https://doi.org/10.48047/AFJBS.6.Si3.2024.2369-2385

African Journal of Biological Sciences

Journal homepage: http://www.afjbs.com

Research Paper Open Access

Exploring the effects of personalized learning technology on student engagement and cognitive achievement in secondary schools

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Volume 6, Issue Si3, Jun 2024

Received: 09 March 2024

Accepted: 10 May 2024

Published: 20 Jun 2024

doi: 10.48047/AFJBS.6.Si3.2024.2369-2385

Abstract

Purpose

In a world where technology and social media are increasingly shaping our interactions and access to information, it is crucial to understand their effect on education. Physical education, in particular, is an area where individualized learning and active student engagement are essential.

Objective

The aim of this study was to design and validate a measurement instrument that would make it possible to assess students' level of learning in terms of their intrinsic motivation, autonomy, creativity and perceived competence. Such an instrument could be useful for identifying the factors that promote or hinder learning in physical education, as well as for adapting teaching methods to the needs and preferences of learners.

Methods

The study sample consisted of 546 middle and high school students who practice physical and sports education (PSE) in the school setting, with an average age of 16.59 ± 2.51 from different Tunisian regions. The data will be collected using a specific questionnaire and an in-depth analysis will be carried out using appropriate statistical methods.

Results

The alpha coefficients for the four dimensions of the individualized learning instrument in physical education indicated excellent internal consistency, respectively 0.989 (intrinsic motivation), 0.986 (autonomy), 0.861 (creativity) and 0.953 (perceived competence). The adequacy indices of the confirmatory factor analysis were satisfactory.

Conclusion

The use of technology in physical education and sport has opened up new forms of individualized learning. However, there is a lack of valid and reliable instruments for evaluating individualized digital learning (IDL) in PE among Tunisian pupils. The aim of this study is to develop and evaluate an instrument for assessing ANI in PES among Tunisian pupils.

Keywords : intrinsic motivation, autonomy, creativity, perceived competence, physical education, digital competence.

Introduction

Individualized learning is a concept that refers to the ability of individuals to learn on their own, without outside intervention, by exploring their environment and adapting to the situations they encounter. (Astari & Kartika, 2022). The authors proposed a scale for measuring individualized learning, based on four dimensions: intrinsic motivation, autonomy, creativity and perceived competence.

Individualized learning has many educational benefits, particularly in terms of fostering the development of cross-disciplinary skills, self-confidence and the pleasure of learning. (Ansari & Khan, 2020). However, it remains little studied and little valued in the current education system, which often favors more directive and prescriptive approaches. Furthermore, the emergence of information and communication technologies (ICT) in the field of education poses new challenges and new opportunities for individualized learning. (Charlier et al., 2006). ICT can both facilitate and hinder spontaneous learning, depending on how it is used and integrated into teaching practices. (Martin et al., 2015).

In this context, our research aims to study the validity of the individualized learning scale in physical education, taking into account the influence of ICT. (Rousselle & Vigneau, 2016). We hypothesis that ICT has a moderating effect on the relationship between individualized learning and the variables of intrinsic motivation, autonomy, creativity and perceived competence.

Our article is organized into four parts. In the first part, we present the theoretical framework of our research, defining the concepts of learning and ICT, and outlining previous work on the subject. In the second part, we describe the methodology we have adopted, specifying the

characteristics of the sample, the procedures for administering the questionnaire and the data analysis techniques. In the third part, we present the results of our analysis, highlighting the effects of ICT on individualized learning and its dimensions. In the fourth and final part, we discuss the pedagogical implications of our research, highlighting the limitations and prospects of our study.

Methods

The aim of this research is to study the validity of the individualized learning scale in physical education, taking into account the influence of social networks. (Rasheed et al., 2020). We formulate the hypothesis that social networks have a moderating effect on the relationship between individualized learning and the variables of intrinsic motivation, autonomy, creativity, and so on.(Léger, 2022) and perceived competence.

Population

Our study sample comprised 546 Tunisian pupils with an average age of 16.59 ± 2.51. Of these, 331 were boys (60.6%) and 215 girls (39.4%). At the time of data collection, 253 participants (46.3%) were middle school students, while 293 were high school students (53.7%). In addition, 259 participants (47.4%) had digital communication skills, while 287 (52.6%) had only digital sharing skills. They came from different regions of Tunisia.

