The importance of choosing the right keywords for educational technology publications

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Keywords refer to important words or concepts that represent the research foci and theoretical backgrounds of an academic study. They enable readers to glean a quick impression about what they are going to read from an academic article. Keywords also provide valuable information for researchers who intend to search for articles related to a particular field or conduct a survey related to a specific topic. Therefore, in selected academic journals, detailed guidelines are provided to help authors choose appropriate keywords for highlighting their research. In this editorial, we examine the role of keywords from several perspectives by reviewing the keywords adopted by AJET authors in recent years. Accordingly, we attempt to provide recommendations to AJET authors for their future submissions. It is expected that, via using proper keywords, the authors and readers as well as the journal can be benefited.

Keywords: keywords, academic publishing, AJET, academic search engine optimisation, editorial

Introduction

Keywords play a crucial role in the discoverability of academic articles. With increasing rates of academic publication across an ever-growing range of journals and other online channels, it has never been more important to ensure that articles can be easily found and cited by others in the field. Yet, the identification of keywords is often an afterthought for authors when preparing a manuscript for submission. In this editorial we will consider the role of the keywords in how articles are found, the ways in which keywords are used to map progression of fields of study over time, and the ways that authors can identify and optimise their keywords to maximise the findability of an article. In doing so, we will also explore how keywords have been used by authors in AJET in recent years and provide recommendations for how authors can approach the identification of keywords for future AJET submissions. Getting keywords right has benefits for both authors and journals in terms of the impact that published articles can have within the field of educational technology. While quality will still be a determining factor in whether an article ultimately impacts the work of others, optimising the keywords attached to publications can help to make sure that research can be easily found and considered as part of discussions in the field.

How keywords are used

The primary purpose of keywords in academic articles is to be used by indexing systems so search engines, scholarly databases, and library catalogues can identify the most relevant matches for a search query. Exactly how these systems utilise keywords is not always transparent, rather they are part of proprietary algorithms developed by each search engine or database vendor. These algorithms enable relevance ranking using a range of bibliographic metadata including, but not limited to, the article title, authors, keywords, and headings (Schilhan et al., 2021). The frequency of the occurrence of the search term within the main text of the article can also be incorporated in the calculation of the relevance ranking if the full text is available as open access (or is licenced by the database or catalogue).
The extent of the variation in the different systems’ algorithm results was explored in a study published in the Journal of Clinical Epidemiology where the same keyword search was conducted using three bibliographic databases (PubMed, Scopus, and Web of Science) as well as via Google Scholar (Linder et al., 2015). The precision of the results (calculated by dividing the percentage of relevant articles by the total search results) was much higher for the databases (PubMed = 93%, Scopus = 89%, Web of Science = 89%) compared to 53% precision for the Google Scholar search. However, the Google Scholar search provided around eight times the number of overall results than the databases. Without knowing exactly how the different systems use keywords, it is difficult to explain this variation. However, these findings provide an interesting perspective on which systems may be most useful when conducting keyword searches for relevant research.

Keywords are also used by researchers conducting systematic reviews of a topic in order to provide an overview and synthesis of a range of research outcomes. Identifying relevant keywords and building this into a search strategy is key to performing a robust systematic review. Most search strategies will involve the use of keywords to search titles, abstracts, and keywords in databases/search engines and sometimes also a search of the full text of the article. A challenge to developing an effective search strategy is the fact that commonality between keywords in research articles is often low (Buchanan & Grimmer, 2021). A scoping review of a particular medical topic (the transition back to work following a hand injury) found that from the 38 papers identified there were 135 unique keywords used (Buchanan & Grimmer, 2021). This demonstrates the fact that there can be many perspectives on a single topic area as well as the use of different synonyms.

