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What works in financial education? Experimental evidence on program impact

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ABSTRACT

Financial education is increasingly essential for safeguarding both individual and corporate well-being. This study systematically reviews global financial education experiments using a dual-method framework that integrates a deep learning classifier with advanced multivariate statistical techniques. Our analysis indicates that while short-term improvements in financial literacy are common, such gains tend to diminish over time without ongoing reinforcement. Moreover, the limited impact of digital innovations and monetary incentives suggests that successful financial education depends on more than simply deploying technological solutions or extrinsic rewards. Overall, this review provides valuable insights into the evolving landscape of financial education in a dynamic economic context and underscores the need for sustainable strategies that secure lasting improvements in financial literacy.

1. Introduction

Financial education is widely acknowledged as a pivotal element on the international agenda (Kirton & Wang, 2022; OECD, 2022a). Although the COVID-19 pandemic has highlighted existing financial vulnerabilities and renewed the focus on financial education (Fornero & Lo Prete, 2023), there remains limited evidence on whether this crisis has triggered lasting shifts in financial literacy levels (Litterscheidt & Streich, 2020; Proestakis, Marandola, Lourenço, & van Bavel, 2024; Sconti, Caserta, & Ferrante, 2024). Recent data from OECD (2023), for example, reveals a concerning statistic: a substantial proportion of adults lacks a fundamental grasp of core financial concepts and the capacity to apply essential financial skills in complex scenarios. In fact, OECD (2023) reports that merely 34% of adults worldwide reach the minimum target level for financial literacy.

The OECD (2020b) defines *financial literacy* as a combination of awareness, knowledge, skills, attitudes, and behavior. This underscores a *multidimensional* framework essential to sound financial decision-making and broader societal well-being (Compen, De Witte, Declercq, & Schelfhout, 2023). In some academic work, the terms *financial literacy* and *financial knowledge* are used interchangeably (Huston, 2010). Nonetheless, financial knowledge entails a range of theoretical competencies, such as mathematical proficiency, the ability to understand interest rates, and the capacity to evaluate various financial operations and basic practices like saving, investing, and diversification (Lusardi & Mitchell, 2014). Thus, financial knowledge is fully subsumed under the broader construct of financial literacy. The economic disruptions set in motion by COVID-19, coupled with rising inflation and interest rates, have significantly underscored the urgency of fortifying financial literacy (Bruce et al., 2022; Clark, Lusardi, & Mitchell, 2021). Far from being confined to arithmetic or accounting, financial literacy involves informed decision-making across saving, consumption, investment, and debt management (OECD, 2013, 2016), ultimately enhancing individuals' well-being and exerting positive spillover effects on the broader economy (Nicolini & Cude, 2021).

The concept of *financial education* is articulated by the OECD as "the process by which financial consumers/investors improve their understanding of financial products and concepts and, through information, instruction and/or objective advice, develop the skills and confidence to become more aware of financial risks and opportunities, to make informed choices, to know where to go for help, and to take other effective actions to improve their financial wellbeing" (OECD, 2005). This definition has evolved from an optional notion to a recommended practice that demands more than a superficial distinction between assets and liabilities (OECD, 2022b). It requires a deep commitment to fundamental financial principles to promote personal financial stability and broader economic growth (Lyons & Kass-Hanna, 2021; Ozili, Ademiju, & Rachid, 2023). Core topics, such as capital accumulation, compound interest, and risk premiums, can present significant obstacles for various demographic groups (Lusardi & Oggero, 2017; OECD, 2022b).

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Although the COVID-19 pandemic drew increased attention to socioeconomic disparities, particularly for populations dependent on digital financial services (Aina, Brunetti, Mussida, & Scicchitano, 2021), recent research also underscores the opportunities and challenges emerging technologies pose to bridge financial gaps (da Silva, Becker, & Vieira, 2025). Consequently, it remains uncertain whether such changes will lead to enduring improvements in overall financial literacy. Addressing this *digital financial divide* – the differential access to digital financial services across diverse social groups (Vassilakopoulou & Hustad, 2023) – hinges on robust financial literacy paired with specialized digital training (OECD, 2020a; Wright, 2019).

The main goal of financial education exceeds the transfer of theoretical concepts; rather, it aims to reshape behaviors and facilitate informed financial choices (Haupt, 2021). This objective includes putting new knowledge to use in genuine financial decisions, from budgeting to consumption and investment (Boyd & Díez-Amigo, 2023; García, 2013). The comprehensive scope of financial education thus spans the path from mere knowledge acquisition to the application of actionable strategies and refined decision-making (Frisancho, 2022; Hastings et al., 2013; Lusardi & Mitchell, 2014), alongside practical resource management (Bruhn, de Souza Leão, Legovini, Marchetti, & Zia, 2013).

Recent scholarship emphasizes a holistic lens on financial education, one that stretches beyond conventional knowledge gains (Collins & O'Rourke, 2010; Compen et al., 2023). Several meta-analyses have investigated how educational interventions in financial literacy, particularly those aimed at children and adolescents, affect behavior and attitudes (Fernandes, Lynch, & Netemeyer, 2014; Kaiser & Menkhoff, 2017, 2020). Indeed, randomized school-based experiments often highlight positive impacts on financial knowledge and behavioral changes (Amagir, van den Brink, Groot, & Wilschut, 2022; Maldonado & De Witte, 2021; Rodriguez & Martinez, 2022; Sconti et al., 2024). Building on this evidence, recent randomized trials that deploy fully digital, game-based courses mark a new frontier in the field (Cannistrà et al., 2024). However, notable gaps remain in the literature, particularly when it comes to systematic reviews of randomized controlled trials spanning multiple social and demographic contexts (Sayinzoga, Bulte, & Lensink, 2016).

Although meta-studies such as Kaiser, Lusardi, Menkhoff, and Urban (2022), Kaiser and Menkhoff (2020) have thoroughly assessed the scope of financial education programs, our study employs a dual-method quantitative framework that combines machine learning with multivariate statistical methods, examining an extensive array of experimental interventions. We adhere to the PRISMA 2020 guidelines (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) to maintain transparency and reproducibility in our selection, screening, and inclusion procedures (Page et al., 2021). Drawing from major bibliographic sources like Scopus, Web of Science, and Google Scholar, we screened out articles that failed to specify a clear financial education component or lacked sufficient outcome data to evaluate program effectiveness. Ultimately, 70 empirical studies were included, allowing for a wide-ranging, multiangle view of financial education' s impact on financial literacy.

Our dual-method framework combines *XGBoost*, an advanced gradient-boosting algorithm known for robustly identifying key predictive features in complex, heterogeneous datasets (Chen & Guestrin, 2016; Natekin & Knoll, 2013), with an *ordinal logistic regression* to enhance interpretability. Specifically, XGBoost' s capacity to model non-linear interactions (Zhang & Haghani, 2015) offers nuanced insights into the factors driving financial education effectiveness. We then employ ordinal logistic regression (Agresti, 2002; Tutz, 2022) to address the ordered nature of our outcome categories, clarifying both the magnitude and direction of crucial predictors. This more granular approach transcends a simple comparison of differences across studies, analyzing in detail how each variable influences financial education, while also incorporating a time dimension and evaluating robustness. In essence, our method presents a richer, predictive complement to traditional meta-analytic models, ensuring that both interpretability and forecasting power are maximized.

