How Does Collaborative Authoring in Doctoral Programs Socially Shape Practices of Academic Excellence?

Kai Hakkarainen, Kaisa Hytönen, Kirsti Lonka, and Juho Makkonen

Abstract: The purpose of the present investigation was to examine the social shaping of practices of collaborative authoring in doctoral programs which have led to the achievement of academic excellence in the natural sciences and in education. Toward that end, we interviewed 9 leaders of Finnish national centers of excellence doing science research and 12 Finnish and European leaders of educational research communities both of whom were engaged in supervising article-based doctoral dissertations consisting of international refereed articles co-authored by students and their supervisors. Qualitative analyses of the interviews revealed various ways that supervisors socially facilitate academic activity of their students. Their methods, which are expanding from natural to such social sciences as education, included guiding students in structuring articles, selecting publication forums, framing their investigations according to journal-specific requirements, and addressing review feedback collectively. Despite receiving a great deal of support, doctoral students were usually first authors of their articles. While doctoral students needed much support in the first article, their contribution became increasingly central in subsequent ones. Because of rising academic standards, however, senior researchers’ support continued to be important in later articles. Intellectual socialization to shared academic knowledge practices effectively boosts the development of academic competence allowing doctoral students gradually to make more productive contributions to joint knowledge-creation efforts.

Keywords:
academic writing, article thesis, co-authoring, identity, knowledge practice, epistemic artifact

Academic achievements are still often attributed to the personal gifts and talents of individual researchers. Such conceptions do not appear to fit very well in the collective research practices that modern research communities have cultivated across many decades (Hakkarainen, Hytönen, Makkonen, Seitamaa-Hakkarainen, & White, 2013). The present investigation is aimed at addressing the sociocultural foundations of the collaborative practices of research and publication designed to produce academic excellence; the context is doctoral programs which have, in fact, achieved excellence in their recognized publications in natural sciences and social sciences. Academic excellence is a complex attribute of scholarly and scientific activity of a community; it is a capability based in sophisticated theoretical, methodological, and practical competencies that allow a participant to take productive part in designing, conducting, and publishing original scientific investigations in collaboration with his or her research community. Such competencies constitute academic expertise (Ericsson, 2006) that develops across a sustained process of socializing to practices of an academic research community and deliberately practicing various aspects of investigation under guidance of senior researchers. The present investigation focuses specifically on examining practices of intellectually socializing doctoral students to produce published articles in international,
refereed journals. Toward that end, we will examine the role of co-authoring in the epistemic socialization of doctoral students to knowledge practices of academic communities in natural sciences and in the field of educational research. By knowledge practices we refer to personal and social practices related to working with knowledge and carrying out academic inquiries (Hakkarainen, 2009; Ritella & Hakkarainen, 2012). We use the term “knowledge” here in the broadest sense, to include what is explicit in published texts and articles in refereed journals; we conceive of knowledge existing in disciplinary funds inherited from networks of published findings of earlier generations of investigators (Fleck, 1979); it comprises the theoretical and methodological repertoire of research communities. Further, we would include the procedures that implicitly and pre-reflexively shape an investigator’s working habits; and further yet that tacit capability which underlies the methodological and procedural skills and competencies of academic experts. Elaborating Knorr Cetina’s (2001) concepts, it may be argued that research communities rely on fuzzily determined, dynamically developing, exploration-oriented, and problem-laden practices that are occasionally innovative. Knowledge practices, while sometimes just supporting routine learning (transmission), at their creative edge, diverge from other routine social practices in that they take place in specific purposefully dynamic and fluid settings designed for the furtherance of innovation and knowledge (Hakkarainen, Lallimo, Toikka, & White, 2011; Knorr Cetina, 1999; Paavola, Lipponen, & Hakkarainen, 2004). Rather than relying only on mere mundane habits or repeated routines (that may also be needed), such practices are aimed at solving emergent problems and constantly pursuing novelty and innovation. Such practices are socially and physically distributed, and therefore cannot be located in individual minds only. Practices that emphasize collective knowledge creation and networked expertise (Hakkarainen, Palonen, Paavola, & Lehtinen, 2004) are typical in natural sciences, where pursuit of “big science” capitalizes on expensive equipment and large internationally networked research communities (Holmes, 2004; Nersessian, 2006; Pickering, 1995; Thagard, 1999).

Academic research communities may be seen as learning environments (Pyhältö, Stubb, & Lonka, 2009) that accurituate doctoral students to academic practices of their discipline (Austin, 2009; Delamont, Atkinson, & Odette, 2000; Hakkarainen et al., 2013; Knorr Cetina, 1999; Lee & Boud, 2009). Academic practices rely on relatively stable disciplinary genres that may be characterized as socially and culturally recognizable forms of textually mediated communication or discursive practice (Bazerman, 1988; Hyland, 2004; Prior, 1998). The genre of journal article emerged through efforts of Isaac Newton and other investigators to find an appropriate way of justifying their knowledge claims. Hence, research genres have their own historically evolved and relatively stable implicit norms that are not easy to recognize and grasp by students. Natural sciences have perfected, across decades, academic practices that allow new cohorts of doctoral students to pursuit of cutting edge research; they learn, through coauthoring, to appropriate the scientific genre, write like scientists, and gain the competencies required for publishing in high-ranking journals (Florence & Yore, 2004; Kamler, 2008). Toward that end, doctoral students are engaged in pursuing article-based theses that consist of a summary and 3–5 internationally published articles co-authored between junior and senior researchers (about PhD by publication, see Dong, 1998; Dudley-Evans, 1999; Kwan, 2013; Green & Powell, 2005); such knowledge practices put doctoral students in the very heart of collective knowledge-creation efforts. Though co-authoring practices supervisors and other senior researchers come to the visible forefront of fostering the development of their students’ academic expertise, rather than remain “in the shadows” (Gruber, Lehtinen, Palonen, & Degner, 2008). Interviews of doctoral students functioning in natural science communities reveal how the students learn to capitalize on collectively shared investigative practices and socially distributed resources of investigation (Hakkarainen et al., 2013; Vekkaila, Pyhältö, Hakkarainen, Stubb, & Lonka, 2013).

