

STUDENTS' SATISFACTION WITH SELF-PACED E-LEARNING: EVIDENCE FROM A META-ANALYSIS

SODDISFAZIONE DEGLI STUDENTI PER L'E-LEARNING AUTOGESTITO: PROVE DA UNA META-ANALISI



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ABSTRACT

This study sought to synthesize meta-analysis evidence that self-paced e-learning (SPL) addresses learning needs in SPL contexts. A systematic literature review and a meta-analysis were conducted. Only 13 articles were included to evaluate the overall pooled satisfaction prevalence. Any potential differences between traditional instructor-led (TIL) and the SPL modalities were also examined and cross-compared. The results indicated that over 80% of the students experienced the learning practices of interest. When comparing TIL to SPL, the random-effects model yielded a standardized mean difference of 0.494 (95% CI: 0.278 - 0.710) and a significant average outcome difference from 0 ($z = 4.485$, $p < 0.0001$), indicating that students preferred SPL over TIL, despite their reported insufficient self-regulation skills. Finally, detailed results are discussed and a conclusion is drawn.

L'obiettivo di questo studio era sintetizzare le prove di meta-analisi che l'e-learning autogestito (SPL) soddisfa le esigenze di apprendimento nei contesti SPL. state condotte una meta-analisi e una revisione sistematica della letteratura. Per valutare la prevalenza della soddisfazione complessiva, stati inclusi solo tredici articoli. Inoltre, state prese in considerazione e confrontate le potenziali differenze tra le modalità tradizionali con istruttore (TIL) e quelle SPL. I risultati hanno indicato che più dell'80% degli studenti ha sperimentato le pratiche di apprendimento di interesse. Confrontando TIL e SPL, il modello a effetti casuali ha prodotto una differenza media standardizzata di 0,494 (95% CI: 0,278 - 0,710) e una differenza media significativa tra i risultati e lo zero ($z = 4,485$, $p < 0,0001$). Ciò indica che, nonostante la loro insufficiente capacità di autoregolazione, gli studenti preferivano SPL rispetto a TIL. Infine, vengono discussi i risultati e le conclusioni.

KEYWORDS

Self-paced E-learning (SPL), learning Satisfaction, prevalence, meta-analysis.

La modalità di e-learning autogestito (SPL), apprendimento Soddisfazione, prevalenza, meta-analisi.

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Introduction

The twenty-first century has seen a significant growth in the use of digital technologies such as artificial Intelligence (AI), internet of things (IoT), digital learning tools and modes etc. in a variety of sectors, including education. This surge is most likely due to the COVID-19 pandemic, which outbreaked in December 2019 and declared on March 11, 2020 to be a fatal respiratory disease (Sohrabi et al., 2020). COVID-19 is often considered as a catalyst for emerging novel educational modalities such as online, blended, and hybrid learning, adapted when traditional modes of learning were abruptly stopped (Camargo, Tempiski, Busnardo, de Arruda Martins, & Gemperli, 2020; Rose, 2020; Taylor et al., 2020), and so the SPL grew in popularity as illustrated in Figure 1 by a search of the phrase SPL in Google Trends worldwide.

SPL is a novel pedagogy that stresses students' self-regulating behavioral strategies for achieving learning outcomes. It is defined as either electronic or non-electronic learning with a structured course provided asynchronously online and

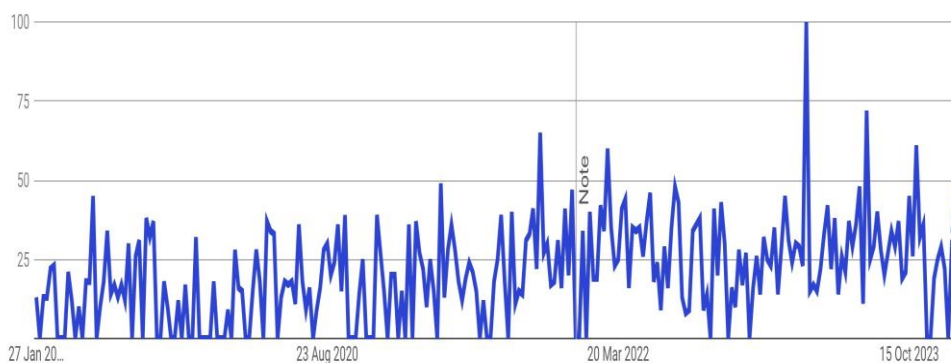


Figure 1. The popularity of the search term 'SPL' in Google Trends worldwide in the past four years.

