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RESEARCH ARTICLE

Representing Researchers in the Library Linked Data Environment: A Case Study of ORCID Users at the University of Tennessee, Knoxville

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The University of Tennessee Libraries

ABSTRACT

Introduction: This study explored Open Researcher and Contributor ID (ORCID) usage at the University of Tennessee, Knoxville (UTK) for research support and library catalog metadata.

Methods: The data were captured in 2021 of 862 faculty members in Elements database, 284 e-dissertation authors, and 42 e-thesis authors in Tennessee Research and Creative Exchange (TRACE, 2024). The data were analyzed for ORCID adoption by faculty ranks, degree types, academic disciplines, and their usage of ORCID metadata.

Results: UTK faculty adopted ORCID more than UTK authors of e-theses and e-dissertations (ETDs). Faculty ranks and disciplines contributed to ORCID usage with higher numbers among assistant and associate professors and Engineering and Natural Sciences. Work, employment, and education are the top three metadata shared in their ORCIDs, among other identifiers, websites, and country metadata.

Discussion: ORCID's integration with Elements (the faculty evaluation system) and the lack of requirements for ETD authors to add ORCIDs to their ETDs may impact the number of UTK ORCID users. Faculty ranks, degree types, and academic disciplines should be factored into understanding ORCID usage. Work, employment, and education metadata would support the identification and disambiguation of authors' names. Funding metadata is in low use, possibly due to the grant database's integration with Elements. Other identifiers and web profiles, especially those with social networking features, support the disambiguation and identification of these scholars.

Conclusion: ORCID is a hub for a scholar's profiles. ORCID metadata elements support both identification and disambiguation in library metadata and open science infrastructure. To gain a deeper understanding of UTK ORCID users, future studies should involve direct input from UTK scholarly communities via qualitative research methods.

Keywords: ORCID, researcher identifiers, metadata, name authorities, scholarly communication

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IMPLICATIONS FOR PRACTICE

1. The findings would support any university's and the University of Tennessee Libraries' promotion of Open Researcher and Contributor ID (ORCID) for wider adoption among their scholarly communities.
2. To promote improvement of ORCID's data quality by ORCID users, especially for compliance with the federally funded research mandate.
3. To support the use of ORCID and its metadata when cataloging e-dissertations and e-theses and when creating and updating Library of Congress (LC) name authority records at any academic library or other libraries in higher education settings.

INTRODUCTION

This study of the University of Tennessee, Knoxville (UTK) faculty and e-theses and e-dissertations (ETD) authors as Open Researcher and Contributor ID (ORCID) users is relevant to ORCID usage in research services and catalog metadata records. Since 2012, ORCID has become a researcher identifier of choice ([ORCID, 2020](#)). ORCID's non-profit status, community-driven model, content neutrality, commitment to its users' privacy, and integration with research workflows and other identification systems and databases possibly contributed to its growth with over 8 million active users ([ORCID, 2024j](#)). ORCID users can control their information visibility in three settings (everyone, trusted parties [trusted organizations or trusted individuals], or only me) ([ORCID, 2024b](#); [ORCID, 2024c](#); [ORCID, 2024k](#)). ORCID was designed to be a persistent identifier for persons with a research graph meta-model mapping the interrelationship among researchers, funding, datasets, and publications ([Haak et al., 2018](#)).

As an ORCID member organization, UTK offers its researchers benefit from ORCID's integration with the grant database, Pivot ([ORCID, 2024h](#); [Ex Libris, 2016](#)), and other systems, such as DataCite, International Standard Name Identifier (ISNI), ResearcherID (Clarivate), and Scopus Author ID (Elsevier) ([ORCID, 2024f](#)). ORCID is also integrated with the Symplectic Elements software UTK uses for its Faculty Activity Reporting system ([UTK Office of the Provost, n.d.](#)). UTK faculty can update their publications in ORCID and set their ORCID to send data automatically to update their Elements accounts ([UT Libraries, 2024c](#)). UTK researchers can also access ORCID and other researcher identifiers via the Dimensions database ([UT Libraries, 2024a](#)). UTK graduate students also have the option to submit their ORCID with their ETDs to the institution's repository, Tennessee Research and Creative Exchange ([TRACE, 2024](#)).

ORCID is also one of the identifier systems adopted by the Library of Congress Program for Cooperative Cataloging (LC PCC) to apply in bibliographic and authority records since 2019 (LC PCC, 2019; LC PCC, 2020; LC PCC NACO, 2020). The Cataloging Department at UT Libraries adopted this practice in January 2021 for catalog and name authority records for ETD authors and their advisors, as shown in this template:

```
100    1_ |a [Author], |e author |4 http://rdaregistry.info/Elements/a/rdaa:P50541
      |0 (orcid)[number] |1 [orcid URI].
```

In 2023, Ex Libris added the advanced search feature in Alma for URIs (Ex Libris, 2023); thus, catalogers and other authorized staff users can search in Alma using both ORCID's URIs and number strings. However, ORCID is not yet searchable via UT Libraries' discovery services (UT Libraries, 2024b). ORCID metadata (i.e., personal names and their variants, ORCID iD, biography, employment and affiliation, education and qualifications, works, websites and social media links, other identifiers, countries, and keywords) can also be used to create or update personal name authority records in the LC Authority File (LC PCC NACO, 2020). Therefore, having access to ORCID metadata is crucial for libraries' cataloging meta-data practices.

In summary, this study contributes to our understanding of ORCID usage for not only local practices but also any academic library contributing catalog metadata with ORCID to OCLC WorldCat's bibliographic and authority databases and other library services platforms. ORCID has been integrated with linked-data services, such as the Library of Congress's Linked Data Service, Virtual International Authority File (VIAF), Online Computer Library Center (OCLC) WorldCat Entities, and Wikidata. The increasing number of ORCID users and member institutions worldwide and ORCID's availability in library and catalog databases underscores the imperative to understand ORCID users. This study also aims to add to the existing knowledge on this topic and to identify variations in local practices. The following section is a literature review on ORCID usage in general and in catalog and authority meta-data, especially in academic settings.

LITERATURE REVIEW

OCLC's report, *Registering Researchers in Authority Files*, addressed how funders and publishers prefer researcher identifiers and encouraged research institutions and libraries to adopt persistent identifiers to link scholars with their output (Smith-Yoshimura et al., 2014). They also found overlaps among researcher identifier systems that did not include all researchers as well as the need for a third-party system to provide reconciliation or resolution services.

