

Strengthening Economic Learning Based on Deep Learning to Improve Financial Literacy of SMAN Tondano Students

Vinda Afnita^{1*}, Dominikus Rojoki Manullang², Iis Azelya³

^{1,2} Economic Education, Manado State University, Indonesia

³ Management, University of Bangka Belitung, Indonesia

*Corresponding Author

e-mail: vinda.afnita@unima.ac.id

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Abstract: Digital financial services expand adolescents' transactional convenience while exposing them to credit, fraud, privacy, and impulsive-consumption risks. This exploratory qualitative study examined how students in three public senior high schools in Tondano, Indonesia, organize economic concepts when reasoning about everyday financial decisions and what these patterns imply for deep learning-oriented economics instruction. Thirty students completed open-ended problem-based tasks used to map variation in conceptual structure; 15 were then purposively selected for semi-structured interviews and think-aloud activities. Data were organized in NVivo and analyzed thematically, with the Structure of Observed Learning Outcomes (SOLO) taxonomy used to interpret structural complexity and thematic-network mapping used to represent relationships among analytic domains. The findings indicate that students could identify saving, consumption, investment, and risk concepts but often treated them as disconnected elements rather than integrated decision rules. Operational familiarity with QRIS, e-wallets, and paylater did not consistently include recognition of fees, debt, fraud, or digital-security risks. Peer and promotional contexts shaped spending considerations, while experiential reflection and self-regulatory practices appeared to support more connected reasoning. The study does not test a Deep Learning intervention; instead, it provides a diagnostic basis for designing economics tasks that require students to relate concepts, justify trade-offs, evaluate digital risks, and transfer principles to new situations.

Keywords: Financial literacy; Digital financial literacy; Economics education; SOLO taxonomy; Deep learning

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INTRODUCTION

Financial literacy is increasingly understood as the capacity to mobilize financial knowledge, skills, attitudes, and behaviors in decisions that affect individual well-being, rather than as the possession of isolated financial facts (OECD, 2023, 2024). This functional interpretation is particularly important during adolescence, when learners begin to make routine choices about spending, saving, digital payments, and short-term credit while still developing the cognitive and self-regulatory resources needed to evaluate consequences. International evidence

shows that financial education can improve knowledge and downstream behaviors, but outcomes depend on when, how, and in what contexts learners are asked to use what they know (Kaiser et al., 2022; Frisancho, 2023). Consequently, a central educational problem is not simply whether students have encountered financial concepts, but whether those concepts are organized well enough to guide decisions under authentic constraints.

Digitalization makes that problem more consequential. The ability to scan a QR code, top up an e-wallet, or activate a deferred-payment facility is an operational skill; it does not by itself demonstrate understanding of fees, debt accumulation, fraud exposure, privacy, data trails, or opportunity costs. Contemporary digital financial literacy therefore combines financial understanding with digital know-how, risk recognition, and self-protection (Koskelainen et al., 2023; OECD, 2025). Recent evidence likewise indicates that digital competence can influence how consumers adopt and benefit from digital financial services, while practical awareness and protection from scams can matter alongside conventional financial knowledge (Pak et al., 2026; Noveiri Delshad et al., 2026; Sabri et al., 2026). For adolescents, the distinction between operational fluency and informed financial judgment is especially important because convenience, promotional cues, and social influence can compress the time available for reflective choice.

The Indonesian context underscores this urgency. The 2025 National Survey on Financial Literacy and Inclusion reported a national financial-literacy index of 66.46% and a financial-inclusion index of 80.51% (Otoritas Jasa Keuangan & Badan Pusat Statistik, 2025). This gap indicates that access to financial products and services can develop faster than the capability required to use them judiciously. Studies involving Indonesian Generation Z and secondary-school populations likewise highlight the importance of literacy for everyday financial behavior and broader economic capabilities (Laturette et al., 2021; Rengkuan et al., 2026). Yet much of the literature operationalizes literacy through scores, associations, or program effects. Such evidence is valuable, but it offers less detail about how students actually connect concepts when confronting a concrete financial problem.

