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Quantitative skills and methods training in graduate-level education research and related fields in Ethiopia: challenges and opportunities from Addis Ababa University

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Background: Developing the next generation of researchers in education and the social sciences is a primary responsibility for higher-education institutions and graduate programs in education. In low- and middle-income countries (LMICs) where resources for research training and supports may be scarce, limitations or gaps in access to training opportunities can affect graduate students' development of research and quantitative methods skills and their confidence in applying these skills to address existing and future challenges in education and related fields. These limitations have consequences for development of leaders in education research capable of identifying local priorities, strengthening education systems, and improving national-level educational outcomes.

Methods: An online survey was developed and administered to graduate students in education and related fields at Addis Ababa University (AAU) in Ethiopia. The survey was informed by a prior AAU dissertation review and a brief online survey in the United States, and focused on formal and informal training experiences, specific methods skills, and confidence in those skills. A 22-item scale was subjected to principal components analysis and used to assess skills training opportunities and confidence related to design (11 items) and analysis (11 items) aspects of quantitative methods.

Results: Results are presented for $n = 44$ graduate students and summarized to clarify training opportunities and curricular gaps in research and quantitative methods training. Access to formal training was lower for analysis skills (range 29.5% to 63.6%) than design skills (range 52.3% to 79.5%) (one item related to grant writing was excluded at 6.8%). Students were significantly less confident in analysis skills ($p = 0.027$).

Conclusion: Our findings highlight how access to methodology coursework, as well as disruptions due to university and school closures, can affect students' skill-building and methodological confidence. Implications for collaborative research and knowledge exchange in support of high-quality locally-prioritized and nationally-relevant research are discussed.

KEYWORDS

quantitative training, education research, capacity building, Ethiopia, statistics

1 Introduction

Across the globe, the missions of universities are, in part, to educate and produce competent graduates and promote and enhance research toward meeting several goals—including contribution to a country's social and economic development and to the wellbeing of local, national, and global communities (Addis Ababa University, 2025; Bloom et al., 2014; Cortéz-Sánchez, 2017; Ohio State University, 2025). Developing competent researchers is a critical issue for US and African Universities and in fact for all higher-education institutes (HEIs) granting masters and doctoral degrees, for which a successful thesis or dissertation is typically considered as the capstone requirement for conferral of the degree. Thus, HEIs have a responsibility to appropriately prepare graduate students for independent work embodied by the thesis or dissertation, as well as for their continuing independent research careers.

Competencies are not uniquely defined but can be considered as specifically desired outcomes of programs that integrate knowledge, skills and attitudes with a demonstrable ability to conduct high-quality research. HEIs are expected to fulfill the capacity needs of graduate students to do research, and such a capacity for research can occur at different levels of a system (Adriansen et al., 2015; Menter and Murray, 2009; Uwizeye et al., 2022). For example, building individual capacity could involve developing the range and competence of individual faculty or students so they can be better equipped to perform specific tasks or skills. On the other hand, institutional capacity refers to broader opportunities or ability for an institution to attract and support funded and/or collaborative research, upgrade or build research facilities, and provide research resources to faculty or students (Maassen and Cloete, 2009; Uwizeye et al., 2022). Institutional capacity also serves to improve the numbers and quality of trained researchers; capacity isn't useful if the quality of the skills or activities is low.

The United Nation's 2030 Agenda for Sustainable Development encourages all countries to commit to improved health, education and wellbeing of all people, particularly within high-poverty regions of the world [United Nations Research Institute for Social Development (UNRISD), 2017]. Indeed, the United Nations Educational, Scientific and Cultural Organization's (UNESCO) recent call for a new social contract for education has heightened the importance of HEIs and their contribution to advancing science, innovation, and excellence in education at all levels (UNESCO, 2021). Among the compelling priorities set forth in the UNESCO report is the empowerment of local and national research capacities. Education and education research "must be understood not merely as a field for the application of external experimentation and study, but as a field of inquiry and analysis itself" (p. 123). This commitment to inquiry and analysis does not favor one research paradigm over another—more explicitly it emphasizes the importance of high-quality production of knowledge through diverse methodologies that capitalize on the experiences and realities of all stakeholders in the education system: students, parents, teachers, and school, district and country leaders. Training in diverse paradigms for the next generation of education researchers is essential to elevating

education world-wide and is consistent with the public mission of HEIs.

As quantitative methodologists, our work has focused on collaboration for strengthening quantitative methodology skills for emerging researchers in education, the social/behavioral sciences and veterinary science. In our review of the literature, we found no prior studies specifically examining training opportunities and/or course and topic gaps within quantitative methods in education and the social sciences within Ethiopia. This information is integral to informing capacity-building efforts, fostering competence in use of quantitative methods, and equipping graduate students to conduct high-quality education and social-science research. This capacity work is inherently interdisciplinary, due to the great deal of similarity across disciplines in terms of quantitative methodology tools and analyses. Supporting interdisciplinary approaches to research strengthening is critical to developing competent researchers who can directly contribute to policy decisions and practice. To inform capacity efforts, we focus in this study on access to quantitative skills and research training and confidence in quantitative research methods for graduate students (95% doctoral) in education and related social sciences including veterinary medicine at Addis Ababa University.

Factors contributing to the development of a skilled or knowledgeable quantitative researcher have been studied in the US, Ethiopia and other countries. Some of these factors include individual attributes such as motivation, self-confidence or other personal characteristics (Kibret and Kebede, 2016; Matthews et al., 2016; Murtonen et al., 2008; Widyastuti and Muyana, 2019). Other factors include past experience or the strength of one's background in mathematics or statistics, which can either assist or hinder students in terms of their capacity to develop skills in quantitative analysis and quantitative research (Kassa and O'Connell, 2014; Sutter et al., 2024). Among undergraduate and graduate students, inadequate statistics education is an oft-cited reason for flawed understanding of probability concepts, weak statistical approaches in research, and resistance to statistical innovation (Sharpe, 2013). Other factors include access to high-quality schools or curricula (Bloom et al., 2014); challenges and/or supports for first-generation students (Froggé and Woods, 2018); gender disparities in education/training (Sen, 2015; Sharma et al., 2021) and the rural vs. urban divide (Woldehanna et al., 2005).