Based on this report, Panigabutra-Roberts (2015) conducted a pilot study on how the faculty at the American University in Cairo distributed and shared their scholarly and creative works and how their names were identified in author identifier systems and/or on the Web by evaluating selected author identifier systems. They found disciplinary differences to be a major factor in the representation of these academic authors in the Library of Congress Name Authority File (LCNAF). The School of Humanities and Social Sciences faculty were better represented than the School of Sciences and Engineering faculty in LCNAF. Sandberg & Jin (2016) proposed a solution using BIBFRAME linked data and a combination of identifiers, including ORCID, in providing identity management for the authors of journal articles. Panigabutra-Roberts (2019) compared eight researcher identifier systems and concluded that combining ORCID with LCNAF would better serve the research community. Downey (2019) conducted a survey to identify the source of author URIs for Duke's institutional repository for research data, DukeSpace. By comparing their researchers' records in ORCID, LCNAF, and VIAF, Downey concurred with the finding in Panigabutra-Roberts' study (2019). They found ORCID's uptake to be higher than LCNAF's and VIAF's.

Faculty's and researchers' use of ORCID

Since ORCID's launch in 2012, an earlier review of the literature found that some researchers were unaware of the identifier and/or its benefits, with some researchers not wanting to adopt ORCID. Tran & Lyon (2017) studied the faculty at Stony Brook University and found that, overall, only 32% (95 of 300) of the respondents expressed familiarity with author identifiers. Youtie et al. (2017) tracked researchers and their outputs at the article level and found a greater adoption of ORCID in Europe compared to Asia and the United States. Similarly, Porter (2022) concluded that the United States had relatively low ORCID adoption and engagement rates compared to countries in the same World Bank income brackets, perhaps because of the lack of a centralized and government-based research system. In addition, some faculty members and/or researchers may not have wanted to adopt ORCID (Reimer, 2015; Boudry & Durand-Barthez, 2020; Houghton & Foster, 2024), were unaware of ORCID, or aware of ORCID but unaware of its full range of benefits (Droog & Bredahl, 2021).

Automating ORCID with enterprise systems and/or other research and publications' sources and also requiring ORCID for internal funding requests would benefit both researchers and their institutions and increase ORCID's adoption and use (Reimer, 2015; Powell et al., 2019; Droog & Bredahl, 2021; Schneiders et al., 2022). Reimer (2015) discussed ORCID's implementation at Imperial College London in 2014 by creating ORCIDs for academic and research staff, with an opt-out option to respect privacy concerns. Academics were encouraged to make information public. The college also linked Symplectic Elements data with ORCIDs. Powell et al. (2019) reported that the success of ORCID use by researchers at Los Alamos

National Laboratory depended on integration with other enterprise systems and the requirement of an ORCID for internal funding requests. Schneider et al. (2022) used datasets from two German research institutions to investigate their researchers' ORCID identifiers' presence in open data sources, FREYA PID Graph, OpenAlex, and ORCID to evaluate whether (semi-) automated reporting from these sources can reduce reporting efforts. They concluded that ORCID's coverage in these open data sources was still too low to reliably be used for reporting, but with a promising future for such coverage. Beyond automation, promoting ORCID to faculty by highlighting the benefits of using ORCID in the context of research impact and academic profile management, integration with grants, and publications were key factors to the faculty's adoption of ORCID, such as at the University of Waterloo's School of Optometry and Vision Science (Droog & Bredahl, 2021). Funders' and publishers' mandates to add ORCID to their works also accounted for ORCID's adoption (Porter, 2022).

There were those who did not adopt ORCID, especially due to privacy concerns (Reimer, 2015). According to ORCID's 2019 survey on the perception that ORCID values users' privacy, Business/Management, Chemistry, and Materials Science respondents, students, and those in Africa were more likely to agree or strongly agree, whereas Arts and Humanities, Social Sciences, those in the United States/Canada, and retirees were more likely to disagree or strongly disagree (ORCID, 2019). Porter (2022) concluded that the lower ORCID adoption in the United States was because of U.S. researchers' privacy concerns. Beyond the U.S., Houghton and Foster (2024) found a similar concern on privacy and security issues among Ireland's teaching faculty in the technology sector and senior librarians. Protecting the privacy of identity metadata has been advocated by Billey (2019). Thus, in this study, the privacy concern is one of the key variables in analyzing the choice of UTK faculty to share their ORCID data with the public by discipline and the impact on availability of metadata for identification and disambiguation.

ORCID's usage and disciplinary differences

A higher percentage of scholars in the physical sciences use ORCID compared to those in other disciplines, including the broader disciplines of Sciences, Technology, and Medicine (Tran & Lyon, 2017; Klein & Van de Sompel, 2017; Downey, 2019; Boudry & Durand-Barthez, 2020; Porter, 2022; Schnieders et al., 2022; Fuhr & Monnin, 2024). Among the disciplines with lower usage are Health Sciences, Social Science, Engineering, Psychology, and Education; the lowest percent of use is in Arts and Humanities and Mathematics (Tran & Lyon, 2017; Klein & Van de Sompel, 2017; Downey, 2019; Porter, 2022; Schnieders et al., 2022; Fuhr & Monnin, 2024). ORCID's usage in Mathematics was low due to the faculty's preference for arXiv ID (Tran & Lyon, 2017), and Law faculty tended to use Social Science Research Network (SSRN), Scopus, or HeinOnline profiles more

than ORCID iDs per their discipline's publication platforms (Quinn, 2023). However, Porter (2022) found Humanities researchers to have a higher engagement level or more complete ORCID records. In contrast, Medical and Health Sciences had a lower engagement rate compared to Chemical or Biological Sciences (Porter, 2022). This study's findings on disciplinary differences in ORCID usage differed from previous findings. These findings underscore the need to account for the local variation of disciplinary differences in ORCID usage and to apply this knowledge to further question the motivation for using ORCID or the local ORCID users' attitudes toward ORCID in general (Houghton & Foster, 2024).

ORCID as authors' unique identifiers, disambiguation, and metadata

ORCID's unique identifiers can be used to disambiguate persons with the same names, such as the last names Wang and Smith (Youtie et al., 2017; Granshaw, 2019), and to verify the identities of ORCID users. However, the availability of ORCID's data can be limited if the persons do not want to share information in their ORCID profiles with the public. According to Youtie et al. (2017), for ORCIDs for authors with similar names, in this case, Jun Wang, 68% of the search results by this name did not have public information available for disambiguation (131 out of 193 search results). As mentioned previously, there were privacy concerns around adopting and using ORCID in general (Reimer, 2015; ORCID, 2019), among U.S. researchers (Porter, 2022), and among faculty in Ireland's technology sector (Houghton & Foster, 2024).