Source: Google Trends (<http://www.google.com/trends>).

offline. In this case, learners regulate and manage their own learning, at their own pace, at any time, and anywhere within a specific time frame. SPL course content is normally instructional text, but it may also include interactive visuals, video lectures, software simulation, animation, digital games, quizzes, assessments, and so on (Kim et al., 2021). In a recent study that reported personalization strategies in STE(A)M education, digital tools were more frequently utilized to create self-pacing content tailored to the needs of each learner (K. C. Li & Wong, 2022). That is, digitally created learning materials outnumber traditionally prepared content in

SPL environments. The main issue with SPL is that it is difficult to assess. Nonetheless, self-reported satisfaction surveys are frequently employed in many studies to assess learning outcomes in SPL settings (Garrison, Baia, Canning, & Strang, 2015; Korucu-Kış, 2022; S. Li et al., 2020; Luginbuehl et al., 2023; Mak & Georges, 1997; Minnes, 2022; Newman, Fink, Clough, & Johnston, 2021; Ning et al., 2023; Schimming, 2008; Segal et al., 2013; Tangcheewinsirikul, Takkinsatian, Yenjabog, Sirimongkolchaiyakul, & Prempraparn, 2023; Vavasseur et al., 2020; von Grünigen et al., 2023).

Satisfaction surveys are widely thought to play an important role in assessing the quality of learning outcomes, and so many educational institutions use them to prove how well their pedagogical approaches work so as to attract a large number of learners (Arambewela & Hall, 2013). Improved learning outcomes depend on a variety of factors, some of which are related to schools' settings and the conditions under which teaching and learning occurs; thus, learners self-reporting their learning situations is an effective approach to understanding pedagogical practices and developing countermeasures to overcome problems encountered by learners. Despite the widespread use of satisfaction surveys, some research raised major criticism about bias in learners' ratings, the utility and validity of the satisfaction instruments (Winstone, Ajjawi, Dirkx, & Boud, 2022), language issues (Kornell, 2020), and meta-cognitive errors in assessing one's own learning which can result in 'illusions of learning' in which learners rate highly and positively instructors who are enthusiastically engaging and appear to simplify the teaching and learning content, yet these factors do not correlate with actual learning (Carpenter, Witherby, & Tauber, 2020).

The paper is organized as follows: The first section introduces the entire study and provides a comprehensive picture of what is meant by student satisfaction, self-paced learning, and the linkage between the two key concepts. The second section discusses the methodology employed in the research, from search strategy to data analysis. Next, the results are reported and discussed, followed by conclusion, limitations and the future research considerations.

1. Methods

1.1 Search Strategy

Articles, that reported on self-paced modes of learning (SPL) in all fields, were included. The systematic literature review was carried out by searching databases such as Web of Science Core Collection (WOS-Core collection), Google Scholar, and

ResearchGate. Our most recent search took place in January 5, 2024. The search for English articles simply containing the term 'self-paced*' yielded 5733 results. To search and include related studies in the current study, we initially utilized the keyword "self-paced learn*" that was limited to English literature. The initial search in WOS-Core collection produced 1551 articles. Ultimately, terms 'self-paced learning' and 'satisfaction' being searched simultaneously, only 131 articles were obtained.

1.2 Selection of articles and Data Extraction

Published articles were considered eligible for the study analysis provided that they fulfilled the following criteria: (1) cross-sectional articles with full-text available in English; (2) articles reporting the prevalence of SPL satisfaction. In contrast, the following articles were excluded: (1) non-English full-text reports; (2) articles with insufficient data to estimate the prevalence rate; (3) expert opinions, letters to the editor, commentaries, editorials, case series, reviews, case reports; and (4) articles with overlapping data.

Subsequently, two authors independently reviewed all included articles that were deemed possibly relevant. They assessed the relevancy of each article and extracted the following information in Excel datasheets: Author's name, sample size, overall satisfaction, references, subject area of the article, mean age, category, and percentage of male participants. The analysis followed the preferred reporting items for systematic reviews and meta-analyses (PRISMA) (Moher et al., 2019; Page et al., 2021). Egger and Begg's tests were used to assess publication bias. The quality of eligible articles was assessed using the 'Newcastle Ottawa Scale (NOS)'.