Economics education provides a natural site for examining that connection because concepts such as scarcity, needs and wants, consumption, saving, investment, risk, and intertemporal choice are meaningful only when learners can relate them. Research on active financial education indicates that instructional designs requiring learner participation and decision-making can produce stronger outcomes than lecture-dominant approaches (Kaiser & Menkhoff, 2022). More broadly, cognitive-engagement research distinguishes passive reception from constructive and interactive activity in which learners generate explanations, connect ideas, and evaluate alternatives (Chi & Wylie, 2014). These processes are closely aligned with deep, meaning-oriented learning, which emphasizes integration, sense-making, and transfer rather than reproduction. In this article, the term Deep Learning refers exclusively to this educational conception, not to machine-learning algorithms. Contemporary analyses of deep learning in education likewise emphasize conceptual connectedness, active engagement, and transfer while cautioning against treating the term as an undefined label for any student-centered activity (Darling-Hammond et al., 2020; Hattie & Donoghue, 2016; Kovač et al., 2025; Wu, 2024).

The Structure of Observed Learning Outcomes (SOLO) taxonomy offers an explicit language for describing the structural quality of such reasoning. SOLO characterizes responses as prestructural, unistructural, multistructural, relational, or extended abstract, with increasing levels representing progressively more integrated organization of relevant elements (Biggs & Collis, 1982). A systematic review of SOLO applications shows that the framework can be

operationalized across educational domains to distinguish the complexity of open-ended learning outcomes (Adeniji et al., 2022; Malik et al., 2021). Applied to financial reasoning, a learner may mention one relevant factor, list several correct but disconnected considerations, integrate those considerations into a coherent decision rule, or generalize the rule to a new financial context. This makes SOLO useful as an interpretive lens for the organization of reasoning; it is not treated here as a standardized financial-literacy score or as evidence of instructional effectiveness.

This distinction addresses a specific gap in the financial-literacy literature. Established work demonstrates the economic importance of financial literacy and the benefits of appropriately designed education (Lusardi & Mitchell, 2014; Kaiser et al., 2022), while emerging research clarifies the additional competencies required in digital finance (Koskelainen et al., 2023; Pak et al., 2026). Less is known about the internal structure of secondary students' reasoning when conventional economic concepts, digital-finance risks, peer influences, and self-regulatory considerations must be coordinated within one decision. A qualitative account of that structure can identify where knowledge remains fragmented and therefore where instruction should require learners to explain relationships rather than merely name concepts.

Accordingly, this study examined students from three public senior high schools in Tondano. An initial pool of 30 students completed open-ended problem-based tasks, and 15 students were purposively selected for deeper qualitative exploration. The study addressed three questions: How do students connect economic and financial concepts when reasoning about everyday financial problems? What patterns characterize their digital-finance practices, risk recognition, social influences, and self-regulatory responses? What implications do those patterns have for the design of deep learning-oriented economics instruction informed by SOLO? The contribution is diagnostic and design-oriented. It does not claim that a Deep Learning intervention has already improved financial literacy; rather, it identifies empirically grounded reasoning patterns that can inform subsequent instructional development and testing.

METHOD

This study used an exploratory qualitative design to investigate the organization of students' financial reasoning in context. The design was appropriate because the research questions concern how learners connect concepts, justify choices, and interpret everyday financial situations rather than the estimation of treatment effects. No Deep Learning classroom intervention, pre-post comparison, control group, or standardized financial-literacy outcome was implemented. Deep learning-oriented instruction is therefore treated as a pedagogical implication derived from the qualitative diagnosis, not as an intervention evaluated by the present study.

The study was conducted across three public senior high schools in Tondano. Initial recruitment involved 30 students who were actively engaged in economics learning and had experience with digital financial instruments such as e-wallets. All 30 completed open-ended problem-based tasks (PBTs) that elicited reasoning about digital financial literacy and pocket-money management. Their responses were examined through SOLO to identify variation in response structure. Fifteen students were then purposively selected for in-depth inquiry so that the final group represented different forms of conceptual organization identified during screening. Where more students met a given selection need than were required, active participation in economics learning and willingness to take part in the interview phase were considered. The study reported that recruitment ceased after the interview material was judged to yield no substantively new themes; because saturation was not documented interview by

interview, this claim is interpreted cautiously in line with contemporary guidance on qualitative sample adequacy (Hennink & Kaiser, 2022).

