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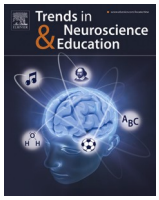

YouTube as a complementary learning tool in times of COVID-19: Self-reports from sports science students

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ABSTRACT

Objectives: This study reports on sports science students' educational experience in times of the COVID-19 pandemic and explores their interactions with online technologies, exclusively for learning purposes.
Methods: A total of 181 Tunisian final-year sports science students were surveyed using, a custom-designed questionnaire, following the end of the academic year 2020/2021. Semi-structured interviews were conducted for triangulation and validation of the findings.
Findings: Participants reported that COVID-19-induced educational disruptions had detrimental effects on their learning experiences. Even though they deemed emergency remote teaching to be less effective than classroom-based teaching, participants recognized the role technology had played in mitigating the impact of the pandemic on their graduation year. They reported using a wide range of online technologies to complement remote curriculum delivery. Ranking second after Google Meet, with a marked difference from the rest of the list, YouTube seemed to be sports science students' best "learning companion" in times of COVID-19. YouTube helped them better understand instructional content delivered remotely and compensate for the missed opportunities for knowledge and motor skill acquisition.
Conclusions: It is very likely that curriculum-based YouTube videos can smoothen emergency implementation of flipped classrooms during future crises that may force teachers and students into home confinement once again, but further empirical research is needed in this area.

1. Introduction

The SARS-COV-2 virus first broke out in the Chinese city of Wuhan in December 2019 and, later, its massive spread triggered the COVID-19 global pandemic [1]. In response to the urgent crisis, most countries announced the imposition of strict measures to contain the spread of infection [1]. Education was one of many sectors that were severely impacted by the government-imposed measures [2]. By April 2020, 91% of students worldwide were forced into quarantine as COVID-19 took hold, causing temporary closure of schools and universities [3].

Exposed to an unprecedented scene of events upon the COVID-19 breakout, researchers in the field of education found themselves with a scarce literature addressing educational challenges in pandemic times. Urgently, several research projects were designed and conducted to fill the gap in the literature. Early studies investigating the response of educational institutions to the COVID-19 pandemic and national lockdowns [4–8] concluded that most of those institutions worldwide either postponed or canceled classroom-based teaching activities [7,8] and, instead, shifted towards emergency remote teaching [6,9].

The overwhelming dominance of emergency remote teaching at the age of COVID-19 urged the research community to debate its effectiveness compared to the traditional classroom-based modality. Today's literature on the topic clearly shows that emergency remote classes are less preferred for a variety of reasons. Mathrani and Sarvesh [10] argue that the disparities in socioeconomic and education/literacy backgrounds of students are likely to promote the notion of digital divide and, hence, widen the gaps of inequalities between advantaged and disadvantaged students. Another reason, reported by higher education students who participated in the studies of Lin and Nguyen [11] and Bestiantono and Agustina [12], is that CBT has a higher potential to

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promote, not only teacher-student interaction, but also peer socialization. Bestiantono and Agustina [12] added that engaging students in emergency remote teaching during COVID-19 confinement periods was associated with signs of social disconnection, isolation, and emotional instability. The list of challenges associated with the sudden shift to emergency remote classrooms during the COVID-19 pandemic goes on to include connectivity issues and internet dropouts [13] and the unavailability of materials and resources necessary to conduct emergency remote teaching (e.g., high-speed internet connection, laptops, tablets, etc.) [14].

Coming to the main drawback of emergency remote teaching that inspired this work, previous research further argued that online distance learning is not suitable for all academic disciplines [15–17]. For instance, an evaluation of online delivery of practical competencies to undergraduate medical students demonstrated that such a distance teaching modality is significantly less effective than classroom-based teaching, particularly at learning complex technical skills [16]. Implemented in sports science curricula during the COVID-19 pandemic, emergency remote teaching couldn't fully substitute for the traditional classroom-based teaching, according to Zhu and Wang [17]. Findings of the Chinese study Zhu and Wang [17] argue that emergency remote teaching was poorly suited to teaching motor skills and monitoring student's involvement in movement-based learning tasks. Further evidence of the inappropriateness of remote teaching for sports science curricula can be drawn from Mocanu and Murariu [15] study. Self-reports of Romanian sports science students indicated that the lowered levels of habitual physical activity and, consequently, the increased amounts of theoretical content addressing athletic movement and physical exercise during emergency remote teaching often created a state of reluctance and disengagement with the videoconferencing session [15]. Moustakas and Robrade [18], along the lines of Zhu and Wang [17] and Mocanu and Murariu [15], cautioned that subjects involving practical, motor, and procedural learning dimensions, such as sports and physical education, are nearly impossible to deliver in an emergency remote teaching context because of their high dependency on hands-on intervention, interactivity and motor function. German teachers who took part in the study of Moustakas and Robrade [18] reported that emergency remote teaching is difficult to implement in practical classes, while sports science students who took part in the same study explicitly expressed their aversion to such a teaching modality.