When ORCID users publicly share their profile information, their inclusion of ORCID metadata and information also varies. An ORCID record includes the user's name and ORCID identifier, with the option to add other versions of the user's name, biography, employment (and affiliation), education and qualifications (and affiliation), professional activities (invited position, distinction, membership, and service), funding, works, emails, websites and social media links, other identifiers, keywords, and countries (ORCID, 2024a; ORCID, 2024e; ORCID, 2024i). For work types (Blackburn, 2022), Klein and Van de Sompel (2017) analyzed ORCID's 2014-2016 datasets and found that the top four work types were the same—from high to low: journal article, conference paper, book, and book chapter. They also found in the 2016 dataset that works were found in 19.3%, affiliations in 26.0%, and web identities in 6.4% of ORCID records. In ORCID's 2019 survey, respondents were more likely to add education and employment affiliations to their ORCIDs (65.1% and 55.6%, respectively). Conference participation was ranked fourth, whereas publications were ranked first as the data type to add to their ORCIDs. Respondents in the United States and Canada were most likely to have connected employment affiliations to their records (70.7%), whereas those in Asia were least likely (43.4%). Arts and Humanities respondents (71.6%) were most likely to have added educational affiliations, and those in Medical and Health Sciences (60.1%)

were least likely. Other identifiers included in ORCID records were ResearcherIDs and Scopus Author IDs. Web identities were used less (6.4%). ORCID's 2019 survey also found preferences of users to add anything they make public, with their names associated with their ORCID records. Kim & Owen-Smith (2021) compared entries in ORCID's dataset for MEDLINE publications published between 1991 and 2009 in the Author-ity2009 database to the National Institutes of Health Principal Investigators data and authors' self-citation. The data were further refined by ethnicity and gender. They found that ORCID's dataset was a good disambiguation tool due to its continuous growth, being publicly available and released annually, and its coverage of publications and works across diverse academic disciplines. Some drawbacks in using ORCID's data for disambiguation were the overrepresentation of early- and mid-career researchers and English names and the underrepresentation of Asian names. Some of ORCID's data still included owners' errors and incomplete profiles due to the owners' lack of updates. Similarly, a case study of ORCID usage by the Faculty of Arts and Humanities of the University of Porto, Portugal, found 170 ORCID records (out of 188 faculty members) to be incomplete for disambiguation purposes (Fernández-Marcial et al., 2023). The top usage of ORCID metadata elements in their study is Employment (80.4%), Education and qualifications (75.3%), Works (86.5%), and Funding (54%).

This study adds to Klein & Van de Sompel's findings (2017) by using ORCID's data from multi-disciplinary users with more recent datasets (up to 2021). Kim & Owen-Smith (2021) limited their data to the citations in MEDLINE publications between 1991 and 2009. ORCID's 2019 study was based on a survey dataset, not the actual data in ORCID's profiles. However, Klein & Van de Sompel (2017) and Kim & Owen-Smith (2021) used larger ORCID datasets in their studies. This study adds to the literature by examining public access to ORCID data and available metadata to use for identification and disambiguation at the institutional level across academic user types, faculty by ranks (as in Fuhr & Monnin, 2024), graduate students by degree types (master's or PhD), and academic disciplines at an R1-land grant institution (Carnegie Classification, n.d.).

METHODS

This study's goal is to understand ORCID's availability, ORCID metadata's availability, and the quality and usage patterns of UTK faculty and ETD authors in response to the main research question: How did UTK authors of ETDs in TRACE and UTK faculty who have Elements profiles include their ORCID and supply metadata elements and related information in their ORCID profiles to identify and distinguish themselves from other ORCID users?

Such understanding would support the use of ORCID's and their data in the UT Libraries' cataloging metadata practices and for the university's research services. Furthermore, the results can be used (a) to recommend ORCID's wider adoption among UTK research communities and beyond and (b) to support improving ORCID's data quality by UTK's ORCID users and in other similar academic settings.

Populations

This study's populations included UTK authors of ETDs published from December 2017 to December 2020 in TRACE and all UTK faculty who were required to have Elements profiles as of Spring Semester 2021. The data excluded the University of Tennessee (UT) Institute of Agriculture's populations due to their early stage of re-unification with UTK ([UT Board of Trustees, 2019](#)). According to UTK 2020-2021 *Fact Book* ([UTK Office of Institutional Research and Assessment \[OIRA\], 2021](#); p. 40),¹ with the addition of 43 Library faculty from Elements data ([UTK Office of Innovative Technologies, 2021](#)), a total of 1,492 faculty members (including 442 professors, 372 associate professors, 293 assistant professors, 26 instructors, and 359 lecturers) at UTK were represented in this study. The populations of ETD authors were based on TRACE datasets sent to the author as of November 2021, including 1,344 dissertations and 716 theses from December 2017 to December 2020 graduation dates, from when bepress first allowed the addition of ORCID identifiers in Digital Commons in late 2017 ([bepress, 2017](#)).

Data collection and analysis

The author used an unobtrusive method to collect data from trusted secondary data sources. With the approval of the UTK Institutional Review Board ([UTK IRB, 2021](#)) to ensure the protection of this study's human subjects, the author and a research assistant received and collected the following datasets:

1. UTK faculty's data from the Elements database (Spring Semester 2021). Including Elements data for tenured and tenure-track faculty who are required to have their Elements profiles and some non-tenure track faculty not required to have their profiles in Elements, this dataset was received from OIT in a Microsoft Excel file through UTK Vault (a secure file transfer service) on March 29, 2021 ([UTK OIT, 2021](#)). The dataset includes 2,318 rows of Elements data of UTK faculty with their first and last names, titles, colleges and/or academic units, departments,

¹ The *Fact Book's* statistics for the faculty include only "Full-Time Instructional Faculty By College, Appointment Type, Tenure Status and Rank"; thus, librarians were excluded.

ORCIDs, and ORCIDs' statuses ("is claimed," "is pending," or "is declined"). After the author removed the duplicated faculty names (due to the multiple ORCIDs per the same faculty members), post-doctoral students, UTK campus-level administrators (in order to compare data by discipline), and UT Institute of Agriculture faculty, the total number of UTK faculty for the data analyses was 986 faculty members. Of those faculty members, 862 confirmed their ORCIDs (one faculty had two confirmed ORCIDs), 120 had pending ORCIDs, and 4 declined ORCIDs identified by the system. For 862 faculty members with confirmed ORCIDs, the research assistant collected the data that were publicly available from ORCID.org website (name[s], listed website[s], country[-ies], KW [keywords], and other researcher ID[s]) to add to the datasets. The research assistant also checked and logged the data from each ORCID profile on the presence or absence of publicly available data, without collecting the actual ORCID data elements for the following metadata: employment, education, funding, works, peer review, invited positions, and distinctions, membership and service, biography, alias (aka), and email.