2. Data Analysis

The overall satisfaction with SPL was computed using STATA software 18MP. The effect size for estimating a single proportion (prevalence) in a random effects model was used to calculate the overall pooled SPL satisfaction. The between-study heterogeneity was assessed using the Q test ($P < 0.10$) and I-squared statistics ($I^2 > 40\%$). To investigate publication bias, Egger (Egger, Smith, Schneider, & Minder, 1997) and Begg's tests (Begg & Mazumdar, 1994) were employed.

Similarly, to analyze any potential difference and compare traditional instructor-led and SPL modes of learning, the analysis was conducted using the standardized mean difference as the outcome measure. A random-effects model

was fitted to data. The amount of heterogeneity (i.e., τ^2), was estimated using the restricted maximum-likelihood estimator (Viechtbauer 2005). In addition to the estimate of τ^2 , the Q-test for heterogeneity (Cochran 1954) and the I^2 statistic are reported. Studentized residuals and Cook's distances are used to examine whether included articles may be subjected to outliers or any influential in the context of the model. According to literature (Barker et al., 2021), articles with a studentized residual larger than the $100 \times (1 - 0.05 / (2 \times k))$ percentile of a standard normal distribution are considered potential outliers (i.e., using a Bonferroni correction with two-sided $\alpha = 0.05$ for included articles). Articles with a Cook's distance larger than the median plus six times the interquartile range of the Cook's distances are considered to be influential. Our study reported no any outlier or influential. Ultimately, the rank correlation and the regression tests, using the standard error of observed outcomes as predictor, are used to check for funnel plot asymmetry.

3. Results

3.1 Search Results and Study Selection

Figure 2 illustrates the process used to select the eligible articles. A total of 131 articles were potentially linked to students' SPL satisfaction. After reviewing the titles and abstracts, 99 articles were excluded based on the above-mentioned inclusion and exclusion criteria. Eventually, after full-text screening and quality assessment, 13 articles were deemed eligible for final analysis. Ten of the 13 articles included are in the field of health sciences, with the remaining three in computer science, environmental science, and English. These 13 articles were considered in analyzing the overall pooled satisfaction prevalence.

To analyze any potential difference and to compare traditional instructor-led and SPL modes of learning, of the 13 included articles, a total of 3 articles ($n=3$) whose relevant data (mean and standard deviation), were included in the analysis.