All participants in the study were volunteers and took part anonymously and confidentially. They gave written informed consent. Participants had to use the same pseudonym for both tests, and no financial or material incentives were offered.

Measures

Table 1. Basic characteristic of the sample population

Variable		Effective		Pourcentage (%)
Gender	Male	Total (N = 546)	331	60,6
		EFA (n = 273)	197	72,2
		CFA (n = 273)	134	49,1
		Test retest (n=35)	13	37,1
	Female	Total (N = 546)	215	39,4
		EFA (n = 273)	76	27,8
		CFA (n = 273)	139	62,9
		Test retest (n=35)	22	37,5
Niveau scolaire	Middle	Total (N = 546)	253	46,3
		EFA (n = 273)	138	50,5
		CFA (n = 273)	115	42,1
		Test retest (n=35)	14	40
	secondary	Total (N = 546)	293	53,7
		EFA (n = 273)	135	49,5
		CFA (n = 273)	158	57,9
		Test retest (n=35)	21	60
Competence	Communication	Total (N = 546)	253	46,3
		EFA (n = 273)	137	50,2
		CFA (n = 273)	122	44,7
		Test retest (n=35)	14	40
	Partage	Total (N = 546)	287	52,6
		EFA (n = 273)	136	49,8
		CFA (n = 273)	151	55,3
		Test retest (n=35)	21	60

Table 2. The test-retest reliability of the 16-item SLS (n = 35)

Variable	Test 1	Test 2	α-Cronbach	r de Pearson	*P*-value
	M ± SD	M ± SD	(IC = 95%)	(IC = 95%)	
Moti (4 items)	18,43±1,86	18,51±1,78	0,91	0,91	p<0,001
Aut (4 items)	19,23±1,41	19,34±1,32	0,90	0,77	p<0,001
Creat (4 items)	19,40±1,41	19,34±1,43	0,87	0,74	p<0,001
Compet (4 items)	19,26±1,24	19,29±1,20	0,80	0,91	p<0,001
Total (16 items)	76,31±3,02	76,49±2,94	0,71	0,86	p<0,001

** P < 0.001,

Note: Motiv, intrinsic motivation; Aut, autonomy; Creat, creativity; Competence, perceived competence.

Table 3.Factor structure of the in the Arabic language

	Components			
	1	**2**	**3**	**4**
E1	0.916			
E2	0.895			
E3	0.956			
E4	0.955			
E5		0.840		
E6		0.908		
E7		0.930		
E8		0.920		
E9			0.872	
E10			0.832	
E11			0.877	
E12			0.912	
E13				0.791
E14				0.801
E15				0.879
E16				0.908

The questionnaire used is based on the Individualized Learning Scale, which comprises 16 items divided into four dimensions: intrinsic motivation (ALLOUCHE & ZOUAOUI, 2023) (4 items), autonomy (4 items), creativity (Astari & Kartika, 2022) (4 items) and perceived competence (4 items). The items are formulated in the form of assertions, which the students are asked to answer on a 5-point Likert scale, ranging from 1 (strongly disagree) to 5 (strongly agree). The questionnaire also includes socio-demographic questions (age, gender, school level) and questions on physical activity (frequency, duration, type of activity, use of ICT).

The questionnaire was administered online, using the Google Forms platform, after obtaining informed consent from the pupils and their parents. Pupils completed the questionnaire individually and anonymously, within two weeks. The response rate was 85%.

Procedure

Our procedures for translating and adapting the individualised learning instrument to the Tunisian context of students exposed to ICT. This validation followed the guidelines of the International Testing Commission (ITC)(Benson & Clark, 1982; Bouletreau et al., 1999).

The questionnaire was administered between January 2024 and February 2024, and distributed. We informed the pupils and their parents of the aims of the work.

This study complied with the principles set out in the Declaration of Helsinki. The research protocol was approved by the committee for the protection of people (C.P.P.SUD) of the University of Sfax. Before taking part in the study, the young participants and their parents were given a full verbal explanation of the study, detailing the protocol and its potential risks and benefits. The raw data collected from the participants was analyzed in complete confidentiality.

