Online Quantitative Research Methods: A Scoping Review on Education, Psychological Factors in E-Learning, and Working from Home

Giusi Antonia Toto*a,*, Pierpaolo Limone*a,*

a University of Foggia, Arpi street, Italy, Foggia.

Abstract

Quantitative research methods have undergone an online evolution both in content, in the data collected, but also in methodology and tools. The article is a scoping review that aims to trace the emerging issues in the field of research methodology. The online research has embraced the most disparate fields of research, in this review we have chosen to circumscribe to three main themes: education, psychological factors in elearning and working from home. Specifically, the emergence of an important amount of data such as big data and learning analytics made it necessary to review the purposes, methods of analyzing and reading emerging data in research contexts. The emerging themes during the pandemic related to education, psychological factors in elearning and working from home have had a research intervention due to social isolation and the need for such application models in the context of the pandemic.

1. Introduction

Quantitative research methods are increasingly finding space in systematized online research. In the panorama of international quantitative methodological studies [1], a reflection on the main techniques and the analysis of emerging research tools is increasingly necessary. Of course, quantitative methods are shared among multiple disciplines and have different research questions, so to start a reflection it will be necessary to narrow the field of analysis. Therefore, the analysis of the cases studied in this contribution is limited to three specific areas: the educational sciences, the psychological and social factors of research in social media, and the evolution of agile work. The COVID-19 pandemic has exponentially increased research in these three areas, also supported by periods of social distancing. Not only have online data and research that allow the launch of evidence-based research increased, but so has the amount of available scientific literature collected in online databases, catalogs, resources, and online and open access journals.

The aim of this research is to investigate the tools and methods of quantitative research applied to educational studies, psychological studies, and work-organizational contexts. To maximize the fairness of assessment and learning processes in educational settings, it is necessary to focus on understanding programs, organizations, policies, and individuals from early childhood to adulthood [2]. Data analysis

and quantitative research methodologies are increasingly used to analyze the contexts of education. The analysis of psychosocial factors related, for example, to online stress is increasingly assuming an imposing dimension in quantitative studies and requires innovative tools for researching data and analyzing results.

Finally, the online dimension and social isolation have profoundly changed the organization and management of online work, the so-called smart working, so as to orient the analysis of data and of the factors emerging from the professional management (well-being, control) of analysis tools diversified in response to the present context.

Methodology

This study represents a scoping review because it allows us to examine the extent and scope of the research activity. The research question on which this work is based seeks to investigate the emerging trends of quantitative research methods in the three domains of training, social media (communicative and statistical aspects), and smart working. The scoping review model follows the five-step theorization of Arksey and O'Malley [3]. By searching for relevant empirical studies in databases such as Google Scholar and Scopus, we selected studies in harmony with the area circumscribed by the research question. Table 1 records the data and information of the included studies and finally summarizes the results in the following five areas of relevance.

a) Educational Phenomena in the Most Disparate Training Contexts (Formal and Informal)

The scope of learning analytics in the context of education becomes the development, selection, administration, analysis, reporting, and use of a variety of assessments in educational settings are all part of educational measurement and assessment. The following will be covered: evaluation design, item writing and task development, scoring, scaling, matching, standard-setting, item-response modeling, design and execution of validity studies, reliability, and the impact of measurement errors and biases.
Evaluation is a central practice in producing a "quality certification" that interests not only students and teachers but the whole system involved in the training. In the international scenario, since the 1990s, the need has emerged for the educational sector to make use of scientifically tested models to promote the continuous improvement of teaching practices [4]. In order for the evaluation to be objective and reliable, the statistical discipline is the adequate tool to give rigor and systematicity to the data synthesis. There is therefore a need to outline research models that follow evidence-based principles to build shared and reliable forms of knowledge on training processes [5]. Evidence-based education mediates the implementation of concrete tools and resources capable of producing an advancement in the quality of learning [6].
In education, statistics and psychometrics encompass a wide range of statistical methods, basic theories, and principles of statistical reasoning and research design: The management of real-context educational data concerns statistical methods such as multilevel modeling, longitudinal and structural equation data, and a variety of multivariate methods. This area includes modifying and developing research methods; testing the properties of statistical models; developing [7] and exploring methods for improving the teaching, learning, and evaluation of statistics; and acquiring practical and research experience in teaching statistics. These techniques help improve training and other psychometric factors involved in education [8].

b) Social or Psychological Dimensions (Commitment, Satisfaction, Stress, Perception, etc.) Based on Online Practices

The ability to conduct traditional quantitative social science research online allows for more efficient procedures and better data integrity in experiments and surveys, including in the educational sciences. These tools share many methodological concerns whether conducted online or offline.

