Editorial

Authorship practices in educational technology research

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Authoring documents and academic articles is a key means by which researchers share new knowledge and is closely tied to academic progression, prestige for individuals and institutions, and continued funding of research. In this editorial we continue our discussion around ensuring quality research and publication practices, with a focus on authorship. There are concerning trends emerging around practices in relation to authorship across the publishing landscape. In the field of educational technology research, projects can involve teams of people in a variety of roles. This can result in a particular risk, that important contributions of learning designers and technologists are overlooked, despite their involvement in the creation of the tools tested, or the infrastructure with which we collect data. In this editorial we will consider the importance of authorship, explore the common issues related to how authorship is determined and represented, and relate the debate currently in play across different disciplines around authorship to our context of educational technology research. We will conclude by introducing our revised guidelines for authorship at AJET.

Keywords: authorship; collaboration; ethics

Introduction

Authorship in academic professions is a crucial method of sharing new knowledge in order to advance a field. It marks the end of a stage of research and is an opportunity for the research and findings to be discussed by peers (Editors' Network, European Society of Cardiology (ESC) Task Force et al., 2019). This type of research output is tightly tied to promotion and tenure opportunities within organisations as well as successful proposals for new research funding. A list of publications is often used to communicate the expertise of a particular researcher. Authorship is essentially about appropriate credit and accountability (House & Seeman, 2010), however what tasks and who is given credit and held accountable differs depending on the disciplinary culture, institutional norms, and group dynamics (Smith et al., 2020). The order of authors can communicate an author's role in a project (such as supervision or leadership), can be used to rank contribution (including assigning co-first authors), or may be simply organised alphabetically (Smith et al., 2020). Hyperauthorship occurs when hundreds of authors are listed on a paper (for example in high energy physics or genetics) (Cronin, 2011).

Authorship showcases particular researchers and the associated theories, methodologies, analytic techniques. There is significant power involved in distributing recognition and determining prominence (Smith et al., 2020). It is often the role of the principal investigator to determine who conducts the work, who contributes to papers and the order of the authors (Patience et al., 2019). Historically, authorship has signified credit for writing of the manuscript and accountability for its contents (Borenstein & Shamoo, 2015). In some fields, authors also include those who have contributed to the creation of new knowledge, through roles related to the creation of research software, or visualisations, regardless of their written contribution to the manuscript. Given the importance of authorship, it is necessary that journals provide clear guidelines so that those submitting articles are able to appropriately acknowledge all contributions to

the research. In this editorial we will continue our discussion around ensuring quality research and publication practices (Lodge et. al., 2021) particularly related to authorship. We will explore the common issues that are raised in relation to authorship, and then describe the debate in defining authorship guidelines in different disciplines.

Questionable research practices relating to authorship

There is a significant amount of literature that relates to the investigation and discussion of authorship practices in academia (Borenstein & Shamoo, 2015; Cronin, 2001; Patience et al., 2019; Pfleegor et al., 2019; Smith et al., 2020; Uijtdehaage et al., 2018). As the ways in which research is conducted change in relation to new fields (such as genetics), ways of working (with cross-institution, cross-disciplinary or international collaborative teams), and organisational systems (tenure and promotion), so too do the ways in which authorship is negotiated and used. However, some of these research changes have resulted in the emergence of less than desirable practices. Unethical practices that have been identified include those associated with the supervision of HDRs (particularly in terms of PhD by publication); honorary authorship; gift authorship; coercive authors; guest authorship; outsourcing writing; prestige authorship; plagiarism; self-plagiarism; citation amnesia; multiple submissions; duplicative publications; international collaborations and non-native English speakers; opaqueness of author order; vague authorship criteria; and diminishing accountability (it may not be reasonable to expect this from all authors) (Borenstein & Shamoo, 2015; Patience et al., 2019; Pfleegor et al., 2019)

These practices occur, at times, because of the pressures of publishing in order to further careers, pressures within institutions from individuals (managers or colleagues), or because they are seen as common practice in that particular field, discipline, or research group (Uijtdehaage et al., 2018). Other research has found that authors often find the guidelines set by publishers, institutions or other oganisations too restrictive (Patience et al., 2019), some feel unethical pressure from their organisation or colleagues (Uijtdehaage et al., 2018); or simply do not agree with the guidelines (Uijtdehaage et al., 2018; Smith et al., 2020). Guidelines need to acknowledge the messiness of scientific practice if they are to be followed by the research community (Penders, 2016).