The article-based approach emphasizes the importance of acculturating doctoral students to work iteratively with shared research objects embedded in an evolving network of a
supervisor’s research projects (Gruber, 1981) that are transmitted from one cohort of inquirers to the next. Social sciences have, in contrast, relied on the traditional individual model of doctoral education that involves pursuing an extensive monograph based on personal research objects often not related to those of the supervisor (Becher & Trowler, 2001; Hakkarainen et al., 2013). This is partially due to different paradigms and qualitative research methodologies, requiring more theoretical framing and lengthier explanations. Historical examinations of knowledge practices across disciplines reveal that natural sciences relied on the lone-scholar model in the beginning of the last century, and that the collectivization of academic research is a relatively recent phenomenon (Merton, 1973; Thagard, 1997). While natural sciences have historically pioneered the collective approach to academic research, collaborative research communities are emerging in social sciences and some areas of their application in which the researchers have focused on collective creation of knowledge, by co-authoring articles (Figure 1a and 1b).

Many Scandinavian and other European investigators have been working to extend the collective, article-based model to social sciences in general and educational research in

![Figure 1. Collectivization of academic research in terms of increasing proportion of co-authored articles (A) and increasing number of co-authors (B) in high-impact journals. Three selected journals with very high-impact values across six disciplines and classified 36000 articles according to percentage of co-authored articles and number of authors.](image-url)
particular. The individual model of doctoral education functions rather well in thousands of cases of social sciences, and the point of the present investigation is not to argue for complete replacement of the individual model with the collective one. Detailed examination of the collective practices of doctoral education allows one, however, to investigate various processes and mechanisms crucial for the social shaping of academic competence. Article theses appear to represent a very productive “pedagogic practice” of writing for publication in doctoral education (Kamler, 2008; Kamler & Thomson, 2007): publication of refereed journal articles often does not take place at all in social sciences in absence of co-authoring practices. Kamler (2008) found that publishing the results of one’s academic dissertation is the best predictor of a student’s later scholarly productivity. Academic productivity is subject to tremendous variation: about 20% of the investigators produce most of the publications. Early socialization to collaborative publication and resulting appropriation of the implicit genre of “journal science” (Fleck, 1979, p.112) appear to be critical in terms of assisting the participant to move to the highly productive section of the academic population. Nevertheless, there is evidence that most social science students do not receive adequate mentoring, but instead, have to learn publication through sustained and troublesome, personal trial-and-effort efforts, if at all.

Learning to produce academic knowledge is not only an intellectual challenge, but a personal and identity-related one as well (McAlpine & Amundsen, 2009). Doctoral students who experience that they are valuable members of their scholarly community express higher levels of well-being and also proceed faster in the doctoral projects (Stubb, 2012; Stubb, Pyhältö, & Lonka, 2011). Solo-publishing social-science students feel personally vulnerable when being evaluated by external investigators. They have a propensity to seek “safe spaces of publication” (Kamler, 2008; Kamler & Thomson, 2007), such as conference proceedings or journals with low criteria of peer review. The article-based model arises from the assumption that students should not be left on their own to produce academic publications, but should be provided collective support, deliberate supervision, and constructive feedback during their writing process (Kamler, 2008; Lonka, 2003). Coauthoring facilitates the growth of students’ academic competence, makes otherwise tacit strategic aspects of writing visible, and integrates personal with collective knowledge-creation efforts (Florence & Yore, 2004). Thus, deliberate and systematic co-authoring with supervisors in pursuing an article thesis appears to be “the crucial part of learning the ropes of academic publishing” (p. 288). We believe that there is something to be learned from the natural sciences in terms of levels of social engagement and collaborative productivity (Hakkarainen, Hytönen, Makkonen, & Lehtinen, 2014; Stubb, 2012). Although social sciences are still, to a great extent, based on an individual definition of excellence as exceptional personal competence, it appears that much can be learned from the more collective model of doctoral education characterizing natural sciences. Hence it appears beneficial to expand collective practices of academic knowledge production from natural to social sciences.

The purpose of the present article is to examine to what extent practices of collaborative authoring, characteristic of the article-based collective model of doctoral education, may be fruitfully expanded from natural sciences to the field of educational research. By interviewing leaders of both science and education research communities oriented to supervise article-based theses, we examined the central academic practices that their respective research communities have developed for socializing doctoral students to article publication. The intention was to learn something of the best practices in both fields. We addressed the following questions: How do senior researchers assist students in structuring their articles, selecting publication forums, and framing their arguments? How are doctoral students assisted in dealing with review feedback? How do the present research collectives determine authorship, and what kinds of tensions and challenges have emerged? How do research communities representing natural sciences and educational research differ across these knowledge practices?
Method

The Context of the Study

The present investigation is aimed at developing doctoral education in Finland, therefore, the requirements of Finnish doctorate may be explained as follows: The Finnish students do not pay any tuition fee, and their studies are usually funded by grants from private foundations, discipline-specific doctoral schools, university posts, or research grants. Characteristic for Finnish doctoral education is that it is quite unstructured compared to many other European countries (or the USA) and highly embedded in conducting doctoral research, although more systematic pedagogical models have been developed over the last decade. There is no extensive course work required before undertaking the doctoral research. Subject and methodological studies require 40 to 60 ECTS credits (1 credit in the European Credit Transfer System equals approximately 27 hours of study) for a doctoral degree, depending on the discipline.¹ Doctoral studies are recommended to be completed in four years of full-time study, but it often takes longer. When completed, a Finnish doctoral dissertation is evaluated by two external evaluators, usually professors coming from other national or international universities. In Finland, the dissertation may be either a monograph (50k words) or an article-based thesis consisting of a synthesizing summary (20k words) and 3–5 internationally refereed journal articles. Although practically all theses of natural sciences are article-based, three quarters of theses accepted in the field of educational research are monographs. The article-based model is being extended to educational research by pioneering efforts of certain professors oriented to international publication. After evaluation, the manuscript is approved by the faculty for public defense, and the “academic opponent” (i.e., examiner) is nominated. After the public oral defense, the opponent decides whether he or she recommends ratification of the thesis, and the faculty grants the doctoral degree to the student and publishes her dissertation locally with an ISBN number (International postgraduate student mirror, 2006). The article-based approach of doctoral dissertation was initially developed in science and medical research from the 1940s, expanded to psychology and became the dominating model in these disciplines in 70s and 80s in Finland. In the field of educational research, article-based dissertations have been produced since the beginning of the 90s; although this approach still represents a minority (about 20%), it has become a well-established aspect of doctoral education in this field in Finland and many other countries in Scandinavia and Europe (Hakkarainen et al., 2014).