2. UTK ETD authors' data for ETDs published in TRACE from 2017 to 2020. In 2021, the TRACE administrator sent metadata and data for UTK ETDs published from 2017 to 2020 in two separate Excel datasets by degree type for dissertations and master's theses. These TRACE datasets include the metadata and data for each author as publicly displayed on its TRACE webpage: the author's name, title, date of award, degree type, degree name, major, major professor, URL, and ORCID (if present). In these datasets, 284 of 1,344 authors of dissertations and 42 of 716 authors of master's theses included ORCIDs in their TRACE metadata. For these ORCID users, the research assistant logged additional data from ORCID.org to their datasets following the same data collection procedure for the UTK faculty.

RESULTS

Public information in ORCID profiles

To assess metadata elements used in ORCID profiles, their owners need to add and share their information in their ORCID profiles with the public. The majority of all three groups of UTK ORCID users share information in their ORCID profiles with the public, with a small portion of users within each group who either set their privacy setting as private for themselves and/or trusted parties only or did not provide other information beyond their names. The following sections provide details on how the faculty's ranks, ETD authors' academic statuses, and the disciplines of ORCID users in these datasets were factored into understanding how they share their ORCID information with the public.

UTK faculty with confirmed ORCIDs and public information

UTK faculty with confirmed ORCIDs were divided into two groups: (a) UTK faculty who share their ORCID information with the public and (b) UTK faculty who do not include or include but do not share their ORCID information with the public. For the subset of 862 UTK faculty with confirmed ORCIDs (one faculty has two confirmed ORCIDs) for both figures below, 66.5% (574 of 862) or two-thirds of the faculty share their ORCID information with the public.

Based on the results in [Figure 1](#), the number of UTK faculty with confirmed ORCID public profiles compared to the total of those with confirmed ORCIDs by rank (freq. ≥ 5) from high to low are professors (204/325), associate professors (169/250), assistant professors (138/183), lecturers (21/40), research assistant professors (15/16), clinical assistant professors (7/12), clinical associate professors (7/13), and research professors (5/6). The top three ORCID user groups with public information are professors, associate professors, and assistant professors as they are also larger groups of UTK faculty compared to other faculty ranks.

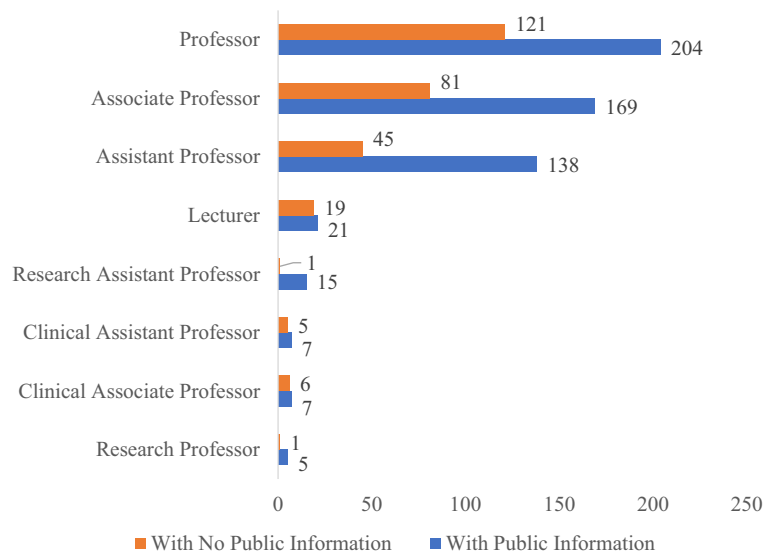


Figure 1. UTK faculty's confirmed ORCIDs and public information by rank (freq. ≥ 5).

For the same comparison by rank in percentage from high to low as shown in [Figure 2](#), UTK research assistant professors have the highest (94% or 15 of 16), followed by assistant professors (75%), associate professors (68%), professors (63%), clinical assistant professors (58%), clinical associate professors (54%), and lecturers (53%).

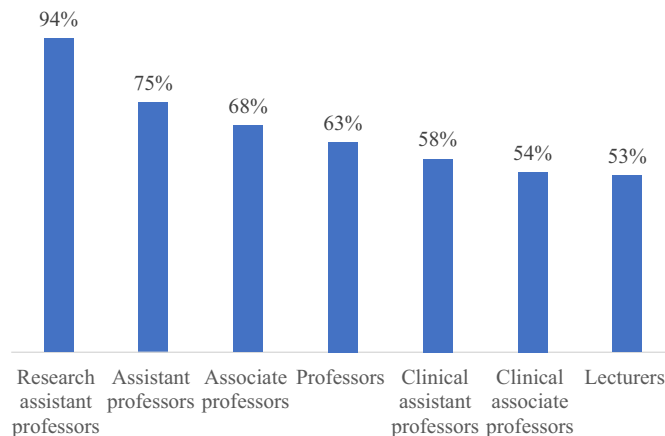


Figure 2. Percentage of UTK faculty with confirmed ORCIDs and public information per the total of those with ORCIDs by rank (freq. ≥ 5).

UTK ETD authors with confirmed ORCIDs and public information

UTK ETD authors are not required to add their ORCIDs to their theses or dissertations submitted to TRACE. Furthermore, bepress only began to allow the addition of ORCIDs in Digital Commons in late 2017 ([bepress, 2017](#)) as shown in the first dissertation with ORCID in TRACE, *Drivers of Stormwater Runoff Characteristics from Non-Point Source Urban Pollution* ([Wyckoff, 2017](#)). This factor may contribute to the small number of ORCIDs from the TRACE datasets of UTK ETD authors compared to those of the faculty. Based on the TRACE datasets, 80.6% (229 of 284) of the authors of dissertations and 69% (29 of 42) of the authors of master's theses with confirmed ORCIDs share their information with the public in their ORCID profiles.