Education systems globally could be interrupted again at any given time without prior warning, with potential threats such as COVID-19 variants, climate change, and armed conflicts lurking around the corner [19]. When one of those arises, researchers and scientists must be ready to assist in sustaining quality education through providing scientifically based solutions. For that purpose, they need to learn from past experiences (under similar circumstances) and build upon them. In the present study, we aimed at building a multidimensional understanding of sports science students' learning experiences during the second year of the COVID-19 pandemic (academic year 2020/2021). A triangulation approach, involving a questionnaire-based survey and a set of interviews, had as objectives to (1) report on the impact of the COVID-19 preventive measures (e.g., repeated suspensions of classroom-based teaching, the implementation of emergency remote teaching, curriculum narrowing, etc.) on sports science students' learning during the academic year 2020/2021 in Tunisia, and (2) investigate the different technological aids that contributed to those students' learning, in a way or another, amid pandemic-influenced circumstances.

In light of the existing evidence of the suboptimal performance of remote teaching as an emergency learning delivery modality in the sports science context in times of COVID-19 [15,17,18,20], several aspects of sports science students' learning experiences during the pandemic were brought into question by the authors of this work. The overlapping set of research questions addressed by this study entails the following:

- Had the COVID-19 pandemic impacted negatively on Tunisian sports science students' learning experiences?
- Had emergency remote teaching been less effective than classroom-based teaching in the Tunisian sports science context?
- If yes, what other technological aids had been mobilized by Tunisian sports science students with a view to complementing or perhaps substituting for emergency remote teaching?

2. Methods

2.1. Participants

A total of 181 Tunisian final-year students (96 males and 85 females, $M^{age} = 22.3 \pm 0.6$ years) pursuing an undergraduate degree in sports science at the High Institute of Sport and Physical Education (French acronym: ISSEPS), University of Sfax, took part in this study. According to statements from the institute's administration and the responsible ministry, this number of participants represented 85% of the targeted population (final-year undergraduate students majoring in sports science) at an institute level (sampling margin of error; SME = 0.01%) and roughly 30% at a national level (SME = 6%) at the time the study was conducted, knowing that four higher education institutions in Tunisia award their graduates a degree in sports science.

To meet the inclusion criteria set for the study the participant must: (1) be a student enrolled at ISSEPS, (2) be a final-year student, (3) have attended no less than 90% of the classroom-based and remote classes that had been conducted during the 2020/2021 academic year. This purposive sampling method was implemented to avoid any confounders that could stem from socioeconomic and financial disparities between institutes/regions (inclusion criterion 1), grade-influenced motivation to study (inclusion criterion 2), and absenteeism (inclusion criterion 3).

2.2. The questionnaire-based survey

2.2.1. Questionnaire development

First draft. At early stage of the questionnaire development process, a focus-group interview, involving 11 students from the targeted research population and four university teachers, was conducted to capture key insights on priority areas the different questionnaire items should focus on. Following discussions of the interview transcripts, the research team was able to conceive three main themes for investigation and, thereupon, compose the questionnaire items. A preliminary draft of the questionnaire underwent several rounds of review by experts in fundamentals of survey research methodology and peer researchers from different nationalities. Eventually, all reviewers confirmed that the investigation tool was highly qualified to serve the purposes of the study (content and face validity).

Pilot study. The first draft of the questionnaire was administered twice to the same sample of students (N= 22) in one sports science institute in Tunisia, with a test-retest interval of 4 weeks. The Cronbach's Alpha coefficient (α) and the Intraclass Correlation coefficient (ICC = *r*) were used to investigate the internal consistency of items (α) and the test-retest reliability index of the questionnaire (*r*). Overall, the statistical analyses showed that the version of the questionnaire implemented in the pilot study at retest should be reliable (test-retest and internal consistency reliability) after deleting three items — more details in subsection "Data analysis".