We also delve into specific variables frequently emphasized in previous studies, including *treatment duration*, *monetary incentives*, *experiment year*, *post-treatment evaluation*, *digital tool*, and *region*, all of which appear repeatedly in the empirical and theoretical literature on financial education (Fernandes et al., 2014; Kaiser & Menkhoff, 2017, 2020; Miller, Reichelstein, Salas, & Zia, 2015). For example, research frequently debates the effect of longer treatment durations or the provision of monetary rewards on keeping participants engaged and helping them retain financial concepts over time (Carpena, Cole, Shapiro, & Zia, 2011; Fernandes et al., 2014). Similarly, the growing adoption of digital tools, especially during and after the pandemic, has invited a critical examination of their effectiveness in financial education contexts (Kuntze, Wu, Wooldridge, & Whang, 2019; Salas-Velasco, 2022). Likewise, the scheduling of post-treatment evaluations and the regional context have emerged as pivotal elements that can substantially shape the outcomes of the intervention (Bruhn et al., 2013; Rodriguez & Martinez, 2022). Although factors such as pedagogical methods, teacher qualifications, or participant motivation may offer additional insight, our chosen dimensions stand out as consistently measurable and analytically feasible across a spectrum of diverse study settings, thus guaranteeing methodological rigor and facilitating cross-study comparisons.

Our findings strongly suggest that most interventions exert a favorable effect on financial literacy—here conceptualized as an integrated gauge of knowledge, behaviors, and attitudes. We categorize the examined programs as fully effective, partially effective, or ineffective, using both independent researcher appraisals and a transformer model (GPT-4). These findings largely accord with prior meta-analyses (Kaiser et al., 2022; Kaiser & Menkhoff, 2017, 2020; Miller et al., 2015), albeit diverging somewhat from the more reserved stance of Fernandes et al. (2014), who notes that financial education' s overall impact may be limited. Our findings also reveal multiple factors that substantially shape program effectiveness. Simply increasing intervention length or offering monetary incentives does not automatically yield better outcomes, whereas more frequent post-intervention assessments appear to preserve gains more effectively. Likewise, digital technology alone does not guarantee enhanced knowledge retention, emphasizing the need for carefully tailored instructional design. In particular, studies conducted in more recent years tend to show stronger overall effects, suggesting improvements in both pedagogical approaches and methodological rigor. Finally, geographic differences highlight how cultural norms and economic contexts can profoundly influence the success of financial education interventions.

We further observe a notable surge in experimental research on financial education, complemented by significant collaboration among academics. Nearly half of the interventions target student populations, highlighting the critical role of early education in developing lifelong financial competencies. While personal finance themes such as budgeting and saving dominate, issues related to credit, investment, and specialized areas remain comparatively underexplored. This tendency indicates that, although foundational financial skills receive considerable attention, an expansion to more advanced concepts may be necessary to address the wide-ranging and evolving demands of various demographic segments.

The remainder of this paper proceeds as follows. Section 2 outlines the theoretical underpinnings and presents the central hypotheses shaping our analysis. Section 3 describes the data sources and methodological framework, detailing both the systematic review approach and the variables considered. Section 4 then reports the core findings of our quantitative analysis. Finally, Section 5 discusses our findings, offers recommendations for enhancing financial education, and outlines future research directions.

2. Hypotheses formulation

Building on the findings gleaned from the systematic literature review, we formulated five core hypotheses to guide our quantitative analysis (see Table 1). Each hypothesis emerges from the accumulated scholarly evidence detailed within this review, reflecting the principal dimensions of financial education research.

Hypothesis 1: Treatment duration: a longer duration of financial education programs is positively correlated with improved financial outcomes.

Our first hypothesis posits that extended instructional time may enhance financial literacy outcomes. Although Table 4 indicates an average treatment duration of approximately 7.2 h, a figure ranging from less than an hour to nearly 72 h, a deeper reading of the scholarly landscape suggests that program length alone is not a sufficient predictor of success. Indeed, researchers report a spectrum of outcomes. Some studies (Billari, Favero, & Saita, 2023; Burke, Kieffer, Mottola, & Perez-Arce, 2022; Compen et al., 2023; Salas-Velasco, 2022) have demonstrated that even short, targeted interventions can produce meaningful gains. For example, Billari et al. (2023) observed that a mere 25 min online workshop for Italian employees significantly narrowed the wealth gap among pension fund participants and improved their investment strategies. In contrast, Paraboni and da Costa (2021) and Steinert, Cluver, Meinck, Doubt, and Vollmer (2018) highlight the merits of more extensive learning sessions; in particular, Paraboni and da Costa (2021) identifies notable improvements in financial awareness, attitudes and behavior of Brazilian university students after a 72-hour course. These divergent findings underscore the complexity of linking educational duration to tangible outcomes.

Hypothesis 2: The gap between the intervention's implementation and its subsequent evaluation is pivotal for sustaining its effectiveness. The longer this interval, the greater the likelihood of diminished impacts.

A second hypothesis emphasizes the temporal dimension in evaluating long-term results. Research on school-based financial education underscores the importance of follow-up assessments, ranging from standardized surveys to high-stakes data collection, to ascertain the durability of any acquired knowledge or behavioral shifts. Based on this evidence, Cannistrà et al. (2024) report significant gains in student financial literacy just two to three weeks after a fully digital game-based course, but warn that such a brief evaluation window cannot determine whether these improvements last, hence the need for longer follow-ups. This finding reinforces the view that evaluation timing conditions the observed impact of financial education programs. For instance, Frisancho (2022) illustrate how students' initial gains can foster gradual but sustained behavioral change three years later, whereas Amagir et al. (2022), Bruhn et al. (2013) show that benefits may fade when programs are neither reinforced nor re-assessed within a short period (e.g., six months post-intervention). These patterns highlight that retention hinges on ongoing engagement and timely reassessment.

Hypothesis 3: Digital Tools: incorporating digital interfaces and online platforms fosters higher retention of financial literacy.

Academic discourse increasingly recognizes the transformative potential of digital technologies in financial education, especially following the shift to online learning during the pandemic. Yet, evidence remains mixed: while some analyses (Rodriguez & Martinez, 2022) find that traditional classroom methods can sometimes outperform digital solutions, recent large-scale experiments – such as (Sconti et al., 2024) and Cannistrà et al. (2024) – show that well-designed, game-based online platforms can yield significant gains in financial literacy, rivaling those of conventional instruction. In particular, Cannistrà et al. (2024) demonstrates that such digital interventions are both scalable and cost-effective, requiring minimal teacher involvement and enabling wide dissemination. However, the benefits of digital learning often appear strongest in the short term, with sustained improvements depending on ongoing reinforcement and thoughtful pedagogical integration. As highlighted by Angel (2018) and others (De Beckker, De Witte, & Van Campenhout, 2021; Kuntze et al., 2019; Salas-Velasco, 2022), digital tools' impact ultimately hinges on their alignment with effective instructional design, suggesting that technology alone is not a panacea but can be highly effective when embedded within a coherent educational framework.

Hypothesis 4: Monetary Incentives: applying monetary incentives in financial education reinforces participant engagement and potentially improves outcomes.

Another significant debate centers on the effect of monetary rewards on both participation and learning. Although some scholars (Rousu et al., 2015) confirm the beneficial role of incentives in heightening engagement, the broader impact on knowledge retention and behavioral change can vary. For instance, studies (Blanco, Hernandez, Thames, Chen, & Serido, 2023; Bu, Hanspal, Liao, & Liu, 2022; Huang, Nam, & Sherraden, 2013; Salas-Velasco, 2023) reveal that incentives successfully attract participants to experimental programs and may enhance efficacy. Huang et al. (2013) specifically notes that incentives facilitate higher account ownership rates under the CDA program. On the contrary, Carpena et al. (2011) illustrates that such rewards do not invariably enhance learning outcomes, particularly when motivation remains superficial. These contrasting findings underscore the contextual dependencies of incentive-based strategies, including sociocultural factors and participant demographics.

Hypothesis 5: Evolution of Research Expertise: cumulative scholarly experience increases the effectiveness of emerging experimental studies in financial education.