The Participants

In order to examine the role of collaborative authoring in socializing doctoral students to practices of scientific publication, the first author interviewed 21 research leaders (table 1) from well-known Finnish and European universities representing a) leaders of Finnish national centers of excellence (medicine, physics, neuroscience, N1-N9) and b) professors of education engaged in collective practices of supervising article-based theses, involving journal articles co-authored with the supervisors (E1-E12).² The educational research leaders were selected for interview because they have worked to extend the article-based practices of doctoral education to their field of social science. Research groups of the present research leaders varied in size from a few doctoral students and the supervisor to large communities with several subgroups led by professors and tens of doctoral students. Although acculturation of science students often takes place through laboratory settings, the present educational research communities rely on the more or less continuous presence of doctoral students, postdocs and senior researchers in shared office spaces; in the background there is the insight that effective academic socialization appears to require a physically present community (compare Delamont et al., 2000; Gardner, 2007; Knorr Cetina, 1999; Nersessian, 2006).
Table 1. Background of the Participants and Research Data

<table>
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<tr>
<th></th>
<th>Gender</th>
<th>Nation</th>
<th>Own PhD</th>
<th>Supervised</th>
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<th>Length of interview</th>
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Note. FIN=Finnish; INT=international. a In order to protect anonymity of the participants, only a rough estimation of supervised PhDs is provided. b The citation record of the participants was assessed by using the Publish or Perish program (http://www.harzing.com) and categorized according to the most highly cited ones (1) to the least cited ones (3): Group 1 (10.001-25.000), Group 2 (1001-10.000), and Group 3 (less that 1000 citations).

Practices of collaborative authoring were addressed as a part of an extensive interview covering knowledge creation processes from the collective nature of research problems and socialization of doctoral students to shared academic practices to scientific supervision. The length of interviews varied from 42 minutes to 155 minutes; interviews took longer when the interviewee wanted to share detailed aspects of his or her activities. Finnish participants were interviewed in Finnish and international ones in English. The interviews were audio recorded and transcribed word-by-word from audio files by experienced research assistants. The transcribed data were analyzed according to qualitative content analysis using the ATLAS.TI 6.0 program. The contents of transcribed interviews in which the participants addressed collaborative authoring practices were adjudged to represent the same hermeneutic category and structured according to the main themes of co-authoring that emerged from the data.

Results

The results section is organized as follows: We will, firstly, examine extending the article-based model from natural-science to education programs and address, in subsequent sections, various practices of supporting students’ publication, such as structuring manuscripts, selecting publication forums, framing manuscripts for specific journals, and collective addressing of review feedback. Finally, there will be a discussion of issues regarding determination of authorship and associated challenges. In each section, we will first examine academic practices characteristic of natural science programs and subsequently those of educational research by relying on the interviewee data.
Emergence of Article-Based Practices of Doctoral Education

All of the natural science communities that were investigated here pursued article-based dissertations, and co-authored doctoral articles constituted a major part of their research output. Focusing on solving collectively shared research problems related to a supervisor’s research projects, more than personal ones; this puts doctoral students into the heart of a collective knowledge-creation agenda instead of merely pursuing their personal study projects. The fact that some of the leaders had themselves completed monograph theses indicated that a major transformation of practices of producing scientific knowledge had taken place in their research communities. The interviewed education professors were transforming practices of doctoral training in their field toward the collective model by following the lead of natural sciences: “It came from the models given by other sciences, because I mean we already had incredibly capable research groups in the 70’s and 80’s in the fields of natural science and medicine, so of course we were interested in finding out how it is that they do it” (E4). The first article theses were authored by students only because it would not have been possible to have dissertation articles approved with a supervisor’s name on them. Education leaders have moved to an article-based approach in order to make the doctoral process more transparent in terms of pursuing shared objects rather than mere personal projects. Currently, the article model dominates the practices of doctoral training in the interviewed education professors’ research communities in Finland (E1, E3, E4, E7, E8, E9) and Europe (E2, E6, E10). Almost all dissertations of their core students aiming at a professional academic career are based on co-authored international articles: “Normally it is a dissertation by publications and everybody accepts that now” (E6). Students may, however, pursue monographs when warranted by specific reasons, such as a huge amount of ethnographic or historic data on a national language. Many education doctoral students are, further, practicing teachers (or other professionals) who pursue doctoral degrees to facilitate their self-development and may not trust in their capabilities of producing international articles. In general, doctoral students need encouragement, support, and active persuasion so as to orient themselves toward article-based dissertation: A supervisor is “like a salesman who tries to convince them to buy this way of doing an article dissertation, but I also help and do a lot for them as well” (E1). After seeing their peers do it and getting first articles out, the students gradually build their confidence and establish a disciplinary identity based on article pursuit (E6). Students cannot, however, be asked to do article-based dissertations without provision of full-time funding; this requires that education professors also obtain external research grants.