As we have previously discussed (Lodge et al., 2021), there is a renewed emphasis in the last decade on questionable research practices, including the so-called 'replication crisis'. The issues identified through this increase in interest in the assurance of research integrity and quality range from outright fraud, such as data fabrication, through to approaches that have been commonly accepted but are technically incorrect (e.g., underpowered studies). The seriousness of fraudulent and deceptive practices have rightly remained central to the focus on combating questionable research practices. Over time, however, there is now a shift in focus to other practices where the quality and integrity of research can be compromised, including those related to authorship. Those most commonly discussed in the literature include honorary and gift authorship and publishing cartels, and ghost authorship. We will discuss these in some detail below. In educational technology research, we suggest that there is also a potential problem in the lack of attribution of authorship to those who create the educational technology in question, such as the learning designers and technologists who create the technology researched as well as the infrastructure through which we conduct our research.

Honorary and gift authorship and publishing cartels

There are many ways in which authorship can be attributed to researchers where their contribution has been minimal or non-existent which can lead to what Ioannidis et al. (2018) identified as 'hyperprolific authors'. There are thousands of hyperprolific authors, who publish a new paper on average every five days (Ioannidis et al., 2018). While some are in fields that have particular publishing practices that revolve around large team projects, such as high-energy physics which can have hundreds of authors on a single paper, this practice does raise questions about how some hyperprolific authors are able to achieve this level of research output (Smith et al., 2020).

Some of the ways in which this might be achieved is through honorary and gift authorship, as well as publishing cartels. In these cases, a researcher receives credit for the research without having contributed to the piece of written work. In honorary authorship, a person's name is added because they are considered to be prestigious in the particular research area or within the institution (Kharasch et al., 2021). In gift authorship the addition of a person's name is done as a gift to someone who has had little to do with the

research, in the hope that this will expand the other authors' networks or there will be some reciprocal arrangement in the future (Brand, 2012). Publishing cartels occur when a group of authors often publish together, but do not always all contribute to the publication, and they may take turns in leading the team (Kovacs, 2017).

Other than that the practice is inherently unfair, there are many implications for research in assigning credit to researchers who have not contributed to the publication. In particular, for early career researchers, unrealistic standards are set for promotion or tenure, increasing pressure on achieving large numbers of research outcomes (Teixeira da Silva & Dobránszki, 2016). This practice can often be aligned with coercive or bullying behaviour, where early career researchers have not felt comfortable to deny the addition of authors who did not contribute to the piece of work when asked to do so by someone in a position of authority (Grieger, 2005). A common situation in which these practices occur is when HDR students need to determine whether supervisors are included as co-authors on publications arising from their thesis (Echeverria et al., 2015).

Ghost authorship

In the case of ghost authorship, the contribution of an author is not assigned appropriate credit. Ghost authorship occurs when individuals contribute to a publication but are not acknowledged as an author because there are significant concerns about conflict of interest that the team would like to obscure (Stocks et al., 2018; Smith et al., 2020). Ghost authorship is discussed mostly in relation to medical research, but should be considered in relation to any collaboration with industry partners. The implications of this questionable research practice are related to the reliability of the research that is reported. If an industry partner who has a vested interest in the outcomes of the research could influence the way in which the results are presented, without stating their involvement, then readers are unable to assess the work in relation to any potential bias (Stocks et al., 2018)

Diverse authorship teams

In diverse authorship teams, there can be a range of ways in which the team are given credit for their contribution to a publication. In a survey of hundreds of researchers around the world, Patience et al. (2019) identified that larger teams with more complex infrastructure recognised a broader range of contributions for authorship. Beyond drafting a manuscript, roles such as acquisition and analysis of data or computing skills (Aliukonis et al., 2020), or editorial contributions for those authors from a non-English speaking background (Patience et al., 2019) could be included. Some members of the team may be excluded despite having made a significant contribution to the research that is being reported. This has significant implications for the understanding of how knowledge is created, as well as for funding, if the diversity of teams is not adequately acknowledged in the research outputs. It also has implications for the career progression of those who support the conduct of research and the creation of new knowledge through the development and operation of research infrastructure. Research infrastructure includes lab equipment, but also emerging data capture techniques, such as drones, or the development of new ways of creating, such as in advanced manufacturing. It may involve the visualisation of data in ways that provide insights for researchers.

In the AJET community, this could include the creation of specialist technology, such as a VR application, the design of a unit in a LMS by a learning designer or technologist, or the algorithms to extract data from a MOOC. These contributions are an important part of the research process, but sometimes not acknowledged through authorship as the person hasn't "written" anything in the article for publication. Creating greater consistency around what is accepted authorship practice in the educational technology research field can help all members of a project team understand their right to be acknowledged as an author and assist in how teams approach the drafting of publications going forward. Journals and professional societies can play a useful role in promoting greater transparency and consistency in the attribution of authorship in several ways, which we will now explore in more detail.