The final hypothesis addresses the progression of the academic field. Early meta-analytic work, such as Fernandes et al. (2014), presented mixed views on the potency of financial education, while more recent investigations, often featured in highly ranked economics and finance journals, showcase refined methodologies and deeper theoretical insights. For example, Kaiser and Menkhoff (2020) and Kaiser et al. (2022) report a predominance of positive effects on financial knowledge and behavior, attributing these outcomes partly to improved study designs and more targeted interventions. Consequently, ongoing scholarly developments highlight how advanced methodologies and cumulative experience reveal more precisely the true impacts of financial education, offering increasingly robust evidence of its benefits.

3. Data and methodology

3.1. Research strategy

Our systematic review follows the PRISMA statement outlined by Page et al. (2021), ensuring a replicable and transparent methodology to identify all studies that meet the specified eligibility criteria. By closely adhering to PRISMA guidelines, we provide a structured framework that future researchers can replicate to obtain comparable findings. The complete catalog of included references is presented in Appendix A.

3.1.1. Eligibility criteria

Studies were included in this systematic review if they met all the following criteria:

- *Subject of Inquiry:* Studies were included if they specifically examined a distinct financial education intervention. Studies that focused exclusively on financial technology adoption or policy reforms without an explicit educational component were excluded.
- *Participant Demographics:* We included studies involving participants of different ages, such as youth, adults, and retirees, provided that the studies clearly implemented a specific financial education intervention designed to improve financial literacy.
- *Methodological Design:* We included randomized controlled trials, quasi-experimental designs, and field or lab experiments that explicitly measured changes in financial knowledge, attitudes, or behaviors. Purely observational or correlational studies lacking a clear experimental component were excluded.

Table 1
Summary of hypotheses and supporting literature.

H.	Core statement	Key references
H1	Longer program duration generally improves outcomes in financial education.	Billari et al. (2023), Compen et al. (2023), Paraboni and da Costa (2021), Steinert et al. (2018)
H2	Extending the time between implementation and evaluation leads to reduced long-term impact.	Amagir et al. (2022), Bruhn et al. (2013), Cannistrà et al. (2024), Frisancho (2022)
H3	Using digital tools and online platforms enhances the retention of financial literacy.	Angel (2018), Cannistrà et al. (2024), De Beckker et al. (2021), Salas-Velasco (2022), Sconti et al. (2024)
H4	Monetary incentives can increase engagement and improve overall program effectiveness.	Blanco et al. (2023), Huang et al. (2013), Rousu et al. (2015), Salas-Velasco (2023)
H5	Greater research expertise results in more effective experimental designs and stronger findings.	Fernandes et al. (2014), Kaiser et al. (2022), Kaiser and Menkhoff (2020)

- *Language Criteria:* Only studies published in English were considered.
- *Publication Status:* To ensure academic rigor, only studies published in peer-reviewed academic journals were included.

3.1.2. Search strategy

We conducted a thorough search across three widely recognized bibliographic databases: Scopus, Web of Science, and Google Scholar. For each database, we examined titles, abstracts, and keywords, using two distinct sets of keywords. Within each set, terms were combined using the logical operator `OR`, while the two sets themselves were intersected using `AND`. This strategy ensured a focused yet inclusive retrieval of studies relevant to financial education experiments.

- *Set 1* encompassed a range of terms including *Financial education*, *Financial literacy*, *Financial capability*, *Financial skill*, *Financial inclusion*, *Microfinance*, *Financial behavior*, *Personal finance*, *Internet banking*, *Financial decision*, *Financial service*, and *Household finance*.
- *Set 2* comprised terms related to methodological approaches, specifically *Experimental evidence*, *Experiment*, and *Randomized controlled trial*.

This detailed search strategy yielded 592 records from Scopus, 455 from Web of Science, and 210 from Google Scholar. Due to the high volume of results typically returned by Google Scholar, we adapted our search strategy by restricting the search to titles only, using combinations of *Financial Education* or *Financial Literacy* with *Experiment* or *Experimental Evidence* to filter out less relevant or duplicate results. These searches were initially conducted in April 2023, with the last update performed in November 2023.

3.1.3. Record selection

Our search process led to 1,257 records. Both authors collaboratively undertook the responsibility of the screening and final selection of these records. In instances where discrepancies arose regarding the eligibility of an article, these were resolved through in-depth discussion. The sequence and methodology of our selection process are illustrated in Fig. 1.

The initial stage of our screening process involved a rigorous examination of titles, abstracts, and keywords. This step was instrumental in identifying records that preliminarily met our research criteria. Subsequently, we removed duplicate records and those that did not fulfill the inclusion criteria established for this review.

In the secondary phase of screening, we engaged in a thorough analysis of the full text of the remaining records. Our inclusion criteria were applied, specifically targeting articles that implemented an experimental approach within the context of financial education. The selected articles were required to demonstrate a clear focus on enhancing participants' financial knowledge, skills, and behaviors through specific financial education interventions.

Following this comprehensive two-step screening process, a total of 70 studies were selected for inclusion in our systematic literature review. These studies collectively represent a diverse range of experimental approaches to financial education, reflecting the depth and breadth of current research in this field.

3.1.4. Data description

During our systematic literature review, we carefully identified and classified key attributes from the included articles, drawing on both bibliographic details and experimental methodologies relevant to financial education. To ensure conceptual clarity and consistency with the variables discussed in Section 2.1.4 and Fig. 2, we organized these attributes into four overarching categories: *General Data*, *Experimental Aspects*, *Study Characteristics*, and *Contents & Results*.

The first category, *General Data*, covers foundational elements such as the article's title, authors, publication year, and journal. By capturing these bibliographic identifiers, we obtain a contextual overview of each study's academic lineage and collaborative nature.

In the second category, *Experimental Aspects*, we examine methodological nuances. This includes identifying the scientific field of the research, the type of experimental design (e.g., randomized controlled trials, field experiments), the role of digital tools in delivering the intervention, and the use (or absence) of monetary incentives. This grouping enables us to compare levels of methodological rigor and technological integration across diverse studies.

The third category, *Study Characteristics*, provides a window into how the interventions are conducted in practice. It logs the total number of training hours (*treatment duration*) and the post-treatment evaluation period (in months) to gauge the sustainability of the impact over time. Furthermore, it details key demographic information – encompassing, for example, school-age populations, university students, retirees, immigrants, and other community groups – to reveal how the scope and applicability of financial education vary across contexts.

Lastly, the *Contents and Results* category addresses the intellectual core of each study. It itemizes keywords, educational content, and stated objectives, then aligns them with significant findings and conclusions. This comprehensive view not only illuminates prevalent themes (e.g., personal finance topics or specialized concepts like credit and investment) but also helps us assess how effectively interventions translate into measurable improvements in financial knowledge, attitudes, or behaviors.

These four categories collectively shape an integrative framework that underpins our systematic review. By segmenting bibliographic

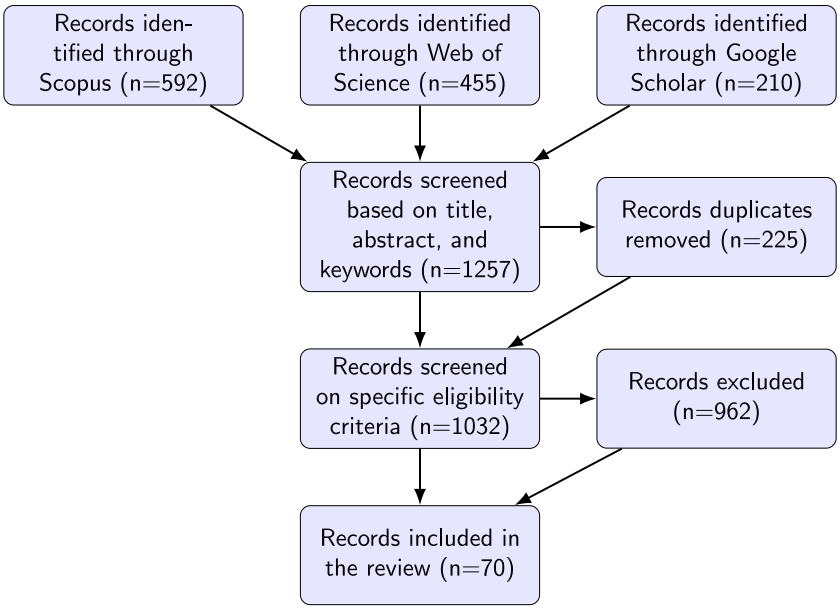

Fig. 1. Flow diagram of the search strategy.