Structuring a Manuscript According to Disciplinary Genre

Although academic writing is a critical aspect of scientific knowledge creation, the current educational system produces “very weak writers” (N4); students are seldom able to tell a good story that is required for effective communication of one’s findings to external investigators. Because learning of academic English is also difficult for many students, a great deal of effort has to be invested to coach students in academic writing. In natural sciences, the whole community assumes responsible for the quality of publications, and both junior and senior researchers take part in writing and rewriting dissertation articles. Social shaping of the students’ academic competence takes place by introducing students to the disciplinary genre (Bazerman, 1988) through coauthoring. Accordingly, doctoral students are taught what elements are commonly present in articles, how the elements should be integrated to reach desired coherence, and how the knowledge claims may be justified or supported. Toward that end, the student author will typically create an outline of an article so that each bulleted point will correspond to one paragraph of the completed article (N6, N7). A student writes a draft for each section starting from method, moving to results, discussion, introduction, and finally abstract; gets feedback from seniors and moves to the subsequent section when he or she feels ready. It is essential, further, to learn to use appropriate figures and interpret and explain them so
as to communicate to the readers what is truly significant in the findings. N8 estimated that the time required for constructing an article is cut in half with each dissertation article (from 18 months to 9 months, and finally 3-4 months). Although the senior researcher initially, to a large extent, determines the content and structure of an article, an experienced student may suggest his or her own structure and make a greater contribution. When completing their theses, students often become main writers who are able to independently generate ideas and drafts that are only reviewed by the leader.

The interviewed education professors also highlighted collaborative practices of writing. Although it has seldom been a problem in educational research to collect data or cultivate methodological competences, producing “a coherent text, a claim, background, substantiation, and a main point is something which some people do easily and other people have big big big problems in” (E6). Consequently, students are sometimes selected (E12) according to their proven capacity to produce a high quality academic text (e.g., master’s thesis). The article-based practices acculturate students to writing articles so that the main burden for molding students to appropriate the article genre is carried out by postdocs and senior researchers: “I try to demystify this writing process by making it step by step, so now you present the background, you have one page, what would you say, and now you present your data, how you collected them, what is relevant about them, and then to decide on what are the main things you want to say, and then to see how that can be fitted into an article” (E6). Co-writing starts in E1’s community after they have collected and partially analyzed data and a doctoral student has produced a draft. She works intensively with a doctoral student in front of a joint computer over the whole day, creating joint frameworks for categorizing data, analyzing results, and composing other parts of the article. The student is responsible of completing each part of the article and formatting it according to disciplinary- and journal-specific guidelines. Reciprocal sharing of competence plays a crucial role in her community: “As a person gets it [an article] published their capability grows and then in turn they can help others” (E1). By circulating manuscripts between co-authors synchronously and asynchronously, doctoral students are socialized to a process of writing that involves thoroughly rewriting manuscripts several times during the publication process (E2). Doctoral students’ development is facilitated by involving them as co-authors in writing many side articles besides their dissertation ones. Students vary a great deal according to the level of support they need; this is not visible in the end product because co-authors compensate for each other’s weaknesses. Supervisors highlight the importance of early socialization to writing for publication. Toward that end, students are often engaged in publishing their master’s thesis as a journal article co-authored with the supervisor (the first dissertation publication).

Expanding Abstracts to Journal Articles

Collectively oriented research leaders guide their students to learn academic writing by starting from writing short abstracts, upgrading and extending those to long abstracts, assuming responsibility for writing a section to an article, and finally constructing a whole article. In communities of N1, N3, and N4, students are guided to publish an abstract or poster immediately after they have collected “good data”. Correspondingly, educational research leaders send students to conferences to introduce their own work and become familiar with the disciplinary community as early as possible. “They must learn to write outlines and abstracts for conferences and then we refine them” (E6). Conferences are good environments for testing one’s research ideas; formal and informal discussions indicate whether ideas can be communicated, how argumentation should be improved, and what kind of new evidence should be obtained (E4). Conferences also provide deadlines and facilitative structures that assist in building articles (E12). Thus, when completing their dissertations, students not only write articles but also participate in an international academic network. By the time they finish their Ph.D.s, the doctoral students have to master academic writing as a generic competence, being able to produce comprehensive
academic knowledge for synthesizing literature and adequately reporting empirical research findings.

**Selecting a Publication Forum**

One of the first tasks in submitting a publication is selection of the publication forum. In natural sciences, journals are selected according to their impact, scope, target community (academic; clinical), length of reviewing process, and article-specific publication price (many journals require researchers to pay for publication). Many articles are rejected because they fall outside the scope of journal; because of that, one needs to select journals to which one has “something to say and contribute” (N7). Experiences of natural sciences indicate that you need to put your objectives as high as possible, focusing on quality rather than quantity (N5). Departmental incentives of natural sciences emphasize the importance of having articles appearing in journals with an impact factor more than five. The present science communities start from considering Nature and Science and move down if data are not of sufficient quality and impact (N1). Many investigations adequate for a dissertation cannot, however, be published in the best journals. Risky doctoral studies do not often, so to say, produce the “desired jacket but only a pair of pants or just a hankie” (N1) that functions as a student’s training piece. Publishing in high-impact journals is a challenging and long-term process; according to one participant half of the submitted articles are initially rejected and need to be sent elsewhere (N4). This has to be taken into consideration in selecting journals because “time is money” (N6) in the doctoral process.

Non-publishing education professors used to claim, according to E1 and E3, that there are no international forums for publishing data on the Finnish education system; hence they did not try. Successful experiences of supervising article-based theses have, however, revealed that numerous publication forums are available. When submitting manuscripts, it is essential to be aware that the journals are working within certain research fields, which submissions need to advance further (E7). Targeting high-quality forums, respective to the field, is an important concern of many of the interviewed educational research leaders (E1, E3, E4, E7, E8, E9) when selecting journals. Nevertheless, discourse regarding journal impact is, overall, new in the field of educational research. Initially, supervisors of article theses had had to try publishing “by improvising; we just tried to think about where they [doctoral students’ manuscripts] fit in thematically, and for example this whole idea about the varying demands or impact of different journals was totally unknown to us” (E4). Investigators who have just started to create a publication culture tend to focus on quantity of publications. Article pursuit has guided the present education leaders, however, to follow citations, and publish less frequently, but in better journals (E2, E7). Many of the interviewed education leaders utilized the European Science Foundation’s (ESF) ranking of educational journals to select publication forums so that articles are deliberately aimed at journals with “high quality”. Tightening academic standards are supported by emerging departmental and university-level incentive systems that emphasize quality so that articles in high-quality journals, respective to the field, count more that low impact ones. By following practices of medical research, there is an attempt to get the last submitted manuscript, the final piece of an article thesis, to one of the highest-quality or -impact journals (E7). Submitting manuscripts to high-quality journals provides useful review statements, even when they are not accepted. Doctoral articles are often not sent to the most demanding journals because it may take such a long time (E3); one picks the tenth of the ranking rather than the most prestigious one. Doctoral students socialized to journal science are reported to become aware of the quality of scientific journals; they have made statements opposing departmental publication discourse focused on quantity (E7, E8). Overall, many educational leaders stated that publishing in high-quality journals should be better recognized and supported. In a rapidly evolving research field, impact based on journal history cannot, however, be the only criteria of publication, as mentioned by E6; it is also essential to publish in journals representing new methods and
fields of research in spite of initially low impact. ESF rankings in educational sciences are not only based on impacts, but for instance, the rejection rate is one of the additional measures among others.