ORCID and disciplinary differences

The following charts compare UTK faculty's confirmed ORCIDs with versus without public information in this study, by college and by divisional breakdown for the College of Arts and Sciences (due to the large size of the college), by the number ([Figure 3](#)), and by percentage ([Figure 4](#)). Based on its divisional structure in 2020, the College of Arts and Sciences was the largest, consisting of four major disciplinary areas: Arts (Art, Music, and Theatre), Humanities (Classics, English, History, Modern Foreign Languages and Literature, Philosophy, and Religious Studies), Natural Sciences (Biochemistry and Cellular and Molecular Biology, Chemistry, Earth and Planetary Sciences, Ecology and Evolutionary Biology, Mathematics, Microbiology, and Physics and Astronomy), and Social Sciences (Anthropology, Geography, Political Science, Psychology, and Sociology) (CAS, 2020).

As shown in Figures 3 and 4, there were disciplinary differences among UTK faculty who shared information in their ORCID iDs with the public. The faculty in Engineering (142), Natural Sciences (126), Education, Health and Human Sciences (65), Social Sciences (60), and University Libraries (37) were the top five ORCID iD faculty user groups who publicly shared information in their ORCID iDs. However, by percentage, University Libraries (88%) ranked the highest for UTK faculty with confirmed ORCID iDs who shared information in their ORCID iDs with the public, followed by the faculty in Engineering (83%), Natural Sciences (81%), Nursing (70%), and Social Sciences (69%). The lower tiers were Humanities (46%), Architecture and Design (29%), Law (including the Law Library) (25%), and Art, Theatre and Music (18%).

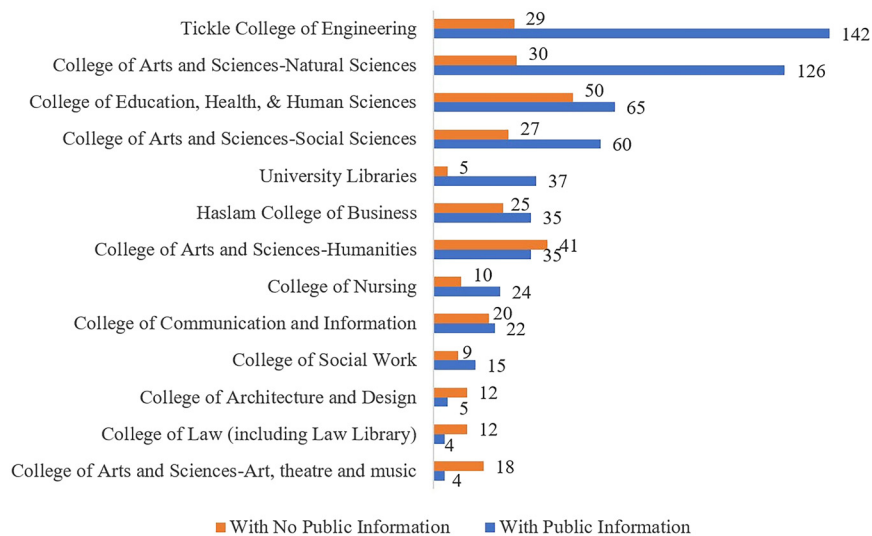


Figure 3. The number of UTK faculty's confirmed ORCID iDs with versus without public information by college and by division in the College of Arts and Sciences.

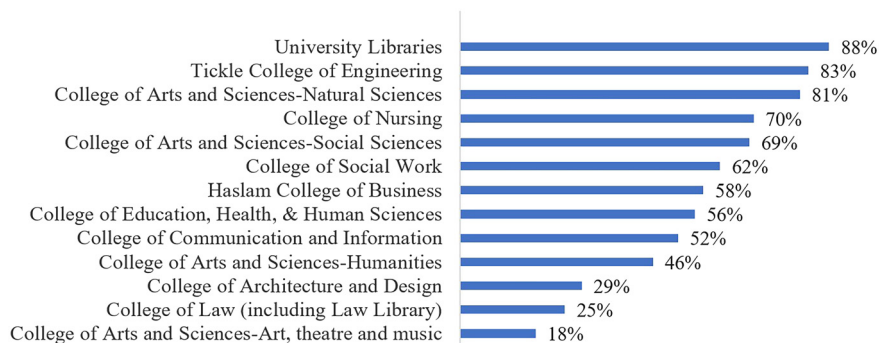


Figure 4. Percentage of UTK faculty's confirmed ORCID iDs with public information per the total of those with confirmed ORCID iDs by college and by division in the College of Arts and Sciences.

As shown in Figure 5, the UTK colleges and/or divisions with high numbers of dissertation authors with confirmed ORCIDs who publicly shared their information versus those who did not were Engineering (138/164 or 84%) and Natural Sciences (60/73 or 82%). The remaining colleges and divisions had much lower numbers: Education, Health and Human Sciences (10/14 or 71%); Social Sciences (9/15 or 60%); Business (4/6 or 66%); Humanities (4/4 or 100%); Social Work (3/3 or 100%); Communication and Information (1/4 or 25%); and Nursing (one with no public information).

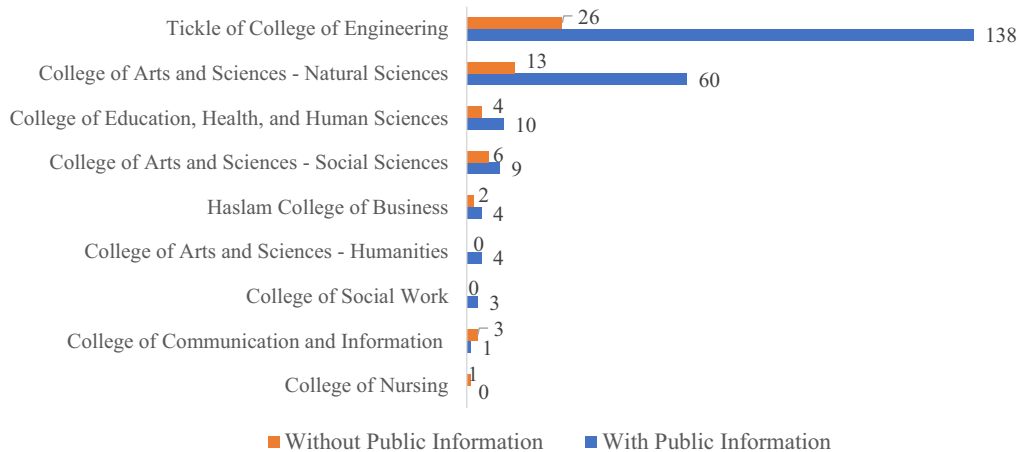


Figure 5. UTK authors of dissertations' confirmed ORCIDs with versus without public information by college and division in the College of Arts and Sciences.