Statistical analysis

The normality of the data was assessed by evaluating skewness and kurtosis. To check the psychometric quality of the construction, internal consistency was assessed by calculating Cronbach's alpha coefficient. The temporal stability of the questionnaire was measured using a test-retest approach. Predictive validity was tested by calculating a correlation matrix and Pearson's correlation coefficient.

To examine the factor structure of the questionnaire, an exploratory factor analysis (EFA) using orthogonal Varimax (Kaiser, 1958) with a principal component analysis (PCA) was carried out on our 16-item questionnaire from the spontaneous learning tool (Archer et al., 1997; Moore et al., 2011). Sampling adequacy was measured by calculating the Kaiser-Meyer-Olkin (KMO) test.

A first-order confirmatory factor analysis (CFA) with maximum likelihood estimation was performed to verify the four-dimensional factor structure. To test the fit of the data collected to the theoretical model, it is generally recommended to use several types of indices(Schermelleh-Engel et al., 2003). Roussel et al (2002) recommend presenting at least two fit indices for each family of indices. These indices assess the extent to which the a priori theoretical model faithfully reproduces the data. The most commonly used index is the Chi-square (Satorra & Bentler, 1994), which should not be statistically significant. For a complete evaluation of the model fit, we used the goodness-of-fit index (GFI) (Satorra & Bentler, 1994) and its adjusted value (AGFI), which must be equal to or greater than 0.90 and 0.85, respectively. We also used the root mean square error of approximation (RMSEA). Unlike the GFI, this index can be used to test a poor fit. According to some researchers, it should be less than 0.05 for a good fit and 0.08 for an acceptable fit (Jöreskog & Sörbom, 1996; MacCallum et al., 1996), who also suggest using the Chi-square ratio over the degrees of freedom to distinguish "over-fitted" models from "under-fitted" models. The target threshold generally proposed by Carvalho and Chima is ≤ 3. However, some authors (Rousselle & Vigneau, 2016) agree on an acceptance threshold of ≤ 2. In addition, we used the

standardized root mean square residual (SRMR), which must be ≤0.10 for an acceptable fit (Schermelleh-Engel et al., 2003). In addition, the Comparative Fit Index (CFI), Non-Normalized Fit Index (NNFI), Normalized Fit Index (NFI) and Parsimonious NFI (PNFI) are also particularly relevant, especially when comparing different alternative models. The value of the NFI must be ≥0.90 and the values of the CFI, NFI, NNFI and PNFI must be ≥0.95. (Byrne, 2001). An AFE was conducted on a random sample while the AFC was conducted on the other half of the sample. The AFE was carried out using the commercial software "Statistical Package for Social Sciences (SPSS for Windows, version 24, IBM, Armonk, NY, USA)", while the CFA was carried out using AMOS (version 24, IBM, Armonk, NY, USA).