Online data collection strategies are continuously expanding and increasingly used in the health sector [9]. Braun and colleagues [10] deconstructed preconceptions about the online qualitative survey by demonstrating that this method is flexible and beneficial for researchers and participants.

Data collection in social networking research has progressed to include online questionnaires, the extraction of digital metadata from websites, and the use of remote-sensing technologies [11]. Mechanized or automated data collection through the use of digital software, for example, can improve data integrity compared to manual collection, and data can be collected quickly and frequently at a low cost online. Furthermore, compared to offline administration, the administration of surveys and experiments mediated by technology can increase the flexibility of the project or allow greater adaptation in relation to the data emerging from the collection [12]. The use of the internet can therefore make it easier to reach and collect data from populations of interest for research activities [13].

Sumra and colleagues [14] examined the governance of information transmission, decision-making, and objectives in public institutions, health sector organizations, well-being, and research that have adopted artificial intelligence in the operationalization of data. They found process improvement and easier data management.

c) Dysfunctional or Unprecedented Behaviors Regarding New Work and Learning Practices That Are Completely Online

Based on scientific evidence in the literature, online teaching methods and e-learning have long been considered effective tools for students who may find online learning problematic due to the lack of relational interaction between peers and non-verbal communication. Other factors, such as interactions between students and professors, accessibility of material, and time management, can influence participants' attitudes toward online education. Dysfunctional behavior in general can lead to a lot of stress, anxiety, and depression. According to psychological analyses, fatigue and stress, particularly due to harassment, have been linked to extreme fear and fury. Bullying can also negatively impact mental health by causing shame, lower self-esteem, or humiliation [15]. On the other hand, in the workplace-company context, a favorable work environment encourages and inspires employees to improve their performance because they are happy with their work. High levels of employee engagement and dedication to their efforts arise when they believe their organization's environment is meaningful, psychologically safe, and useful and empowers them to openly express their views and share decisions.

In support of what was stated, students view e-learning favorably for the same reasons as employees view their workplace favorably; online, however, it would seem that in educational contexts it is more widespread for two reasons: 1) time factor to process the criticisms of the situations observed; 2) less developed empathy factor thanks to physical distance. The cross-sectional study by Elzainy and colleagues [16], which explores the advantages of e-learning, found high satisfaction with virtual classrooms, online assessment, and workshops. E-learning allows easy access to online learning resources and knowledge regardless of the geographic locations and schedules of teachers and students [17]. The working context, and not just the educational one, benefits from digital learning environments: From Beckett's [18] study, it emerges that the majority of nurses who participated in an online training course agreed that e-learning contributes to continuous professional development by being flexible, practical, and engaging.

d) Building or Adapting New Techniques to Analyze the Current Reality of Research

The emergence of "Big Data," or data driven by technology and characterized by a huge volume, rapid communication speed, and a surprising variety of types of information, has become a huge resource for research and characterization of learning analytics, providing a research opportunity in educational sciences [19]. As more people interact and help researchers in these contexts, Big Data repositories organically emerge from the massive number of people using a variety of websites,

participating in online surveys, and lending themselves to online teaching experiments (both as students and as teachers), web-based interactive applications, and social media technologies.

The methodology of scientific research today is challenged by the data science discipline, which involves the use of methods to analyze huge amounts of data to extract specific knowledge [20]. The advances made by scientific and technological research in the field of hardware and software have guaranteed satisfactory performance in terms of efficiency, speed of access to Big Data, and processing power and effectiveness.