Final version. The validated version of the questionnaire comprised two main sections asking about students' (1) learning experiences and (2) interactions with digital technologies for learning purposes during the second year of the COVID-19 pandemic (academic year 2020/2021). Section 1 was composed of six items, while section 2 contained seven items. All questionnaire's items (excluding item 7 of section 2) had to be rated on a five-point Likert scale. Each of the five points was attributed to a given level of agreement: 1 = strongly disagree, 2 = disagree, 3 = neutral stance, 4 = agree, 5 = strongly disagree. The multiple-checkbox

response method was implemented in item 7 of section 2, allowing students to choose one or several online technologies they had used for learning purposes during the academic year 2020/2021.

2.2.2. Questionnaire administration

The questionnaire was administered to 181 participants on the 14th of June 2021. The study date was purposely selected to coincide with a final examination day to maximize participation rates. Members of the research team, waiting at the exits of examination halls, handed a paper-version of the questionnaire to each student leaving the hall and referred him/her to the main hall of the institute (study site), only if willing to participate in the study. At the main hall, two research team members were present to further explain the study purposes, help clarify ambiguous points in the questionnaire, and ensure strict compliance with the COVID-19 sanitary protocol (i.e., social distancing, wearing face coverings, and hand disinfection).

2.3. Semi-structured interviews

Upon completion of the analyses of data collected through the questionnaire-based survey, members of the research team encountered difficulties in identifying root causes and explaining several findings by just relying on the existing scientific literature. That is when they decided to conduct a set of semi-structured interviews with participants who uncovered their identities and provided contact details (107 out of 181) at early stages of the study in an attempt to triangulate data from both sources (questionnaire and interviews). When contacted, only 52 students (18 males and 34 females) agreed to be interviewed.

Interviews were administered either face-to-face, via Skype, or via phone (at the participant's convenience) and lasted approximately 20 to 30 minutes in duration. The research team conducted the interviews in students' mother tongue (Arabic) to avoid misunderstandings and reduce passivity and reticence in students' expressions caused by language barriers. The content of interviews was audio-recorded and, later, transcribed verbatim and translated into English for reporting purposes.

Open-ended questions (N= 18 to 24) sought explanation to the participant's response to each of the questionnaire items. Here are some examples:

- You reported that you had been able to compensate for the lack of knowledge acquisition during the academic year 2020/2021 by resorting to online technologies. Would you confirm that?
- Then, you selected YouTube as one of those technologies. Did it really help you learn?
- Could you please tell us more about your experience with YouTube as a learning aid during confinement periods?

2.4. Legal and ethical considerations

Approval to undertake the survey was sought and gained from the local research ethics committee (CPP: N°0130/2020) and the administration of ISSEPS. In accordance with the code of ethics and practices established by the American Association of Public Opinion Research [21], in the introductory page of the questionnaire's form, participants were informed about the study's administrators, background and objectives. They were also assured that their data are not intended to be communicated to third parties other than persons or entities designated for scientific research purposes. Participants were offered the option of hiding their identities. In all cases, they were assured that their responses will be treated anonymously and confidentially. Furthermore, it was made clear to all participants that they can withdraw from the survey/interview at any stage without incurring any penalty. By signing at the bottom of the introductory page, participants acknowledged their agreement to the study's terms.

3. Data analysis

All quantitative data collected, whether for questionnaire validation (pre-study stage) orfinal statistical analyses (post-study stage), were collated using Microsoft Excel spreadsheets (OFFICE 365. MICROSOFT Corporation, Redmond, WA, USA) and later analyzed using STATISTICA software (STATISTICA 13.3.0. TIBCO Software Inc., Palo Alto, CA, USA).