Broadband connectivity and access to the internet are also likely factors that can affect the development of quantitative and related methodological and research skills. While great strides have been made in Ethiopian higher education regarding internet access and information and communication technology (ICT; Ferede et al., 2022), poor internet connectivity and ICT infrastructure continues to challenge higher education teaching and learning (Adamu, 2024). Across Ethiopia, only 35% of the population are able to access and use the internet (World Economic Forum, 2024), hindering engagement in education through digital learning. Comparatively, a little over 5 years ago in the US, 6.5 million students attended schools with under-connected facilities (9,400 or about 12% of schools) (EducationSuperhighway, 2017). While the connectivity situation has improved in the US in recent years, particularly since the COVID-19 pandemic (down to 504 or about 0.6% of schools without broadband connectivity)

([EducationSuperhighway, 2023](#)) the impact of internet access on students in terms of catching up with their peers and being ready to succeed in higher education—or even consider higher education as an option—has been critical.

It's well-known that COVID-19 has affected educational technology use and online learning experiences at all education levels, including post-secondary ([Aagaard et al., 2023](#); [Adamu, 2024](#); [Lopez et al., 2021](#); [Turu et al., 2023](#)). In general, issues with technology and/or internet access and affordability persist beyond undergraduate-level education and can impact research training and productivity for graduate students, particularly for students in LMICs. For example, availability and affordability of statistical software packages; software training for free- (i.e., R) or commercial- software; availability and accessibility of research methods and statistics training options and/or support centers; engagement in research colloquia or conferences and professional meetings; mentoring and specialized support for graduate student dissertation/thesis advising; support for student working groups and involvement in research practice; etc., are often more limited in lower- and middle-income countries relative to the graduate student experience in the global North ([Igumbor et al., 2022](#); [Uwizeye et al., 2022](#)).

In the Ethiopian context, there have been concerns raised regarding students' incoming skills and the subsequent development of social, educational, and behavioral researchers ([Kibret and Kebede, 2016](#); [Kassa and O'Connell, 2014](#); [Michael and O'Connell, 2018](#)). The depth of statistics and reasoning activities included in the early-grades curriculum may contribute to later development of statistical and research skills. In earlier work we found that while statistics as a subject was given due importance in Ethiopia's primary/secondary curriculum ([Kassa and O'Connell, 2014](#)) it was not well-emphasized at the university level ([Michael and O'Connell, 2018](#)). However, statistics is included in the recently revised curriculum in some disciplines including teacher education. Despite the assumption that future teachers have mastered content required for the upper primary and basic secondary education curriculum in Ethiopia, pedagogical methods for teaching statistics are lacking in teacher-education programs. These limitations in training affect learning opportunities of early grade students. Upon entering secondary school and college, students' backgrounds in statistics and statistical reasoning/concepts are under-developed and these gaps can then contribute to limitations in university or college quantitative research training and subsequent research engagement or output. The gap in solidifying statistical knowledge at colleges or universities exacerbates the gap in competency to conduct quantitative research. Consequently, graduate students may pursue other research paradigms (i.e., qualitative approaches) given concerns of their training/knowledge or fear/anxiety of statistics.

There are guidelines that education researchers have promoted in support of building research competence [e.g., National Research Council ([National Research Council \(NRC\), 2002](#)), and [Richardson, 2006](#), as cited in [Wester and Borders, 2014](#)]. Briefly, these include substantive knowledge of the field; framing of meaningful research questions; capacity for research design and data collection; and capacity for analysis and presentation of findings. To advance education research that

is situated to the local and/or national context, graduate-level training should build students' capacity to connect researchable questions with methods of data collection and analysis, and promote the importance of research dissemination to different audiences. This research and training process then best leverages knowledge production by building on local context, needs, and goals.

Methods used by graduate students generally reflect the emphasis that faculty place on design, methods and statistics. In essence, students' methodological competence reflects faculty values and strengths, as well as areas of weakness, neglect, or gaps. To a great extent, faculty decide or make arrangements for students to emphasize particular approaches among competing research paradigms, so the methodologies represented in student dissertations should indicate where these emphases are, or are not ([Passaw, 2012](#)).

1.1 Purpose and research questions

Guided by these indications, as well as a desire to explore useful ways to collaborate through competence-building in quantitative methods, we set out to understand the experiences of education and social science graduate students at AAU in terms of quantitative methods and research training experiences. Using a needs assessment framework, we designed an online survey to examine graduate students' access to training opportunities and self-reported research and quantitative skills and confidence.

Three research questions framed the current study:

1. What kinds of quantitative methodology training opportunities are available to support development of competency and skills in research and quantitative methods within our sample of AAU/Ethiopian graduate students?
2. What are AAU/Ethiopian graduate students' self-reported levels of confidence for quantitative skills and research content areas?
3. How did COVID-19 affect students' learning progress at AAU?

One of our long-term goals includes developing training and research collaborations for graduate students between our respective universities. The intended outcomes of these cross-country collaborations are to boost students' quantitative and research skills and their research confidence through hands-on research and training opportunities, and prepare students for the conduct of high-quality education and related research. The onset of COVID-19 coincided with much of our cross-country collaborative research efforts including the survey administration, and unfortunately was followed by war and unrest throughout most of Ethiopia with impacts on all levels of education. Despite these issues, our hope is that the results of this study can contribute to design and delivery of effective cross-country collaborative training and research efforts as Ethiopian higher-education continues to rebound. We provide one example of our progress in this area in our discussion.

We begin by briefly presenting methodology for two preliminary activities related to the development of the survey used in the main study, followed by methodology for the main study

including the design and administration of the quantitative skills and training survey administered to AAU graduate students. We then present our results and implications of our findings.