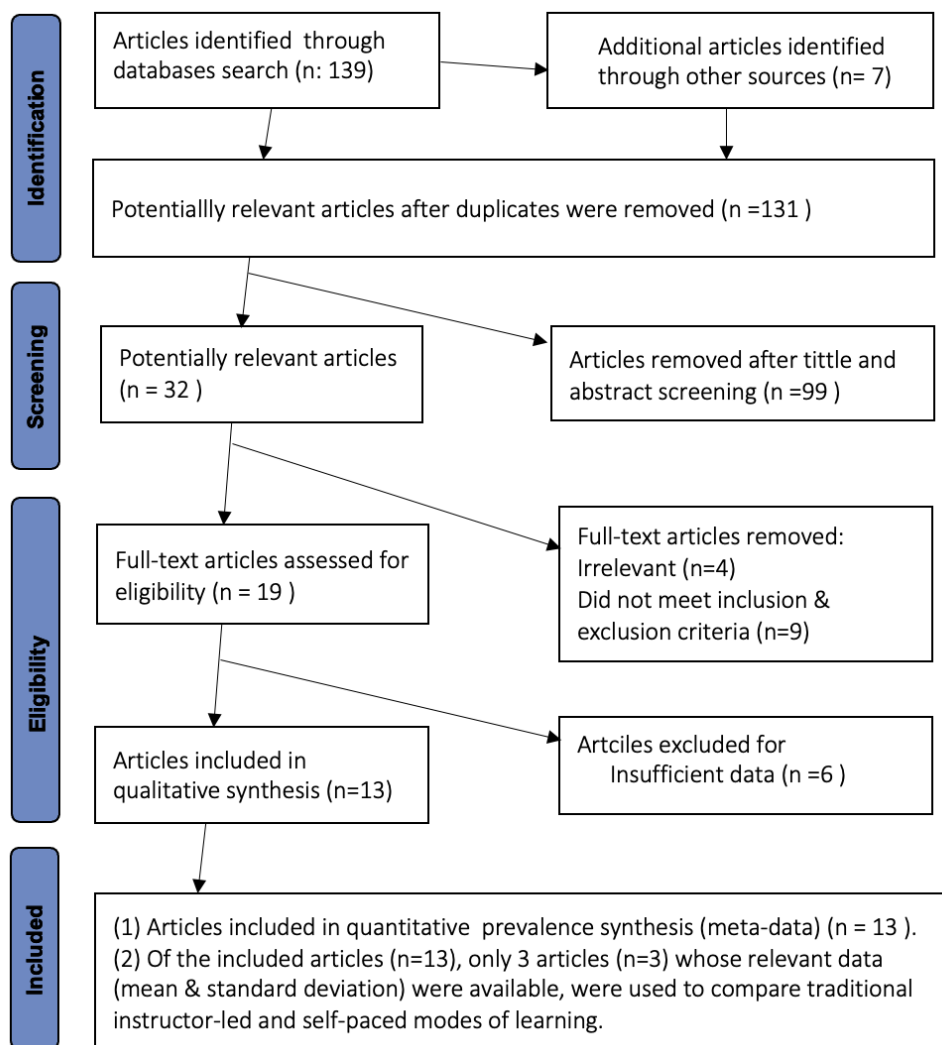


Figure 2. The selection process of articles search based on the PRISMA guideline

3.2 Students' overall learning satisfaction with SPL

A total of 1681 students were evaluated, with 1265 being in health sciences (medicine (1194), nursing (58), and clinical pharmacy (13) and 416 in other subjects (English language (55), environmental science (38) and computer science (323)). Table 1 shows the extracted data from the included articles, which includes the first author's name and the year of publication, the study's location, sample size, overall satisfaction, subject name, mean age, male percentage, SPL modality, and the

mean and standard deviation for only four articles included in the comparison of traditional instructor-led and SPL modes of learning.

Table 1. Characteristics of included published articles on Students' satisfaction with SPL

Reference	Country	Sample size	Overall satisfaction	Subject	Mean age	Male percentage	SPL modality
Ning et al. (2023)	China	81	86.25%	Medicine	29	36%	CRS software mediated SPE-L.
Garrison et al. (2015)	USA	13	74%	Pharmacy	NA	NA	Asynchronous Online learning.
Mak et al. (1997)	Australia	38	32.7%	Environmental sc.	NA	34.6%	Computer-assisted self-paced Learning.
Vavasseur et al. (2020)	France	304	99%	Medicine	NA	NA	Video lectures.
Minnes (2022)	USA	323	84%	Computer Science	NA	NA	Online self-paced contents.
Li et al. (2020)	China	41	77%	Medicine	NA	NA	GSR software mediated SPE-L.
von Grünigen et al. (2023)	Cross-cultural (17 C.)	82	99%	Medicine	NA	NA	Asynchronous, self-paced e-learning class.
Newman et al. (2021)	USA	364	90%	Medicine	NA	NA	Video lectures
Schimming (2008)	USA	231	81.6%	Medicine	NA	NA	Self-paced online tutorials.
Tangcheewinsirikul (2023)	Thailand	45	80%	Medicine	23.1	21 (46.7%)	Self-paced online learning materials.
Segal et al. (2013)	Israel	58	95.8%	Nursing	24.95	5 (14.6%)	Video lectures.
Korucu-Kış (2022)	Türkiye	55	89%	English language	NA	14 (25.5%)	Video lectures.
Luginbuehl et al. (2023)	Germany	46	66.7%	Medicine	23.8	11 (24%)	Video lectures.

Notes: N: Sample size, SD: standard deviation, NA: not available. To compare the two modes of learning, the following data were used: **Traditional instructor-led modes of learning:** Li et al. (2020) (n1= 21, mean1= 78.76, SD1= 7.58); Schimming (2008) (n1=70, mean1= 2.23, SD1= 0.83); Segal et al. (2013) (n1= 32, mean1= 8.4, SD1= 2.72). **SPL modes of learning:** Li et al. (2020) (n2= 20, mean2= 83.7, SD2= 5.99); Schimming (2008) (n2= 231, mean2= 2.54, SD2= 0.596); Segal et al. (2013) (n2= 58, mean2= 9.6, SD2= 2.57).