Authorship Guidelines

Many societies and journals have authorship guidelines on their websites and as part of their submission instructions. These vary in the amount of detail that they provide, as well as the particular journal or discipline's stance on the need for written contributions to be counted as authorship. The following two extracts from journals aligned with AJET (American Educational Research Association (AERA) and iEEE) demonstrate these differing opinions:

> *All parties who have made a substantive contribution to the article should be listed as authors. Principal authorship, authorship order, and other publication credits should be based on the relative scientific or professional contributions of the individuals involved, regardless of their status. A student is usually listed as principal author on any multiple-authored publication that substantially derives from the student's dissertation or thesis.*

AERA author instructions: https://journals.sagepub.com/author-instructions/ero

> *IEEE considers individuals who meet all of the following criteria to be authors:*
> - *Made a significant intellectual contribution to the theoretical development, system or experimental design, prototype development, and/or the analysis and interpretation of data associated with the work contained in the article.*
> - *Contributed to drafting the article or reviewing and/or revising it for intellectual content.*
> - *Approved the final version of the article as accepted for publication, including references.*
>
> *Contributors who do not meet all of the above criteria may be included in the Acknowledgment section of the article. Omitting an author who contributed to your article or including a person who did not fulfill all of the above requirements is considered a breach of publishing ethics.*

IEEE ethical requirements:
https://journals.ieeeauthorcenter.ieee.org/become-an-ieee-journal-author/publishing-ethics/ethical-requirements/

In both cases, the journals identify a substantive or significant contribution to the article, without further explanation of what this constitutes. AERA guidelines are quite broad, recognising the diversity of practice in different disciplines. The only issue that they specifically refer to is related to HDR students. IEEE, on the other hand, requires contribution to the drafting of the article or reviewing and/or revising to be considered an author. IEEE also insists that all authors be accountable for the content of the paper. They recommend using the acknowledgments section to describe other contributions to the work. Neither require authors to identify their specific contribution to the publication of the research.

Beyond the fields of education and technology, the most widely discussed criteria are those proposed by the International Committee of Medical Journal Editors (ICMJE). The main discussion in the literature, relates to written input to the paper, or an intellectual contribution that supported the research such that it could not have been completed without it (Editors' Network, European Society of Cardiology (ESC) Task Force et al., 2019). As was discussed earlier, this differs depending on the ways in which research is conducted in a particular discipline. Similar to the iEEE guidelines, those identified by ICMJE require all four criteria to be met to be considered an author, which includes a contribution to the writing (International Committee of Medical Journal Editors, 2021). ICMJE guidelines suggest that a contributor model be adopted:

1. substantial contributions to the conception of the research or to the collection, analysis or interpretation of data;
2. drafting or revising important intellectual content of the manuscript;
3. final approval of the published version; and
4. accountability for all aspects of the work

In a contributor model, transparency of who is responsible for specific aspects of research projects is considered important (Borenstein & Shamoo, 2015). Those who make contributions are indicated and the nature of each contribution is listed (Holcombe, 2019). This is common in journals such as *Nature, as well*

as many in medicine, such as the *British Medical Journal and Nature Cell Biology* (Borenstein & Shamoo, 2015).

The contributor model is intended to reduce honorary authorship and clarify researcher contributions (Holcombe, 2019). It also supports cross-disciplinary and cross-subfield collaborations, the development of scientific software, and appropriately recognises contributions of those in specialist roles with research (such as statisticians or those who create visualisations) (Holcombe, 2019). The evaluation of the impact of each author can be more nuanced and accurate (Aliukonis et al., 2020). This approach also informs the readers about the nature of the research and the individual work (Editors' Network, European Society of Cardiology (ESC) Task Force et al., 2019).

The Contributor Roles Taxonomy (CRediT) has been recommended as a way to standardise and record contributions to research by proposing specific roles a contributor can claim. It was proposed by journal editors and researchers hosted by the Wellcome Trust and Harvard University in 2012 (Holcombe, 2019). The taxonomy allows for credit through authorship for research activity including the creation of visualisations or project management. The fourteen contributor roles in the taxonomy are: conceptualization, data curation, formal analysis, funding acquisition, investigation, methodology, project administration, resources, software, supervision, validation, visualization, writing – original draft, writing – review and editing, These roles account for the value that disciplines place on core activities whether that is writing or designing and operating equipment (Patience et al., 2019). It also allows those composing research teams to have more flexibility as all members could be legitimate authors of a paper (Aliukonis et al., 2020). CRediT is currently in use by publishers such as PLoS and Springer (Holcombe, 2019). Research into the ways in which these roles are assigned in different disciplines showed that conceptualization, formal analysis, methodology, writing – original draft and writing – review were used by those in engineering, psychology, medicine, cognitive science and ecology (Whetstone & Moulaison-Sandy, 2020). In the study carried out, software and supervision were not used by authors in any of these fields (Whetstone & Moulaison-Sandy, 2020).