3.1. Questionnaire statistical validation

The Intraclass Correlation Coefficient (ICC = r) was calculated for each item of the questionnaire at 95% confidence interval to assess the strength of association between data collected at two test times (test and retest). Cronbach's Alpha coefficient (α) was calculated for each item and section to investigate the internal consistency of the questionnaire. Statistical significance was set at $p < 0.05$. Levels of test-retest and internal consistency reliability were interpreted according to the rating scale proposed by Landis and Koch [22]: $0.0 < r/\alpha < 0.2$ was considered poor, $0.2 < r/\alpha < 0.4$ fair, $0.4 < r/\alpha < 0.6$ moderate, $0.6 < r/\alpha < 0.8$ substantial, and $0.8 < r/\alpha < 1$ almost perfect.

Alpha coefficients were almost perfect at retest for both sections (section 1: α = 0.99; section 2: α = 0.98) after ruling out four items at first test (two from each section), indicating that the final version of the questionnaire features very high internal consistency reliability [22]. ICC results showed that test-retest reliability was substantial to almost perfect for all questionnaire items (least $r = 0.71$, $p < 0.01$; highest $r = 0.96$, $p < 0.001$).

3.2. Questionnaire final data analyses

Final statistical analyses of data collected through the questionnaire relied on descriptive statistics, including mean ($\bar{x}$), standard deviation (SD), median ($\tilde{x}$), inter-quartile range (IQR), frequencies (f) and percentages (%). Typical responses were identified on the basis of the median value ($\tilde{x}$ = the number/response that is exactly in the center of the distribution of data across the 5-point Likert scale). The dispersion of data around central tendency was computed using IQR values. Further descriptive statistics ($\bar{x}$, SD, f and %) were presented in the text and tables to provide detailed summaries about the collected data.

3.3. Interview qualitative analyses

Qualitative data collected from interviews were processed using thematic coding techniques in the computer software package NVivo (NVivo 12.6.0. QSR International, Melbourne, Australia). After importing the interview transcripts into NVivo, participants' textualized responses to each question were coded into 'Nodes'. Each node represented one of the interview questions and gathered references to the question's answers. NVivo nodes allow for gathering related material in one place, thereby making it easier and quicker to look for emerging patterns and ideas.

4. Results

4.1. Section 1: Sports science students' learning experiences in time of COVID-19

Participants agreed that they haven't learned enough during the academic year 2020/2021 (Item 1: $\bar{x} \pm SD = 3.5 \pm 1.3$, $\tilde{x} = 4$, IQR = 3) and that they haven't received enough training content necessary for the professional life (Item 2: $\bar{x} \pm SD = 3.3 \pm 1.2$, $\tilde{x} = 4$, IQR = 2). They also agreed that their academic performance was somehow impacted by the COVID-19 pandemic (Item 5: $\bar{x} \pm SD = 3.2 \pm 1.4$, $\tilde{x} = 4$, IQR = 2) and that ruling out tutorials has negatively affected their skill and knowledge acquisition (Item 4: $\bar{x} \pm SD = 3.1 \pm 1.3$, $\tilde{x} = 4$, IQR = 2). Furthermore, students involved in this study agreed that catching the COVID-19

infection or showing its symptoms forced them to skip many classroom-based lessons (Item 3: $\bar{x} \pm SD = 3.1 \pm 1.3$, $\tilde{x} = 4$, IQR = 3). In general, they agreed that the COVID-19 pandemic had negatively affected their learning experiences during the academic year 2020/2021 (Item 6: $\bar{x} \pm SD = 3.3 \pm 1.3$, $\tilde{x} = 4$, IQR = 2). Further details are available in Table 1.

4.2. Section 2: Sports science students' interactions with online technologies

Disappointingly, the participating students believe that they hadn't attended enough remote classes scheduled during the academic year 2020/2021 (Item 13: $\bar{x} \pm SD = 3.5 \pm 1.2$, $\tilde{x} = 2$, IQR = 3). However, they reported that missing remote classes was not due to their weak digital literacy (Item 14: $\bar{x} \pm SD = 2.4 \pm 1.3$, $\tilde{x} = 2$, IQR = 3) nor due to the lack of the required technological tools at their homes (Item 15: $\bar{x} \pm SD = 2.6 \pm 1.3$, $\tilde{x} = 2$, IQR = 3). Participants also disagreed that remote classes were as effective as classroom-based classes (Item 16: $\bar{x} \pm SD = 2.2 \pm 1.3$, $\tilde{x} = 2$, IQR = 2). On the other hand, they reported that they were able to compensate for the lack of knowledge acquisition during the academic year 2020/2021 by resorting to online technologies (e.g., online-course providers, YouTube, etc.) (Item 17: $\bar{x} \pm SD = 3.3 \pm 1.4$, $\tilde{x} = 4$, IQR = 2). In general, the participating students believe that digital technologies contributed to mitigating the impact of the COVID-19 pandemic on their graduation year (Item 18: $\bar{x} \pm SD = 3.3 \pm 1.2$, $\tilde{x} = 4$, IQR = 2). Further details are available in Table 2.