A recent review of educational technology research examined the 50 most frequently used keywords of the last 20 years to see what trends could be observed (Valtonen et al., 2022). It was found that while some keywords were declining in prevalence (e.g., computer-mediated communication, distance learning, simulations), others were experiencing upward trends, including educational technology, learning environments, technology acceptance model, game-based learning, and learning environments. There were also notable increases in relation to newer topics such as learning analytics and flipped learning, while learner-focused concepts such as self-efficacy also experienced notable increases. When examining these 50 most frequent keywords, seven categories emerge for the types of keywords featured, including: pedagogical approach (e.g., simulation, assessment); educational context (e.g., higher education, K-12); technology used (e.g., learning management systems, virtual reality); learning environment (e.g., online learning, blended, classroom); discipline (e.g., teacher education, science); intent (e.g., improving classroom teaching, technology integration); theoretical framework (e.g., self-regulated learning, motivation); and stakeholders (e.g., teachers, students). While not all of these types would need to be included in all educational technology research publications, they provide inspiration for a more structured approach to the allocation of keywords to articles that could make them more findable for this kind of research in the future.

In their annual editorial for the journal TechTrends on trends in educational technology, Kimmons and Rosenberg (2022) examined the most frequent keywords and bigrams (two words commonly used next to each other) from journals (via Scopus) and Twitter during 2021. They grouped these keywords and bigrams into four information type categories: contexts, methods, modalities, and topics. From the journal search the most frequent context term was COVID-19 along with the related terms pandemic, emergency, and “shift to” and the most common level of education of research was higher education, followed by secondary and then primary. In terms of methods, systematic review and meta-analysis were the most commonly used, and online and virtual were the most common terms for modalities. For the topics category environments, models, and systems were the most frequent keywords, while computational thinking and learning environments were the most frequently used bigrams. On Twitter the most frequent topics were education, learning, elearning, online learning, technology, and remote learning. Interestingly, the frequency of tweets related to K-12 education were higher than higher education despite there being more research reported in journals that related to higher education. All of these findings show an impact of the response to learning and teaching during the COVID-19 pandemic on educational technology publishing trends, but also demonstrate that the most common keywords tend to be fairly generic (e.g., education, learning, environments, etc.). While these generic words can provide context, it is only when combined with other terms that they provide clues to a more specific research focus.
For a journal like AJET, keywords also help in the process of allocating reviewers to articles for publication. When new reviewers join the journal, they are asked to specify their areas of research interest in terms of keywords. These keywords are then used by the Associate Editors when selecting appropriate reviewers for articles as they enter the review process. The online system allows the Associate Editors to search by the keywords identified in the article, which helps to filter the list of possible reviewers. This ensures that articles are reviewed by someone with knowledge related to the topic area and/or who has skills in the particular methodology applied in the research. Ensuring that keywords incorporate the main topics covered in the article as well as the context and methodology means an article can be allocated to a reviewer who can give informed, constructive feedback to allow authors to make improvements to the article as it goes through the review process. For academic journals this also enhances the quality of articles that are eventually published, as reviewers experienced in the topic area are best suited to assess how/whether the research presented in the article fits within, and contributes to, the advancement of knowledge in the field.

**Keywords requirements in educational technology publications**

The requirements for the identification and quantity of keywords in educational technology publications vary by journal. An examination of the top 14 educational technology journals, as ranked by Google (AJET is ranked #15), found that the number of keywords required by each journal varies widely. Three journals provide only a maximum limit, while the other 11 provide a recommended range with the minimum being three keywords and the maximum being 10, with most sitting around the 4-6 keywords range. One journal, Computers and Education, provides a list of 33 pre-defined keywords and requires authors to select up to five words from this list. This list of words includes keywords related primarily to the context and topic of the study, with only one option that refers to methodology. The Learning Analytics and Knowledge conference proceedings (not a journal, but featured in Google’s journal list due to its high impact in the field) requires two levels of keywords. The first group of up to six terms must be chosen from the Association for Computing Machinery (ACM) Computing Classification Concepts System list, followed by an additional four “author-supplied” keywords.

Journals generally allow authors to choose their own keywords, with only a few providing advice on how to do this, as well as recommendations as to where keywords should appear in the article to make it more discoverable. The Journal of Computer Assisted Learning (JCAL) recommends that authors feature main keywords in the first 65 characters of the article’s title and in the first two sentences of the abstract. The British Journal of Educational Technology (BJET) also encourages the use of keywords in the title. However, there are other publishers that recommend against this approach, suggesting instead to use words similar to the keyword, but not the keywords themselves in the article title. The use of abbreviations is usually discouraged unless the abbreviation is a firmly established term within the field. An example in the educational technology field would be the use of the term “TPACK” to represent the Technological Pedagogical Content Knowledge framework (Mishra & Koehler, 2006).