In Figure 6, the colleges and/or divisions with high numbers of master's theses authors' confirmed ORCIDs with versus without public information were Engineering (15/24 or 62%) and Natural Sciences (8/11 or 72%). Social Sciences, Humanities, Education, Health and Human Sciences, and Intercollege (Health Sciences) had much lower numbers of confirmed ORCIDs with public information. Although the number of ORCID users among UTK theses' authors was small, their use in Engineering and Natural Sciences was in larger numbers than other groups and supported the same findings of high usage of ORCIDs in these disciplines among UTK faculty ORCID users in this study.

Metadata elements used by UTK faculty and ETD authors (2017–2020)

Although ORCID provides metadata elements for their users to choose from, ORCID users can choose to add a few or as many metadata elements as the platform provides (ORCID, 2024i). For 594 UTK faculty ORCID users in this dataset who shared their ORCID information with the public, Figure 7 shows their metadata usage from high to low: works

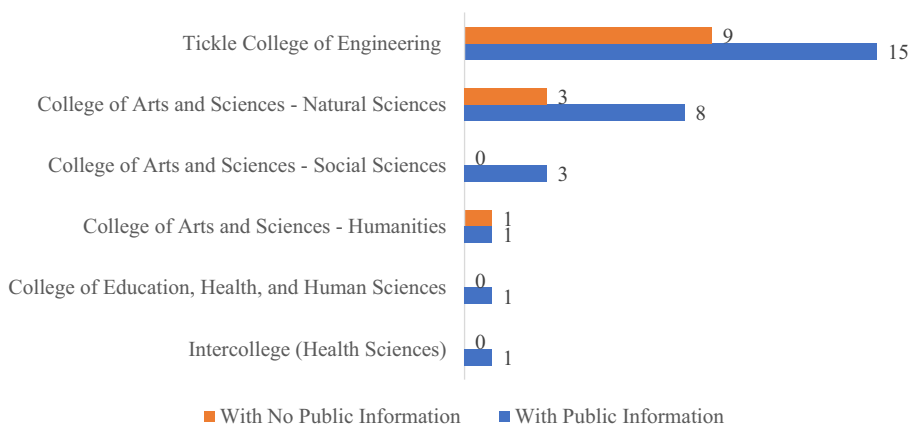


Figure 6. UTK master's theses authors' confirmed ORCIDs with vs. without public information by college and division in the College of Arts and Sciences.

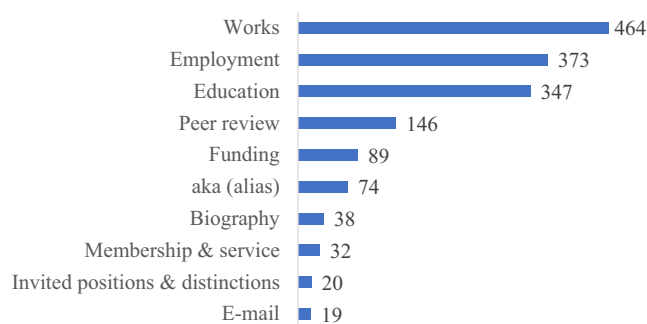


Figure 7. UTK faculty's use of ORCID metadata elements.

(464/594 or 78%), employment information (373/594 or 62.7%), educational background (347/594 or 58%), peer review (146/594 or 24.5%), funding information (89/594 or 14.9%), alias (74/594 or 12%), biography (38/594 or 6%), membership and service (32/594 or 5%), invited positions and distinctions (20/594 or 3%), and e-mail (19/594 or 3%).

For 252 UTK dissertation authors and ORCID users in this dataset who shared their ORCID information with the public, [Figure 8](#) shows their metadata usage from high to low: works (213/252 or 84%), educational background (165/252 or 65%), employment information (144/252 or 57%), peer reviews (53/252 or 21%), aliases (30/252 or 12%), membership and service (27/252 or 11%), biography (13/252 or 5%), funding (12/252 or 4.7%), emails (9/252 or 3.5%), and invited positions and distinctions (7/252 or 2%).

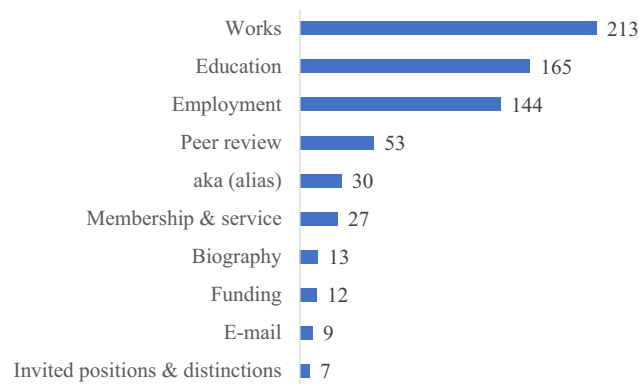


Figure 8. UTK dissertation authors' use of ORCID metadata elements.

For 29 UTK master's theses authors in this dataset who publicly shared their ORCID information, [Figure 9](#) shows their metadata usage from high to low: educational background (25/29 or 86%), works (20/29 or 68%), employment information (18/29 or 62%), aliases (8/29 or 27%), biography (4/29 or 13.7%), membership and service (4/29 or 13.7%), funding (2/29 or 6.8%), emails (1/29 or 3%), invited positions and distinctions (1/29 or 3%), and peer review (1/29 or 3%).

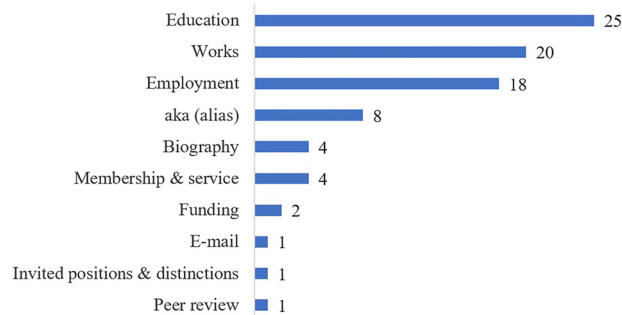


Figure 9. UTK master's theses authors' use of ORCID metadata elements.

In summary, for all UTK ORCID users in this study who shared their ORCID information with the public, the top three metadata elements used in their ORCID profiles were work, employment, and education, with low use of research funding metadata.

