Impact of Health Crisis on the Evolution of the Use of Scientific Knowledge Sharing Tools by Academics: A Comparative Study Within the Faculty of Sciences of Tunis

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ABSTRACT

Intensively sharing knowledge ensures the quality of research, high-level teaching, and development of partnership opportunities. Sharing scientific knowledge using innovative technologies such as Information and Communication Technologies for Education (ICTE) seems to be, to date, differently applied by research teachers. Recently, the United Nations site in the Global Sustainable Development Report (GSDR) 2023, reported the mention of focusing on the quality of education cited by "Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all." In this context, the present study aims to analyze the degree of involvement and the skills acquired in the field of Information and Communication Technologies and distance education (DE) of research teachers from two departments of biology and chemistry at the Faculty of Sciences of Tunis (FST) before and after the COVID-19 health crisis. Obtained results showed that the health crisis has a positive impact on the use of sharing tools through ICTE and has promoted the shift from traditional to innovative methods in the delivery of education and training activities to innovative methods of education 4.0. Similarly, these results revealed the extent of the evolution in the participation of research teachers in virtual scientific communities after the COVID-19 crisis, such as "professional social networks" (Academia.edu, LinkedIn.com, and ResearchGate). An evolution and improvement in the use of "bibliometric databases and citations of scientific publications" like "SCOPUS, Researcher ID, and Web of Science" were also revealed, confirming the positive impact of the COVID-19 health crisis on digital practices and the use of ICTE in the performance of teaching activities, and in the production of scientific articles. Altogether, these results suggest that institutions and universities must work to build a culture of digital, sustainable, and dynamic learning.

Keywords: Global Sustainable Development**,** Quality education**,** Communication tools**,** Dynamic Learning

INTRODUCTION

In the current era, the notion of education 4.0 is based on a concept of learning through practice, in which learners are asked to learn and discover different concepts originally, based on experimentation to build knowledge collaboratively. Active methodologies are deeply exploited in Education 4.0, namely, learning by project, by

problems, by collaboration, by the inverted, mixed class, by simulation, by creativity, or by digital games (Silva et al., 2021). All of these methods of pedagogical innovation use information and communication technologies for education (ICTE) as a basis through the Internet (Wannapiroon and Pimdee, 2022). Universities and their institutions must work to build a culture of digital, sustainable, and dynamic learning for all learners (Ghavifekrand and Seng, 2022). Nevertheless, the gap between the skills of university/teacher tutors and the ICTE skills required to meet the needs of a 4.0 education remains large. Assessing the use of scientific knowledge sharing tools among academics is a critical step in addressing this issue. In this context, the objective of our contribution is to analyze the impact of the COVID-19 pandemic crisis on the evolution of the use of ICTE and scientific knowledge-sharing tools among university teachers at the FST. To do this, we opted for a comparative study between the degree of involvement and the skills acquired in the field of ICTE and distance education (DE) research teachers from the two departments of biology and chemistry before and after the COVID-19 health crisis.

The present study conducted among FST researcher teachers has targeted two departments of the FST among its six departments, namely the departments of biology and chemistry. FST created on March 31, 1960, by Decree No. 98, is the first core of scientific higher education in Republic of Tunisia after independence in 1956. It is a public institution of a civilian character, independent and endowed with civil competence and higher education. Since its creation, FST has been assigned the mission to train its students for the obtaining of licenses in various scientific disciplines (Mathematics, Physics, Chemistry, and Natural Sciences). The training offered by FST is renowned for its multidisciplinary approach and diversity. It awards degrees in bachelor's, master's (research and professional), and engineering (analytical chemistry, electronics, geology, and computer science). It also offers two types of preparatory courses: scientific preparatory courses for the competitive National engineering school admission process in Biology-Geology, Maths-Physics and Physics-Chemistry, and an integrated preparatory program (MPI) for access to FST engineering degrees in Data Science and Electronics. FST has two doctoral schools, one in Chemistry, Computer Science, Electronics and Physics, the other in Geology and Biological Sciences.

The organizational structure of the faculty includes central administration and six departments of scientific research and training, respectively concerned with mathematics, physics, chemistry, information, biology, and geology. The faculty consists of around 5,000 students and 1,000 PhD students. It is also a place dedicated to scientific research. To date, human resources in terms of teaching and research staff are currently around 465, with a respected gender ratio distributed by grade as follows: 200 full professors, 231 assistant's professors and 5 senior assistant.

The FST is distinguished by its high scientific production: contribution of 4805 publications, which represent 30% of the 14171 publications of the UTM published between 2018 and 2023 (Source: Scopus, 2023). This research activity materialized by the work of the 47 research structures of the faculty and the networking of its researchers, who contribute within the framework of active research units and laboratories, to its international reputation and influence. The departments participate in international scientific research projects, notably European projects, and to a lesser extent, those of the American continent (Canada, USA). There are numerous scientific days, symposia, and seminars, as well as a wide range of academic associations. The FST is also a place of conviviality and openness, notably through exchanges and events aimed at developing links with the economic sector to strengthen its attractiveness and visibility.

METHODOLOGY

Target audience

To conduct this study and provide responses to the research objectives, we have carried out two questionnaire surveys. The first investigation was carried out in 2019 as part of a research master's degree in information and document sciences (Ghaffari, 2019), and the second in 2023. Teacher-researchers represent the target audience from the two departments of biological sciences and chemistry of the FST. This choice aims to establish a comparative study of research teachers' practices concerning the use of pedagogical innovation methods and knowledge sharing tools.