Results

Building quality

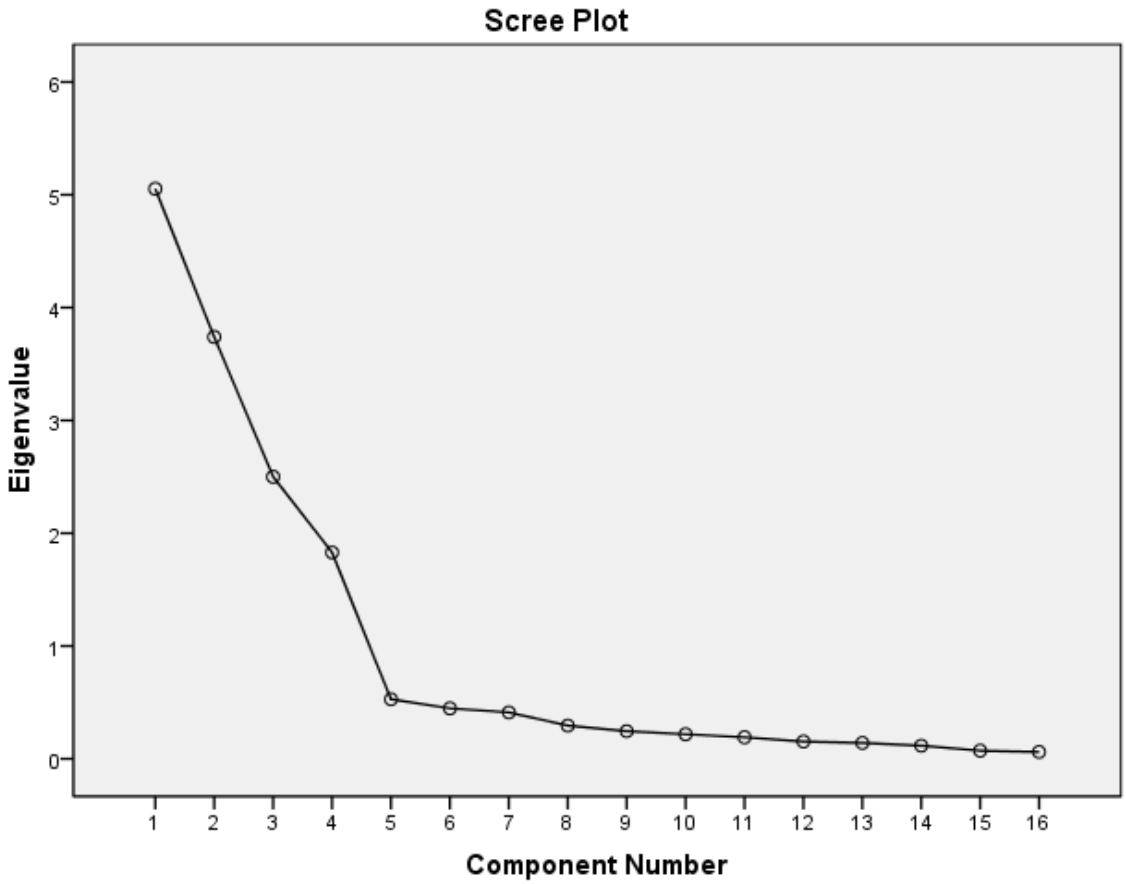
The data was found to be normally distributed with respect to skewness and kurtosis. In addition, our results revealed that this scale exhibited good temporal stability, with a correlation coefficient (r) of 0.86 between test and retest measures.

Predictive validity was tested using Pearson correlation. The results of the correlation matrix between the 16 statements of the Individualized Learning in Physical Education scale showed a positive correlation at $p < 0.001$ between most of the variables.. The correlation coefficient (r) was between 0.002 and 0.928. For some statements, the correlations were strong, such as the correlation between item 15 ("I have a good command of the technical gestures of a physical activity shared on social networks") and item 16 ("I am satisfied with my level of performance in a physical activity") ($r = 0.838$ at $p < 0.01$), and between item 3 ("I feel proud when I succeed in a challenge to share technical movements with groups of friends") and item 4

("I don't need to be rewarded for commenting on technical movements shared on facebook or instagram") ($r = 0.90$ at $p < 0.01$). However, there are inversely correlated items, such as between item 9 ("I try to vary the way I do physical activity.") and item 13 ("I feel able to do physical activity without difficulty after collaborating on social networks. ") ($r = -0.065$ at $p < 0.05$). Nevertheless, certain coefficients are weak, for example the correlation between item 1 ("I like to learn new things by myself on social networks") and item 15 ("I have a good command of the technical gestures of a physical activity shared on social networks") ($r = 0.002$ at $p > 0.05$), and between item 1 ("I like to learn new things by myself on social networks") and item 16 ("I am satisfied with my level of performance in a physical activity. ") ($r = 0.03$ at $p >0.05$). (Reported in table4).

Exploratory factor analysis

The results of the exploratory factor analysis (EFA) indicate that the physical education e-learning readiness scale for students faithfully reproduces the expected theoretical model (in terms of item homogeneity) with good overall internal consistency ($\alpha = 0.845$). Each dimension (Table 2) shows excellent internal consistency, with respective values of 0.955 (intrinsic motivation), 0.941 (autonomy), 0.914 (creativity) and 0.871 (perceived competence). The Kaiser-Meyer-Olkin measure indicated good sample adequacy (KMO = 0.825 at $p<0.001$). The eigenvalue of the intrinsic motivation dimension was 5.05, accounting for 31.58% of the total variance, while the eigenvalue of the autonomy dimension was 3.73, explaining up to 54.95% of the total variance. The eigenvalue of the creativity dimension was 2.50, explaining up to 70.57% of the total variance. Finally, the eigenvalue of the perceived competence dimension was 1.82, explaining up to 82.01% of the total variance. (See Fig. 1)



C

Fig 1. Scree plots of eigenvalues in factor analyses.