Regarding the online technologies participants used the most for learning purposes during the academic year 2020/2021, Google Meet ranked first ($f = 176$, 97.2 %) while YouTube ranked second ($f = 167$, 92.7 %) with a marked difference from the rest of the list. Facebook ($f = 63$, 34.8 %), Google Search ($f = 56$, 30.9 %), WhatsApp ($f = 54$, 29.8 %), and Wikipedia ($f = 44$, 24.3 %) were also used by one-quarter to one-third of the studied sample. The list also contained online technologies that a minority of participants had used to learn during the academic year 2020/2021, namely ZOOM ($f = 31$, 17.1%), Udemy ($f = 21$, 11.6%), LinkedIn Learning ($f = 18$, 9.9%), and Google Scholar ($f = 13$, 7.2%). Further details are available in Table 3.

4.3. Semi-structured interviews

The huge amounts of qualitative data collected through interviews cannot be fully presented in this section. When triangulation of data of the questionnaire and interviews is deemed necessary, excerpts from interview transcripts will be reported in the "Discussion" section.

5. Discussion

5.1. Sports science students' learning experiences in times of COVID-19

The main findings of the present investigation indicated that the COVID-19 pandemic has negatively affected the learning experience of the participating sports science students during the academic year 2020/2021. Students believe that they hadn't learned well nor developed enough professional skills they would need for work-life success. They also think that the pandemic-influenced situation somehow undermined their academic performance (data from questionnaire). Altogether, these findings align well with what has previously been published in the literature. An online dataset published by UNESCO [3] cautions that the repeated closures of universities during one academic year in reaction against a pandemic emergency have several adverse consequences on students, including interrupted learning and unfulfilled learning goals, resulting in limited opportunities for knowledge and skill acquisition. The same dataset hints at expecting a generational dilemma in terms of professional competencies if the pandemic persists for a long time [3]. Supporting the reliability of our participating students' reports, the findings of Sintema [23], based on teachers' views, suggest that the levels of academic performance of students are likely to drop during pandemic times due to reduced peer-to-peer contact freedom inside the campus and the lack of consultation with teachers when encountering difficulties in learning and understanding. Pokhrel and Chhetri [24] went to some length in arguing that groups of students have been unequally affected by the pandemic. In other words, students who have innate or refined learning abilities are relatively unaffected in terms of learning outcomes given their low dependence on supervision and guidance, while the vulnerable group consisting of students who have weak learning abilities could struggle with learning due to the lack of interaction with their teachers amid the pandemic situation [24].

On top of the explanations already existing in the literature [23,24], our findings highlight further points that could partially explicate why the participating sports science students believe that the COVID-19 pandemic has negatively affected their learning experiences during the academic year 2020/2021. Participants reported that canceling tutorial classes and just keeping lectures eroded their knowledge and skill acquisition opportunities (data from questionnaire). This is unsurprising, given the high importance of tutorials as an integral part of higher education programs [25,26]. Tutorial classes are essential to students' holistic learning experience [25], as they empower them to delve deeper into concepts, phenomena, and skills introduced during lectures [26]. It is very likely that canceling tutorial classes may have resulted in lower levels of understanding of lectures' material. Another explanation could be that the increased rates of class absenteeism, due to being infected or showing COVID-19 symptoms (data from questionnaire), may have led to learning losses and, in turn, poorer academic

Table 1
Tunisian sports science students' learning experiences in times of COVID-19.