Previously AJET has provided some guidance on the inclusion of keywords in articles although, as these have only been recommendations, some exemptions have made it through to publication. For example, the previous guidance recommended that authors not include the words “higher education” or “tertiary education” due to the fact that to be included in AJET meant that the research fell into these contexts by default. However, on reflection of the main purposes for which keywords are often used (e.g., for other authors to find the article for inclusion as a reference, to conduct systematic reviews, etc.) it does make sense to include at least one of these context-related terms to boost the discoverability of the article. AJET also previously recommended the inclusion of 5-7 keywords. The new recommendations for keywords for AJET publications will be discussed towards the end of this editorial. But first we will look at the keywords authors have been including in their AJET articles over the last five years.

**Keyword trends for AJET articles (2017 - 2021)**

There were a total of 1,468 keywords included in 302 AJET articles over the past five years (excluding editorials). This is an average of 4.86 keywords per article, with the minimum being 0 and the maximum being 11. Within this sample there are 977 unique keywords, although some are only slight variations of others (e.g., “21st century”, “21st century skills”, “21st century competencies”). Note that keywords in AJET can be a single word or a short phrase. More than half of keywords contained two words (52.3%),
followed by one word (24.3%), and three words (15.7%). The longest keyword phrase was eight words long (“unified theory of acceptance and usage of technology”). Twenty-five keywords were an acronym, while 31 keywords contained the full wording of the acronym followed by the acronym in parentheses.

The list of the 15 most frequently used keywords in the last five years is included in Table 1 below. Topping this list is the contextual keyword of “higher education”, followed by the learning environment terms of “blended learning”, “online learning” and “mobile learning” (‘e-learning’ also makes the list further down). “TPACK” was the most commonly included framework term, with “quantitative” the only methodology-related term to make the top 15. The most frequently used discipline-specific term was “teacher education”. Variations in how a term is expressed somewhat skew the total frequencies for keywords. An example is terms related to the methodological approach of mixed methods. There are nine different ways that this concept is represented in keywords across the sampled articles including versions that are hyphenated, non-hyphenated, plural, singular, and combined with other terms such as “research” and “study”. The most used representation is “mixed methods” with no hyphen or other associated words. When combined there are 15 instances of keywords related to mixed methods which would rank it equal with mobile learning in the table below. Even more frequent, but with fewer variations, is the concept of self-regulated learning with a total of 20 instances. The term “e-learning” also increases in prevalence by three to a frequency of 13 when combined with “elearning” (no hyphen).

<table>
<thead>
<tr>
<th>Keyword</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>higher education</td>
<td>30</td>
</tr>
<tr>
<td>blended learning</td>
<td>18</td>
</tr>
<tr>
<td>online learning</td>
<td>16</td>
</tr>
<tr>
<td>mobile learning</td>
<td>15</td>
</tr>
<tr>
<td>educational technology</td>
<td>14</td>
</tr>
<tr>
<td>learning analytics</td>
<td>13</td>
</tr>
<tr>
<td>TPACK</td>
<td>13</td>
</tr>
<tr>
<td>learning design</td>
<td>11</td>
</tr>
<tr>
<td>social media</td>
<td>11</td>
</tr>
<tr>
<td>teacher education</td>
<td>11</td>
</tr>
<tr>
<td>e-learning</td>
<td>10</td>
</tr>
<tr>
<td>technology</td>
<td>10</td>
</tr>
<tr>
<td>MOOCs</td>
<td>9</td>
</tr>
<tr>
<td>motivation</td>
<td>9</td>
</tr>
<tr>
<td>quantitative</td>
<td>9</td>
</tr>
</tbody>
</table>

Building on the categories we identified from the Valtonen et al. (2022) study, there are 10 different category groupings into which the 977 unique keywords of the 302 AJET articles of the past five years can be assigned. These categories are outlined in Table 2 below. From this table it can be seen that the range of keywords that indicate the intent of the research was the highest (24.1%), followed by pedagogical approach (19.7%) and technology (10.7%).
Table 2