Big Data can be used in many sectors, and e-learning is one of them. Whenever learners interact with the content of a course, they produce data. Today, we can track and collect these data not only through learning management systems (LMS), but also through social networks and any other media. Alongside the usual "end-of-course evaluation" by learners via satisfaction questionnaires, the need to acquire more detailed and organized information in real time on the various teaching evaluation areas is growing and becoming relevant. For example, visits to webpages constitute information bases for evaluating teaching [21].

Marketing and communication psychologists are increasingly able to use the digital and mobile communication traces that people leave behind, both intentionally (e.g., people contribute information for public consumption in the form of a status update on Instagram or a product review) and unknowingly. New communities comprising people in different geographic areas have formed and evolved thanks to the internet, allowing scientists of study their behaviors and dynamics.

e) Procedure for Applying Different Organizational Systems that Addresses the Opportunities and Risks of Online Work

The term "online work," brought into vogue during the pandemic in all public and private work organizations, refers to work that can be done from home rather than commuting to work, which became necessary during COVID-19 to continue work while in social isolation. Employers use online job management systems, internet-based scheduling systems, and systems that use the internet to manage their online workforce. Although remote working has been around for decades, the COVID-19 pandemic is fueling the demand for remote employees every day and has brought out the countless potentials and benefits of teleworking. Employers and employees benefit from an online job management system that helps both parties gain knowledge and plan workflows, and employers improve labor cost control and production efficiency [22].

Comparing online workers with those engaged in traditional-mode activities, causal evidence has emerged that the flexibility of smart working increases workers' productivity and improves their well-being and work-life balance [23]. Smart working must mean more than saving on housing costs or commuter fares: IT systems will enable people to realize their full creative potential to provide personalized goods and services to consumers, with whom they can engage in a co-creative partnership through networking. Collaborating with intelligent agents can help staff find greater meaning in their job roles by removing tedious and monotonous tasks and automating control systems. However, great attention is needed in (co)creating the organization of the future [24].

2. Discussion and Conclusions

Sampling and data integrity are two major methodological challenges with Big Data and learning analytics, just as in more traditional research venues using written sources. It may be difficult to apply social science sampling tactics and methods to Big Data, for this area, as demonstrated in this study, is rapidly developing. Because online behavioral or communication data can develop rapidly or change over time [25], establishing standardized and unique units of analysis can be difficult. Furthermore, some scholars have questioned which individuals or which population is represented by Big Data, arguing that the characteristics of these individuals are hard to understand, and the data are typically more limited in generalizability than the results suggest [26]; a greater understanding of the results and data obtained is needed in the future.

While adequate sampling within these large datasets is still a significant methodological challenge in real-life settings, researchers can now often conduct research on a census of behaviors or participants

rather than a sample of them thanks to online datasets. Indeed, it is currently routine practice to evaluate datasets with millions of observations [27]. Data integrity concerns with large datasets collected or observed online include variations of traditional threats to research validity (e.g., biases and effects of social desirability), such as opinions that could be amplified or masked by the relative anonymity of participants and the ability to distinguish ordinary human behaviors from those initiated by a computer [28].

When investigating educational issues related to online training, many huge datasets acquired from online sources describe people's daily activity in their online environment, increasing the ecological validity compared to laboratory experiments. However, the exploitation of internet user communication and behavioral traces raises some distinct ethical concerns [29]: Online interactions or communications are widely open, internet users may have different views on what constitutes a violation of privacy when their data are used for the study, and the use of informed consent follows different national regulations and depends on what kind of data is being collected. Finally, datasets derived from internet sources are sometimes much larger than those generally used by social scientists; sociological analyses may therefore need to adopt descriptive and inferential statistics, which they currently do not.

Communication psychologists also have a number of study options that are relatively unique in breadth and scale thanks to the research possibilities of modern technologies, especially the availability of Big Data. With the rise of Big Data, it is necessary to be able to understand and apply computational or IT methodologies to social data [30]. Communication scholars can contribute with the grammar of their disciplines, and their theoretical questions about what happens on social media and the degree of collaboration, sharing, and participation, as well as their techniques for understanding human interaction and association, increase the number of technical methods for studying communities and online interactions.