Other researcher identifiers

ORCID's integration with other researcher identifier systems and publishers (ORCID, 2024g) allows ORCID users to add other researcher identifiers to their ORCID profiles

and vice versa, such as Scopus ID (Elsevier), ResearcherID (Clarivate), and Loop (Frontiers). UTK ORCID users added 281 Scopus IDs, 115 ResearcherIDs, and 48 Loop IDs as the top three other researcher identifiers visible in their ORCID public profiles (see [Figure 10](#)). Other researcher identifiers were used in a few cases: three SciProfiles, two ISNIs, and one Pitt ID. One UTK ORCID user added LinkedIn as a researcher identifier, which is available as websites and via mobile applications (LinkedIn); thus, they are included in the analysis section on websites in ORCID profiles.

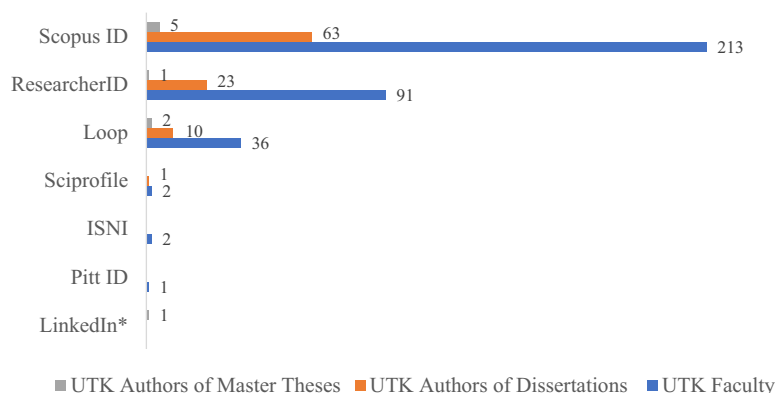


Figure 10. Other researcher identifiers.

Multiple identifiers per person

This study also found that one researcher may have more than one ORCID even though ORCID does not support that practice (ORCID, 2024d). The use of multiple identifiers is also true for Scopus ID and ResearcherID.

Websites and personal and professional profiles

In this study, UTK ORCID users with confirmed ORCIDs and public profiles also included websites in their ORCID profiles as follows: 72 of 594 (12%) UTK faculty, 46 of 252 (18%) UTK dissertation authors, and 10 of 29 (34%) UTK master's theses authors. For UTK faculty, the top three types of websites added to their ORCID public profiles were UTK departmental websites, personal websites, and research and/or lab websites. UTK dissertation authors listed their personal websites, Google Scholar, and LinkedIn as their top three types of websites, followed by research/lab websites at UTK. Three authors included Oak Ridge National Laboratory (ORNL) websites in their ORCID profiles due to UT-ORNL's three joint PhD programs ([Bredesen Center for Interdisciplinary Research and Graduate Education, n.d.](#)).

UTK master's thesis authors listed LinkedIn, personal website, and research/research group website as their top three types of websites in their ORCID profiles. These ORCID users also added to their ORCID profiles other websites, including Google Scholar (Google LLC), ResearchGate, Academia, LinkedIn, Publons (Clarivate), figshare (Figshare LLP), GitHub (GitHub, Inc.), SSRN, an academic and professional association's profile, a journal's website, YouTube, an alum's company website, curriculum vitae (WordPress.com), Twitter, and other universities' profiles.

Country metadata

Along with websites, the following UTK ORCID users added country metadata to their ORCID public profiles: 126 of 594 (21.2%) UTK faculty, 82 of 252 (32.5%) UTK dissertation authors, and 16 of 29 (55%) UTK master's theses authors. The United States is listed in the majority of UTK ORCID profiles (125 faculty, 70 dissertation authors, and 15 theses authors). The remainder are five users with dual countries: one faculty member listed the United States/Bangladesh, four dissertation authors listed the United States/Japan, one United States/Iran, one United States/India, and one United States/China. Other individual countries listed are as follows: dissertation authors, four China, two Finland, one Iraq, and one Bangladesh; and one thesis author listed Puerto Rico.

DISCUSSION

This study aims to understand ORCID's availability, metadata availability and quality, and usage patterns of UTK faculty and ETD authors. The results highlight factors about ORCID usage. Regarding user type, UTK faculty has the largest number of users with confirmed ORCIDs, followed by the authors of dissertations and master's theses. This result may be due to the faculty's use of Elements with ORCID integration and no requirement for ETD authors to submit ORCIDs when submitting their ETDs in TRACE. Factors contributing to the low number of ORCIDs submitted with ETDs need to be further explored. Regarding ORCID and public information, a higher percentage of early career faculty used ORCID and shared their information with the public than other ranks, possibly due to their active engagement with research and creative works to meet the requirements for tenure and promotion. On the other hand, UTK faculty with no research requirement based on their ranks, such as clinical professors and lecturers, had a lower percentage of ORCIDs with public information than the tenured and tenure-track faculty did.

For ORCIDs and public information by discipline, the top five disciplines of faculty ORCID users who shared their ORCID information with the public were Engineering, Natural Sciences, Education, Health and Human Sciences, Social Sciences, and University Libraries.

This finding differed from past studies, possibly because the College of Engineering has the largest research expenditure at UTK ([UT System, n.d.](#)). University Libraries faculty had the highest percentage of confirmed ORCID with public information, possibly due to the Libraries' promotion of ORCIDs to the campus communities. In the Humanities, there were more UTK faculty who did not share their ORCID information with the public than those who did. Faculty in Architecture and Design, Law (including the Law Library), and Art, Theatre, and Music used ORCIDs in the lowest numbers, similar to past findings. It should be noted that for artistic works, ORCID provided one work type under the "other" category for "artistic performance," which was broadly defined ([Blackburn, 2022](#)). For UTK ETD authors, Engineering and Natural Sciences were the top disciplines for ORCID users with public information. The remaining ETD authors had much lower numbers of ORCID users with public information per discipline (15 users or lower), due to the small number of their ORCIDs in TRACE. In general, UTK ETD authors' patterns of ORCID use by disciplines were similar to UTK faculty ORCID users; however, the datasets are too small to apply the findings to the majority of UTK ETD authors. Overall, the findings of disciplinary differences among UTK ORCID users were similar to the findings in ORCID's 2019 survey and other studies, except for Engineering as the top UTK ORCID users.