	Item	$\bar{x}$	SD	$\tilde{x}$	IQR	f(%) 1	2	3	4	5
1	I believe that I haven't learned enough during this academic year	3.5	1.3	4	3	8 (4.4)	52 (28.7)	12 (6.6)	61* (33.7)	48 (26.5)
2	I believe that I haven't received minimum training content necessary for the professional life	3.3	1.2	4	2	8 (4.4)	59 (32.6)	14 (7.7)	65* (35.9)	35 (19.3)
3	Catching COVID-19 or exhibiting its symptoms forced me to skip many classroom-based lessons	3.3	1.4	4	3	22 (12.2)	47 (26)	19 (10.5)	42* (23.2)	51 (28.2)
4	I believe that canceling tutorials has negatively affected my skill and knowledge acquisition	3.1	1.3	4	2	23 (12.7)	42 (23.2)	25 (13.8)	70* (38.7)	21 (11.6)
5	I believe that my academic performance was somehow impacted by the COVID-19 pandemic	3.2	1.4	4	2	31 (17.1)	34 (18.8)	18 (9.9)	61* (33.7)	37 (20.4)
6	I believe that, in general, the COVID-19 pandemic has negatively affected my learning experience during this year	3.3	1.3	4	2	26 (14.4)	36 (19.9)	16 (8.8)	73* (40.3)	30 (16.6)

$\bar{x}$, mean; SD, standard deviation; $\tilde{x}$, median; IQR, inter-quartile range; f, frequency; %, percentage; *, the typical response based on $\tilde{x}$; 1, strongly disagree; 2, disagree; 3, neutral stance; 4, agree; 5, strongly agree.

Table 2
Tunisian sports science students' interaction with digital technologies in times of COVID-19.

	Item	$\bar{x}$	SD	$\tilde{x}$	IQR	f(%) 1	2	3	4	5
7	I believe that I have attended enough remote classes during this academic year	2.5	1.2	2	3	46 (25.4)	60* (33.1)	20 (11)	51 (28.2)	4 (2.2)
8	I couldn't attend remote classes because of my weak digital literacy	2.4	1.3	2	3	60 (33.1)	56* (30.9)	19 (10.5)	31 (17.1)	15 (8.3)
9	I couldn't attend remote course due to the lack of the required technological tools at home	2.6	1.3	2	3	45 (24.9)	61* (33.7)	13 (7.2)	45 (24.9)	17 (9.4)
10	I believe that remote classes were as effective as classroom-based classes (not less effective)	2.2	1.3	2	2	69 (38.1)	56* (30.9)	14 (7.7)	32 (17.7)	10 (5.5)
11	I believe that I had been able to compensate for the lack of knowledge acquisition during this academic year by resorting to online technologies (e.g., online-course providers, YouTube, etc.)	3.3	1.4	4	2	28 (15.5)	31 (17.1)	19 (10.5)	68* (37.6)	35 (19.3)
12	In general, I believe that digital technologies contributed to mitigating the impact of the COVID-19 pandemic on my graduation year	3.3	1.2	4	2	16 (8.8)	32 (17.7)	37 (20.4)	72* (39.8)	24 (13.3)

$\bar{x}$, mean; SD, standard deviation; $\tilde{x}$, median; IQR, inter-quartile range; f, frequency; %, percentage; *, the typical response based on $\tilde{x}$; 1, strongly disagree; 2, disagree; 3, neutral stance; 4, agree; 5, strongly agree.

Table 3
The most used technologies by Tunisian sports science students for learning purposes in times of COVID-19 (item 13).

Rank	Technological tool	f	%
1	Google Meet	176	97.2
2	YouTube	167	92.7
3	Facebook	63	34.8
4	Google Search	56	30.9
5	WhatsApp	54	29.8
6	Wikipedia	44	24.3
7	ZOOM	31	17.1
8	Udemy	21	11.6
9	LinkedIn Learning	18	9.9
10	Google Scholar	13	7.2
11	Microsoft Teams	7	3.9
12	Coursera	1	0.6
13	Instagram	1	0.6

performances. Indeed, previous research works have confirmed the existence of a correlation between class absenteeism and academic achievement [27,28].