Modeling of online communication networks, for example, is a thriving and diverse field of study that allows both the prediction of online behavior and the understanding of the dissemination of information through online social networks. The researchers examined how information spreads across the strong and weak links of social networks, as well as the size and structure of online information cascades [31]. Of course, if you study the content of communication between nodes simply based on the structure of the links, the relationships suggested by these models of huge volumes of online communication could be substantially different (because it can also introduce a measurable psychological factor). Online social networking links between people constitute a reliable predictor of interaction [32]. The content of the communication between these links could help scholars understand not only when the network links represent interactions, but also what these interactions are like. In fact, one of the main disadvantages of the current Big Data craze is that it can sometimes distance scholars from the content of communication contained in most internet data, enriched by the theories of social sciences that inform on issues related to subjects' thinking and human behavior.

In general, quantitative data in both online and face-to-face versions reveal respondents' preferences. The online quantitative research methodology helps to obtain data efficiently, so there should be less chance of errors. Future research perspectives could be directed to improve quantitative techniques online. Large datasets that are currently attracting significant research interest through the convergence of disciplines spanning the fields of culture, computing, and communication present the opportunity to formulate theory-based research questions regarding the nature of online communication to help understand the main issues that emerged during the administration of online surveys during COVID-19.

2. References

[1] D. Review Wang, Y. Ueda, R. G. Kula, T. Ishio, K. Matsumoto, Can we benchmark Code Review studies? A systematic mapping study of methodology, dataset, and metric. Journal of Systems and Software (2021) 111009.
[2] M. K. Kaushik, D. Agrawal, Influence of technology readiness in adoption of e-learning. International Journal of Educational Management (2021).

[3]   H. Arksey, L. O'Malley, Scoping studies: towards a methodological framework. International journal of social research methodology 8(1) (2005) 19-32.

[4]   K. C. Li, B. T. M. Wong, B. Y. Wong, Enhancing Teaching of an Educational Institution via Building up Its Research Capacity. In Innovating Education in Technology-Supported Environments (pp. 333-343). Springer, Singapore, 2020.

[5]   A. Tolah, S. M. Furnell, M. Papadaki, An Empirical Analysis of the Information Security Culture Key Factors Framework. Computers & Security (2021) 102354.

[6]   F. Marsili, A. Morganti, G. Vivanet, New ground for research in special education: the overview of reviews. Italian Journal of Special Education for Inclusion (2020) 184-200.

[7]   A. Morganti, F. Bocci, F. (Eds.), Didattica inclusiva nella scuola primaria: educazione socio-emotiva e apprendimentio cooperativo per costruire competenze inclusive attraverso i" compiti di relatà". Giunti Edu, 2017.

[8]   M. Pellegrini, Verso una cultura dell'evidenza in educazione: il ruolo delle meta-analisi. Armando editore, 2021.

[9]   E. Kuhlmann, M. Falkenbach, K. Klasa, E. Pavolini, M. I. Ungureanu, Migrant carers in Europe in times of COVID-19: a call to action for European health workforce governance and a public health approach. European Journal of Public Health 30 (2020) iv22–iv27, https://doi.org/10.1093/eurpub/ckaa126

[10] V. Braun, V. Clarke, E. Boulton, L. Davey, C. McEvoy, The online survey as a qualitative research tool. International Journal of Social Research Methodology (2020) 1-14.

[11] P. Stys, S. Muhindo, S. N'simire, I. Tchumisi, P. Muzuri, B. Balume, J. Koskinen, Trust, quality, and the network collection experience: A tale of two studies on the democratic republic of the congo. Social Networks 68 (2022) 237-255. doi:10.1016/j.socnet.2021.08.002

[12] F. Kitsios, M. Kamariotou, P. Karanikolas, E. Grigoroudis, Digital Marketing Platforms and Customer Satisfaction: Identifying eWOM Using Big Data and Text Mining. Appl. Sci. 11 (2021) 8032. https://doi.org/10.3390/app11178032

[13] P. M. Bednar, C. Welch, Socio-technical perspectives on smart working: Creating meaningful and sustainable systems. Information Systems Frontiers 22(2) (2020) 281-298.