In accordance with the deontology and ethics of scientific research, we have obtained the agreement of the Dean of the FST before starting the study, emphasizing that we have followed the scientific method in data collection, dissemination, and analysis. By describing the objectives of the study and assuring the confidentiality of responses and that, the study will be used for scientific research purposes exclusively.

Conduct of the investigation

We have adopted a quantitative methodology based on scientific questionnaire survey techniques developed on "Google Forms." The questionnaire essentially included analysis of respondent profiles, knowledge sharing in the field of education and scientific research, distance education, and communication tools used [distance learning platforms (Moodle, Canvas, Genially, Google Classroom, and Microsoft Teams) and communication and discussion tools (Google Zoom)] for group video conferences or remote meetings.

The survey was posted on the "Google Forms" online survey platform. A database containing the e-mail addresses (mailing list) of teacher-researchers affiliated with the two target departments was created to receive responses from all participants.

Data analysis

Following data collection, a quantitative analysis of statistics was conducted using the SPSS software "Statistical Package for Social Sciences Version 23" to compare the results of the two surveys conducted before and after the COVID-19 health crisis in 2019, and 2023, respectively. The comparison was based on a descriptive analysis of figures, frequencies, and percentages.

OUTCOMES

Analysis of profiles

The results of the faculty permanent teachers' responses to the recent survey conducted in 2023 were compared with those of the 2019 survey to study the degree of change in the use of communication and knowledge-sharing tools and new teaching, and education 4.0 methods using e-learning educational platforms before and after the COVID-19 pandemic.

A response rate of 21.5% was noted against 40% in 2019. Respondents are divided as follows: breakdown by department and by seniority of respondents in higher education.

The results in figure 1 show that the number of biology teachers' researchers who completed the questionnaire is 50% before COVID-19 and 55% after COVID-19, while the contribution of chemists doubled after the COVID-19 crisis (20.4% before and 41.78% after the COVID-19 crisis).

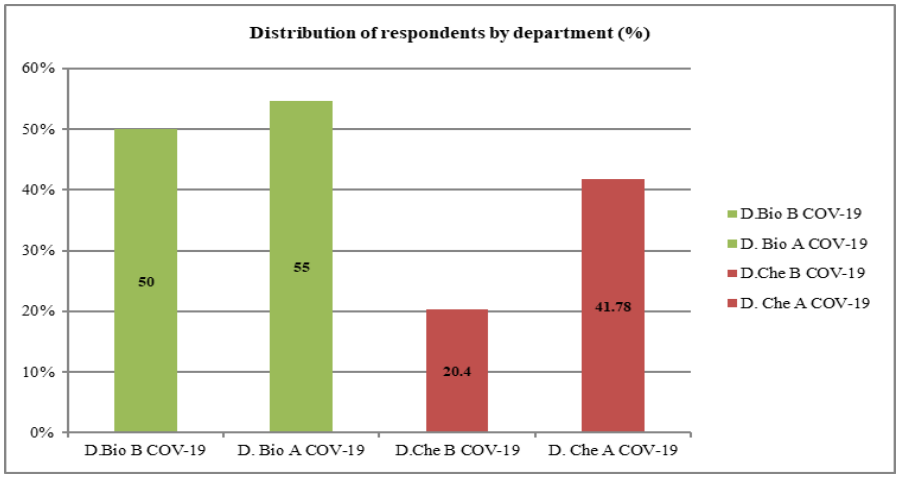


Figure 1: Distribution of respondents by department. D. Bio: department of biology; D.che: department of chemistry; B: before; A: after; COV-19: Covid-19.

Respondents are divided into two categories according to their seniority in the higher education function: those who have completed half of their career, as represented in figure 2, from 1 to 20 years represent 57.7% and 55.14% before and after COVID-19 and those with more than 20 years in total represent 42.6% and 51.61% before and after COVID-19 respectively.