The top three metadata elements used in UTK ORCID users' profiles were works, employment, and education. This pattern of ORCID usage based on the high to low frequencies and the metadata elements used was similar to that of previous findings and according to ORCID's statistics and survey ([Klein and Van de Sompel, 2017](#); [ORCID, 2019](#); [Kim and Owen-Smith, 2021](#); [Fernández-Marcial et al., 2023](#); [ORCID, 2024j](#)). Those three metadata elements help UTK ORCID users distinguish themselves from other researchers. Biography, aliases, and e-mails (if current) are also useful for this purpose, but only a few UTK ORCID users provided this information. The different order of preferences in using ORCID metadata elements for works, employment, and education is noteworthy. UTK faculty and dissertation authors listed works the most. Both the dissertation and master's thesis authors ranked their employment information third in frequency, perhaps because of their student status at the time of their ETD submission. Furthermore, some of their career paths after graduation may not be in academia and/or research, thus perhaps not requiring ORCID usage. They may also have preferred other profiles—such as Google Scholar, LinkedIn, and/or personal websites—or not using online profiles at all.

Usage of research funding metadata was low across the three groups of UTK ORCID users who shared their profiles with the public. Only 14.9% of UTK faculty, 4.7% of UTK dissertation authors, and 6% of UTK master's theses authors provided funding information in their ORCID public profiles, despite the fact that UTK researchers received 1,605 grants from 2012 (ORCID's founding year) to 2021 according to the Dimensions database

([Digital Science, 2024](#)). UTK faculty researchers underused the funding metadata in ORCID, perhaps due to their use of Cayuse software to submit grant proposals ([UTK ORIED, 2024](#)), which allows users to add sponsored projects to their Elements profiles (UTK Provost, 2024).

UTK ORCID users added Scopus ID, ResearcherID, and Loop as the top three other researcher identifiers and made them visible in their ORCID profiles. These authors might have published in the journals indexed in Scopus and Web of Science databases. Authors are automatically assigned Scopus Author IDs when they publish in journals indexed by Scopus ([Elsevier, 2024](#)). For ResearcherIDs, authors can register for free or as subscribers of Web of Science for unique ResearcherIDs to manage their publication lists with the option to integrate with ORCIDs ([Clarivate, 2024](#)). These advantages offered by Scopus ID and ResearcherID might have contributed to their high use among UTK ORCID users. Third in the rank was Loop researcher profile for all Frontiers authors in Loop, integrated with ORCID since 2015 ([Ponto, 2015](#)). Other researcher identifiers used in a few cases are SciProfiles, ISNI, and Pitt ID ([University of Pittsburgh, n.d.](#)). This study also found that some UTK ORCID users may have more than one ORCID per person and in some cases, multiple identifiers in other researcher identifier systems (e.g. Scopus or ResearcherID) per person. To fix this problem, ORCID provides a help page for ORCID users to remove duplicated ORCIDs that any library and/or research support unit can provide to ORCID users ([ORCID, 2024d](#)).

Beyond researcher identifiers, UTK ORCID users preferred adding personal and research/lab websites to their ORCID profiles. Researchers may move their lab websites when moving from one institution to another or after their graduation from master's and doctoral programs. Thus, using these websites may not be sustainable. ORCIDs would continue to be their persistent identifiers as they pursue their career paths. Also listed were other web profiles with social networking functions (not available in ORCID), including Google Scholar, LinkedIn, YouTube, and Twitter. A small number of UTK ORCID users (224 of 875 users or 25.6%) also added countries in their profiles, highlighting the international students' population in UTK doctoral programs according to this study's datasets.

This study has limitations. Because of the small number of ORCID users in the population of UTK authors of ETDs, the results cannot be applied to the majority of this UTK population or beyond. Due to this study's unobtrusive and quantitative research design, the author cannot use the data to speculate the rationale for why UTK ORCID users apply ORCIDs differently within their own groups or in comparison to other groups. To understand how and why faculty and ETD users (a) do or do not use ORCID and (b) whether they share their information in ORCIDs with the public, future studies can use a qualitative research method, such as surveys or interviews, to answer these questions and to complement the quantitative study's findings.

CONCLUSION

Overall, there was wider adoption of ORCID by UTK faculty than by UTK ETD authors due in part to the use of Elements (the faculty evaluation system) with ORCID integration and the lack of requirements for ETD authors to add ORCIDs when submitting ETDs to TRACE, among other factors to explore in future studies. Regarding the impact on ORCID users in general, they may not have perpetual access to other personal profiles and/or websites. They can use ORCIDs as their persistent identifiers, whether they stay at the same institutions or move away on their career paths. For library services, ETD authors' low usage of ORCIDs would impact UT Libraries (and other institutions with similar circumstances) when using their ORCID metadata in catalog and name authority records and disambiguating among others with similar names. The findings also suggest that both the discipline and faculty ranks need to be factored into designing ORCID support services. The amount of research funding by discipline may correlate with the disciplinary differences regarding ORCID adoption at each institution and should be one of the key variables to explore in future studies on ORCID usage.

Regarding metadata elements, if ORCID can add more work types for creative works in both visual and performing arts, an incentive may be provided for faculty and ETD authors from these disciplines to adopt ORCID and share their information with the public. For library services, if ORCID users include at least their metadata on works, employment, and education in their ORCID public profiles, these metadata can be applied to catalog and authority records. Beyond library services, ORCID plays a major role in the global and national open science infrastructure. UNESCO has emphasized that persistent identifiers and their relevant metadata are critical components of open science infrastructure ([UNESCO, 2021](#)). The U.S. Office of Science and Technology Policy released the Nelson Memo requiring researchers to provide access to federally-funded research as open-access resources ([U.S. OSTP, 2022](#)). These mandates require researchers to have persistent identifiers, such as ORCID iDs, including information on their employment, education, funding, works, and scholarly or creative outputs in their profiles and to keep that information up-to-date (University of Tennessee Knoxville Office of Research, Innovation, and Economic Development, Division of Research Administration, email communication, September 27, 2022). Therefore, for UTK and other institutions, promoting and supporting ORCID usage with publicly accessible information would support library services, research compliance for federally-funded research, and the open science infrastructure.

Although an unobtrusive quantitative case study with descriptive statistics such as this study provides a good overview of ORCID usage at an institution, the findings are limited to ORCID's overall usage with no direct input from the actual ORCID users. For future studies,

the author recommends using both quantitative and qualitative methods to understand ORCID's usage campuswide and to gain insight through direct input from ORCID users and non-users among the faculty and ETD authors (Creswell & Creswell, 2023; Houghton & Foster, 2024). The more we understand ORCID users and non-users, the better we can provide ORCID support services to local scholars, especially to comply with federally-funded research mandates. ORCID metadata can potentially provide the knowledge graph or mapping of ORCID users' scholarly contributions from the local to the global levels.

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