5.2. Students' interactions with online technologies

Despite the broad agreement that online technologies contributed to mitigating the impact of the COVID-19 pandemic on their graduation year, the surveyed sports science students reported not attending enough remote classes. We expected the reasons for that to be associated with factors such as low levels of digital literacy and poor access to digital technologies, as argued in previous research works [10,13,14]. The key findings of the questionnaire-based survey were not in line with our expectations, yet corroborated those of Zhu and Wang [17], Mocanu and Murariu [15], and Moustakas and Robrade [18], who deduced that emergency remote teaching was not as effective as classroom-based teaching when implemented in sports science curricula in times of COVID-19. During interviews, participants further reflected on their experiences with emergency remote teaching and provided explanations to why they preferred classroom-based teaching. Malik, a male student, spoke sarcastically saying: "*I find it unfortunate that I don't have a basketball court at home so that I can drill the skills being taught by the teacher during the videoconference*". Rania, a female student, added: "*The quality of the live video was low most of the time* […] *You can't see clearly the movement being demonstrated* (in the videoconference)". Fadi, a male student, also said: "*I sometimes fall asleep during online classes* […] *due to the lack of physical activity and physical interaction with my classmates* […] *We are used to being highly* (physically) *active during practical lessons*".

The explanations already existing in the literature didn't differ greatly from those provided by the interviewed students. The consensus has been that videoconferencing, being two-dimensional and live-streamed, isn't sufficiently conducive to the visualization of complex and fast-paced movement patterns [15,17,18,29] and to monitoring students' involvement in movement-based learning tasks [15,18]. Furthermore, the increased amounts of theoretical content in replacement of overt physical practice can create a state of reluctance and disengagement with the videoconferencing session among sports science students [15].

5.3. YouTube as a complementary learning tool in times of COVID-19

Based on data collected from both questionnaire and interviews, the sports science students who participated in this study resorted to a variety of online technologies, other than videoconferencing software, to compensate for the lack of knowledge acquisition during COVID-19 confinement periods. Ranking second among those technologies after Google Meet, with a marked difference from the rest of the list (see Table 3), YouTube seemed to be sports science students' best "learning companion" during quarantine. It should be noted that Google Meet had been implemented by the institution where the study was conducted (ISSEPS) as the primary videoconferencing platform for emergency remote teaching in times of the COVID-19 pandemic. This could therefore explain why it topped the list (97.2 %), still with a narrow difference from YouTube (92.7 %). Most of the interviewed students also confirmed that they had been obliged to use Google Meet to attend compulsory remote classes, with one (male) stating: "*In times of COVID-19, Google Meet was an obligation, while YouTube was a choice*" (excerpt from Ali's interview). In accordance with these findings, a survey conducted by Smith [30] found that video-based social media services, such as YouTube, are a top choice for samples of Canadian undergraduate students majoring in social sciences, health sciences, natural sciences, and engineering. Those students viewed YouTube as a meaningful part of their own university learning, as it helped them further review and understand academic concepts. Despite being published before the emergence of the COVID-19 pandemic, the findings of Smith [30] could support the assumption that not only sports science students favored YouTube as a learning aid in times of COVID-19, but also students majoring in other study fields. According to the "2022 Global Digital Overview" report [31], as of January 2022, YouTube has 2.562 billion active users worldwide (excluding China) and is the most time-consuming of all social media services, with an average monthly rate of 23.7 hours per user. This makes it the largest online video-sharing platform at the time of this research [31]. Considering the massive popularity of YouTube [31], its fee-free and easy access, and the wide range of user-generated video content it has been offering, including instructional content [32], the findings of the present study—arguing that YouTube was a major source of knowledge for sports science students in times of COVID-19—appear to be relatively rational.

It was clear through interview transcripts that the excessive use of YouTube by sports science students in times of COVID-19 was mainly intended to complement or even substitute for emergency remote teaching, which they perceived as less effective than classroom-based teaching. Firas, one of the interviewed male students, said in this matter: "*I sometimes end up with little understanding of the lesson content after a remote class* […] *I* (therefore) *watch instructional videos on YouTube made by teachers and experts to prepare for my exams*". Ashraf, another male student, added: "*The videoconferencing content is live-streamed and tied to a time bound* […] *YouTube videos* (on the other hand) *are accessible at any time, wherever you are*". More interestingly, Cyrine, a female student, said: "*Rehearsing motor skills most often requires space and equipment* […] *Whenever I find the opportunity* (the required space and equipment) *I play a YouTube video using my smartphone and start following the instructions* (of the tutor/model in the video)". Based upon these statements of sports science students, it could be concluded that the low potential of emergency remote teaching—compared to classroom-based teaching—to fulfill specific objectives of movement-based and procedural learning situations in sports science settings [15,17,18] may have prompted them to seek complementary learning resources to compensate for the lack of knowledge and skill acquisition during the pandemic. Obviously, YouTube provided them with learning opportunities that met their needs. They needed videos with high image quality for a better movement viewing experience and video-based learning content that can be replayed at their convenience, anytime and anywhere (interview content). YouTube's extensive reach and engagement ability make it the ideal technology for serving as a complementary learning channel, extending the classroom environment beyond university walls and into natural physical activity settings [33]. When students access YouTube seeking support in motor and procedural learning, they enjoy the compatibility of their procedural learning strategies with the features that YouTube provides [34], the enormous amount of relevant, up-to-date learning contents [35], the sense of vividness and creativity imposed by the available instructional videos [36], as well as the sense of self-efficacy while learning skills and acquiring knowledge [37].