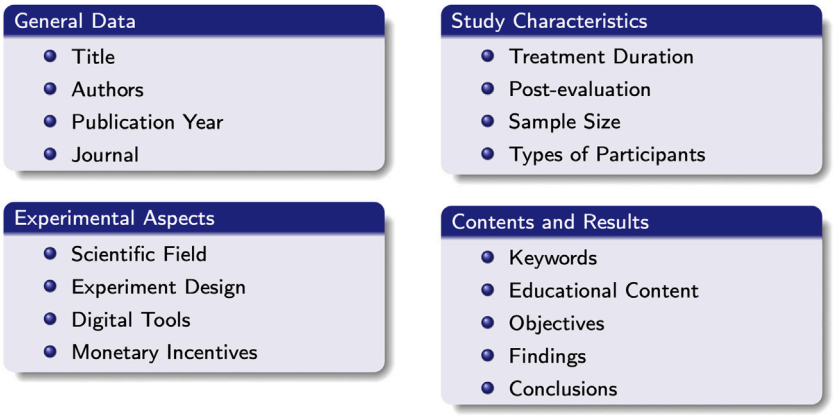

Fig. 2. Description of the database.

Table 2
Publication trends over time: author count distribution per year.

Year	Articles per year	Author count						
		1	2	3	4	5	6	7
2011	3	0	0	3	0	0	0	0
2013	5	1	1	2	0	0	1	0
2014	5	0	1	3	0	0	1	0
2015	5	0	1	1	2	0	0	1
2016	4	1	0	3	0	0	0	0
2018	7	1	0	4	0	2	0	0
2019	5	0	1	2	1	0	1	0
2020	8	2	2	3	1	0	0	0
2021	6	0	2	4	0	0	0	0
2022	14	3	2	4	5	0	0	0
2023	8	2	1	2	1	2	0	0
Total	70	10	11	31	10	4	3	1

data, experimental design features, operational parameters, and substantive outcomes, we aim to capture the full spectrum of each study's contributions. Such categorization also allows for comparisons across studies with different focuses, intervention lengths, participant demographics, and methodological designs, thereby enhancing the methodological rigor and theoretical depth of our synthesis.

3.2. Descriptive overview of the reviewed studies

A temporal distribution of the reviewed studies, shown in Table 2, reveals a marked increase in experimental research on financial education over the past decade, reaching a high point in 2022 (Fig. 3). While initial speculation might attribute this spike to factors such

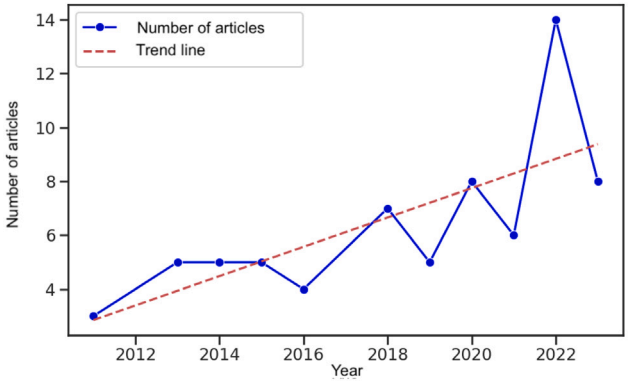

Fig. 3. Number of articles per year.

as heightened policy attention following recent economic disruptions and expanded funding opportunities in behavioral and educational research, our exploratory analysis provides a more nuanced explanation. As detailed below, the 2022 publication surge reflects not only a strong focus on digital innovation but also a substantial publication backlog from previous years.

To further investigate the drivers behind the pronounced increase in publications in 2022, we conducted a targeted analysis of the 14 studies from that year included in our review. Empirical results show that only 2 of these articles (14.3%) explicitly reference pandemic themes, such as COVID-19, lockdown policies, or associated disruptions, in their abstracts or introductions. In contrast, a large majority, 11 articles (78.6%), discuss the adoption or impact of digital tools, online platforms, or technology-enabled instruction. Importantly, analysis of editorial timelines reveals that 13 out of 14 articles published in 2022 (92.9%) had been received by journals prior to 2022, with an average lag of 15.7 months between submission and publication (median: 14 months; maximum: 31 months). These findings suggest that the 2022 publication spike reflects both a strong emphasis on digital innovation and a substantial publication backlog accumulated during earlier years, rather than a sudden, pandemic-driven surge in new research alone.

In terms of participant demographics, many interventions focus on school-aged populations, reflecting a widespread belief that early exposure to fundamental financial concepts can influence lifelong behaviors. Beyond the educational sector, programs targeting broader adult groups, from households and financial institution clients to contexts specific to the workforce, underscore the universal importance of financial literacy. More granular details on participant categories, along with supplementary figures on global distribution, are provided in the Appendix for readers seeking deeper insights.

Focusing on the essential substance of these interventions, Table A1 (cf. Appendix for full breakdown) indicates that the majority of courses still emphasize foundational topics such as personal finances, budgeting, and saving. Although these themes align well with the basic competencies promoted by international organizations, more advanced subjects – such as investing, credit management, and retirement planning – appear less frequently. To benchmark the comprehensiveness of the reviewed programs, we reference the "Financial Competence Framework for Children and Youth in the European Union", jointly developed by the OECD and European Commission (European Union/OECD, 2023). This framework provides a widely recognized set of core financial education competencies, spanning areas like money and transactions, planning and managing finances, risk and reward, and the financial landscape. Comparing our findings to these international benchmarks, it is clear that while most programs effectively address foundational skills, there is considerable room to incorporate higher-level competencies relevant to diverse life stages and economic challenges. Strengthening such advanced modules could help bridge gaps in financial literacy, especially for adult learners and specialized cohorts, thereby enhancing the overall impact and comparability of financial education initiatives.

3.3. Research metrics

In order to capture both the quantitative and collaborative dimensions of our systematic review, we computed specific metrics that illuminate how financial education research has evolved in terms of authorship, impact, and productivity. These metrics do more than simply quantify output: they offer insights into the breadth of disciplinary collaboration and the potential for interdisciplinary advances in financial education. For instance, understanding whether studies are primarily single-author or highly collaborative can reveal the complexity and scope of the field, as well as the degree of knowledge sharing across domains such as economics, psychology, and education.

Collaboration Index (CI)

$$CI = \frac{\sum_{i=1}^{n} a_i}{P}$$

where a_i represents the number of authors of document i, n is the total number of documents with authors, and P is the total number of publications. This index serves as a gauge of collaborative intensity, indicating whether the field tends toward solo or multi-author projects and highlighting overarching trends in authorship patterns.

Collaboration Coefficient (CC)

$$CC = 1 - \frac{\sum_{j=1}^{k} \left(\frac{1}{j} \cdot F_j\right)}{N}$$

where j denotes the number of authors of an article, F_j is the frequency of articles with j authors, N is the total number of articles, and k is the maximum number of authors on a single article. The Collaboration Coefficient (CC) provides a more nuanced understanding of co-authorship dynamics by highlighting both the diversity and magnitude of collective research ventures.