Table 1. Study design, sampling stages, evidence sources, and analytic functions

Component	Evidence	Analytic function
Research design	Exploratory qualitative inquiry	Interpret reasoning patterns and conceptual connections rather than estimate effects.
Initial pool	30 students from three public senior high schools	Open-ended PBT screening to identify variation in response structure.
Key informants	15 purposively selected students	Semi-structured interviews and think-aloud exploration.
Data sources	PBT responses, interview transcripts, think-aloud material, field notes	Compare complementary evidence about financial reasoning and practice.
Analytic lenses	SOLO + thematic analysis + thematic network	Describe structural complexity and organize recurring substantive patterns.
Software	NVivo	Support data organization, coding, retrieval, and matrix queries.

Table 1 makes the evidence chain explicit: the 30-student task stage was used to map qualitative variation, whereas the 15-student phase supplied the in-depth material for thematic interpretation. The table also separates the analytic function of SOLO from the organizational role of NVivo, avoiding any implication that software itself validates qualitative interpretation.

Data collection combined three elicitation modes and supporting field documentation. First, the PBTs required students to respond to realistic economic and financial situations and explain the reasoning supporting their choices. Second, semi-structured interviews explored the meanings students attached to saving, consumption, investment, financial risk, digital transactions, and allocation decisions. Third, think-aloud activities asked participants to verbalize their reasoning while working through economic-financial problems, allowing attention to how multiple considerations were brought together during a decision. Field notes were used as contextual support. This combination was intended to compare what students wrote, what they reported, and how they reasoned during task performance rather than to produce a single numerical literacy score.

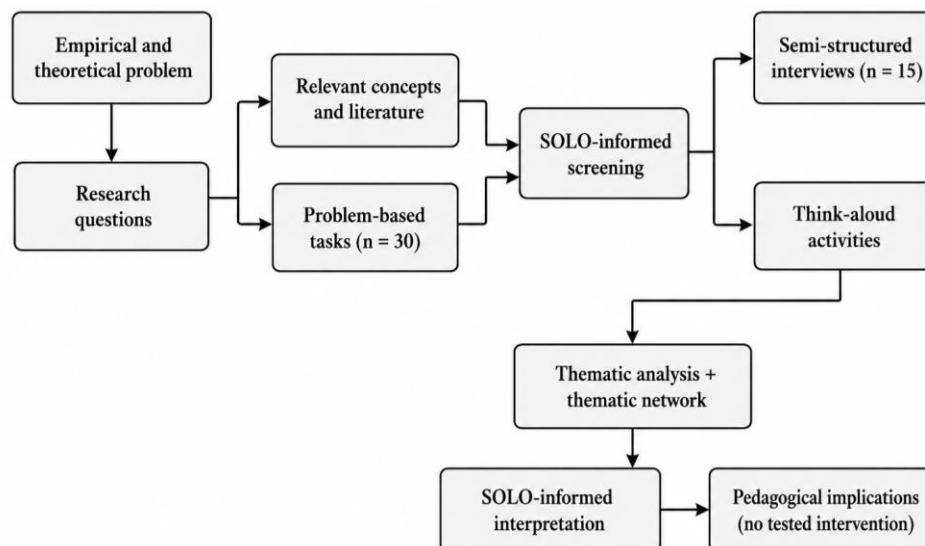


Figure 1. Research procedure for the exploratory qualitative study.

Figure 1 clarifies that the study moves from problem formulation and open-ended screening to in-depth elicitation, thematic analysis, and SOLO-informed synthesis. No

experimental-treatment stage is present, which constrains the conclusions to qualitative findings and design implications.