**Framing and Justifying Arguments**

The interviews revealed that doctoral students need a great deal of support in framing articles and justifying their arguments. In order to adequately frame their investigations, doctoral students need to comprehend the wider context of their investigations rather than focus only on a specific area of investigation assigned to them. To truly understand what they are doing and the deeper significance of the problem they are working with, doctoral students need to read widely (N5). They should not, however, read too widely because students who know everything easily become academic “fire extinguishers” (N1) who may prematurely end potentially promising lines of investigation on the basis of superficial information about earlier research efforts. Without being able to contextualize one’s work adequately, doctoral students would not be able to “highlight the fundamental significance of their work” (N8). In natural sciences, investigators have to be economical in their argumentation through making only those knowledge claims that are necessary for the main point of the article. When submitting to the most prestigious journals, it is, moreover, essential to convince the editors that one’s contribution is substantial enough and interesting to a large body of readers. Because framing plays such a crucial role in publishing in high-impact journals, senior researchers’ support is often needed long after science students have learned other aspects of academic publication.

Framing of investigations is a central concern also of the interviewed educational leaders. When assisting a student with an article that includes a good question and research design, E7 emphasizes “focusing and argumentation… they probably need my help most in that, smoothing out the rough edges and that you don’t need to say everything in one article and all the data doesn’t need to be used to solve one research question…” (E7). Cultures of publication vary, for instance, between European and American journals, and each journal has its own preferences regarding methods and argumentation that may be difficult for doctoral students to understand. In order to surmount the publication threshold, it is essential, according to E1, E2, E3, and E10, to guide doctoral students to investigate articles that have appeared earlier in the target journal so that they are able to make a contribution that advances associated academic discourse. It is also essential to cite relevant articles that have formerly been published in the journal. In E1 and E3’s groups, students are guided to read and analyze a large number of articles published in the target journal and give a corresponding presentation to their research groups. Students of E7 and E8 have collected a database regarding a number of journals and the length and nature of review processes so as to rapidly select an appropriate publication forum. While other supervisors focus on facilitating data analysis, E3, in contrast, guides students systematically to examine their manuscripts from the perspective of specific academic audiences: “They always learn in the beginning what journal they can send to, what’s the readership, how to frame them [manuscripts]; this is where I help a lot.” (E3). She stated that the senior researcher’s contribution is to provide “an invisible hand” that assists in framing a student’s good manuscript in a way that makes it publishable in the target journal. This entails writing the manuscript deliberately for a specific audience and providing transparent arguments without excessive jargon.

**Collective Address of Review Feedback**

All interviewees across natural sciences and educational research had developed practices of addressing review feedback collectively. Rather than leaving doctoral students alone to deal with oftentimes strict review criticism, natural science groups of N2, N3, N4, and N5 sent it to all co-authors and other relevant community members to be collectively responded to. An inexperienced student cannot adequately interpret the meaning of review statements; even critical feedback may be a positive indication that a
manuscript is about to be accepted. Doctoral students are guided to accept rejection; immediate acceptance of manuscripts would imply following too low standards and submitting pieces to weak journals. Participation in the journal science acculturates students to work productively with external reviewers, forcing them to do inquiry in depth, contextualize findings, and try to go beyond the next edge of knowledge creation. Doctoral students are challenged to stretch their capacities for initially considering how to respond to review criticism (N5); senior researchers come to help only when necessary. In many other cases, the seniors are more closely involved in considering rebuttal of review criticism, making changes to improve the submission, and constructing the final cover letter accompanying the manuscript.

Review comments are also shared among co-authors and other relevant community members rather than processed by doctoral students alone in the selected educational research communities. Receiving unforgiving review criticism is always a “shock” (E8) to a doctoral student. “If [the student] was alone in this kind of a phase he or she would think there was something wrong with them, that they were talentless or something” (E3). Working closely with external reviewers makes the doctoral process more transparent in nature because “you get much more regular feedback from the group and the feedback by reviewers” (E10) so as to overcome weaknesses that are not obvious to students. Co-authoring acculturates students to deliberately seek criticism outside of their immediate academic circle, and, thereby, expand their creativity by relying on experience and competence of investigators coming from different contexts. Going through repeated reviews is essential because it socializes students to openly share their unfinished manuscripts without which collective resources could not be mustered to support improvement. Partially because writing a monograph is a lonely process, “there are a lot of people that are afraid to show their texts …to [outsiders]”(E1). E3 is deliberately training her students to work productively with people commenting on his or her manuscripts: “I try to train each group to give constructive and encouraging feedback. It’s the whole idea of the seminar, that you form a collective flow and people start to help one another” (E3). Instead of individual rumination on negative feedback, E3’s community has created a practice of warmly congratulating a student who is requested to make “major revisions and resubmit this thing. Then we congratulate them that it’s excellent for this thing to be moving forwards, and then we do the corrections [as soon] as possible and move on” (E3). Even if a manuscript were to be rejected, the spirit is to get good review comments and submit it elsewhere.