[14] K. B. Sumra, M. Alam, R. Aftab, Artificial intelligence for strengthening administrative and support services in public sector amid COVID-19: Challenges and opportunities in Pakistan. Springer, 2022 doi:10.1007/978-3-030-77302-1_9

[15] P. Salvador, K. Alves, C. Rodrigues, L. Oliveira, Online data collection strategies used in qualitative research of the health field: a scoping review. Revista gaucha de enfermagem 41 (2020) e20190297. https://doi.org/10.1590/1983-1447.2020.20190297

[16] A. Elzainy, A. El Sadik, W. Al Abdulmonem, Experience of e-learning and online assessment during the COVID-19 pandemic at the College of Medicine, Qassim University. Journal of Taibah University Medical Sciences 15(6) (2020) 456–462. https://doi.org/10.1016/j.jtumed.2020.09.005

[17] K. Regmi, L. Jones, A systematic review of the factors - enablers and barriers - affecting e-learning in health sciences education. BMC medical education 20(1) (2020) 91. https://doi.org/10.1186/s12909-020-02007-6

[18] H. Beckett Effect of e-learning on nurses' continuing professional development. Nursing management 27(2) (2020) 16–22. https://doi.org/10.7748/nm.2020.e1899

[19] M. Baldassarre, Informazione, Conoscenza, Didattica. La sfida dei big data al mondo della formazione Informazione, Conoscenza, Didattica. Pedagogia oggi 2016 (2016) 90-112.

[20] M. Giacalone, S. Scippacercola, Il ruolo dei Big Data nelle strategie di apprendimento. In Atti Conferenza Didamatica, AICA ed, 2016, (pp. 1-10).

[21] M. Angelici, P. Profeta, Smart-working: work flexibility without constraints. CESifo Working Paper No. 8165 (2020).

[22] L. A. Bragg, C. Walsh, M. Heyeres, Successful design and delivery of online professional development for teachers: A systematic review of the literature. Computers & Education 166 (2021) 104158.

[23] J. R. Evans, A. Mathur, The value of online surveys: A look back and a look ahead. Internet Research (2018).

[24] R. Herkanaidu, S. M. Furnell, M. Papadaki, Towards a cross-cultural education framework for online safety awareness. Information & Computer Security (2021).

[25] K. A. Jeffery, C. F. Bauer, Students' Responses to Emergency Remote Online Teaching Reveal Critical Factors for All Teaching. Journal of Chemical Education 97(9) (2020) 2472–2485.

[26] M. K. Kaushik, D. Verma, Determinants of digital learning acceptance behavior. Journal of Applied Research in Higher Education 12(4) (2020) 659–672.

[27] S. Kurten, N. Brimmel, K. Klein, K. Hutter, Nature and Extent of Quantitative Research in Social Work Journals: A Systematic Review from 2016 to 2020. The British Journal of Social Work (2021).

[28] R. I. Williams, L. A. Clark, Clark, D. M. Raffo, Re-examining systematic literature review in management research: Additional benefits and execution protocols. European Management Journal (2020).

[29] M. Lu, T. Cui, Z. Huang, H. Zhao, T. Li, K. Wang, A Systematic Review of Questionnaire-Based Quantitative Research on MOOCs. The International Review of Research in Open and Distributed Learning 22(2) (2021) 285–313.

[30] F. Martin, T. Sun, C. D. Westine, A systematic review of research on online teaching and learning from 2009 to 2018. Computers & Education 159 (2020) 104009.

[31] N. Matović, K. Ovesni, Interaction of quantitative and qualitative methodology in mixed methods research: integration and/or combination. International Journal of Social Research Methodology (2021) 1–14.

[32] L. Parks-Leduc, L. Mulligan, M. Rutherford, Can Ethics Be Taught? Examining the Impact of Distributed Ethical Training and Individual Characteristics on Ethical Decision-Making. Academy of Management Learning & Education 20 (2021) 30–49.

[33] J. P. Salameh, P. M. Bossuyt, T. A. McGrath, B. D. Thombs, C. J. Hyde, P. Macaskill, … P. Whiting, Preferred reporting items for systematic review and meta-analysis of diagnostic test accuracy studies (PRISMA-DTA): explanation, elaboration, and checklist. Bmj 370 (2020).