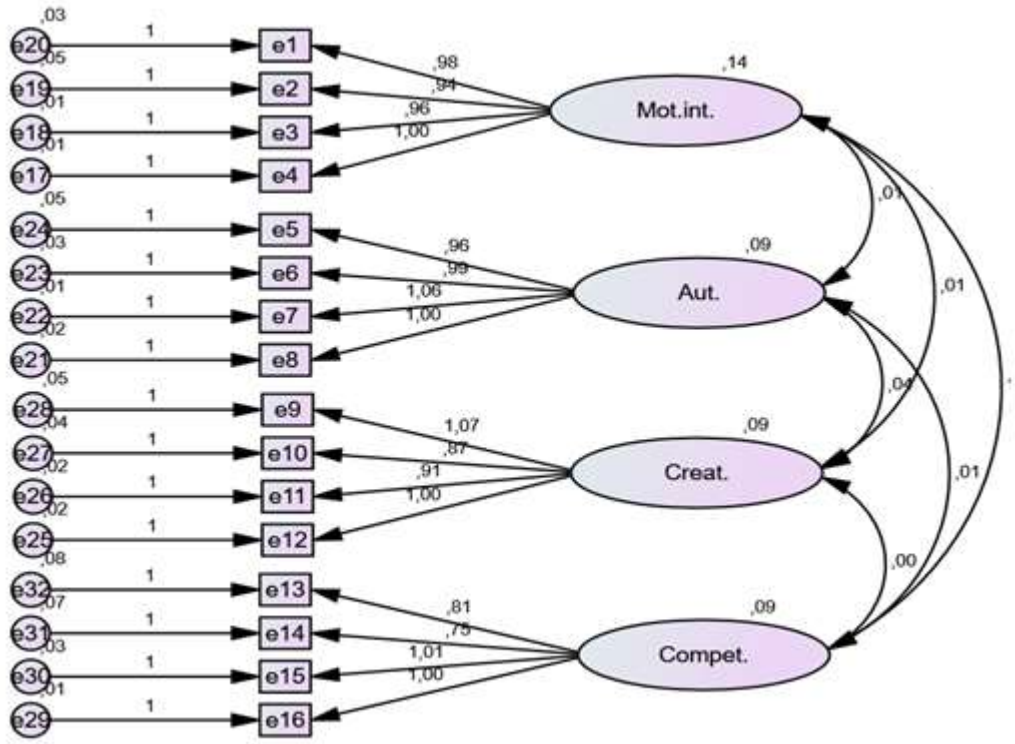


Figure 2: Structural equation model (SEM)

onfirmatory factor analysis

Sensitivity Analysis

Our model had a statistically significant Chi-square value [χ^2/df = 2.065, with 98 degrees of freedom, at $p<0.01$]. The goodness-of-fit index (GFI) was satisfactory (0.917), the standardized goodness-of-fit index (NFI) was 0.946 and the non-standardized goodness-of-fit index (NNFI) was 0.972. In addition, the comparative fit index (CFI) was 0.971, the adjusted fit index (AGFI) was 0.885, the root mean square error of approximation (RMSEA) was 0.06, the standard root mean square residual (SRMR) was 0.04, and the parsimonious standard fit index (PNFI) was 0.773. In summary, the 16-item model showed an excellent fit to the theoretical model for all indices tested, thus confirming the four-dimensional factor structure for the Tunisian school population (as illustrated in Figure 2). Based on the ANOVA results, the sensitivity analysis did not indicate any remarkable effects of age, gender and education level on the scores in the different domains. However, in terms of interaction effects, no significant influence was detected.

Discussion

The aim of our research was to study the validity of the individualized learning scale in physical education and sport. (Visioli, 2022), taking into account the influence of information and communication technologies (ICT). We formulated the hypothesis that ICT has a moderating effect on the relationship between spontaneous learning and the variables of intrinsic motivation,

autonomy, creativity and perceived competence. (Eschenauer et al., 2023). Our results partly confirm this hypothesis, showing that ICT has a positive effect on intrinsic motivation and creativity, but not on autonomy and perceived competence. (El Kartouti & Juidette, 2023).