E6 and E10 taught students to understand seemingly punitive review criticism as a communication problem. A very detailed critical feedback is a good sign that a busy evaluator has some appreciation for the manuscript in question. The manuscript needs to be improved so as to better communicate its ideas to reviewers coming from a different context. According to E6, it is sometimes equally crucial to furnish a more extensive cover letter interpreting and rebutting reviewers’ critiques and explaining changes when resubmitting the actual, revised article. In submitting manuscripts, it is essential to learn to understand the target community, appropriate corresponding academic language, identify proper references, and share the relevant research paradigm. Also personal connections matter; getting articles accepted is difficult if nobody knows your work and face. E11’s community organizes specific research seminars for collectively responding to review feedback of doctoral students or other researchers: “We take the reviewers’ arguments or corrections and go through them one by one, examine them and think about how we could plausibly implement them without it turning into an impossibly large assignment” (E11). Senior researchers are required to carefully prepare for such discussions often intended to produce concrete guidelines of improving the manuscript in question. The acceptance of the first dissertation article is often critical, but sometimes it could take two or three years, and keeping up the motivation becomes difficult: “One important thing is to keep the flame burning in the beginning once the idea has been hatched because usually it comes with a fair bit of excitement, but then there’s arduous long
work, and it isn’t always obvious that the inspiration stays the same; there can come a time when it runs out” (E4).

Determming Authorship for Collaborative Publications

Practically all science publications are co-authored. The science leaders agreed that only those who have made “a sufficient intellectual contribution” (N1), in accordance with the sciences’ ethical principles, should be included as authors. The participants may have very different but relevant roles in joint publications, from creating research ideas and theories, developing instruments and methods, experimenting and collecting data, and analyzing and modeling data, to writing of the manuscript. Overall, it is essential to try to find a balance between the most loose and most constrained criteria of authorship (N7). Doctoral articles are co-authored because of being embedded in collective research achievements (N9). In most science-research communities, doctoral students were first authors of publication credited in their dissertation, even if they received substantial support from senior colleagues: “Well, they become the first authors, get the primary credit on their works, even if they need a lot of support, even if we write it over 20 times” (N1). Students who do the hard work of collecting data will always be the first authors in spite of being pushed and supported. In N3’s community, the starting point is that each article published is a part of a doctoral student's dissertation. Sometimes research assistants are taken as co-authors to encourage their academic interests. In medicine, it is sufficient that the doctoral student be the first author in a half of the doctoral articles; elsewhere three or four first authorships are needed.

Most of the education leaders were also oriented toward systematic collaborative publication. As E7 stated, “Nobody here publishes alone. Our work is collaborative, it's difficult to identify a single person who has created our solutions or ideas” (E7). Co-authoring was considered an essential form of collectivity; it gives visibility to the whole group, indicating that they are engaged in doing interesting studies. E2 stated that the doctoral students “learn to publish together with me. So the regular proceeding is that the first article is published with me as a supervisor, the second is quite often either with me or other senior colleagues, and the third article, or the fourth article is either alone or it could be together with other PhD students” (E2). While the importance of publishing doctoral investigations was emphasized by E11 and E12, it did not necessarily mean co-authoring; often students prepared and submitted their studies personally. E1 often asks doctoral students to submit one article without the supervisor's direct assistance so as to facilitate their academic independence. Some research leaders proposed that it is essential to vary the composition of co-authors from one publication to the next. Sometimes capable research assistants are involved as coauthors to “spark” them to become researchers later on (E4). In the case of dissertation articles, doctoral students are the first authors, carrying the main responsibility for creating the draft, constructing the outline, analyzing and interpreting the data; they control the process and keep up the pace when the manuscript is written in turns (E6). Various contributions should be recognized, from creating research ideas, determining research designs, constructing tools and instruments, analyzing results, and writing the article. Because of the increasing complexity of research designs and methods, it is more and more important to have methodological experts as co-authors (E4).

Challenges and Possibilities of Collaborative Publication

The collectivization of academic research entails that it is more difficult to determine the boundaries of authorship, especially in natural sciences, which rely on complex and heterogeneous division of academic labor in massively distributed global knowledge production centers. Investigations increasingly have to rely on socially distributed expertise, such that one participant knows information technology; another one, experimental methods; a third one, human genetics; a fourth one, academic writing, and so on (N5, N6). Consequently, for a single paper, the number of authors has been rapidly
increasing in medicine and physics (from five to ten authors on average) across the last two decades. It used to be relatively easy to agree about authorship among half a dozen participants along the same corridor. In present contexts, such decisions present intricacies: There are varying contributions to data acquisition, instrument development, and data analyses from 15 researchers in 10 different countries. In order to proactively avoid conflicts, it is essential to inform relevant stakeholders that an article is about to be produced, agree about authorship beforehand, and provide participants with opportunities to contribute to the actual writing. When several doctoral students were involved in investigations, conflicting expectations could emerge, for instance, regarding first authorships or order of authors. In order to avoid conflicts, “I’ve always had the opinion that borderline cases are included, so that nobody’s feelings are hurt. If someone thinks that he should be in, ... it’s not [taking] away from anyone else, if there’s a seventh name there, why should we drop it?” (N5)

Education professors reported that conflicts sometimes emerge because the publication process takes a long time and within an open community a student may quickly utilize another one’s pioneering idea as a part of his or her publication before the former one has been able to complete his or her investigation (E4). Sometimes students coming from an individualist culture do not understand why the supervisor should be included as an author in an article. E3 compared the supervisor’s contribution with creating trails that assist a student to successfully ski across difficult terrain: “It’s really consuming [demanding] to ski where nobody has skied before, there’s no route and you don’t know where you’re going. So you can go to ski there, but it’ll take a damn long time and there’s no guarantee you’ll make it back alive. When you do go skiing, you’ll have to do the physical work, you’ve got to ski for yourself, [because] that’s your job. But [in the contrasting situation] you are skiing along a track that’s been readymade; your skis are waxed and you’re wearing a hat. So you can think, when you’ve skied fifty kilometers, that you’ve skied it all by yourself, but you didn’t build the track. So [in fact] the track is there, you’ve got a hat on and the skis are sliding, you can’t even begin to imagine what it would be like to ski without those things” (E3). Usually, problems can be avoided by contributors openly discussing principles of co-authorship and beginning to negotiate about authorship when first preparing publications.

