of collaboration in higher education course design. *Higher Education Research & Development*, 39(4), 748–763. <https://doi.org/10.1080/07294360.2019.1690431>
- Nguyen, D., & Ng, D. (2020). Teacher collaboration for change: sharing, improving, and spreading. *Professional Development in Education*, 46(4), 638–651. <https://doi.org/10.1080/19415257.2020.1787206>
- Nissen, H. A., Evald, M. R., & Clarke, A. H. (2014). Knowledge sharing in heterogeneous teams through collaboration and cooperation: Exemplified through Public-Private-Innovation partnerships. *Industrial Marketing Management*, 43(3), 473–482. <https://doi.org/10.1016/j.indmarman.2013.12.015>
- Nurwidodo, N., Ibrohim, I., Sueb, S., Abrori, F. M., & Darajat, T. A. (2023). Improving the creative thinking and collaborative skills of prospective biology teachers using the EMKONTAN learning model in environmental science courses. *JPBI (Jurnal Pendidikan Biologi Indonesia)*, 9(1), 15–25. <https://doi.org/10.22219/jpbi.v9i1.24382>
- Patel, M., & Ragsdell, G. (2011). To share or not to share knowledge: An ethical dilemma for UK academics. *Journal of Knowledge Management Practice*, 12(2), 1–16. <http://www.tlinc.com/articl257.htm>
- Ronfeldt, M., Farmer, S. O., McQueen, K., & Grissom, J. A. (2015). Teacher collaboration in instructional teams and student achievement. *American Educational Research Journal*, 52(3), 475–514. <https://doi.org/10.3102/0002831215585562>
- Savolainen, R. (2017). Information sharing and knowledge sharing as communicative activities. *Information Research*, 22(3), 767. <https://files.eric.ed.gov/fulltext/EJ1156371.pdf>
- Schmid, M., Brianza, E., & Petko, D. (2020). Developing a short assessment instrument for Technological Pedagogical Content Knowledge (TPACK.xs) and comparing the factor structure of an integrative and a transformative model. *Computers and Education*, 157(June), 103967. <https://doi.org/10.1016/j.compedu.2020.103967>
- Schuster, J., Hartmann, U., & Kolleck, N. (2021). Teacher collaboration networks as a function of type of collaboration and schools' structural environment. *Teaching and Teacher Education*, 103, 103372. <https://doi.org/https://doi.org/10.1016/j.tate.2021.103372>
- Sepuru, M., Musonda, I., & Okoro, C. S. (2021). An assessment of factors influencing collaboration impacts on organisational performance: A review. *Collaboration and Integration in Construction, Engineering, Management and Technology*. https://doi.org/10.1007/978-3-030-48465-1_54
- Sobko, S., Unadkat, D., Adams, J., & Hull, G. (2020). Learning through collaboration: A networked approach to online pedagogy. *E-Learning and Digital Media*, 17(1), 36–55. <https://doi.org/10.1177/2042753019882562>
- Sudrajat, A. K., Susilo, H., & Rohman, F. (2020). Student perspective on the importance of developing critical thinking and collaboration skills for prospective teacher students. *AIP Conference Proceedings*, 2215. <https://doi.org/10.1063/5.0000558>
- Świgoń, M. (2015). Knowledge and information sharing in the opinion of the Polish academic community. *International Journal of Social, Behavioral, Educational, Economic, Business and Industrial Engineering*, 9(4), 1057–1064. <https://zenodo.org/records/1099914>

- Tichenor, M., & Tichenor, J. (2018). The many sides of teacher collaboration. *Kappa Delta Pi Record*, 54(3), 139–142. <https://doi.org/10.1080/00228958.2018.1481663>
- Tolstykh, T., Shmeleva, N., Gamidullaeva, L., & Krasnobaeva, V. (2023). The role of collaboration in the development of industrial enterprises integration. *Sustainability*, 15(9). <https://doi.org/10.3390/su15097180>
- Vangrieken, K., Dochy, F., Raes, E., & Kyndt, E. (2015). Teacher collaboration: A systematic review. *Educational Research Review*, 15, 17–40. <https://doi.org/https://doi.org/10.1016/j.edurev.2015.04.002>
- Vangrieken, K., Meredith, C., Packer, T., & Kyndt, E. (2017). Teacher communities as a context for professional development: A systematic review. *Teaching and Teacher Education*, 61, 47–59. <https://doi.org/https://doi.org/10.1016/j.tate.2016.10.001>
- Vlachou, M. A. (2015). Does Assessment for learning work to promote student learning? the england paradigm. *The Clearing House*, 88(3), 101–107. <https://www.jstor.org/stable/43999583>
- Woodland, R., Lee, M. K., & Randall, J. (2013). A validation study of the Teacher Collaboration Assessment Survey. *Educational Research and Evaluation*, 19(5), 442–460. <https://doi.org/10.1080/13803611.2013.795118>
- Wullschleger, A., Vörös, A., Rechsteiner, B., Rickenbacher, A., & Maag Merki, K. (2023). Improving teaching, teamwork, and school organization: Collaboration networks in school teams. *Teaching and Teacher Education*, 121, 103909. <https://doi.org/10.1016/j.tate.2022.103909>
- Xie, W., Sui, Y., Liu, X., & Liu, S. (2023). Effects of teacher collaboration on teaching practices in china and england: a structural equation model with TALIS 2018 data. *SAGE Open*, 13(2), 1–14. <https://doi.org/10.1177/21582440231177908>