2 Method

Two activities guided the development of the AAU survey for which the methods used are first described here. These activities included (1) a content analysis of dissertations from the College of Education and Language Studies [CELS; formerly College of Education and Behavioral Studies (CEBS)] at Addis Ababa University, and (2) graduate student responses to a quantitative methods survey at OSU. We describe these activities first, and then present the methods used for the development and administration of the AAU survey.

2.1 Preliminary work

2.1.1 AAU dissertation content analysis

As a precursor to the current study, $n = 31$ PhD dissertations were examined from four departments across the College of Education and Language Studies at AAU prior to COVID-19 shutdowns. The dissertations were independently reviewed by a team of three AAU reviewers including members of our research team using a framework analysis with major themes indicated in the graduate research outline of the University, and uncovering additional information based on methods [e.g., research paradigm, methods (quantitative, qualitative, or mixed)], data analysis types including types of descriptive and inferential analyses, assumptions, appropriateness, etc., and, if quantitative, data management processes (cleaning, adjustments to missing data, etc.). The coding process used a deductive approach with a commentary note for the raters, which was followed by a back-and-forth deliberation among members of the coding team until consensus was achieved. Variables were coded and frequency distributions were constructed based on the data. The analysis was used in part to develop a methods typology that was not mutually exclusive as students could have used more than one method within their overall dissertation work. Dissertations were also reviewed for identification of gaps in procedural and conceptual knowledge for the specific quantitative methods used in each dissertation. Research ethics approval for the dissertation review was obtained through AAU's College of Education and Language Studies.

2.1.2 OSU quantitative methods survey

In part to inform development of the Ethiopia survey, OSU student experiences were assessed regarding quantitative research training via an online survey administered using a convenience sample approach with outreach to students in selected courses and programs; the email was sent via listserv to graduate students in quantitative programs within education, veterinary medicine, life-sciences/biology education, etc., however, all OSU students were eligible when they received the link to the survey. A total of $n = 82$ graduate students from multiple disciplines completed the anonymous survey. Items asked about intended data manipulation,

analysis methods and software for their thesis or dissertation; formal training in quantitative methodologies; informal training or resources used (non-credit workshops, online tutorials or videos, advisor meetings/office hours, data science clubs, etc.); and the extent to which the quantitative methodologies or software tools were taught as part of their degree program/curriculum. We also asked students whether they felt prepared to *assess*, *understand*, *apply*, and *create* emerging quantitative methods and software. IRB approval for the OSU survey was obtained through OSU Office of Responsible Research Practices.

2.2 Main study

2.2.1 AAU skills and confidence survey: development

Informed by the dissertation content analysis and the earlier OSU survey, we developed and administered an online survey to graduate students within AAU in Ethiopia. The survey included items on participant background, program specifics, education and research experience, availability of mentoring, confidence in and training for 22 specific methodological and quantitative research skills, and needs/gaps for quantitative training. We also included one item on the impact of COVID-19 on students' studies and research activities. IRB approval was obtained from AAU and OSU prior to administration of the survey.

Survey items were based on review of the literature as well as input from the research team and the preliminary work described above. In lieu of a formal pilot, the survey was pre-tested on a sample of students at AAU and OSU with follow-up modifications. The survey is made up of eight sections: (a) demographics; (b) program background/history; (c) experience with quantitative skills and methodology training and confidence with specific methods/procedures; (d) research types used; (e) specific methods for thesis/dissertation; (f) training opportunities and preferences; (g) participation in informal courses/arrangements; (h) impacts of COVID-19 on research efforts.

For the quantitative skills section (c), we identified 22 quantitative approaches/techniques focusing on research design and analysis skills and spanning the research process from designing a study, developing researchable questions, following informed consent processes, to analyzing data and interpreting statistical output, and communicating results. We used an iterative approach to select the final 22 items based on input from our research team and the pre-testing process. One item asked about experience in writing a grant application, as this was a skill of interest to our team. The survey is available on request from the first author.

2.2.2 AAU survey administration

The Ethiopian quantitative methodology survey was designed to be completed online and anonymously; graduate students at AAU in education and social science fields including veterinary medicine were invited to participate. Veterinary medicine was specifically included given the applied statistical and research approaches similar to those in fields of education, and due to

our existing collaborative training efforts in methodology by OSU and AAU for students in these fields. The targeted due date for administration of the survey was spring of 2020; however, the university shutdown due to COVID-19 delayed the release. The survey was available via email link to a Google Survey from January 2021 to May 2021. Graduate program directors and college officers for research and technology transfer at AAU's College of Education and Language Studies and the College of Veterinary Medicine agreed to send the email with a survey link to all graduate students in programs including quantitative methods; other students were able to access the survey through word of mouth or if forwarded by a colleague.

Responses were obtained from 44 students. Several limitations to response included complications due to timing (university shutdowns from COVID-19 and civil unrest beginning in November 2020), challenges to internet connectivity, and use of personal vs. university email accounts. Records indicate 78 students were directly contacted with the survey email; this number does not include students who may have forwarded the survey to others. We address concerns on the convenience nature of the survey in the discussion.

2.2.3 AAU participants

The AAU survey was completed by a total of 44 individuals in a master's or doctoral program from Addis Ababa University in 2021 during the early months of the COVID-19 pandemic and during COVID-19 shutdowns. Ninety-three percent (41) of respondents identified as males and 7% (3) of respondents identified as females. Ninety-five percent of respondents ($n = 42$) were doctoral students (PhD or DVM) with 5% ($n = 2$) being master's or equivalent (M.A/MSc/MED). Out of the 44 respondents, 19 indicated they were full-time graduate students, 15 were Associate Professors, one person was an Assistant/Senior Lecturer and nine people did not answer this question. We note that Associate/Assistant professors may be appointed at AAU or other universities prior to defending their dissertation work. For departmental affiliations, 77.3% ($n = 34$) were in an education or social science program, and 22.7% ($n = 10$) were in veterinary science, mathematics or a natural science. Ninety-three percent of respondents identified as male between the ages of 33–52, and 7% ($n = 3$) identified as female between the ages of 33–37.