Table 3 summarizes key findings derived from these metrics. Our review covers 70 publications, with an average of 6.36 articles produced per year (PAY). Notably, 60 documents feature multiple authors, highlighting the prominence of teamwork within financial education research. This pattern is confirmed by a high Collaboration Index (CI) of 3 and Collaboration Coefficient (CC) of 0.94, signifying that co-authoring is not only frequent but spans multiple perspectives—an indicator of how multidisciplinary and comprehensive the field can be.

Moreover, the field' s influence is evident from the 1,564 total citations (TC), averaging more than 22 citations per paper, and a cited ratio (PCP) of 0.857. These numbers point to the robust and expanding nature of financial education research, which resonates strongly across academic circles. By working collaboratively, scholars may be better positioned to combine expertise in economic theory, behavioral insights, and pedagogical practice—an approach that is reflected in the thematic clustering revealed by our keyword network (see Figure A3). In that figure, we observe how certain terms (e.g., *student*, *saving*, *retirement*) cluster together, underscoring the synergy between researchers with different specializations.

Hence, both the collaboration metrics and the keyword network analysis serve a dual purpose: they not only quantify the scope of co-authorship but also illuminate how diverse academic backgrounds converge to tackle the challenges of financial literacy. This synergy is precisely what drives innovation and deeper inquiry within financial education, enabling researchers to craft more holistic interventions and methodologies for improving financial well-being.

Table 3
Performance analysis of the included articles.

Metric	Results
Total Publications (TPs)	70
Contributing Authors (NCA)	174
Single-author Documents	10
Multi-author Documents	60
Publication Years (Y)	11
Productivity per Year (PAY)	6.36
Total Citations (TC)	1564
Average Citations per Document (AC)	22.34
Collaboration Index (CI)	3
Collaboration Coefficient (CC)	0.94
Cited Publications (NCP)	60
Cited Ratio (PCP)	0.857

3.4. Quantitative approach

The methodology used for the quantitative analysis of data from the systematic literature review incorporates two advanced techniques: Gradient Boosting and an Ordinal Logistic Regression Model. Gradient Boosting, a machine learning technique founded on decision trees, has demonstrated substantial efficacy across a broad spectrum of practical applications (Natekin & Knoll, 2013). This approach leverages non-parametric techniques to construct a model directly from data, taking into account the assumption of any predetermined functional form fitting the sample data. Constructed in a supervised manner, it needs pre-processed datasets. For our analysis, we employ Extreme Gradient Boosting (XGBoost), an evolution of Gradient Boosting (Friedman, 2001) proposed by Chen and Guestrin (2016). XGBoost's distinctiveness lies in its consideration of dispersion for sparse data and implementation of a weighted quantile sketch. Its efficacy is well-established in various predictive modeling competitions.

The fundamental principle of this decision-tree-based algorithm is the development of a loss function that correlates the dependent variable Y and its prediction $\hat{Y}$, formulated as:

$$L(Y, \hat{Y}), \tag{1}$$

with the algorithm's objective function $Obj(\Theta)$ defined as:

$$Obj(\Theta) = \sum_{i=1}^{n} l(Y_i, \hat{Y}_i) + \sum_{i=1}^{n} \Omega(f_i), \tag{2}$$

where $l(Y, \hat{Y})$ is as defined above and $\Omega(f)$ represents the regularization function, which mitigates overfitting by penalizing model complexity. The regularization function is expressed as:

$$\Omega(f) = \gamma T + \frac{1}{2}\lambda \|w\|^2, \tag{3}$$

where T denotes the number of leaves in the tree, w is the vector of leaf scores, γ controls tree complexity, and λ is a regularization term on leaf weights. The objective is to minimize the difference between Y and $\hat{Y}$ by optimizing the objective function. XGBoost efficiently identifies the most predictive features of the dependent variable.

Further, to model the behavior of the dependent variable, we considers an ordinal cumulative regression model, aligning with the ordinal categorical nature of the variable, which comprises three categories. The model, as outlined by Tutz (2022), is formulated as:

$$P(Y \geq j|x) = F(\alpha_j + x^T \beta), \quad j = 1, \ldots, k, \tag{4}$$

where $F(\cdot)$ denotes the logistic link function. Here, x includes the explanatory variables $x = \{IM, HD, DF, EP, AE\}$, β is the vector of coefficients for each variable, and α_j is the intercept parameter for each jth ordinal category, corresponding to the levels of financial literacy impact.

3.5. Data

To conduct the quantitative analysis, we selected a set of variables based on insights from our literature review to evaluate the impact of financial education interventions across the studies included in this review. The dependent variable, denoted as Y_k, is categorical and measures the effectiveness of each training program. It is classified into three tiers: a high-impact category for studies showing substantial effects, a moderate-impact category for studies with noticeable but less pronounced effects, and a low-impact category for studies where the intervention was deemed ineffective. Formally, this is defined as:

$$Y_k = \begin{cases} 2 & \text{if } k \in \text{Effective}, \\ 1 & \text{if } k \in \text{Moderate}, \\ 0 & \text{if } k \in \text{Ineffective}. \end{cases} \tag{5}$$

Initially, the studies were independently classified into these three categories by the authors, with any discrepancies resolved through consensus. In addition, we employed an advanced machine learning algorithm – the Transformer model (Vaswani et al., 2017) – to analyze textual data from the studies and assign classifications according to Eq. (5), thereby providing an objective comparison to the manual categorizations.

We further selected several explanatory variables, grounded in key themes from the literature (Bhattacharya, Gill, & Stanley, 2016; Bonga & Mlambo, 2016; Kaiser & Menkhoff, 2017; Marcolin & Abraham, 2006; Reich & Berman, 2015), to capture factors influencing the effectiveness of financial education. These include the duration of financial training (measured in hours) and the interval between the intervention and its subsequent evaluation (measured in months). Our results reveal a median training duration of 4 h (interquartile range: 6 h) and a median evaluation interval of 3 months (interquartile range: 9 months), as detailed in Table 4.

In addition, the use of digital tools is represented by a binary variable (*digital tools*), where a value of 1 indicates that digital resources were employed and 0 indicates their absence. Studies such as Koskelainen, Kalmi, Scornavacca, and Vartiainen (2023) and Munna and Khanam (2021) have shown that digital tools can enhance the learning experience and skill acquisition, underscoring the transformative potential of digitalization in financial education.

Another important variable is the presence of monetary incentives, captured by the binary variable *monetary incentives*, where a value of 1 signifies that financial rewards were incorporated to encourage participation. Finally, we include variables for the *region* where the training was conducted and the *year* of the experiment, providing essential context regarding geographical and temporal variations that may influence the outcomes of financial education programs.

4. Results

In this section, we present our findings on the factors influencing the effectiveness of financial education programs, drawing from both a

Table 4
Summary of numerical variables.

Statistic	T. Duration	P. Evaluation	D. Tools	M. Incentives	Exp. Year	FE Eff.
Minimum	0.25	1.0	0.0	0.0	2001	0.0
1st Quartile	1.31	1.0	0.0	0.0	2011	1.0
Median	4.00	3.0	1.0	0.0	2015	2.0
Mean	7.19	7.6	0.5	0.4	2014	1.5
3rd Quartile	8.00	10.0	1.0	1.0	2018	2.0
Maximum	72.00	72.0	1.0	1.0	2021	2.0

Note: T. Duration: Treatment duration (hours); P. Evaluation: Post-treatment evaluation (months); D. Tools: Digital tools; M. Incentives: Monetary incentives; Exp. Year: Experiment year; FE Eff.: Financial Education effectiveness.

Table 5
Relative importance of predictors in the gradient boosting model.