One interviewed education professor was reluctant to put his name to a doctoral student’s article because it would mean taking advantage of the latter’s work in building the professor’s own CV. Because education is a more literate activity than science, it would, said this professor, be “incomprehensible and against norms of science” (E12) to be included as an author in an article without taking part in the actual writing of it. The other supervisors of article theses did not at all consider being designated co-authors with doctoral students, in such cases, to be ethically problematic. Nevertheless, because the whole rationale of the collective model is to acculturate doctoral students to knowledge creation through co-authoring, it is critical to have seniors contributing to the actual writing of publication, beyond mere reading and commenting on a student’s manuscripts. The present interviews indicated consistently that the research leaders were actively involved in pursuing investigations in which students’ dissertation articles were embedded. Substantial collective support and facilitation by senior researchers appeared to play a crucial role in getting student papers accepted by rigorous journals. In any case, if one is setting up a collaborative approach to scientific publication in order to genuinely improve the quality of doctoral education, it is essential to recognize and overcome potential biases of co-authoring (including too loose criteria for authorship of senior investigators).

An advantage of pursuing article theses is in fostering collaboration within a research community as well as assisting supervisors and postdocs to “get some merit [credit] for doing it [supervision], that they get publications under way” (E6). It would be “a suicide in terms of academic practices” (E3) to stay many years in a cubicle and create a monograph destined for a library shelf. Doctoral investigations become a part of the collective body
of scientific knowledge and subject to citation only after being published. An advantage of an article thesis is that even if something goes wrong, the student at least has the articles to his or her credit. It is, further, possible to be fairly confident that after the articles have gone through the peer review, the dissertation is likely to be approved; said one professor, “I’ve had doctoral students whose first publications have been already been cited 60 times by the time that they’re defending their thesis” (E3).

The collective approach appears, on the present evidence, to be a desirable way to proceed in the future, in educational research, but there are certain risks involved as well. According to E4, it does not assist in improving the quality of educational research if one moves mechanically to the “classic model of repetitive empirical research” (E4) recycling similar questionnaires infinitely with new populations, so as to maximize the number of publications. E11 agreed that it is a risk if “the pressure to produce is interpreted to [mean] this kind of quick putting out [of] these articles, no matter the cost” (E11). Because projects have short life cycles, doctoral studies often relate to more than one project; keeping a coherent focus can become a problem: “The risk is that it [the research object] begins to fragment because working one article at a time is a threat [to coherence]. So that's when the supervising relationship becomes incredibly important, [in order] that the totality of the project needs to be bigger than just the one article, so these two levels need to be made to work together with some certainty” (E11).

Discussion

The role of co-authoring practices in doctoral education was examined by interviewing leaders of cutting-edge groups in the natural sciences as well as leaders of educational research communities oriented to supervising article theses. Because actual enacted academic practices were not directly observed, the responses should be taken to represent the interviewees’ perceptions and interpretations of the collective facilitation of the development of doctoral students' academic competence. Yet the interviews provided striking similarity across natural-science and educational research communities regarding social shaping of practices that give rise to recognized academic excellence through socializing doctoral students to scientific publication through co-authoring.

Co-authoring is a principal method for acculturating doctoral students to producing knowledge publishable in peer reviewed journals. It appears as a truly significant educational achievement of leading-edge science communities to be able to systematically train doctoral students capable of pursuing publications appearing in highly regarded, refereed, scientific journals. Although only a few dissertation articles are likely to end up being published in the top, prestigious journals and meeting the highest standards of professional creativity, deliberate enculturation of doctoral students to international publication raises epistemic standards and facilitates the scientific competence and productivity of the participants. Hakkarainen and his colleagues' (2013) analyzed the knowledge-creating agency of doctoral students of physics and medicine: the study revealed that two-thirds of the doctoral students’ talk addressed the intellectual and social support that their research community provided for academic knowledge creation. Doctoral students taking part in research collectives are able to use collective resources to surpass their individual capabilities; they co-develop with their research objects, investigative processes and resulting co-authored articles, “authoring themselves” during the process (Holland, Lachicotte, Skinner, & Cain, 1998). Such accounts of the collective facilitation of investigative competencies in natural sciences are very valuable because academic achievements are still often considered to mainly rely on individual gifts and talents, and there are only a few studies concerning collective creativity of academic research (e.g., Delamont et al., 2000; Hakkarainen et al., 2013; Knorr Cetina, 1999).

Collective publication practices appropriated from natural sciences are being productively implemented in research communities of the interviewed education professors. Creation of a publication culture is a long-standing and labor-intensive
process. A senior researcher interested in appropriating it should ensure that his or her university accepts article-based theses consisting of co-authored articles. As far as the supervisor is also him- or herself struggling to learn practices of international publication, creating and moving the first article thesis to completion could take a relatively long time. After the first students have graduated, however, they can guide and support the newcomers. In order to become quickly socialized to journal science, doctoral students should be involved in publication efforts already when they are doing their master’s theses. Initially, senior researchers should provide a great deal of guidance and support; later on, the doctoral student’s contribution becomes more central so that the supervisor may fade to the background. It is very important to encourage collaboration and support between newcomers and more experienced peers. After acculturating a few cohorts of doctoral students to journal science, resources of supervision distributed among a community are likely to kick in. Nevertheless, the supervisor should take care of his or her students and personally ensure that they get the support and guidance needed. Social support is critical because learning to publish is not only an epistemic but identity related achievement as well. Going through the publication process with assistance of senior researchers and seeing his or her own article published, is likely to build the doctoral student’s self-efficacy (Bandura, 2006). When extending the collective model to the educational research, it should, however, be taken into consideration that many students are practicing professionals who are not aiming at a professional research career; in their cases the traditional approach of doing a monograph and going through corresponding formative experiences may be adequate.