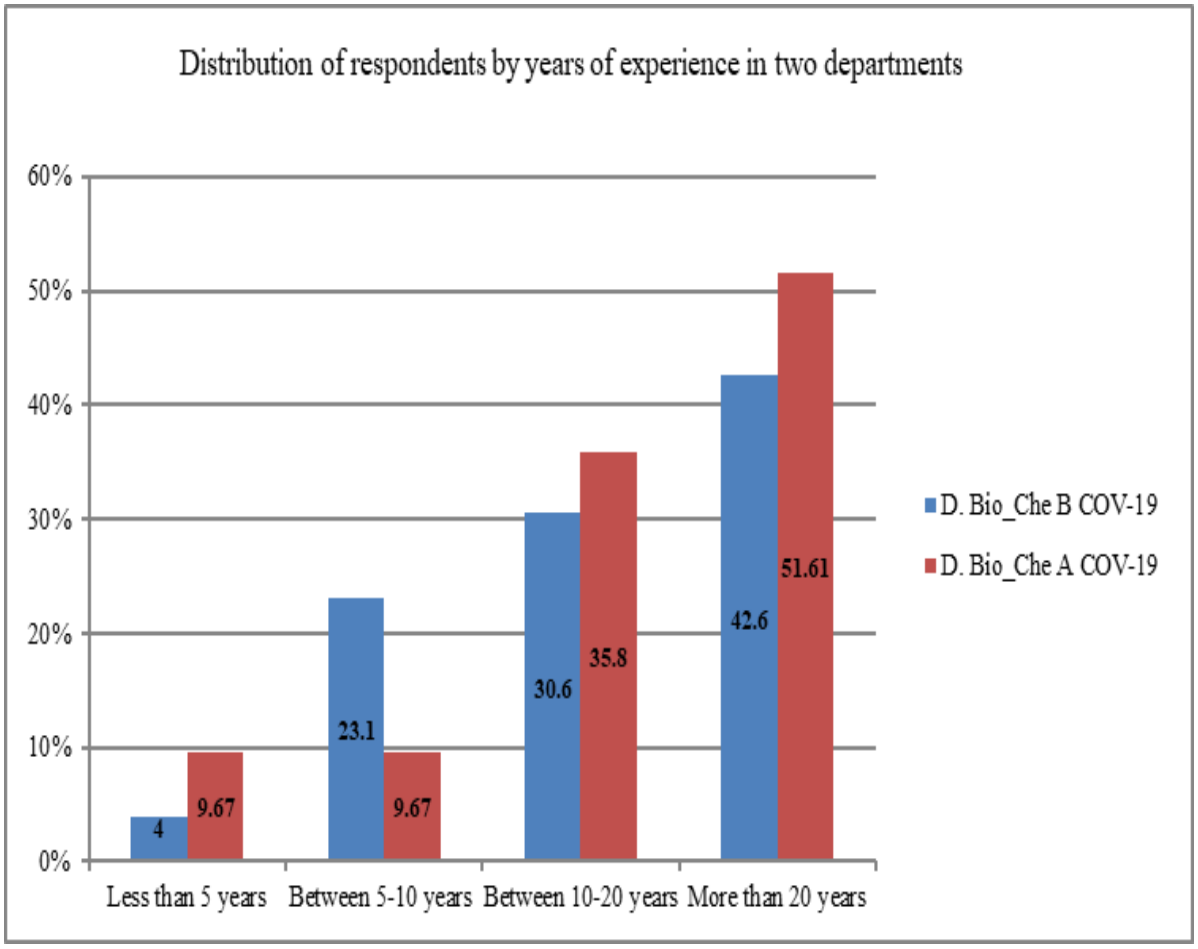
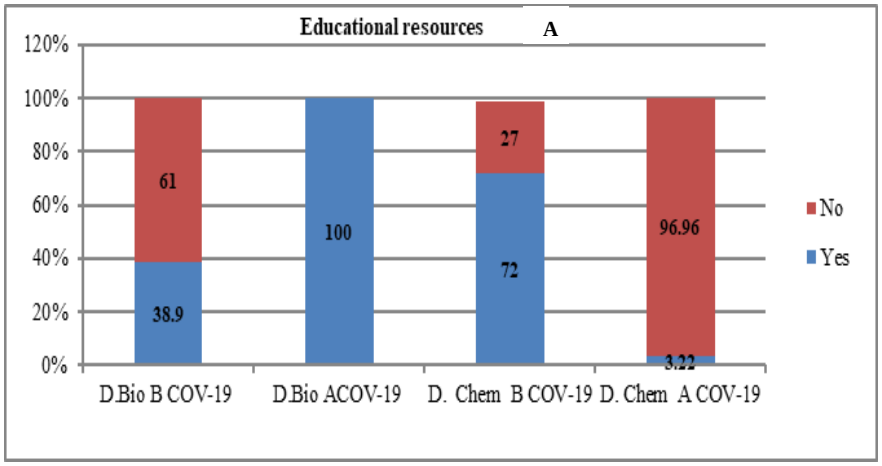


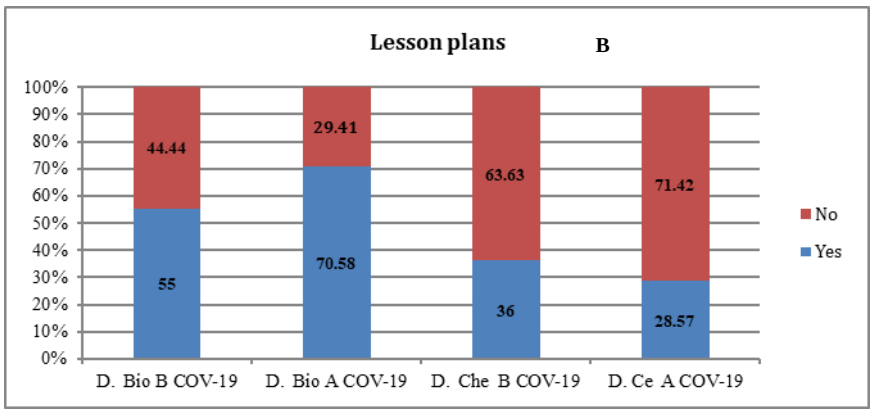
Figure 2: Distribution of respondents by years of experience in two departments. D. Bio: department of biology; D.che: department of chemistry; B: before; A: after; COV-19: Covid-19.

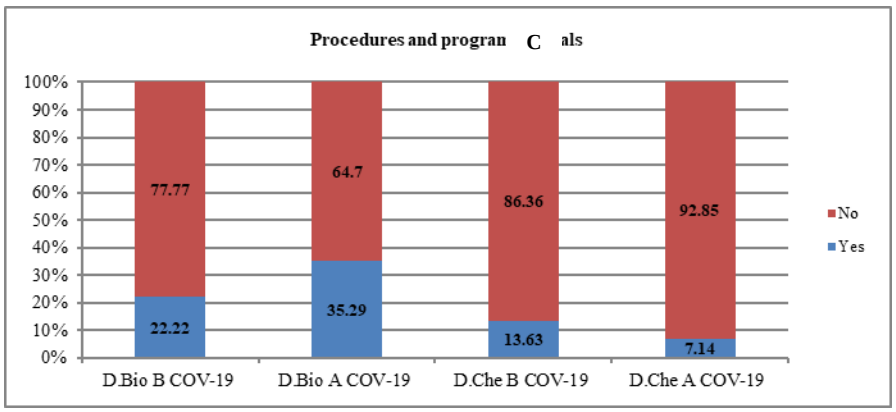
Sharing knowledge in the teaching activity

The results of the question asked of the interviewees, "During your teaching activities, what types of materials or knowledge are most shared?" The level of use of the most shared materials or knowledge by research teachers in the execution of their teaching activities before and after the COVID-19 crisis is discussed in figure 3.