Two Forest plots of the overall pooled satisfaction prevalence and the comparative estimates between traditional instructor-led and SPL modes of

learning are presented in Figure 3 and 4 respectively. Firstly, the overall pooled satisfaction prevalence is 0.83 (95% CI 0.73 – 0.92) ($Q = 232.04$, $df = 12$, $p < 0.001$, $I^2 = 98.39\%$, and $Tau^2 = 0.03$), indicating that 83% of students experience the SPL practices of interest. Secondly, the comparative difference analysis between the traditional instructor-led and SPL modes of learning indicated that the observed standardized mean differences ranged from 0.4534 to 0.7070, with the majority of estimates being positive (100%). The estimated average standardized mean difference based on the random-effects model was $\hat{\mu} = 0.4939$ (95% CI: 0.2781 to 0.7097). Therefore, the average outcome differed significantly from zero ($z = 4.4851$, $p < 0.0001$). The Q-test, indicated that there was no significant amount of heterogeneity in the included articles ($Q(2) = 0.5002$, $p = 0.7787$, $\tau^2 = 0.0000$, $I^2 = 0.0000\%$). The evaluated standardized residuals revealed that none of the included articles had a value larger than ± 2.3940 and hence there was no indication of outliers in the context of this model. The evaluated Cook's distances indicated none of the included articles was considered to be overly influential. Neither the rank correlation nor the regression test indicated any funnel plot asymmetry ($p = 0.3333$ and $p = 0.5875$, respectively).

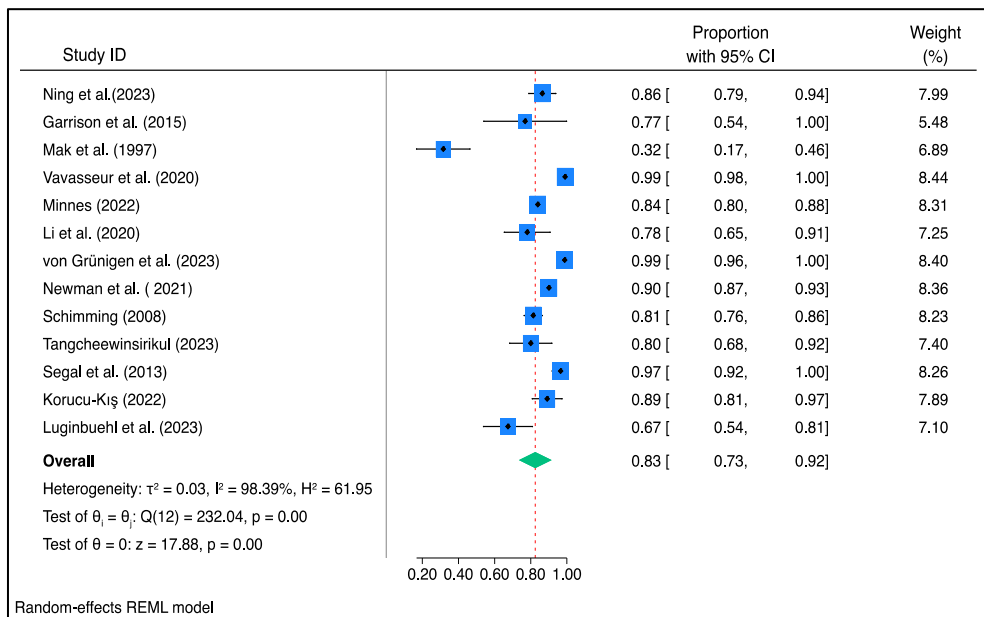


Figure 3. The forest plot of meta-analysis for learning satisfaction prevalence

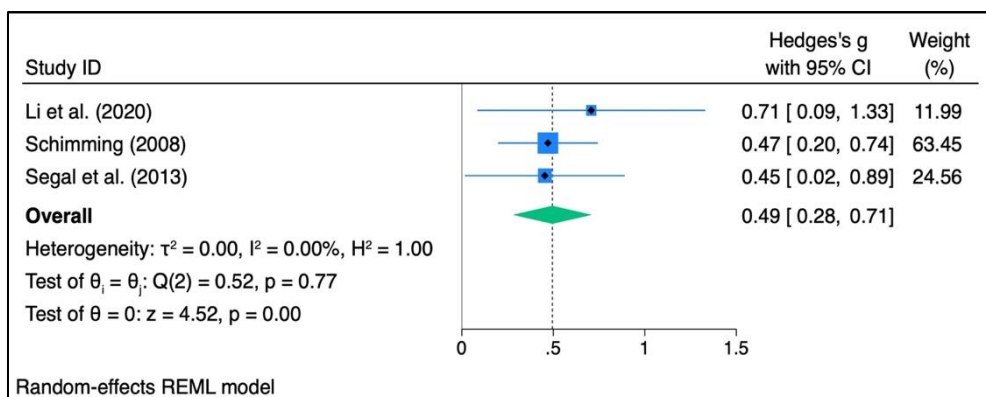


Figure 4. The forest plot of meta-analysis for traditional instructor-led and SPL modes of learning