Respondents were from a wide array of disciplines, for example: Science and Mathematics Education, Curriculum and Instruction, Education Planning and Management, Veterinary Parasitology, Immunology, Psychology, Social Psychology, International and Comparative Education and Policy Studies, and Special Needs Education. Nearly 80% of the students responding indicated that they had already completed all required coursework for their degree. Most respondents reported that they were currently engaged in research for their thesis or dissertation (68.2%). While all respondents were utilizing some form of quantitative methods for their research and participated in quantitative methods training, 68% reported that their thesis/dissertation work involved mixed methods, with 14% being primarily quantitative and 18% being primarily qualitative.

2.2.4 AAU survey analyses

We used a combination of descriptive and correlational techniques to analyze the data for most items on the survey. For the 22 quantitative skills items, students first indicated whether their training was formal, informal, or a combination of both. Next, they rated their self-reported confidence for use of each of these specific design and analysis skills, based on a response scale from 1 = *very low* to 5 = *very high*. We then used principal components analysis with varimax rotation to examine the dimensionality of this set of methodology skills. For the resulting two components—*design* and *analysis*—we created subscales based on means for items corresponding to each component (the item on grant writing failed to load on either component and was not include in the subscale means). Finally, qualitative summaries were created for responses to the open-ended item on COVID-19 research impacts.

3 Results

3.1 Preliminary work

3.1.1 AAU dissertation content analysis

The AAU doctoral dissertation content analysis found that only 23% ($n = 7$) of the $n = 31$ dissertations reviewed used primarily a quantitative research approach, with 32% ($n = 10$) utilizing a combination of quantitative and qualitative approaches or mixed-methods. The majority of dissertations reviewed used qualitative methodologies (45%; $n = 14$). For the types of research studies, 32% ($n = 10$) involved curricula review, development or planning, and 18% ($n = 6$) were implementation studies. Four percent ($n = 1$) of the studies focused on school culture or teacher effects on non-academic outcomes, 18% ($n = 6$) were observational, cultural or social investigations, and 14% ($n = 4$) focused on teacher development or comparison of teacher-level outcomes. Only 14% ($n = 4$) of the dissertations had their primary emphasis on comparison or analysis of student outcomes, i.e., by gender or region.

Table 1 contains the distribution of specific methodologies within the 31 dissertation studies. Coding of the approaches used resulted in a methods typology that was not mutually exclusive, as students often used more than one methodology within their overall dissertation work. Of the 87 methodologies employed across these dissertation studies, the most frequently used methods included interviews of stakeholders (19.5%) and document reviews (16.1%). Among quantitative methodologies, 8.0% used validity methods (EFA, CFA, etc.) and/or reliability analyses; 8% used multivariate or multivariable methods such as MANOVA, ANOVA, or logistic/multiple regression, and 12.6% used questionnaires, surveys or scales as data collection tools. As can be seen in Table 1, some studies included only descriptive or univariate quantitative methods (9.2%), without exploring the data on a deeper plane.

After tabulating the methodologies within these dissertations, we identified some critical issues in the ways in which quantitative research design, statistics or quantitative methods were applied or presented within these dissertations. Our intention in this part of the dissertation review was to identify and call attention to the need for stronger competence in the use of quantitative methods—not to diminish the quality of the work of these dissertations in

TABLE 1 Methodologies used within a sample of AAU education dissertations.

Dissertation methodology	f	%
Interviews	17	19.5%
Document reviews, content analysis, expert reviews	14	16.1%
Questionnaires, surveys, scales (including if translated without modification)	11	12.6%
Observations (i.e., of classrooms, teaching)	9	10.3%
Descriptive statistics or univariate statistics only	8	9.2%
Multivariate or multivariable methods (MANOVA, log reg, mediation, path analysis, multiple reg, non-parametric, other inferential)	7	8.0%
Focus groups	6	6.9%
Non-probability sampling	5	5.7%
Reliability analysis	4	4.6%
Validity (EFA, CFA, etc.)	3	3.4%
Formal instrument development	2	2.9%
Probability sampling	1	1.1%
Total methodologies identified	87	100%

N = 31 dissertations.

whole. We found some technical gaps in (a) statistical knowledge or skills (interpretation of measurement issues; omission of data clustering effects; assumptions regarding missing data or statistical procedures, etc.), (b) capacity to operate and/or interpret output of statistical software (software access or use), and (c) limitations or challenges in reporting statistical results. We note that these skills require strong methodological foundations and practice to help students build competence and confidence in quantitative study design as well as data analysis and interpretation of results.

These results point to training approaches and opportunities that students may or may not be able to engage in during their graduate studies. The findings identified in the dissertation review underscore the need to uncover the kinds of training opportunities available for AAU graduate students, their possible associations with the development of capacity to do quantitative research, and to consider how training opportunities may be related to students' confidence for using quantitative research methods. These are issues examined in our main study.

3.1.2 OSU quantitative methods survey

As part of our efforts to better understand graduate student experiences in quantitative training and contribute to the format for our AAU survey, we developed and administered a brief online survey for OSU students. We had a sample of $n = 82$ OSU graduate students complete the survey. Of these, four students indicated their research was qualitative rather than quantitative, and given our focus on quantitative methodologies, only the responses for the $n = 78$ students applying quantitative methods are summarized here. Doctoral students represented 88% of

TABLE 2 OSU student responses on preparation for aspects of using quantitative methods and software.

Do you feel prepared to	Yes	No	Partly
a. Assess emerging quantitative methods and software?	28.8%	32.9%	38.4%
b. Understand emerging quantitative methods and software?	46.6	13.7	39.7
c. Apply emerging quantitative methods and software?	46.6	16.4	37.0
d. Create emerging quantitative methods and software?	13.7	79.5	6.8

N = 73 (five incomplete responses omitted).

these respondents, and nearly half had reached candidacy stage (48%). The sample was fairly split between education and social science graduate students (51%) and other sciences (49%) such as veterinary medicine, biomed/physics/chem, nursing, biology and microbiology, etc.