As shown in figure 3, the resources most used by teacher-researchers in the two departments involved in knowledge sharing are diversified according to the types of knowledge relevant to the education sector. At the level of the Department of Biology, the evolution of the use of "educational resources," as shown in figure 3A (paper and/or audiovisual media (video capsules, etc..) reached its peak after the COVID-19 crisis (100%); on the contrary, the use of "educational resources" in the chemistry department fell 72% before compared to only 3.22% after the COVID-19 crisis. Similarly, a change in the use of "lesson plans" by biologists is recorded (70.58%) after vs. 55% before COVID-19 as mentioned in figure 3B. On the other hand, a low rate of "lesson plan" sharing is remarkable among chemists 36% before COVID-19 vs. 28.57% after COVID-19. Nevertheless, a decline in the sharing of "teaching and pedagogical activities as presented in figure 3C and the use of "procedures and program manuals," as shown in figure 3D among post-COVID-19 chemists was noted (92.85% vs. 86.36% and 7.14% vs. 13.36% respectively).







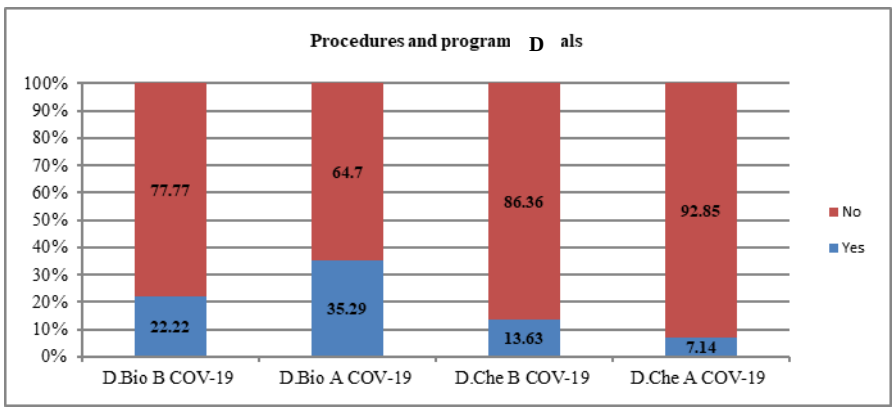


Figure 3: Knowledge sharing the teaching activity via: **A**: Educational resources; **B**: Lesson plans; **C**: Teaching and pedagogical activities; **D**: Procedures and program manuals**.** Types of documents/knowledge shared by

teachers in both departments. Bio: department of biology; D.che: department of chemistry; B: before; A: after; COV-19: Covid-19.

Use of distance learning and virtual communication tools

The study of the impact of the COVID-19 crisis on the evolution of the use of scientific knowledge sharing tools and ICTE was also conducted. In this pre- and post-COVID-19 benchmarking, the results presented in figures 4, 5, 6, and 7 shows the extent of the use of "virtual" communication tools (e-mail, common agenda, websites, distance-learning platforms) in the application of scientific knowledge sharing activities and distance learning. The results presented in figure 4 show that research teachers in the two departments considered the use of e-mails strongly after COVID-19 100% vs. 63.6% for chemists and 94.11% vs. 53.7% for biologists.

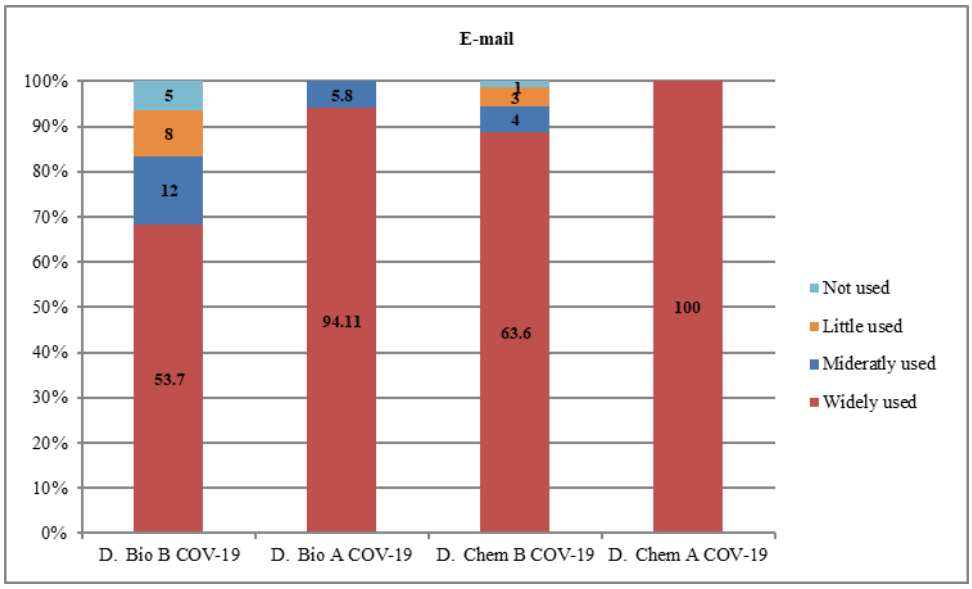


Figure 4: Assessing the use of E-mail in the two departments before and after Covid-19. D. Bio: department of biology; D.che: department of chemistry; B: before; A: after; COV-19: Covid-19

According to figure 5, a net change in the use of the "common agenda" was also noted for biologists and chemists, with 58.82% after vs. 7.4% before COVID-19 among biologists and 35.71% after vs. 4.5% before the pandemic among chemists.