Predictor	Relative importance
Experiment Year	0.237205
Digital Tools	0.227902
Monetary Incentives	0.199880
Post-Treatment Evaluation	0.164723
Treatment Duration	0.136771

Note: The model reports an F1-Score of 74%, indicating a strong balance between precision and recall (Abdullah-All-Tanvir, Khandokar, Islam, Islam, & Shatabda, 2023).

gradient boosting model and an ordinal logistic regression approach. Throughout, it is important to emphasize that primary studies vary substantially in the scope of their outcome measures—some restrict their analysis to *financial knowledge* (e.g., test scores, concept recall), while others encompass a broader definition of *financial literacy*, including changes in behaviors (e.g., savings, spending, or investment decisions) and attitudes (e.g., confidence, intentions, risk aversion). This heterogeneity in outcomes is critical for interpreting the results and their implications for program design.

4.1. Gradient boosting model: Classification and variable importance

We begin with the classifications obtained through the gradient boosting model. This machine learning approach performs predictive classification and assesses the relative importance of each predictor (see Table 5). Significantly, the highest-scoring predictor is "Experiment Year," suggesting a temporal trend in effectiveness. In general, more recent studies are more likely to include holistic measures of financial literacy, capturing both knowledge and behavioral change (Blanco et al., 2023; Koomson, Villano, & Hadley, 2023), reflecting the field's evolution beyond knowledge-based tests.

The importance of variables such as "Digital Tools" and "Monetary Incentives" must also be interpreted in light of outcome measurement. Many digital interventions, especially in earlier years, were evaluated primarily through knowledge tests (Heinberg, Hung, Kapteyn, Lusardi, Samek et al., 2014; Hubbard, Matthews, & Samek, 2016; Kuntze et al., 2019). However, more recent digital studies increasingly report both behavioral outcomes (such as actual saving or investment decisions) and attitudinal shifts (Bu et al., 2022; Carpena & Zia, 2020; Compen et al., 2023; Salas-Velasco, 2023). Similarly, the effect of monetary incentives has often been examined in studies focused mainly on knowledge acquisition (Bruhn, Lara Ibarra, & McKenzie, 2014; Heinberg et al., 2014), but a subset of recent papers extends analysis to behavioral persistence after the incentive is removed (Grohmann, Menkhoff, & Seitz, 2022; Modestino, Sederberg, & Tuller, 2019)

Interpreting the Relative Importance A higher relative importance value indicates that the feature in question contributes more frequently or more substantially to reducing classification error (i.e., improving model accuracy) within the boosting iterations. In Table 5, the highest-scoring predictor is *Experiment Year*, suggesting that more recent studies tend to exhibit a stronger effect on financial literacy outcomes. Conversely, *Treatment Duration*, while still relevant, shows the smallest relative importance, implying that the simple extension of instructional hours exerts a less direct influence on classification accuracy compared to other factors (e.g., digital tools, monetary incentives).

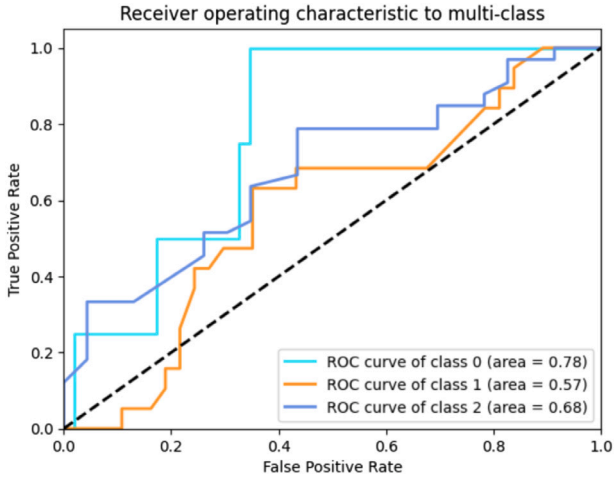

Fig. 4. Receiver operating characteristic for the multi-class classifier.

Model Performance and ROC Analysis. We used the F1-score to measure the balance between precision and recall, achieving 74%. To further assess performance, a Receiver Operating Characteristic (ROC) curve was generated (see Fig. 4). The area under the curve (AUC) typically ranges from 0.5 (random guessing) to 1.0 (perfect classification). Our model' s ROC shows that classes 0 (ineffective) and 2 (highly effective) are distinguished with greater accuracy, aligning with the relatively balanced distribution of the sample (Lahiri & Yang, 2018; Pahlevan Sharif, Naghavi, Waheed, & Ehigiamusoe, 2023).

The gradient boosting model highlights *Experiment Year*, *Digital Tools*, and *Monetary Incentives* as the most decisive features in explaining variation in program efficacy. Nevertheless, this analysis alone cannot unravel the precise magnitude or direction of these influences, which underscores the value of our ordinal logistic approach.

4.2. Ordinal logistic regression: Estimations and interpretations

To complement the machine learning approach with a well-established parametric method, we employ an ordinal logistic regression model, known as the *cumulative logit* model (Agresti, 2002). This technique is particularly suitable for scenarios where the outcomes

Table 6
Coefficient estimates from the ordinal logistic regression.

Variable	Estimate	Std. Dev.	t-ratio	Pr(>| *t* |)	Signif.
Treatment Duration	0.0427	0.0282	1.5150	0.1363	
Experiment Year	1.2621	0.0005	2530.8	0.000	***
Monetary Incentives	−4.5267	0.8282	−5.4659	0.000	***
Post-Treatment Eval.	−0.1256	0.0278	−4.5143	0.000	***
Digital Tools	−1.7506	0.8595	−2.0369	0.0472	*
Level 0|1	2531.51	0.0524	48 322.21	0.000	***
Level 1|2	2537.18	0.5848	4338.36	0.000	***

Note: Significance levels: * ($p < 0.05$), ** ($p < 0.01$), *** ($p < 0.001$). "Level 0|1" and "Level 1|2" are threshold (intercept) terms separating the ordered outcome categories.

Table 7
Odds ratios and marginal effects of key predictors.

	T. Duration	Exp. Year	M. Incentives	P. Eval.	D. Tools
Odds Ratio	1.0436	3.5329	0.0108	0.8819	0.1736
Marginal Effects on Probability					
Y=0	0.000	−0.001	0.014	0.000	0.001
Y=1	−0.006	−0.174	0.749	0.017	0.243
Y=2	0.006	0.174	−0.763	−0.017	−0.244

Note: "T. Duration" = Treatment Duration, "Exp. Year" = Experiment Year, "M. Incentives" = Monetary Incentives, "P. Eval." = Post-Treatment Evaluation, "D. Tools" = Digital Tools.

fall into three or more ordered categories of effectiveness (here labeled as 0 = *ineffective*, 1 = *moderately effective*, and 2 = *fully effective*). Table 6 details the coefficient estimates and significance levels, whereas the odds ratios and marginal effects in Table 7 further clarify how each predictor alters the probability of achieving higher effectiveness levels.

Interpreting Odds Ratios, Marginal Effects, and the Evolution from Knowledge to Literacy.

Because the raw coefficients in an ordinal logistic regression are not directly interpretable as changes in probability, we use odds ratios (OR) and marginal effects for clearer insight. As shown in Table 7, an odds ratio above 1 indicates that a one-unit increase in the predictor raises the odds of achieving a higher effectiveness category (e.g., from "moderately effective" to "fully effective"), while an odds ratio below 1 suggests a negative association.

Experiment Year (OR = 3.5329): Each unit increase in "Experiment Year" is associated with a more than threefold rise in the odds of a program being classified as highly effective. This pattern likely reflects not only advances in research quality, but also a growing shift in the field toward broader, more holistic definitions of program success. Whereas earlier studies focused primarily on knowledge acquisition, more recent research increasingly emphasizes outcomes related to behavioral change and financial attitudes.