The PBT responses were interpreted using the five-level SOLO framework. Prestructural responses did not engage a relevant financial relation; unistructural responses used one relevant element; multistructural responses contained several relevant elements that remained additive or disconnected; relational responses integrated relevant considerations into a coherent explanation or decision rule; and extended-abstract responses generalized or reframed an integrated principle beyond the immediate task. These descriptors served as structural criteria for interpretation and participant selection. They were not proficiency cut scores and are not used to infer the prevalence of SOLO levels in the wider student population.

Table 2. SOLO descriptors used to interpret open-ended financial reasoning

SOLO level	Structural criterion	Financial-reasoning illustration
Prestructural	No relevant financial relation is identified.	The response does not engage the financial problem or its constraints.
Unistructural	One relevant element is used.	A fee, saving goal, or need-want distinction is noticed without integrating other considerations.
Multistructural	Several relevant elements are present but disconnected.	Price, saving, and risk are listed without explaining how they jointly determine the decision.
Relational	Relevant elements are integrated into a coherent rule.	Current funds, future obligations, risk, and alternatives are connected to justify a choice.
Extended abstract	An integrated principle is generalized beyond the immediate task.	The same decision principle is transferred to another financial product or domain.

Table 2 operationalizes the structural logic used in interpretation. It is a qualitative rubric rather than a set of standardized cut scores, and it should not be read as a reconstructed distribution of participant proficiency.

Interview and think-aloud materials were transcribed and organized in NVivo. The analysis followed an iterative thematic process involving familiarization, coding, theme development, review, definition, and reporting, informed by established thematic-analysis guidance (Braun & Clarke, 2006, 2021). Initial analytic codes included 'paylater as additional pocket money,' 'fear of missing out on promotions,' 'recording expenses without reading patterns,' 'running out of pocket money before the end of the month,' and 'reading snack labels.' Codes were then organized into a thematic network distinguishing basic themes, organizing domains, and the global theme of student financial management behavior, drawing on thematic-network principles (Attride-Stirling, 2001). SOLO was used as a complementary interpretive lens to examine whether financial reasoning remained atomistic, additive, relational, or transferable across contexts.

Credibility was supported by comparing evidence from the PBT, interviews, think-aloud activities, and field notes; by iterative review of codes and themes; and by member checking, consistent with established trustworthiness criteria for qualitative research (Nowell et al., 2017). NVivo functioned as a data-management and retrieval tool rather than as an independent validator of interpretation. Participation was voluntary, participants received an explanation of the study, signed informed consent, and were assured that their identities would remain confidential and that the data would be used solely for academic purposes.

RESULTS AND DISCUSSION

Research Results

The combined evidence depicts student financial management as a problem of conceptual coordination rather than a simple absence of financial vocabulary. Across the PBT, interview, think-aloud, and field-note materials, students could refer to familiar financial ideas and digital tools, yet the explanatory relationships among those elements varied markedly. The thematic analysis organized the evidence around financial-concept understanding, financial decision-making, digital financial literacy, environmental and social influence, and food literacy/self-regulation, with experiential learning operating as a recurring context for reflection. Figure 2 presents the final thematic network generated from this analytic structure. Its directional lines are interpreted as conceptual connections among themes, not as statistically tested causal pathways.