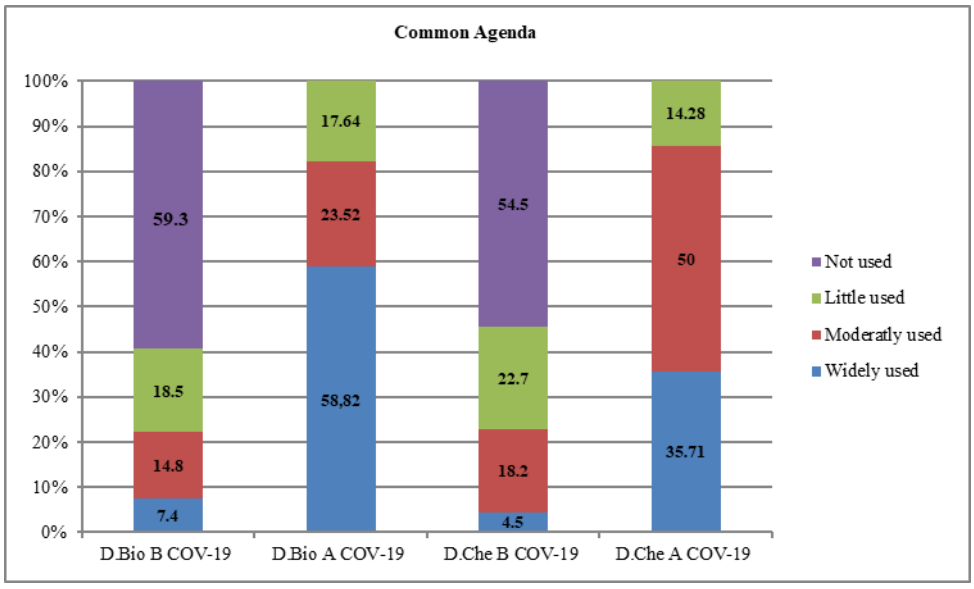


Figure 5: Assessing the use of common Agenda in the two departments before and after Covid-19. D. Bio: department of biology; D.che: department of chemistry; B: before; A: after; COV-19: Covid-19.

Similarly, the rate of "consultation of websites" such as Ministry of Higher Education (MHE), World Health Organization (WHO), the University of Tunis El Manar (UTM), Virtual University of Tunisia (VUT), the sites of Tunisian educational institutions, UNCSD National Centre for Scientific and Technical Documentation, and International Scientific Publishers' Websites (ELSEVIER, Springer, Clarivate Analytics) to access electronic resources has evolved significantly since the COVID-19 health crisis, as mentioned in figure 6: 82.35% after COVID-19 vs. 11.10% before the crisis in biologists and 64.70% after COVID-19 vs. only 18.2% in chemists.

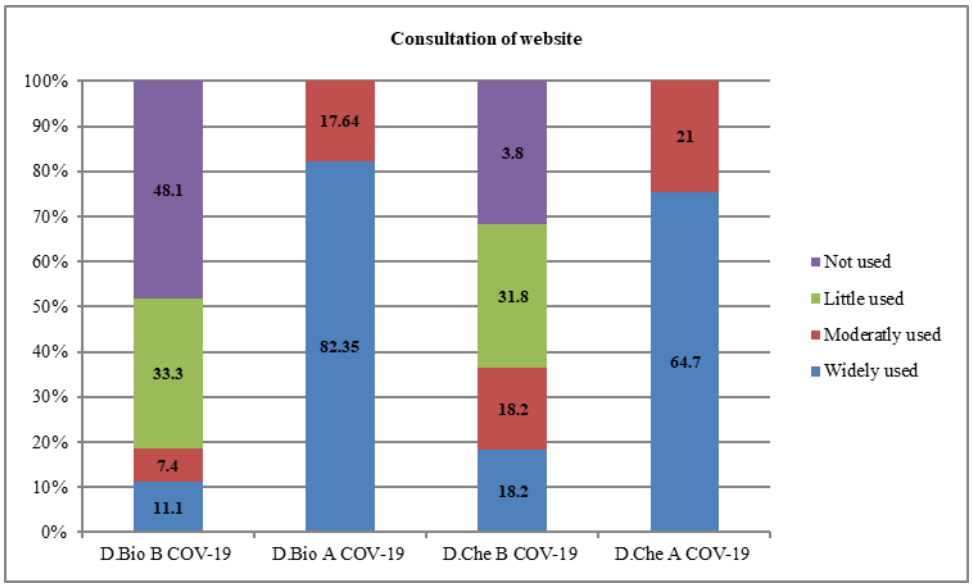


Figure 6: Assessing the consultation of website before and after covid-19 in the two departments. D. Bio: department of biology; D.che: department of chemistry; B: before; A: after; COV-19: Covid-19.

The use of distance learning platforms such as Moodle, Canvas, Genially, Google Classroom, Microsoft Teams, communication and discussion tools (Google Meet and Zoom) for group video conferences or meetings and applications of collaborative work as e-groups, Dropbox, Google Drive , as shown in figure 7, has evolved remarkably by chemists and biologists following the COVID-19 pandemic: 88.23% after COVID vs. 20.4% before and 71.42% after vs. only 9.1% before the pandemic in biologists and chemists.