Responses to questions regarding methods and software used were open-ended. Students indicated a wide variety of quantitative techniques they intended to use for their thesis or dissertation, with most using analysis of variance (38%), linear or logistic regression (38%), structural equation modeling (24%), multilevel analyses (18%), and phylogenetic trees (13%). In terms of statistical software, students intended to use R (26%), SAS (17%), SPSS (18%) or Stata (14%), with a few students also indicating more specialized software for specific techniques (e.g., ArcGIS, ImageJ, Prism, FlexMIRT, etc.).

In terms of formal preparation, students indicated that the methods needed for their thesis or dissertation were not taught or only minimally included as part of their required (63%) or elective (49%) curriculum. Similarly for quantitative software packages, with 58% and 54% indicating that software was not taught or only minimally included in their required or elective curriculum, respectively. Students reported supplementing their methodology or software skills and knowledge through other resources including workshops, online videos or tutorials, working with their peers, or working with their advisor or other faculty.

We asked a series of four items to gauge students' preparation to *assess*, *understand*, *apply*, and *create* emerging quantitative methods and software, with responses as shown in Table 2. It is clear from these responses that many OSU students feel they are lacking in preparation through their curriculum in quantitative methodologies, with less than half of all students indicating they felt prepared in all four areas, although many students felt at least partially prepared. Our final question on the survey asked whether students felt prepared for independently choosing and applying quantitative methods and statistical software for their research careers after graduation, for which 42% reported feeling under- or unprepared.

While students were at different stages of their graduate program, these results do suggest a need for better alignment of coursework and research training opportunities even within a well-resourced university. The importance of these findings is consistent with recent calls for strengthening methodology training in quantitative-heavy programs as well as for substantive researchers (Pek and Bauer, 2023; Randall et al., 2021).

TABLE 3 AAU survey: item endorsements (%) indicating formal, informal or both approaches to training on research methods and skills, with average confidence ratings for each item and subscales.

Items	Formal (%)	Informal (%)	Both (%)	Average confidence (SD)
Collecting data	79.5	11.4	2.3	2.91 (1.01)
Developing a survey instrument or measure	52.3	20.5	6.8	3.18 (0.922)
Stating researchable questions	70.5	15.9	6.8	3.18 (0.917)
Selecting an instrument or measure	63.6	20.5	2.3	3.02 (0.952)
Designing a sample	63.6	20.5	6.8	3.05 (0.914)
Designing a research study	72.7	13.6	6.8	3.23 (0.912)
Creating a testable hypothesis	65.9	13.6	2.3	3.00 (0.940)
Descriptive statistics	72.7	13.6	11.4	2.80 (0.954)
Determining sample size	70.5	15.9	9.1	3.07 (0.961)
Inferential statistics	75.0	13.6	11.4	3.05 (0.888)
<i>Design subscale (k = 10 items) mean (SD)</i>	3.06 (0.68)			
Cronbach's alpha	0.895			
Graphing or visualizing data	38.6	34.1	4.5	2.91 (0.936)
Data management and cleaning	45.5	31.8	4.5	3.02 (0.902)
Adjustments for missing data	29.5	29.5	2.3	2.67 (0.874)
Drawing conclusions based on analysis	54.5	25.0	9.1	3.14 (0.955)
Communicating results	47.7	27.3	6.8	3.14 (0.905)
Understanding limitations of research design	54.5	25.0	4.5	2.95 (0.914)
Interpreting statistical output	63.6	20.5	9.1	3.07 (0.925)
Multivariate statistics	54.5	25.0	6.8	2.75 (0.967)
Examining assumptions for statistical analyses	59.1	15.9	9.1	2.98 (0.913)
Advanced statistics	40.9	18.2	11.4	2.64 (0.942)
Obtaining informed consent for a research project (ethics)	59.1	20.5	6.8	2.82 (0.922)
Writing a grant application ^a	6.8	31.8	0	2.41 (0.897)
<i>Analysis subscale (k = 11 items) mean (SD)</i>	2.88 (0.65)			
Cronbach's alpha	0.897			
<i>Total scale (k = 22 items) mean (SD)</i>	2.94 (0.57)			
Cronbach's alpha	0.920			

n = 44.

^aItem excluded from subscale.

3.2 Main study: AAU methods survey

3.2.1 Research question 1: training opportunities

Most of our AAU student sample (63.6%) reported that the quantitative methods needed for their thesis or dissertation were taught as part of the required curriculum for their degree, but only 34% of respondents said they were taught how to use the statistical packages/software needed to manipulate/analyze data to complete their research. Seventy percent of respondents said their graduate programs required an external faculty mentor/advisor on committee for quantitative research and 61% of respondents said it was incredibly challenging to locate an external expert as a research mentor/advisor.

Our survey asked specifically about access to formal (credit-bearing) vs. informal (workshops, online courses, self-directed, etc.) training for 22 specific skill areas in research and quantitative methods (Table 3, columns 1–3). While many topic/skill areas were identified as part of students' formal research or methods training, several areas were less frequently indicated (i.e., by 50% or fewer of students) as being part of their formal training: data management and cleaning; graphing or visualizing data; working with missing data; applying advanced statistics; communicating results; and writing a grant application. None of the 22 skill areas was identified by more than 50% of respondents as available through informal training, and only a handful of students (<12%) indicated they had access to both types of training in these areas.

TABLE 4 AAU survey: rankings on preferred approaches for training in quantitative research methods (1 = *most* preferred, 6 = *least* preferred).

Type of training	Average ranking
Individual consulting	2.54
Individual or group tutoring	3.26
Online learning/online courses	3.48
Mentoring with advisor	3.82
Formal courses	4.40
Modular courses: workshops or short courses	4.68

N = 44.