<table>
<thead>
<tr>
<th>Category</th>
<th>Definition</th>
<th>Frequency of unique keywords</th>
<th>Examples of keywords</th>
</tr>
</thead>
<tbody>
<tr>
<td>Context</td>
<td>The level of educational in which the study took place</td>
<td>35 (3.6%)</td>
<td>Higher education, university, tertiary education</td>
</tr>
<tr>
<td>Learning Environment</td>
<td>The modality used for learning and teaching, and/or space in which learning occurs</td>
<td>65 (6.7%)</td>
<td>Blended learning, online, hybrid, learning spaces</td>
</tr>
<tr>
<td>Pedagogical Approach</td>
<td>The pedagogical design adopted in relation to the intended outcome or focus of the study</td>
<td>192 (19.7%)</td>
<td>Inquiry-based learning, peer assessment, role play, problem-based learning</td>
</tr>
<tr>
<td>Theoretical Framework</td>
<td>The conceptual framework, model, or lens that was used to inform the design of the study</td>
<td>71 (7.3%)</td>
<td>Constructivism, habitus, motivation, self-regulated learning, TPACK</td>
</tr>
<tr>
<td>Methodology</td>
<td>The research/analysis approach taken in investigating the identified research problem/questions</td>
<td>102 (10.4%)</td>
<td>Case study, design-based research, epistemic network analysis, meta-analysis</td>
</tr>
<tr>
<td>Technology</td>
<td>The educational technology that was used as part of the study</td>
<td>105 (10.7%)</td>
<td>Augmented reality, learning management system</td>
</tr>
<tr>
<td>Discipline</td>
<td>The academic discipline in which the study took place</td>
<td>63 (6.4%)</td>
<td>Clinical education, engineering, mathematics</td>
</tr>
<tr>
<td>Intent</td>
<td>The phenomenon or problem that the study sought to examine and understand</td>
<td>236 (24.1%)</td>
<td>Academic achievement, conceptual understanding, inclusive education</td>
</tr>
<tr>
<td>Stakeholders</td>
<td>The groups of people who are the primary focus of the study</td>
<td>30 (3.1%)</td>
<td>Students, teachers, international students</td>
</tr>
<tr>
<td>Characteristics / Skills</td>
<td>The characteristic and/or skills of a stakeholder group that the study is designed to explore</td>
<td>78 (8%)</td>
<td>21st century skills, creativity, critical thinking, digital literacy</td>
</tr>
</tbody>
</table>

The keywords used in the papers in the current issue were also considered in more detail to illustrate the findings overall. Many of the papers used keywords in the title (e.g., Yu et al., 2022; Gibson et al., 2022). Only one paper referred to the learning environment in the keywords (Bruggeman et al., 2022 included “blended learning”). Many of the papers in this issue included the methodology (e.g., Pais Marden & Herrington included “applied design-based research”; Yildirim & Usluci, 2022 used “cluster analysis and sequential patterns”). Some have included the discipline area (e.g., Jarmillo Cherrez, 2022 investigated “Spanish language learning”) and the technology (e.g., Kemp et al., 2022 included “virtual reality”; Tan et al., 2022 included “mobile learning”; and Ramirez-Montoya et al., 2022 included “MOOCs”). Finally, many of the papers included keywords that related to the intent of the research (e.g., Sefcik et al., 2022 were investigating “remote invigilation”; Hernandez Cardenas et al., 2022 included “personalised learning” and “academic improvement” in their keywords) or characteristics/skills (e.g., Schalk et al., 2022 investigated “professional identity” and “digital capacity”).

This analysis of the keywords used by AJET authors over the past five years gives us an indication of the types of keywords that the authors have considered valuable enough to include. While it is beyond the
scope of this editorial to test the effectiveness of these words in detail, the table above provides prospective authors with some useful categories to consider when allocating keywords to their article. Other considerations for the selection of keywords are considered in the next section of this editorial.

**Recommendations for choosing keywords for your AJET article**

Being strategic when choosing keywords for an article can ensure that it can be easily found by others in the field, which gives the research a higher potential of informing other research and being cited. The improvement of the selection of keywords has been strongly advocated by those in the area of Academic Search Engine Optimisation (ASEO), a concept that emerged through the work of Beel, Gipp and Wilde in 2010 (Beel et al., 2010). The two main goals of ASEO are “providing researchers with the best possible support in finding relevant results for their search queries and … helping authors to achieve a better ranking of their own publications in search engines and databases” (Schilhan et al., 2021, p.1). There are a number of different strategies that authors can implement to optimise the keywords they include in their AJET articles to improve their discoverability and we outline the most relevant approaches here for authors considering publishing in an academic journal such as AJET.