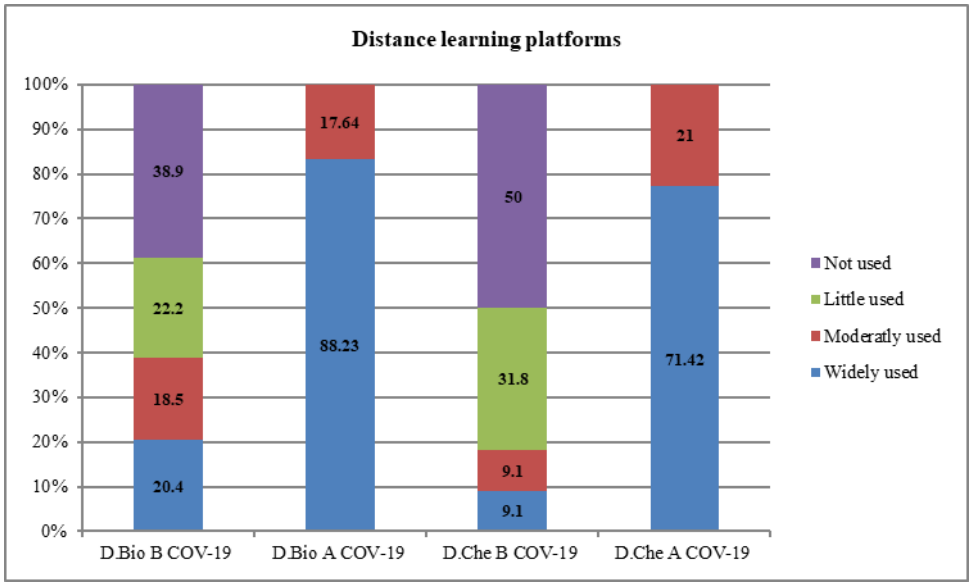


Figure 7: Assessing the use of distance learning platforms in the two departments before and after Covid-19 crises. D. Bio: department of biology; D.che: department of chemistry; B: before; A: after; COV-19: Covid-1

Virtual Scientific Community

Teachers and researchers build theoretical or professional knowledge, share scientific knowledge, and have regular exchanges around a common interest (exchange of information, discussion, sharing), ensuring the proper functioning of the community, (Menvielle et al. 2018; De Valck et al., 2009) through a collaborative tools and applications that rely on a specific technological infrastructure as described by Porter (2004).

In our survey, teacher-researchers from the two departments of biology and chemistry before and after the pandemic were interviewed about their membership in virtual scientific communities such as 'professional social networks' (Academia.edu, LinkedIn.com, and ResearchGate).

The data presented in figure 8 shows the rates of enrollment of research teachers in professional social networks such as LinkedIn.com and ResearchGate.net after COVID-19: 88.23% vs. 9.3% among biologists and 78.57% vs. 13.6% among chemists before the crisis and 88.23% after the crisis in biologists and 94.11% of biologists adhere to ResearchGate after COVID-19 vs. 14.80%, and 92.28% of chemists adhere to it after vs. 13.6% before COVID-19.

In addition, the professors-researchers of both departments never joined the professional social network Academia.edu before COVID-19 and the enrollment rate of biologists and chemists after it changed to about 50%.

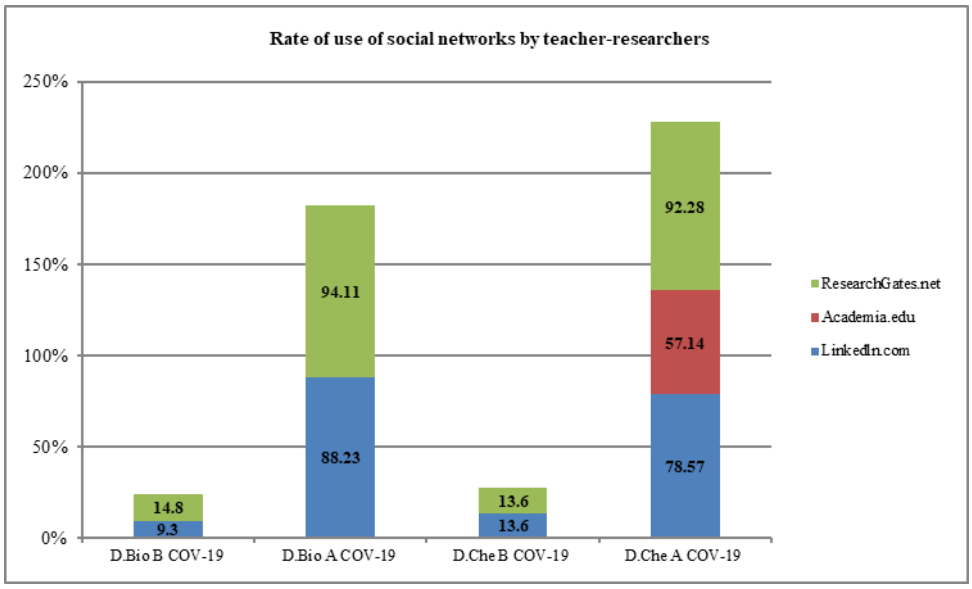


Figure 8: Rate of use of social networks by research-teachers in the two. Bio: department of biology; D.che: department of chemistry; B: before; A: after; COV-19: Covid-19.