An unfortunate limitation of this study is that the size of the sample of sports science students who were interviewed (N= 52) was small compared to the number of participants who responded to the questionnaire (N= 181). This may render the interviewed sample less representative of the entire group of participants. Another limitation could be that self-reported data contain several potential sources of bias (selective memory, telescoping, attribution, exaggeration, etc.) that should be carefully considered when discussing this study's findings, particularly on students' learning experiences with YouTube in times of COVID-19. Fortunately, the plethora of evidence in the literature of the effectiveness of YouTube as a learning aid may somewhat corroborate key findings of the present study.

6. Recommendations

There is a growing body of evidence showing that YouTube, when properly incorporated into formal educational settings, can effectively complement daily curriculum delivery [32,34,38,39]. This provides support to the self-reports of sports science students who took part in this study, perceiving YouTube as a valuable complementary learning resource in times of COVID-19.

Sports science institutions should consider launching their own YouTube channels and sharing instructional videos with relevance to curriculum content. Teachers should also be encouraged to design instructional videos and upload them on the institute's YouTube channel. For an effective implementation of the different YouTube-mediated blended learning modalities, sports science institutions should organize training sessions and workshops on the essential techniques of videography. Curriculum-based YouTube videos could smoothen emergency implementation of flipped classrooms [33] during future crises that may force teachers and students into home confinement once again.

7. Conclusions

The findings of the present study argue that the COVID-19 pandemic, or rather the measures imposed to combat it, had a deep impact on Tunisian sports science students' educational experiences during the academic year 2020/2021. Those students reported that absenting themselves from classroom-based lessons, due to being infected by the virus or showing its symptoms, and canceling tutorial classes by the institute's administration had detrimental effects on their learning needs and resulted in missed opportunities for knowledge and skill acquisition. The participating students also perceived emergency remote teaching as less effective than classroom-based teaching in terms of learning delivery within the sports science context. From their point of view, engaging in procedural and movement-based learning sequences conducted via videoconferencing often resulted in suboptimal learning outcomes.

The most important finding of this research was that the surveyed Tunisian sports science students resorted to a wide range of online technologies, other than videoconferencing software, to compensate for the learning losses in times of COVID-19. One that stood out as a top choice is YouTube. The famous video-sharing platform had been used by 92.7 % of the students during the pandemic to complement curriculum delivery. Reportedly, YouTube helped them better understand instructional content delivered during videoconferencing sessions and compensate for the missed opportunities for knowledge and skill acquisition. Overall, the participating sports science students believed that online technologies, and in particular YouTube, contributed to mitigating the impact of the COVID-19 pandemic on their graduation year. Future research should explore methods for better integrating YouTube into the sports science context in crisis times.

Ethical Statement

Approval to undertake the survey was sought and gained from the local research ethics committee (CPP: N°0130/2020) and the administration of ISSEPS. In accordance with the code of ethics and practices established by the American Association of Public Opinion Research (AAPOR, 2015), in the introductory page of the questionnaire's form, participants were informed about the study's administrators, background and objectives. They were also assured that their data are not intended to be communicated to third parties other than persons or entities designated for scientific research purposes. Participants were offered the option of hiding their identities. In all cases, they were assured that their responses will be treated anonymously and confidentially. Furthermore, it was made clear to all participants that they can withdraw from the survey/interview at any stage without incurring any penalty. By signing at the bottom of the introductory page, participants acknowledged their agreement to the study's terms.

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Declaration of Competing Interests

The authors declare that they have no competing interests.

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