Monetary Incentives (OR = 0.0108): Monetary incentives display a strong negative association with the highest effectiveness category. While such incentives can increase participation rates and boost knowledge test scores in the short term, they seldom translate into lasting behavioral improvements. The marginal effect for Y=1 (0.749) indicates that incentives tend to drive participants toward intermediate levels of effectiveness, typically characterized by temporary gains in knowledge rather than enduring changes in financial behavior.

Digital Tools (OR = 0.1736): Digital tools, when used in isolation, also appear less effective; technology alone does not guarantee meaningful gains unless integrated within a sound pedagogical framework. Initially, digital interventions were assessed mainly via knowledge tests, but recent studies increasingly focus on behavioral and attitudinal outcomes, highlighting the importance of thoughtful instructional design.

Treatment Duration (OR = 1.0436): Treatment duration demonstrates only a modest positive effect, reinforcing the idea that simply increasing instructional hours does little to boost outcomes unless coupled with engaging content and sustained behavioral reinforcement. Furthermore, the significance of post-treatment evaluation timing (OR = 0.88) draws attention to the risk of "knowledge decay" if program impacts are assessed too long after completion.

Post-Treatment Evaluation (OR = 0.8819): The odds ratio below one for post-treatment evaluation timing confirms that a greater delay between intervention and assessment lowers the likelihood of observing high effectiveness. This aligns with previous literature: unless participants receive regular reinforcement, both knowledge and behavioral gains tend to diminish over time.

Collectively, these findings support a key conceptual distinction: while "financial knowledge" refers to theoretical understanding as measured by tests, "financial literacy" encompasses not only knowledge but also the practical ability to act and adopt new financial behaviors and attitudes. The field' s evolution toward including behavioral and attitudinal outcomes alongside knowledge acquisition is essential for determining which interventions truly improve financial capability in a meaningful, lasting way.

Key Takeaways.

Taken together, these results underscore that *Experiment Year*, *Monetary Incentives*, *Digital Tools*, and *Post-Treatment Evaluation* are the primary drivers of program effectiveness—though not always in straightforward or expected ways. Newer studies tend to report greater success, reflecting methodological refinement and broader outcome metrics. Monetary incentives are effective for short-term engagement and knowledge, but rarely for long-term behavioral change. Digital tools must be anchored in robust pedagogical design to be effective. Crucially, timely post-treatment evaluation is essential, as longer gaps between intervention and assessment often lead to weaker and more short-lived improvements. Ultimately, these findings highlight the importance of methodological rigor, continuous reinforcement, and pedagogical integration for achieving genuine, enduring progress in financial literacy.

4.3. Validation and robustness of the estimation process

To confirm our ordinal approach was most appropriate, we used the Akaike information criterion (AIC) to compare various link functions (e.g., complementary log–log, probit) and threshold restrictions. Clustering by *geographical region* further addressed potential heterogeneity across regions. Robust standard errors were obtained via R version 3.4.1, employing packages such as *MASS* (Venables & Ripley, 2002) and *ordinal* (Christensen, 2023).

Regarding the gradient boosting algorithm, we used Python' s `XGBoost` library, known for its efficiency in handling sparse data and

performing well in predictive tasks. The ROC and F1-scores corroborate the algorithm' s reliability for classifying our dependent variable. By examining both a powerful machine learning algorithm (which offers insights into predictor importance) and a complementary ordinal regression framework (which clarifies the magnitude and direction of effects), this dual-method approach provides a more thorough examination of the variables influencing financial education effectiveness.

5. Discussion and conclusions

This study aimed to identify the factors that most strongly influence the effectiveness of financial education programs, testing five hypotheses grounded in our systematic literature review. Overall, our findings both clarify existing debates and reveal new complexities in how training duration, follow-up timing, digital tools, monetary incentives, and accumulated research expertise each affect financial literacy outcomes.

5.1. Analysis of findings

Training Duration. Our first hypothesis posited that a longer training period would significantly improve financial literacy outcomes. Contrary to that assumption, the results here do not support a direct, robust correlation between the number of instructional hours and overall program success. Although some short interventions were highly effective (Billari et al., 2023; Burke et al., 2022; Compen et al., 2023; Salas-Velasco, 2022), other longer programs also yielded positive results (Paraboni & da Costa, 2021; Steinert et al., 2018), suggesting that duration alone is insufficient. One explanation could be that the quality and relevance of content, coupled with participant engagement, overshadow mere time spent in instruction. This underscores the importance of integrating diverse pedagogical strategies, such as case studies, simulations, and interactive components, rather than simply extending instructional hours.

Post-Treatment Interval. Our second hypothesis emphasizes the critical role of timing between an intervention and its subsequent evaluation, a relationship that is strongly supported by our empirical findings. Specifically, we observe that program outcomes tend to deteriorate when participants do not receive timely reinforcement or refresher activities. For instance, Grohmann et al. (2022) we demonstrate that while financial education programs may yield substantial gains at the six-month mark, the majority of these positive effects dissipate by twelve months post-intervention. This pattern suggests that financial knowledge and skills are inherently perishable unless they are regularly reinforced or integrated into daily practice, which may explain why school-based programs that incorporate ongoing assessments tend to produce more sustained benefits (Amagir et al., 2022; Bruhn et al., 2013). More broadly, these results highlight the persistent challenge of maintaining behavioral change over time, particularly in contexts where individuals may lack consistent motivation, external prompts, or institutional support.

Digital Tools. While digital technologies have expanded access and delivery options for financial education, the evidence does not support the notion that digital tools alone substantially improve financial literacy outcomes. Several studies, including Angel (2018), (Rodriguez & Martinez, 2022), and Sconti (2022), find that apps, online courses, or digital games often produce, at best, short-term gains or have little impact on deeper understanding or long-term retention. Effectiveness tends to depend less on the digital format itself and more on its integration within a well-designed pedagogical framework, as highlighted by Agasisti, Cannistrà, Soncin, and Marazzina (2022). Furthermore, digital resources may increase knowledge but do not automatically lead to behavioral change unless they are carefully targeted and supported, as noted by De Beckker et al. (2021). In this regard, technology can act as a catalyst, but it is not a universal solution for enhancing financial literacy.

Monetary Incentives. Our fourth hypothesis predicted a positive impact of monetary incentives on learning outcomes; however, the results reveal a more complex reality. While financial incentives can effectively boost initial engagement and participation, they do not necessarily lead to sustained improvements in financial literacy (Carpena et al., 2011). One likely explanation is that participants may become primarily focused on earning rewards, which can detract from deeper learning and long-term retention. For example, Carpena, Cole, Shapiro, and Zia (2019) found that pay-for-performance schemes failed to produce meaningful gains in participants' financial knowledge, both immediately after the intervention and at follow-up. This suggests that extrinsic motivation – while useful for encouraging attendance or short-term effort – may be insufficient to cultivate the intrinsic interest and behavioral change needed for lasting financial capability (Abarcar, Barua, & Yang, 2020; Bruhn et al., 2014). Therefore, program designers and policymakers should carefully consider the trade-off between increasing short-term participation and the potential risk that incentives might actually undermine the genuine, internalized adoption of sound financial behaviors.

Accumulated Research Expertise. Finally, our study finds that more recent programs are correlated with higher effectiveness, suggesting that accumulated expertise – through methodological refinements, targeted curricula, and evolving theoretical frameworks – strengthens the impact of financial education (Kaiser & Menkhoff, 2020). For example, recent work demonstrates how adopting active learning methods can significantly enhance classroom effectiveness compared to traditional lectures (Kaiser et al., 2022), while other studies highlight the importance of culturally tailored interventions to meet the specific needs of different populations (Blanco et al., 2023). Moreover, there is growing recognition that investing in teacher professional development is key to improving program outcomes as the field advances (Compen et al., 2023). This ongoing refinement of best practices reflects a maturing field in which researchers and practitioners learn from past interventions and continually adapt to new educational challenges.