Authorship practices in educational technology research

Educational technology research in the higher education sector often involves working with teams of learning designers and technologists, sometimes those in data analytics or visualisation teams. These multidisciplinary teams are involved in creating tools, processes and the infrastructure to provide opportunities for learning as well as to collect and analyse data about teaching and learning to inform research and further design. On review of journals in which educational technology research is published, there are a variety of approaches to defining authorship. Some provide no authorship guidance, some state that only those who have made a substantive contribution should be included as authors (for example, *British Journal of Educational Technology*), and others ask authors to use the CRediT taxonomy to define author contributions (for example, *Computers and Education*).

At AJET, we do not currently have guidelines to help teams determine who should be included as authors for the articles submitted. In order to understand the approach to authorship currently practiced by this field, we examined the number of authors for articles published at AJET over the past three years. This was to help us understand the size of the teams that are contributing to the generation of new knowledge in our community. Since 2019, the maximum number of authors on an AJET article was twelve, the minimum was one. In 2019, the maximum number of authors was five on any one article, whereas in 2020 this increased to twelve, and in 2021 was eight. It is most common for articles to have only 2 or 3 authors.

Table 1
Number of authors on AJET articles from 2019 - 2021

Number of Authors		Number of articles by year		
		2019	2020	2021
1		8	8	7
2		23	18	21
3		21	12	15
4		7	7	9
5		4	7	8
6		-	4	4
7		-	2	1
8		-	-	1
12		-	1	-

Until now, AJET has not required authors to specify their individual contributions to an article. However, some authors have acknowledged the contributions of others to the research in the acknowledgement section at the end of their article. When examining articles published in AJET over the last three years, 56% currently include some form of acknowledgement, with the most common acknowledgement being to funding agencies who provided the finances for a project (40% of articles mentioned the funding organisation), followed by study participants (7%), and the AJET reviewers whose suggestions the authors have used to improve the quality of their article (6%).

In relation to authorship, several papers (5%) acknowledge the contribution of others who have assisted in editing the paper prior to submission. Under some journals' authorship guidelines, this contribution could be the basis of a claim of authorship, which highlights the differences in how author teams evaluate tasks that result in authorship. As discussed above, the nature of educational technology research often necessitates the contribution of many different skills to a project. Currently it is not clear whether all contributions are acknowledged at the end of the articles published in AJET. However there were examples found of acknowledgements given to research assistants, educational designers, teaching staff, data analysts, platform support officers, technical staff, and vendor contacts. While it is possible that people who have contributed to articles through these roles have been included as authors for some articles, we cannot determine this with the information we currently have to hand. The adoption of more specific authorship guidelines and a contributorship approach could help us observe the trends of authorship team roles over time in this discipline area.

Authorship guidelines for AJET

The Committee on Publication Ethics (COPE) is an international group established in 1997 and since has created resources for institutions, journals, research teams and individuals related to the ethical publication of research (Committee on Publication Ethics, 2022). They recognise the diversity in research disciplines, and outline the responsibilities of authorship that are common. In order to best facilitate ethical practices in relation to authorship, they recommend that:

> *Clear policies (that allow for transparency around who contributed to the work and in what capacity) should be in place for requirements for authorship and contributorship as well as processes for managing potential disputes.* (p. 6, COPE Council, 2022)

In the Proceedings of the National Academies of Science (PNAS), a *perspectives* piece was published in 2018 as a result of a retreat organised with representatives from publishers, journal editors, and researchers (McNutt et al., 2018). The results were a number of recommendations, aligned with those proposed by COPE (but more specific) for new standards in authorship practices. These included standardised wording for recognition of authorship, expectations for corresponding authors, acknowledging any use of editorial services, and committing to the use of CRediT and ORCIDs (McNutt et al., 2018).

Through this editorial we are announcing a number of measures to ensure consistency and transparency of authorship in AJET and a program of work to align the journal's requirements with the COPE

recommendations. These include guidelines in our information for authors section of the AJET website and a new article template which includes a section to describe the contributions of authors to the research. The guidelines on the website will suggest that teams refer to CRediT, although authors are welcome to write their own descriptions of contributions to the manuscript.

What is clear from a review of the existing literature is that education, and more specifically educational technology, has not been represented as a discipline in any of the discussions of authorship practices that informed the recommendations by organisations such as COPE or the development of CRediT. Further investigation of the utility of this taxonomy for our field needs to be carried out. By requiring authors to state their contribution, we can begin to understand what is valued in production of manuscripts, and by referring research teams to use CRediT we hope to broaden the understanding of how to best provide credit for contributions to the creation of new knowledge. We aim to ensure that our community is supported in the recognition of all the roles that contribute to educational technology research.

Contributions of authors

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