Interestingly, formal courses were among the least preferred approach to learning quantitative research methods for these AAU graduate students. In terms of preference for different forms of research and quantitative training, we asked respondents to rank six types of training modalities (Table 4; 1 = *most* preferred, 6 = *least* preferred). Results showed that most of our respondents preferred individual consultation (average rank = 2.54) followed by individual or group tutoring (average rank = 3.26), with less average preference for modular courses such as short courses or workshops (average rank = 4.68). It could be that issues with access to individualized support during a modular course or workshop may contribute to the lower preference for this type of training.

3.2.2 Research question 2: confidence in quantitative research skills

We asked students about their confidence in research and methodology skills in two ways. First, students were asked to rate their confidence (1 = *very low* confidence; 5 = *very high* confidence) for the 22 research and methodology skills provided in Table 3. The five highest average confidence ratings (last column in Table 3) were for designing a study ($M = 3.23$); stating researchable questions ($M = 3.18$); developing a survey instrument or measure ($M = 3.18$); communication of results ($M = 3.14$); and drawing conclusions based on analyses ($M = 3.14$). The five lowest average confidence scores were in using descriptive ($M = 2.80$) or multivariate statistics ($M = 2.75$), making adjustments for missing data ($M = 2.67$), using advanced statistics (2.64), or writing a grant application ($M = 2.41$). While we acknowledge that writing a grant application is not a skill typically included in quantitative methods coursework, it is an important skill for contributing to advancement of in-country research priorities (Cassell et al., 2022).

A principal components analysis (PCA) was conducted for the set of items measuring students’ confidence in applying different quantitative methods for their research, with rotated loading results as shown in Table 5. Two components were cleanly identified after varimax rotation and consistent with our focus on quantitative *design* skills and *analysis* skills, explaining 50% of the total variance in responses. We used these results to create two subscales as described below.

For this analysis, the grant writing item was excluded because it did not load well on either of the two identified components during preliminary PCAs. For ease of reference the items in both Tables 3, 5 are in order of their corresponding component. Factor

TABLE 5 AAU survey: rotated principal component matrix loadings.

Items	Component loadings	
	Comp. 1 (design)	Comp. 2 (analysis)
Collecting data	0.801	0.121
Developing a survey instrument or measure	0.745	0.198
Stating researchable questions	0.740	0.132
Selecting an instrument or measure	0.738	0.226
Designing a sample	0.680	0.100
Designing a research study	0.610	0.338
Creating a testable hypothesis	0.601	0.286
Descriptive statistics	0.601	0.068
Determining sample size	0.597	0.318
Inferential statistics	0.493	0.413
Graphing or visualizing data	0.035	0.769
Data management and cleaning	−0.083	0.769
Adjustments for missing data	0.047	0.724
Drawing conclusions based on analysis	0.438	0.703
Communicating results	0.283	0.665
Understanding limitations of research design	0.361	0.651
Interpreting statistical output	0.478	0.632
Multivariate statistics	0.354	0.614
Examining assumptions for statistical analysis	0.493	0.555
Advanced statistics	0.385	0.549
Obtaining informed consent for a research project (ethics)	0.233	0.446
Variance and scale statistics	Design	Analysis
% Variance before (after) rotation	41.791 (27.575)	10.652 (24.868)
Scale reliability	0.900	0.928

N = 44, (1) Item v (grant writing) excluded (2) Scale reliability determined from the set of items loading strongest (bold) on respective factor.

one represents “*design*” skills, and consisted of 10 items focused on students’ ability to design a research study as can be seen in the example items “creating a testable hypothesis” and “developing a survey instrument or measure.” Factor two represents “*analysis*” skills, consisting of 11 items focused on students’ ability to prepare and use data for quantitative analysis, as can be seen in the example items “data management and cleaning” and “interpreting statistical output.” Average responses to the set of items loading highest on either component were used to create the two subscales, with strong reliability through Cronbach’s alpha ($\alpha = 0.895$ for the *design* subscale and $\alpha = 0.897$ for the *analysis* subscale). Excluding three cases with missing values on either component, the average self-reported confidence for *design* [$M = 3.06$ ($SD = 0.68$)] was somewhat larger than average self-reported confidence for *analysis* [$M = 2.88$ ($SD = 0.65$)], and this difference was statistically significant with a moderate effect size (paired $t_{40} = 1.990$, Cohen’s

TABLE 6 AAU survey: overall current skill description for respondents.

Options	%
a. I feel I do not yet have the skills I need to be successful at designing and completing <i>all phases</i> of quantitative research.	11.1%
b. I feel I have some or most skills to design a high-quality quantitative research study with some supervision, but I do not have the skills to collect or analyze the data successfully.	13.9%
c. I feel I would be able to analyze data successfully for a quantitative research study, but I have fewer skills for designing a high-quality study without supervision.	11.1%
d. I feel I have some or most skills for designing a quantitative study and for collecting and analyzing the data, but would need strong mentoring or supervision.	47.2%
e. I feel that I can successfully and independently design a high-quality quantitative research study, analyze results and share my findings with the research community.	16.7%

N = 44.

$d = 0.31, p < 0.027$). Notably, formal training opportunities were indicated by fewer students on the *analysis* items relative to the *design* items (Table 3), although slightly higher proportions of students indicated informal access to topics in the *analysis* domain. The two subscales were positively correlated ($r = 0.634$) suggesting a strong relationship between self-reported competence for *design* and *analysis* skills.

We also assessed confidence for design and analysis skills in a broader sense. Students were asked to choose from among five descriptors that best captured their current skill-level at using quantitative analyses to answer a quantitative research question. Results are presented in Table 6. For this sample of Masters/PhD students, 47.2% chose the descriptor option corresponding to having *some or most skills* for designing a quantitative study and analyzing data but needing *strong mentoring or supervision*. Only 16.7% of respondents felt they could successfully design a quantitative study, analyze their data and share findings with the research community. A total of 36.1% of the students indicated not yet having the necessary skills in either (or both) designing a quantitative study or analyzing quantitative data.