**Selecting possible keywords**

When you have finished drafting your paper, read through it and make a list of the terms and phrases most relevant to the overall topic, context, and approach of your research. Consider the different categories outlined above in Table 2 and the applicability of each to your work. Not all categories are relevant for all articles, however the context, theoretical framework, and methodology are particularly important to helping others identify the relevance of your work to their own. The recommendation of AJET is to include between three and seven keywords for your article. It is also recommended that you use the singular form of any keywords rather than the plural (Schilhan et al., 2021).

**Choosing the right format of keywords**

A tricky part of determining the right keywords is how to present words or phrases. Most search engines and academic databases allow the searching of phrases so you don’t need to only use single words. As seen above, it is more common for keywords in AJET to contain two words and they can contain short phrases up to 6-8 words. However, when using longer phrases it is wise to stick to those commonly recognised in the field. For example, in educational technology a commonly accepted phrase would be “computer-supported collaborative learning”. Where possible, it is best to avoid special characters in keywords. Sometimes this can't be avoided if a hyphen is part of the accepted expression of the word or phrase (as seen in the previous example of computer-supported collaborative learning). Hyphens can sometimes hinder the functionality of search engines and database searches impacting the findability of the article (Schilhan et al., 2021).

**Checking the keywords**

It is a good idea to conduct a search using the keywords you have selected via a search engine and/or academic database to see if the results returned are aligned to the kind of work you have conducted. The results of these searches can also provide ideas for other keywords if certain terms are common to similar research articles. If the results of such searches return articles very different to yours, it is a good indication that you need to reconsider the keywords you have chosen. Tools such as Google Trends can be useful to determine whether your keywords represent how the concept is represented currently, or if that particular word/phrase is falling out of favour. Recently systematic review articles such as those profiled above can provide insight into trends in relation to key terms in the field (e.g., Valtonen et al., 2022) which can help in checking that the words you have chosen are the most appropriate.

**Where else to feature keywords**

As discussed above, there has been inconsistent advice provided by academic publishers as to where else to feature keywords within your article. While some advocate for including the main keywords in the article title and abstract, others have discouraged this practice. In AJET we recommend that at least some of your keywords feature in your title and abstract. However, be careful not to overuse keywords in your title,
abstract, and full text. This practice is known as “keyword stuffing” which can be used for search engine optimisation, but often results in a reduction in the readability and quality of how the work is presented when used in an academic publication context (Zuze & Weideman, 2013). Keywords can also be incorporated into the subheadings within your paper as these will be identified by search engines and can provide insight into the structure of the article when it is indexed (Zuze & Weideman, 2013).

**Be consistent**

It is important that you are consistent with the terms you use in your article. For example, if you start the article using a term such as “digital literacy” it is best not to switch to “digital fluency” part way through the article. Keeping spelling and expression consistent with accepted practice in the field is also key for optimising the findability of your article.

**Conclusion**

A strategic approach to the selection of keywords for your article can have a positive impact on how discoverable your work is to other researchers in the field and can result in a higher number of citations of your work. In the higher education field this can have important flow-on effects in terms of recognition and promotion of your scholarship career. The steps outlined in this editorial to optimise keywords for your academic publication can be applied across discipline areas, but are particularly useful in the educational technology field. In this editorial, we have attempted to give readers a sense of the wider trends in the use of keywords in educational technology journals and, specifically, in AJET. From these trends, we have sharpened up our recommendations for the use of keywords in future AJET articles. It is our hope that this focus on the effective use of keywords will help to maximise the impact of forthcoming AJET articles for the benefit of authors and the educational technology community.

**Contributions of authors**

**Linda Corrin:** Conceptualisation, Investigation, Formal analysis, Writing - original draft, Writing - review and editing; **Jason Lodge:** [writing - review and editing ]; **Gwo-Jen Hwang:** [writing – original draft]; **Kate Thompson:** [writing - original draft, writing - review and editing].

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**References**


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