Our results are consistent with those of other studies that have highlighted the benefits of ICT in fostering student engagement in learning activities in physical education and sport.(Cece et al., 2023). ICT can stimulate pupils' interest, curiosity and enjoyment by offering them opportunities for variety, choice, challenge and feedback. (Kahlat, 2023). ICT can also support students' creativity by enabling them to explore, experiment and produce original content. In this way, ICT can enhance students' intrinsic motivation and creativity, which are two important dimensions of individualized learning.

However, our results contradict those of other studies that have highlighted the risks of ICT for students' autonomy and perceived competence in physical education and sport (Lamis & Nada, 2023). ICT can make students dependent, passive or distracted. (Castillo et al., 2023), by distancing them from their own bodies, their environment and their peers. ICT can also affect pupils' self-confidence and self-esteem by exposing them to external standards, comparisons or judgments. (Tessier & Trémion, 2023). In this way, ICT can undermine students' autonomy and perceived competence, which are two essential dimensions of spontaneous learning.

Our results have important pedagogical implications for PE teachers who wish to encourage spontaneous learning in their students. They suggest that ICT can be an effective tool for engaging students in learning activities, provided that it is used appropriately and integrated into teaching practices.(Martín-García, 2020). Teachers must therefore be attentive to the positive and negative effects of ICT on spontaneous learning and its dimensions, and adapt their intervention according to the needs, interests and characteristics of their pupils.

There are also limitations to our results, which must be taken into account when interpreting our findings. Firstly, our sample was relatively small (574 pupils), which limits the representativeness and generalization of our results. Finally, our study was quantitative in nature, which does not allow us to delve more deeply into the mechanisms and processes underlying individualized learning and the influence of ICT.

Our results open up some interesting research prospects, which could extend or complement our study. For example, it would be relevant to replicate our study with a larger and more diverse sample, by including pupils from different school levels, different socio-economic backgrounds, different cultures, etc. It would also be useful to develop or adapt a scale for measuring spontaneous learning specific to physical education and sport, taking into account the needs of the pupils. It would also be useful to develop or adapt a scale for measuring spontaneous learning specific to physical education and sport, taking into account the particularities of this discipline. Finally, it would be enriching to carry out a qualitative study, gathering the perceptions and experiences of pupils and teachers on spontaneous learning and ICT, using interviews, observations or life stories.

Conclusion

The ILS-16 is a measurement tool used to assess learners' adherence to individualized learning in physical education. It can be used to compare learner profiles. It can also be used to identify learners' needs and adapt educational interventions according to their level of autonomy, confidence and creativity. The ILS-16 can also contribute to research on learning in physical education, by allowing the testing of hypotheses relating to the effects of this type of learning on the motor performance, knowledge, attitudes and behaviors of learners. The ILS-16 is therefore a relevant and reliable tool for the Tunisian context, which deserves to be used and developed in future studies.

References

ALLOUCHE, M., & ZOUAOUI, I. Z. I. (2023). Impact de l'intégration des TIC sur la motivation à apprendre des étudiants. *Innovation, Technologies, Education et Communication*(6).

Ansari, J. A. N., & Khan, N. A. (2020). Exploring the role of social media in collaborative learning the new domain of learning. *Smart Learning Environments*, *7*(1), 1-16.

Archer, G., Saltelli, A., & Sobol, I. M. (1997). Sensitivity measures, ANOVA-like techniques and the use of bootstrap. *Journal of Statistical Computation and Simulation*, *58*(2), 99-120.

Astari, S., & Kartika, R. (2022). Blended Learning in Intermediate Accounting I. 4th International Conference on Educational Development and Quality Assurance (ICED-QA 2021),

Benson, J., & Clark, F. (1982). A guide for instrument development and validation. *The American journal of occupational therapy*, *36*(12), 789-800.

Bouletreau, A., Chouaniere, D., Wild, P., & Fontana, J. M. (1999). *Concevoir, traduire et valider un questionnaire. A propos d'un exemple, EUROQUEST*. https://hal-lara.archives-ouvertes.fr/hal-01420163

Byrne, B. M. (2001). Structural equation modeling with AMOS, EQS, and LISREL: Comparative approaches to testing for the factorial validity of a measuring instrument. *International journal of testing*, *1*(1), 55-86.

Castillo, J., Galy, E., & Thérouanne, P. (2023). Le Technostress et sa relation avec la charge mentale en contexte professionnel. *Psychologie du Travail et des Organisations*, *29*(4), 197-213.