4. Discussion

Of the 19 articles that were potentially relevant to students' satisfaction with SPL, 13 articles, three of which had relevant data (mean and SD, see Table 1) to compare traditional instructor-led and SPL modes of learning, met the criteria for inclusion in the final study analysis; no single article with non-student participants was included. The pooled SPL satisfaction with 95% confidence intervals (CI), was 0.83 (95% CI 0.73-0.92). That is, the findings suggested that 83% of students experienced learning practices of interest in SPL environments. Additionally, the random-effects model produced an estimated average standardized mean difference of $\hat{\mu} = 0.494$ (95% CI: 0.278 – 0.710) and a significant average outcome difference from zero ($z = 4.485$, $p < 0.0001$) when comparing SPL with TIL, indicating that students preferred SPL over TIL, despite their reported insufficient self-regulating behavioral skills. These findings are inconsistent with extant literature (Li et al., 2020; Minnes, 2022; Noguera, Albó, & Beardsley, 2022; Schimming, 2008).

Articles included in this study are mostly in the field of health sciences (10/13), with the remaining three in computer science, environmental science, and English. It was discovered (Garrison et al., 2015; Vavasseur et al., 2020) that SPL is an effective and relatively engaging and motivating format. However, health sciences students pointed out that health sciences require broad and diverse knowledge, spanning fundamental knowledge, practical knowledge, particular gestures, and interpersonal or human contact, and thus a hybrid format combining both traditional instructor-led and SPL modes of learning can be used to explore all existing areas of knowledge to enrich learning experiences. In consistent with these findings, all the included articles found that SPL was an innovative and promising

mode for effectively engaging learners, but none of them recommended using SPL as 'stand-alone' mode in the course or program. Ultimately, in the recent research, Ning et al. (2023) confirmed that 'SPL E-learning is not a substitute for traditional instructor-led modes of learning, but an effective supplement to be utilized in combination with traditional learning mode.

Our study findings evidenced the overall extent of students' satisfaction with SPL and showed that more than 80% of the students were satisfied with SPL practices, formats and the space for knowledge creation offered by SPL, while students preferred SPL over TIL. This quantifiable measurement of learning satisfaction is however, heavily criticized not to touch the qualitative data needed to draw effective practical and informed decision (Barker et al., 2021). The qualitative data suggests that improved quality of students' learning hinges on the instructors' efficacy to incorporate the emerging technologies to transform our pedagogical practices. In line with this, building effective student support mechanisms and familiarizing instructors' with technology-enabled learning platforms were indicated as potential ways to increase students' satisfaction (Garrison et al., 2015). Most importantly, educators must teach their students self-regulating behavioral strategies to allow them to effectively regulate and manage their learning in SPL environment.

This study is not without limitations. First, the study included a few articles that were only available in English, focusing on students' satisfaction with SPL environments. This knowledge gap urgently necessitates further investigations. Second, in addition to theories that have yet to be developed, research estimating a single prevalence in a single group are rare. Thus, there is no instrument for testing bias in a single prevalence (Barker et al., 2021).

Conclusion

The overall objective of this study was to synthesize meta-analysis evidence that SPL helps address learning needs in SPL contexts. The results indicated that more than 80% of the students experienced the learning practices of interest, while the random-effects model produced an estimated average standardized mean difference of $\hat{\mu} = 0.494$ (95% CI: 0.278 – 0.710) and a significant average outcome difference from zero ($z = 4.485$, $p < 0.0001$) when comparing SPL with TIL, indicating that students preferred SPL over TIL, despite their reported insufficient self-regulating behavioral skills.

Despite the two modes difference, the included studies indicated that each learning mode demonstrate its pedagogical potential; nevertheless, when it comes to improved learning outcomes, the hybrid mode of the two is suggested. In line with these findings, the following conclusion is drawn: We have noticed patterns indicating that SPL, accelerated by the use of emerging technologies in education, is more and more gaining popularity and it is quite clear that its application will not be abandoned in the near future. Therefore, given the learners' difficulty in developing and internalizing self-regulating behaviors and the SPL's greater reliance on learners' self-regulating behaviors for learning success, teaching self-regulating behavioral strategies can no longer be mandatory but rather a choice to improve learning outcomes in SPL contexts.

Competing interests

This research has no conflict of interests to declare.

Conflict of interest

The authors declare no conflicts of interest.

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