3.2.3 Research question 3: COVID-19 impacts

Our survey was administered after the start of the COVID-19 pandemic. Thus, we included an open-ended question for which students were asked to express their sentiments about how their academic journey had been impacted by the COVID-19 pandemic. Forty students provided comments, and of these all identified difficulties due to school disruption. A summary of responses indicated that some students near to graduation had to delay their graduation by a year because of multiple issues, including data collection challenges given a delayed school year, access to library resources, difficulty in reaching academic advisors or supervisors, and due to school or other closures in Ethiopia. Reported disruptions specific to advancement of research activities due to COVID-19 included limited capacity to focus on research work, research that has been delayed due to school or other research site closures, interruptions in internet access to online resources and technology, difficulties in data collection or meeting participants, research training opportunities that were canceled,

and challenges in communications with mentors/advisors. These disruptions are similar to those expressed by students in the US and other countries. Across the globe, COVID-19 has had a profound effect on students at all levels of education (Jakubowski et al., 2023). During Fall of 2020, civil unrest and war in northern regions in Ethiopia contributed to even greater life and schooling disruptions. In some regions, students continue to experience education challenges due to ongoing conflict or its aftermath. Along with personal wellbeing and safety, student responses to this item illuminate the deleterious effects of disruption to education and research progress and calls attention to potential for shared and global responsibilities for education in emergency situations and in meeting the research and methodology needs of future researchers.

4 Discussion

To our knowledge, this study is the first to examine education and social science graduate student experiences in quantitative methods within Ethiopia and helps clarify some of the methods and research training gaps in these areas. Our research questions focused on AAU graduate student training opportunities in quantitative methods and research, students' self-reported confidence in quantitative research design and analysis skills, and effects of COVID-19 on research and learning progress. A dissertation content analysis from AAU's College of Education and Language Studies and an earlier survey on OSU student experiences with quantitative training helped frame the direction and context for the research presented here.

Our findings revealed that AAU students feel the need for additional options and supports in quantitative design and analysis topics, and for research training. Since growth in research capacity is a goal of all research universities, driving this growth requires significant opportunities for students to build their competence and knowledge and allow them to make essential contributions to the research enterprise and to country priorities. As noted by Bernstein et al. (2014), previous experience in research is one of the best predictors of doctoral-level success.

Over several years through our growing international partnership, we have been able to collaborate on knowledge exchange activities including lectures and seminars on quantitative methods and research topics, both online and in-person. In part due to the findings reported here, members of the OSU team applied for and received funding through OSU's College of Education and Human Ecology to initiate collaborative research with AAU in the area of early childhood education and care. This substantive area was selected for its prioritization by AAU's College of Education and Language Studies and the Ethiopian Ministry of Education. During Autumn 2022, ten graduate students at AAU were trained in classroom observation tools and in direct child assessment. With mentoring and supervision from AAU faculty they conducted the observations and assessments and conducted principal interviews and teacher surveys within selected local schools. Training also included research ethics and data management. In addition, multiple research and quantitative topics were presented through workshops or seminars (online or in-person) to these students and other interested students/faculty at AAU and OSU. While collaborative data analysis and paper development are still in progress, we believe that this research

partnership model will contribute to the strengthening of research competencies and skills expected of independent researchers. A future goal for our research team is to continue to seek out these kinds of collaborative projects to support research and research training opportunities based on local priorities in education and other areas including veterinary and social science fields.

According to our survey results, AAU students would also appreciate greater access to individualized consulting or for mentoring on their research projects. As our findings show, 47.2% of the students responding felt they needed stronger mentoring or supervision for research involving quantitative methodologies. Several existing capacity projects in global/public health have relied on group mentoring to strengthen research training in Africa, which helps to limit the mentor workload when the pool of available mentors or supervisors is low (i.e., [Manabe et al., 2018](#)). Other health research capacity programs have developed “best practice” research mentoring guidelines ([Igumbor et al., 2022](#)). Across all research areas, however, authors of a recent systematic review of research productivity among African HEIs ([Uwizeye et al., 2022](#)) call upon university leadership to prioritize research funding and, among other recommendations, create institutional mechanisms of support for research mentorship. Put together, doctoral-level experiences founded on collaboration and knowledge exchange, research engagement, and strong research mentoring may hold exceptional promise for meaningful high-quality research that can serve local and country-wide development needs.

There was a serious gender gap in our sample when we compare the amount of male respondents ($n = 41$; 93%) to female respondents ($n = 3$; 7%). The gender gap discrepancy in general may stem from cultural, historical, religious and socioeconomic issues ([Tamrat, 2018](#)) around girl child education in developing countries in Africa, affecting girls' later access to higher-education. During the course of this study, our Ethiopian colleagues on this research team observed that women in Addis Ababa, neighboring villages and towns had to step up in terms of home and family care because of the COVID-19 pandemic. This added-on domestic duty during the pandemic could be one of the many reasons why we had extremely low responses from even the relatively fewer female scholars at AAU because of limited time, uncertainty and perhaps general lack of interest to complete a survey during a time period fraught with competing concerns. In a study conducted on the impact of COVID-19 on Africa's Higher Education and Research sector in 2020, women reported higher rates of disruptions in research activities ([ACCORD, 2020](#)); this was consistent with what we observed in Ethiopia. Overall, it is estimated that high-income countries have 3,963 PhD's per one-million people, but very low-income countries including Ethiopia have <100 ([Tsephe and Potgieter, 2022](#)). Thus, participation in higher-education is generally low across the continent and lower still when considering the percentage of women pursuing advanced degrees. Even though there have been efforts in recent years to increase female university enrollment, these efforts are mostly geared toward undergraduate studies ([Klege, 2022](#)); however, these efforts may have potential positive impact on representation over time at the Masters and PhD level. Given the current situation it is not surprising that the percentage of female students, and more importantly, female faculty in the higher-education sector

is very low (13.6% female faculty as reported by the [Ethiopian Ministry of Education \(MoE\), 2017](#)) resulting in fewer female-to-female mentorship opportunities for prospective female students. Like their male counterparts, female students are more likely to pursue graduate degrees in various fields when they encounter outstanding role models of the same gender.