Cece, V., Roure, C., Fargier, P., & Lentillon-Kaestne, V. (2023). L'effet des jeux vidéo actifs sur les élèves en éducation physique et sportive: une revue systématique. *Movement & Sport Sciences*(1), 29-45.

Charlier, B., Deschryver, N., & Peraya, D. (2006). Apprendre en présence et à distance: une définition des dispositifs hybrides. *Distances et savoirs*, *4*(4), 469-496.

El Kartouti, S. E., & Juidette, S. (2023). L'impact de l'usage des TIC en éducation sur l'amélioration de l'apprentissage des élèves scolarisés, et les conséquences sur l'environnement. SHS Web of Conferences,

Eschenauer, S., de Pembroke, E. M., & Aden, J. (2023). *Empathie et bienveillance au cœur de l'apprenance*. Iggybook.

Jöreskog, K. G., & Sörbom, D. (1996). *LISREL 8: User's reference guide*. Scientific Software International.

Kahlat, A. E. (2023). *Impact émotionnel du Covid-19 sur les utilisateurs des réseaux sociaux* Université du Québec à Trois-Rivières].

Kaiser, H. F. (1958). The varimax criterion for analytic rotation in factor analysis. *Psychometrika*, *23*(3), 187-200.

Lamis, G., & Nada, D. (2023). *Les TIC dans l'enseignement supérieur: Cas des étudiants du département des langues étrangères du Centre universitaire de Mila* university center of abdalhafid boussouf-MILA].

Léger, M. T. (2022). Apprendre à être créatif: une étude comparative du développement de la créativité comme compétence numérique en milieu d'apprentissage riche en technologies. *Revue hybride de l'éducation*, *6*(1), 125-147.

MacCallum, R. C., Browne, M. W., & Sugawara, H. M. (1996). Power analysis and determination of sample size for covariance structure modeling. *Psychological methods*, *1*(2), 130.

Martín-García, A. V. c. (2020). *Blended learning convergence between technology and pedagogy*. Springer. https://search.ebscohost.com/login.aspx?direct=true&scope=site&db=nlebk&db=nlabk&AN=2479698

https://doi.org/10.1007/978-3-030-45781-5

http://www.vlebooks.com/vleweb/product/openreader?id=none&isbn=9783030457815

Martin, N. J., Ameluxen-Coleman, E. J., & Heinrichs, D. M. (2015). Innovative ways to use modern technology to enhance, rather than hinder, physical activity among youth. *Journal of physical education, recreation and dance*, *86*(4), 46-53.

Moore, J. L., Dickson-Deane, C., & Galyen, K. (2011). e-Learning, online learning, and distance learning environments: Are they the same? *The Internet and higher education*, *14*(2), 129-135.

Rasheed, M. I., Malik, M. J., Pitafi, A. H., Iqbal, J., Anser, M. K., & Abbas, M. (2020). Usage of social media, student engagement, and creativity: The role of knowledge sharing behavior and cyberbullying. *Computers & Education*, *159*, 104002. https://doi.org/https://doi.org/10.1016/j.compedu.2020.104002

Rousselle, P., & Vigneau, F. (2016). Adaptation et validation d'une version brève en langue française du questionnaire d'impulsivité de Barratt (BIS-15). *European Review of Applied Psychology*, *66*(6), 317-324. https://doi.org/https://doi.org/10.1016/j.erap.2016.05.001

Satorra, A., & Bentler, P. M. (1994). Corrections to test statistics and standard errors in covariance structure analysis.

Schermelleh-Engel, K., Moosbrugger, H., & Müller, H. (2003). Evaluating the fit of structural equation models: Tests of significance and descriptive goodness-of-fit measures. *Methods of psychological research online*, *8*(2), 23-74.

Tessier, L., & Trémion, V. (2023). Pratiques numériques de lycéens et injonctions à l'autonomie à l'épreuve du confinement. *RESET. Recherches en sciences sociales sur Internet*(12).

Visioli, J. (2022). Didier Delignières, On peut toujours penser autrement… L'école, l'université, l'éducation physique et sportive, Paris, Éditions EP&S, coll.«Activités physiques et sports. Recherche et formation», 2021, 265 p. *Staps*, I55-IV.