Rooting collaborative publication culture has been difficult because co-authored publications are still sometimes devalued and considered dubious in the field of educational research, even when published in high-impact journals. Nevertheless, collectivization of doctoral investigations is worthwhile because well-functioning research communities amplify available socio-epistemic resources beyond the sum of individual ones (Hakkarainen et al., 2013). Yet, the collective model is not without limitations and risks. In academic cultures, often hierarchical and competitive in nature, doctoral students pursuing articles co-authored with their seniors may become even more dependent on their supervisors than those relying on the traditional individual model (Hakkarainen et al., 2013). The downside of enhanced academic achievements, may be “academic capitalism” (Slaughter & Rhoades, 2004), characteristic of publication cultures in which doctoral students are treated instrumentally as a part of a “publication machine”, serving the interests of senior researchers and their funders. When co-authoring with students, academic supervisors are not only helping students but also building their own publication record. In order to cope with tightening quality standards and international scientific competition, research in social sciences takes place more and more often in competitively funded multi-disciplinary research projects (Green 2009; Nowotny, Scott, & Gibbons, 2001) which are expected to produce verifiable results published in internationally refereed journal contributions. Funding of Finnish universities relies more and more on their performance measured by academic degrees and internationally refereed scientific publications across all disciplines. In parallel with extending the collective practices of supervision from natural sciences to such social sciences as education, the Finnish university system is going through a major reform that involves a significant percentage of university or departmental funding being determined according to internationally refereed publication, with a specific emphasis of articles in high-impact journals. This is likely to increase publication pressures in general and contribute to further extension of the article-based collective model in particular. When asked to specify contributions required for co-authoring, the supervisors from natural sciences to education highlighted importance of making a genuine contribution to designing, conducting, and analyzing investigations and participating in actual writing of articles. Ethical problems emerge if a senior researcher expects to be included as an author without actually taking part in relevant aspects of a study. Observing such ethically problematic situations has made some senior researchers, such as E12, decide to distance
themselves from their students' publications. In order to avoid internal conflicts, it is essential to explicitly agree about principles of co-authoring and procedures of solving disagreements, and ask newcomers to sign a corresponding research agreement. Co-authoring principles should be transparent and fair (in terms of protecting right of both doctoral students and their supervisors) and focus on maximizing the research community's collaborative efforts.

The present investigation is in accordance with Walker and his colleagues' (2008) suggestion to improve the quality of doctoral education by establishing intellectual communities focused on collaborative research at the heart of doctoral scholarship. As the seminal investigations of Howard Gruber (1981, see also Hakkarainen, 2012) have revealed, research communities and their leaders pursue evolving networks of mutually supporting and complementary research projects which provide ample opportunities for deliberately producing insights, going beyond prevailing frontiers of knowledge, and gradually establishing cutting-edge practices of academic research. Truly significant academic achievements are always made in research communities; "one person can never be the best in the world but a group can be the best" (N3). Many of the present research leaders had invested many years of effort to cultivate collective practices that support effective journal publication. While pursuit of journal science is very difficult to learn on one's own, innovative practices gradually emerging from such intensive transformative efforts may become crystallized and embodied as a part of a research community's shared, routine, everyday knowledge practices. Hence, deliberate epistemic socialization of new cohorts of doctoral students to collaborative practices of journal science arguably represents inter-generational learning (Holmes, 2004; Hakkarainen et al., 2013) and plays a crucial role in the dynamic facilitation of academic knowledge creation. It may be proposed that in such communities, innovation and pursuit of novelty are themselves transformed to shared social practices through the deliberate cultivation of desired personal and collective competencies and patterns of shared activity (Knorr Cetina, 1999, 2001; Paavola et al., 2004; Sawyer, 2007; Simon, 2002). This process allows the immersion of subsequent student cohorts immediately in journal-based scientific endeavor when they enter a research community.

Appropriation of such innovative knowledge practices as an initial cornerstone of one's academic activity appears to provide a good basis for further expansive efforts, for instance, to cultivate research practices rigorous enough to meet requirements of high-quality journals. Accumulating publication and citation records allow academic research communities to obtain competitively funded national, European, and international research projects and initiate novel lines of inquiry breaking boundaries of prevailing knowledge and competence. Although academic communities do not always function perfectly, growing into a community characterized by distributed academic practices enhances doctoral students' cognitive capacities to an extent that enables them to solve significantly more complex problems than would otherwise be possible. Such capacities are best not thought of as individual characteristics or gifts, but, we argue, rather as the appropriation, within individuals, of the capabilities of the research cultures in which they function. Taking part in advancing an already started "long march" (Holmes, 2004) of academic investigation is likely to enable junior researchers to reach higher peaks of knowledge creation than reached when one relies mainly on personal and local experiences (Hakkarainen et al., 2013).

In order to facilitate students' acculturation to collaborative production of academic knowledge, it is important to have supervisors who are willing to invest time for guiding and coaching newcomers. In collaborative research communities supervision is, moreover, distributed across junior (doctoral students and post-doc at different stages of their investigations) and senior participants; learning by working at the elbow of more experienced peers is, in many cases, as important as direct guidance of the supervisor (Hakkarainen et al., 2014). Getting access to sophisticated collective academic practices cultivated across many years and decades appears to be the only known (relative) short-
cut to acquiring the practices of academic excellence. Doctoral students participating in cutting-edge research communities may become competent in knowledge creation, as we have termed it, even if the productions are not necessarily extraordinary or ground breaking. Deep intellectual enculturation to knowledge practices of leading-edge research communities appears to have parallels with races on a track: "when they [students, newcomers] have the opportunity to launch themselves from such a high platform, then they can go for the Nobels and things, when they're not wasting their time and are given – like in a relay race – … kind of a running start" (N5).

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Notes

1 We are thankful for Kirsi Pyhältö for helping us to explain differences between Finnish and European doctoral education.

2 Some of the present neuroscientists designated themselves as working in the field of psychology, in which capacity investigators commonly rely on the methods of both the natural and social sciences. Historically, psychology has played a central role in promoting the appropriation of the collective approach in social sciences. In order to examine how the collective model of doctoral education can be extended from natural to social sciences, however, the participants were clustered into groups according to their methodological preferences. Some of the present educational research leaders have roots in psychology and are oriented to study educational psychology. These issues were, however, not further considered for purposes of the present study.

References


Collaborative Authoring in Doctoral Programs


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