In sub-Saharan Africa, COVID-19 has radically affected university research progress and hit university students particularly hard ([Kigotho, 2023](#)). In Ethiopia, universities were shut down for over 10 months. In addition, the global pandemic coupled with war and country-wide conflict areas has affected opportunities for collaborative efforts between Addis Ababa University and external partners, creating some challenges in continuing or new efforts to support quantitative methodology capacity for graduate students. While online offerings in quantitative methods and other courses have increased worldwide, these are frequently costly and with limited or no access to an actual instructor. Given that our findings indicate AAU students have a preference for individual and mentored training components, a reliance on online delivery and content may not be the strongest option for building methodology and research skills for graduate students, at least not without some modifications such as a hybrid approach to content engagement and/or active engagement in research projects.

4.1 Future directions

Our study findings identified several specific skill areas that could be targeted for future trainings and collaborative projects. For example, several of the skills items that have low confidence scores also tended to have the smallest proportion of students reporting availability of formal or informal coursework on that topic. Further, most of the lowest confidence ratings fall under skills included in the *analysis* subscale, and of the 10 items with the lowest endorsements overall as being taught through formal training, eight of these fell under the *analysis* subscale. Of additional concern is that access to informal training was fairly low across all methodology topic areas. One of the lessons learned through the COVID crisis is that online opportunities as a form of informal training can cover some training gaps, but online trainings often come with costs or internet requirements, which may be challenging for many students and faculty in LMICs. Individualized mentoring can also be very challenging in an online environment. We note that the majority of OSU students similarly reported that the methodology training needed for their dissertation work was not covered in their required or elective coursework. As informal courses and online course opportunities continue to proliferate, training experiences for the next generation of education researchers need to be closely examined for quality, equitable access and appropriate content to close gaps in design and analysis skills.

Revisiting existing curriculum and coursework for the content areas identified through our methods survey could also help improve students' opportunity to learn more or more deeply about quantitative methodologies within their formal classes. It may also be useful to explore innovative training options that can

complement what students acquire from their formal learning. For example, moving beyond short-term content trainings to building opportunities for students to engage in locally-relevant research projects can strengthen their application of quantitative methods and improve potential for research publications. International collaborations can expand a university's research network and broaden opportunities for research engagement. In an increasingly globalized world, collaborations between institutes of higher-education in high-income and low- and middle-income countries have mutual benefits (The Embassy of Good Science, 2020; Masaiti and Mboyonga, 2022). Funders and research universities should prioritize the support and replication of effective networks and models for education and related research, prioritizing collaborations that are replicable and adaptable to different local/national contexts and needs.

A further opportunity for cross-country collaboration was identified in our study as the indicated requirement for AAU students to identify an external mentor and/or advisor. Research collaborations between faculty across institutions would help to support this requirement, and have an additional benefit of fostering knowledge exchange, both formally and informally.

The points discussed above can help mitigate the observed gaps in quantitative design and analysis skills, and we believe that competency for conducting quantitative research can be best achieved through university partnerships and collaborative engagement which allows universities to pool expertise and resources available at both ends, and thus help build and sustain capacity building efforts (e.g., Awe et al., 2022). Many of the training gaps and challenges we've identified are consistent with existing research on higher-education training and development of research skills (e.g., Teferra, 2007), as well as on the impact of COVID-19 in Ethiopia (e.g., Tamrat, 2021). There is wide opportunity to apply modes of research strengthening that have been promoted as effective in other sectors (primarily health and science fields) (Jones et al., 2007) that can serve to strengthen quantitative education research and support development for the next generation of education and social science researchers.

4.2 Study limitations

Limitations to our study were primarily due to the COVID-19 pandemic which also overlapped with civil unrest and war in Ethiopia. Travel restrictions, university and school closures, internet access issues, limited accessibility to prospective respondents, and the general uncertainty that surrounded daily life as well as research activities made it extremely difficult for students to access or complete the survey online, and for the research team to collect data in a timely manner. Consequently, our sample size for the survey is low and in reality may not represent the intended population of students in education and the social or veterinary sciences at AAU, particularly those who did not have access to internet outside of the university. The small sample size may have affected the quality of our principal components analysis, as the recommended sample size for this type of analysis is a minimum of 100 cases (Gorsuch, 1983). However, we believe the relatively clean structure of the components and the high internal consistency of the two subscales contribute useful information.

We were also unable to compare gender outcomes for quantitative methods skills and needs because 93% of our sample were males.

4.3 Implications

Graduate-level challenges with research design and quantitative methods identified in Ethiopia exist in parallel with students in the US. As discussed earlier, the survey results indicate how competencies in research and quantitative methods may be affected by access to and type of training opportunities available, which vary by country and country-specific resources for higher-education. Regardless of country, however, Bernstein et al. (2014) note that the "core component of doctoral training is the advancement of knowledge through original research" (p. 6).

The problems encountered in education and other societal systems today are complex and as such, often need multifaceted methodologies to scrutinize and resolve them. Our research study has identified specific research and quantitative training needs for graduate students in education and related sciences, and these results feed into our continuing efforts to enhance research training for the next generation of quantitatively-focused researchers at Addis Ababa University in education and related fields. Within Ethiopia, these emerging researchers will then be better prepared to tackle complex development priorities for their country.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

The studies involving humans were approved by Addis Ababa University, Ethics Review from AAU's College of Education and Behavioral Studies and The Ohio State University's Office of Responsible Research Practices. The studies were conducted in accordance with the local legislation and institutional requirements. The participants provided their written informed consent to participate in this study.

Author contributions

AO'C: Conceptualization, Data curation, Supervision, Writing – original draft, Writing – review & editing. KM: Conceptualization, Supervision, Writing – original draft, Writing – review & editing. YD: Supervision, Writing – review & editing. RG: Conceptualization, Data curation, Writing – review & editing. WW: Data curation, Formal analysis, Writing – original draft, Writing – review & editing.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Generative AI statement

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