Use of bibliometric databases and citations of scientific publications

Based on the results of the analysis obtained in figure 9, we find that research teachers have been active in using "bibliometric

databases" and in creating "researcher profile accounts" in "ResearcherID" at Clarivate Analytics, in SCOPUS of the ELSEVIER editor, and in "Google Scholar Citation." Before COVID-19, teachers did not use science networks to the same extent as after COVID-19; the gap is representative of before and after the pandemic of using these sources of scientific publication citations. 100% of chemists use SCOPUS after COVID-19 and about 31.80% before it, and the percentage of biologists who used SCOPUS was 82.53% after COVID-19 compared to pre-pandemic, which was 44.40%, which is higher. 92.85% of biologists use ResearcherID after COVID-19, and about 71.14% of chemists use it. Biology and chemistry, respectively, used ResearchID less before COVID-19 (31.5% and 45.5%). Similarly, a remarkable gap is noted before and after COVID-19 compared to the

adherence of biologists and chemists to Google Scholar. Quote, 100% of chemists adhere to it after COVID-19 vs. 18.20% before COVID-19 and 88.3% of post-COVID-19 biologists vs. 14.8% before the crisis.

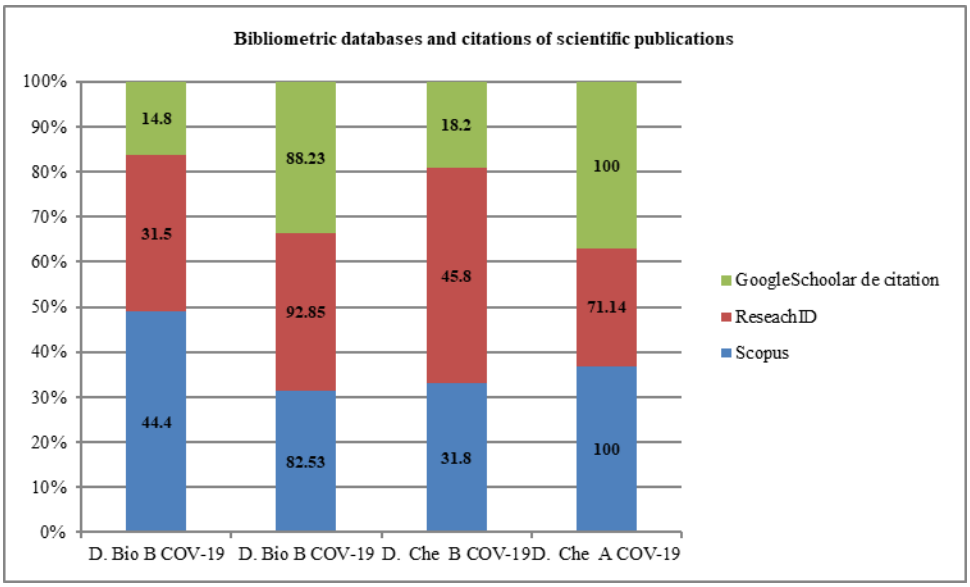


Figure 9. Teachers in both departments consult Bibliometric databases and citations of scientific publications. D. Bio: department of biology; D.che: department of chemistry; B: before; A: after; COV-19: Covid-19.

DISCUSSION

Universities and their institutions must work to build a culture of digital learning, to bridge the gap between the skills of teacher tutors and the ICTE skills required to meet the needs of Education 4.0. In fact, There is a growing recognition that digital learning can contribute to equal opportunities and overcome social and territorial inequalities in education (Khemakhem, 2025). Assessment of the use of scientific knowledge-sharing tools by academics is an essential step in overcoming this problem. In this context, the aim of our work is to analyze the impact of the COVID-19 pandemic crisis on the evolution of the use of ICTE and scientific knowledge-sharing tools among university teachers at the FST. To achieve this goal, we have opted for a comparative study between the level of involvement and the skills acquired in the field of ICTE and distance learning of research teachers from two FST departments of biology and chemistry before and after the COVID-19 health crisis.

The survey conducted in 2023 covered all teachers working in the two departments of biology and chemistry. The response rate was 21.5%, compared with 40% in 2019. Respondents were divided into 2 categories (one from 5 to 20 years of seniority and another over 20 years) from the two departments considered by this study. The second category of teachers seems to be more adapted and ready to change teaching and pedagogical innovation methods even though they are less aware of the evolution of educational technologies and the use of communication and sharing of scientific knowledge compared to the first category.

The results revealed that the resources most frequently used by research teachers in the two departments concerned when sharing knowledge are diversified according to types of knowledge related to the education field. In the Department of Biology, the results showed an evolution in the use of teaching resources, i.e., hard copy and/or audiovisual media (video capsule, etc.), while in the Chemistry Department, the use of "teaching resources" decreased following the COVID-19 pandemic.

Likewise, an evolution in the use of "lesson plans/syllabus" by teachers in the biology department was observed after COVID-19. However, a low rate of "lesson plan" sharing is noted among chemists. Furthermore, an evolution in the sharing of knowledge during teaching and pedagogical activities (series of exercises, case studies, TD, TP, etc.), as well as the use of "procedure and program manuals" was revealed among biologists after Covid-19. Nevertheless, a regression in the sharing of "teaching and pedagogical activities" and the use of "procedural and program manuals" after COVID-19 was noted by teachers in the chemistry department. These results suggest that further investigations should be carried out to further elucidate the factors hindering the

practice of knowledge sharing through exchange tools and ICTE, using an improved detailed questionnaire and applying other qualitative analysis tools such as "Sphinx" software.