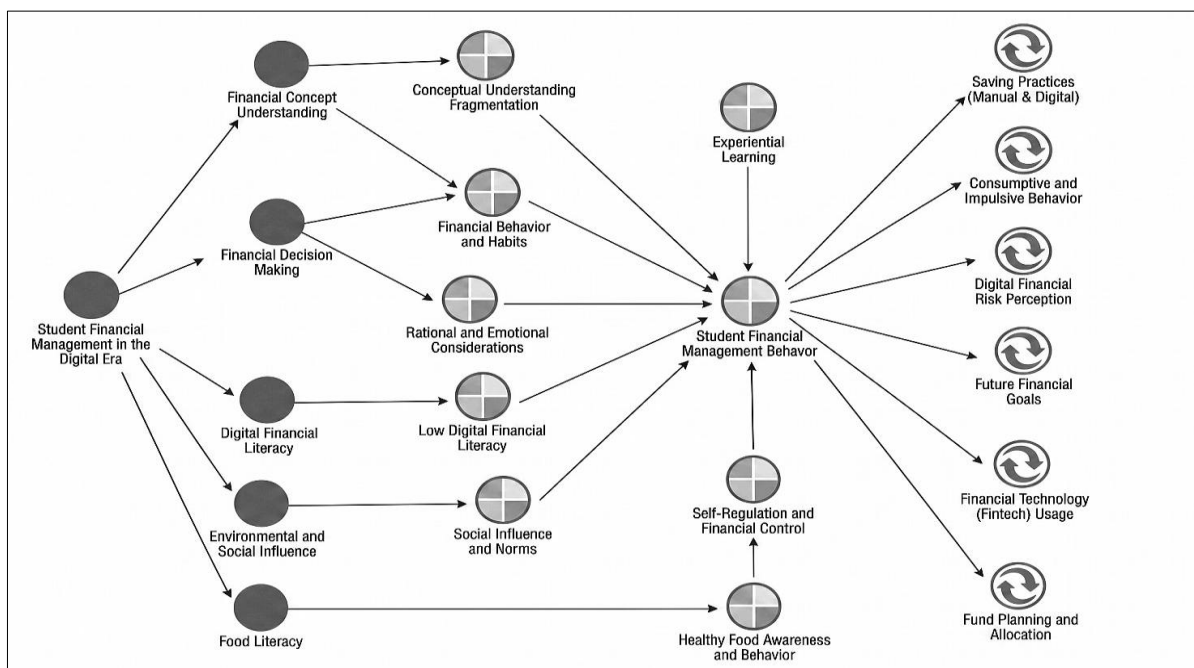


Figure 2. Thematic network of student financial management behavior.

The network positions student financial management behavior as the global theme and connects it with domains of concept understanding, decision-making, digital financial literacy, environmental and social influence, and food literacy/self-regulation. The visual hierarchy is used to organize the qualitative account; the arrows indicate interpretive associations, not causal coefficients.

Table 3. Thematic structure and illustrative analytic indicators

Organizing domain	Source-supported indicators/code labels	Interpretive meaning
Financial-concept understanding	Saving, consumption, needs/wants, investment; "recording expenses without reading patterns"	Relevant concepts are available but may remain insufficiently connected for decision use.
Financial decision-making	Rational and emotional considerations; fund planning/allocation	Choices involve planned constraints as well as immediate affective considerations.
Digital financial literacy	QRIS/e-wallet/paylater; fees, interest, fraud, data-security concerns; "paylater as additional pocket money"	Operational fintech use may outpace integration of debt and risk concepts.

Organizing domain	Source-supported indicators/code labels	Interpretive meaning
Environmental/social influence	Group meals, trends, promotions; "fear of missing out on promotions"	Financial decisions are embedded in peer and promotional contexts.
Food literacy/self-regulation	"reading snack labels"; food budgeting; delaying purchases; account separation	Monitoring and self-control appear across domains.
Experiential learning	"running out of pocket money before the end of the month"	Adverse outcomes can become occasions for reflection and revised control strategies.

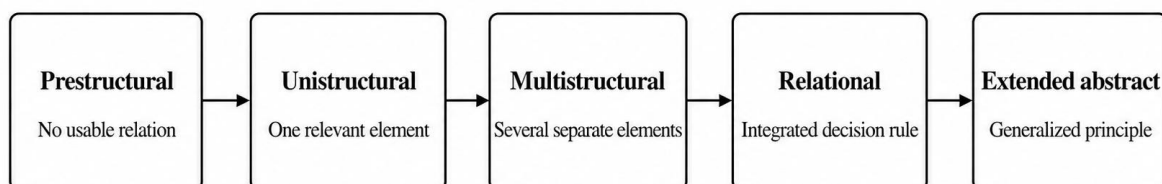
Table 3 clarifies the relationship between the principal themes and the analytic indicators used to interpret them. The phrases shown in quotation marks are code labels that summarize recurring ideas in the qualitative material; they are used as analytic indicators rather than as frequency estimates or causal evidence. The table therefore supports interpretation of the thematic structure while preserving the exploratory character of the study.