A recurring issue in financial education is the tendency for financial knowledge to wane if not actively reinforced. One plausible mechanism is that without periodic engagement, such as refresher modules, ongoing assessments, or real-world application, learners may revert to pre-existing habits. The reviewed interventions underscore the importance of reinforcement cycles, particularly for school-based programs or adult learning contexts where knowledge is most effectively retained through repeated application and contextualized practice.

The patterns just summarized should be read with one important caution: most primary studies do *not* report granular information on teaching method (e.g. project-based versus lecture) or on instructor training and credentials. If those pedagogical choices systematically boost – or blunt – the effect of duration, incentives, or digital delivery, our cross-study estimates may suffer from omitted-variable bias. We return to this limitation, and to a research agenda that can tackle it, in Section 5.3.

5.2. Implications for financial education programs

Our findings have direct implications for the design and implementation of financial education programs, particularly in light of the shift from knowledge-based outcomes to more holistic assessments of financial literacy. First and foremost, the evidence suggests that knowledge and behavioral improvements gained through educational interventions tend to diminish over time if not actively reinforced. Therefore, programs should be structured with ongoing engagement in mind, incorporating refresher modules, periodic assessments, or real-world application exercises. Such reinforcement not only helps to solidify knowledge but is especially crucial for supporting the development of sustainable financial habits and attitudes.

Equally important is the realization that longer instructional duration does not automatically translate into more effective outcomes. The

results demonstrate that the quality of content, diversity of pedagogical approaches, and relevance to participants' lives often outweigh mere instructional hours. In practice, this means that program designers should prioritize instructional quality, leveraging interactive methods – such as case studies, simulations, and peer-based activities – that are shown to promote deeper understanding and behavioral change. This finding aligns with broader educational theory, which emphasizes active learning and contextualization over rote memorization or passive instruction.

The role of digital tools in financial education is nuanced. While technology has expanded access and enabled innovative modes of delivery, its effectiveness is highly contingent on thoughtful pedagogical integration. Digital tools can serve as valuable adjuncts when blended with in-person or collaborative learning environments but are unlikely to yield substantial gains in isolation. This points to the need for blended models that combine digital platforms with opportunities for interaction, mentorship, and feedback, addressing digital skill gaps and fostering motivation among diverse learner populations.

Monetary incentives present a double-edged sword in program design. While incentives can successfully boost enrollment and short-term engagement, our results caution against their use as a primary motivational lever, given their limited effect on long-term behavioral change. Designers and policymakers might therefore consider employing incentives strategically—perhaps in tiered or milestone-based formats that reinforce incremental progress, rather than as blanket rewards for participation. Such an approach seeks to balance extrinsic and intrinsic motivation, supporting sustained engagement without undermining internalized financial competence.

Finally, the observed relationship between the recency of studies and their effectiveness underscores the importance of keeping educational content, methodologies, and evaluation metrics up to date. As financial products, markets, and consumer behaviors rapidly evolve, so too must financial education. Continuous curriculum revision, rigorous evaluation, and the integration of contemporary research findings are all essential for maintaining program relevance and efficacy. This imperative is further strengthened by policy frameworks that increasingly call for the adoption of global best practices and the alignment of educational standards with real-world financial challenges.

Implementing these recommendations will not be without challenges. Resource constraints, institutional inertia, and variability in participant backgrounds all present barriers to adopting more dynamic, integrated, and adaptive approaches to financial education. Nonetheless, the transition toward holistic, behaviorally-grounded models is necessary to realize meaningful and lasting improvements in financial capability. The complex interplay of instructional quality, reinforcement, technological integration, and motivational structures demands a coordinated response from educators, policymakers, and researchers alike, ensuring that financial education evolves in step with the needs of individuals and society.

These recommendations underscore the multifaceted nature of financial literacy, which involves not just imparting knowledge but also nurturing practical skills, sustained motivation, and adaptable behaviors.

5.3. Study limitations and future research

Two pedagogical dimensions rarely reported in primary studies are *instructional style* (for example project based, inquiry, or flipped classroom) and *instructor qualifications or training*. Both can influence learning outcomes. A well trained teacher who uses active learning may shorten the number of hours needed for mastery, whereas a lecture only format may reduce the benefits of digital tools. Evidence, although limited, is suggestive. In a United States elementary-school trial, Batty, Collins, and Odders-White (2015) find larger test-score gains when teachers first complete a training course. In Germany, Lührmann, Serra-Garcia, and Winter (2018) show that a twenty-hour, student centred module produces better results than a worksheet based alternative that covers the same content. Because these pedagogical traits are unobserved in most studies, the coefficients presented in Section 4 should be read as conditional on an average, and largely unspecified, teaching environment.

Future randomized trials can address this gap by recording teaching methods and instructor profiles in a standardized way, by testing how these variables interact with the six dimensions analyzed in this review, and by depositing the resulting data in public repositories so that meta-regressions can examine whether indicators such as an active-learning dummy or a teacher-training index reduce unexplained variance. Practitioners should therefore set aside resources for instructor upskilling and document the pedagogy they choose; this will improve programme impact and provide the fine-grained evidence the field still lacks.

Our review also faces broader limitations. First, the studies cover diverse populations, programme structures, and assessment tools, which complicates direct comparisons and makes it difficult to isolate the effect of specific elements such as duration or incentives. Second, although the final sample of seventy references was carefully selected, its size limits statistical power for detecting subtle effects. Future work could enlarge the database and include a wider range of designs such as quasi-experimental or longitudinal studies, which would strengthen meta-analytic tests.

Finally, contextual factors like local culture, economic conditions, and institutional support remain only partly explored. New research should test how these settings shape the influence of programme features such as digital tools or incentives. Longitudinal designs would also help to track whether literacy gains persist and to see how periodic reinforcement can slow knowledge decay.

5.4. A shift from knowledge to financial literacy

This systematic review reveals a significant paradigm shift within financial literacy research: an evolution from an emphasis on knowledge acquisition, typically measured by quizzes, towards a comprehensive understanding that integrates behaviors, habits, and attitudes. Early experimental studies largely concentrated on participants' knowledge after an intervention. In contrast, contemporary research increasingly assesses whether individuals modify their saving, investment, or money management practices, and how their financial attitudes evolve. This is not merely a methodological adjustment but a fundamental redefinition of "effectiveness" in financial education. Interventions that boost test scores may have limited long-term value if they do not foster new financial behaviors or sustained attitudinal shifts. As such, the field is progressively adopting holistic, behaviorally-grounded metrics of impact, aligning with global standards and policy directives. It is crucial that future interventions and evaluations continue this multidimensional focus, recognizing that true financial literacy means applying knowledge and transforming one's engagement with financial decisions.

5.5. Concluding remarks

Our findings reveal a complex tapestry of influences shaping the effectiveness of financial education. Crucially, the field is undergoing a shift toward measuring and achieving real behavioral and attitudinal change rather than knowledge alone. While shorter, high-quality interventions can be as successful as longer ones, consistent follow-up, careful use of incentives, and the seamless integration of technology all play pivotal roles. Moreover, as research in this domain advances, programs that remain current with financial innovations and participant needs stand to yield stronger and more enduring literacy outcomes. By leveraging these insights, educators, policymakers, and researchers can refine the design of financial education initiatives, ultimately contributing to the economic well-being of individuals and communities.

CRediT authorship contribution statement

Gonzalo Llamosas García: Writing – review & editing, Writing – original draft, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Cristina Mazas Pérez-Oleaga:** Writing – review & editing, Writing – original draft, Validation, Software, Methodology, Investigation.

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Appendix A. Supplementary data

Supplementary material related to this article can be found online at https://doi.org/10.1016/j.socec.2025.102401.

Data availability

Data will be made available on request.

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