It is also important to encourage teacher-researchers in both departments to strengthen their skills (i.e., planning training as organized by the UTM during the COVID-19 period) for better use of distance learning and ICTE platforms to best ensure educational innovation for education 4.0.

In this context, the university/institution should provide the technical and organizational resources required: connection to the Internet network with high speed, access to distance learning educational platforms such as the Virtual University of Tunisia (VUT) platform, organization of training and sharing of tutor materials, and access to digital documentary resources (e-books, electronic journals, bibliographic databases, and citations of scientific publications, e.g., Web of Science and Scopus) to better support teachers, ensure pedagogical innovation and counter . the resistance to technology which has been found to be a prominent reason for most system failures (Hamlaoui, 2021). In fact; tunisian teachers are more likely to be influenced through simple communication strategies, or orders from the top through formal channels and instructions and/or via simple emails or intranet. Thus, senior management should engage the staff, who are mostly relied on to implement their initiatives, by acknowledging that the drivers for the e-learning process are significantly different from the institutional pressures on them. It was also reported that the adoption of digital technologies by teachers in Tunisia's higher education sector is often andicaped by many factors and/or barriers including cybersecurity threat, costly, skills gaps in human capital, apprehensive stakeholders, lack of training resources, lack of collaboration, knowledge gap for the customization of curriculum design, complexity of learning platforms, and insufficient foundation of basic education (Costen, 2021).

The study of the impact of the COVID-19 crisis on the evolution of the use of scientific knowledge-sharing tools and ICTE was also conducted. In this pre- and post-COVID-19 benchmarking, the results showed the extent of the use of “virtual” communication tools (email, common agenda, websites, distance learning platforms) in the application of scientific knowledge-sharing activities and distance learning education. This evolution could be explained by the pressure on research teachers to initiate themselves into new teaching tools using digital technology and the consultation of websites. This could confirm the positive impact of the health crisis on the use of e-mail by research teachers in the two departments studied.

Similarly, the rate of consultation of websites Tunisian Ministry of Higher Education (TMHE), World Health Organization (WHO), University of Tunis El Manar (UTM), Virtual University of Tunisia (VUT) sites of Tunisian educational institutions, University National Center of Scientific and Technical Documentation (UNCSTD), websites of international scientific publishers (ELSEVIER, Springer, Clarivate Analytics) to access electronic resources from biologists and chemists has evolved significantly during the lockdown period due to the COVID-19 health crisis when they were forced to design and file their courses, TD, video clips, namely in the VUT course spaces and to consult the other sites mentioned to create, share and disseminate scientific knowledge within the academic and scientific community. In short, all these results confirm the positive impact of the COVID-19 health crisis on the use of ICTE sharing and communication tools.

It is clear that the COVID-19 crisis has been able to create opportunities to strengthen the means of communication, the use of virtual communication, exchange, sharing tools, and distance learning education tools via the acceleration of transformations, innovations, and new ways of working during the crisis highlight the main organizational changes in the world, as shown by (Frimousse and Peretti, 2020) in distance education and training activities with some of the learners physically present in classrooms and others connected remotely via distance learning tools and platforms. Consequently, academics are obliged to modulate their practices; this suggests a real break with the traditional organizational model towards the innovative methods of education 4.0. According to the Director of Corporate Development and Tailored Programs, ESSEC Business School, Executive Education Cécile Arragon in 2020, the COVID-19 crisis is an accelerator of transformations that were «in seed before the crisis will structure the new normality of our activity of accompanying the scientific and university community in the activities of teaching and scientific research.»

In our survey, we also surveyed research teachers in both biology and chemistry departments before and after COVID-19 about their memberships in virtual scientific communities such as 'professional social networks.' (Academia.edu, LinkedIn.com, and ResearchGate). Based on the results obtained, a change in membership in these communities was noted after COVID-19 crisis.

Accordingly, the results of the survey on the use of bibliometric databases and citations from scientific publications "SCOPUS, Researcher ID, and Web of Science" confirm the major positive impact of the COVID-19 health crisis on digital practices and the use of ICTE by research teachers in the performance of production activities and the publication of scientific articles in scientific research. Indeed, during the lockdown period, FST research teachers have not ceased to create knowledge, produce, and publish their research results.

They benefited from the modalities of access to remote electronic resources via servers and a virtual private network (VPN). VPN was provided by the MHE and Research through the University National Center for Scientific and Technical Documentation (UNCSTD) in collaboration with the UTM. They worked remotely using electronic resources such as electronic journals and bibliographic and bibliometric databases such as SCOPUS from the publisher Elsevier and Research ID Web of Science from Clarivate Analytics and Google Scholar Citation.

CONCLUSION

It is clear that the Covid-19 crisis has created opportunities to strengthen communication vectors, and the use of virtual communication, exchange/sharing tools and EAD tools via the acceleration of transformations, innovations and new ways of working during the crisis. This highlight the main organizational changes in the world (Frimousse, 2020), in teaching and distance learning activities, with some learners physically present in classrooms and others connected remotely via distance learning tools and platforms. There is continuous groundwork on the 2030 Agenda about the Sustainable Development Goals (SDGs).

The present study should be extended to all academic human resources of the FST and UTM researchers to improve the strategic direction in using the ICTE to align them with the internal quality assurance guidelines and promote the visibility of it to recognize the power of science to understand and navigate relationships among social, environmental and economic development objectives. This aim may be reached since the Tunisian government has recently supported this shift by bolstering universities' technological infrastructure and providing students with free access to Moodle platforms. Thus, in the long term, the pandemic is expected to continue shaping teaching methods, making distance learning an enduring feature of the educational landscape in Tunisia (Khemakhem, 2025).

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