Conceptual Fragmentation and Financial Reasoning

A central pattern was conceptual fragmentation. Students could identify familiar categories such as saving, consumption, needs, wants, and investment, yet the presence of those categories did not always produce an integrated decision. The analytic code 'recording expenses without reading patterns' captures the distinction particularly well: recording is a potentially useful financial-management practice, but its value is limited when records are not interpreted to identify recurring spending, changing priorities, or consequences for later choices. In SOLO terms, such reasoning is compatible with a multistructural form in which several relevant elements are present but remain insufficiently related. The evidence therefore points to a difference between concept availability and concept integration.

The same distinction appeared in planning and allocation. Students' accounts included attention to pocket money, spending categories, saving goals, and immediate purchases, but explicit explanations of how these considerations should be weighed against one another were less consistently developed. The study does not report a numerical distribution of SOLO levels because SOLO was used here as an interpretive framework for structural complexity rather than as a standardized scoring scale. The defensible finding is structural: some responses exhibited atomistic or additive reasoning, whereas others showed clearer relational connections among constraints, alternatives, and anticipated consequences.

Figure 3 summarizes the SOLO-informed interpretive pathway used to read these differences. It should not be understood as evidence that students moved longitudinally from one level to another. Rather, it illustrates the increasing structural integration expected when a financial explanation develops from an irrelevant or single-factor response toward a rule that coordinates multiple considerations and can be transferred to a new context.



Interpretive progression only; not a measured longitudinal effect.

Figure 3. SOLO-informed interpretation of increasing structural integration in financial reasoning.

Figure 3 visualizes the interpretive logic that distinguishes disconnected knowledge from relational reasoning. It is not a measured learning trajectory and does not imply that any participant progressed through the levels during the study.

Digital Financial Fluency and Risk Recognition

A second pattern was the separation between operational digital-finance fluency and risk-oriented financial understanding. Students were familiar with QRIS, e-wallets, and paylater functions, demonstrating that digital-financial participation was already part of their everyday environment. At the same time, the analysis identified weaknesses in the integration of concepts related to accumulated fees, interest or repayment obligations, fraud, and the security implications of digital data trails. The code 'paylater as additional pocket money' is analytically important because it represents a possible reclassification of credit as spendable income. When debt is mentally represented as an extension of available cash, the future obligation created by the transaction can be obscured.

This finding should not be described as technological illiteracy. Students' ability to operate digital interfaces is precisely what creates the paradox: technical confidence can coexist with incomplete financial-risk reasoning. Digital financial literacy research similarly treats practical know-how and self-protection as distinct but complementary competencies (Koskelainen et al., 2023; Pak et al., 2026). Evidence from international students and other digitally engaged groups also indicates that the implications of fintech adoption depend on more than access or frequency of use (Noveiri Delshad et al., 2026). In the present study, the qualitative evidence therefore supports a narrower conclusion: operational ease did not reliably demonstrate integrated understanding of the financial obligations and risks embedded in digital transactions.

The risk-recognition theme also has implications for the interpretation of 'financial knowledge.' A student may correctly state what saving, investment, or debt means in isolation yet still make a weak decision if the concept is not activated when a digital interface presents a time-limited promotion or deferred-payment option. This helps explain why a purely definitional approach to assessment can overestimate functional capability. The problem is not necessarily ignorance of every relevant term; it is failure to coordinate the relevant terms at the moment of choice.

Social Influence, Consumption, and Priority Setting

Financial decisions were also socially embedded. Students' accounts linked spending with group meals, fashion trends, promotions, and concern about missing out on peer experiences. The code 'fear of missing out on promotions' illustrates how a financial decision can be reframed by urgency and social comparison before the learner evaluates whether the purchase serves a genuine priority. These influences do not make student decisions irrational by definition: belonging and social participation have real value. The educational issue is whether learners can make the trade-off explicit and recognize what is being sacrificed when social or promotional value displaces a saving goal or another planned expenditure.

This contextual dimension is consistent with evidence that adolescent financial confidence and literacy develop within both school and family environments rather than through classroom knowledge alone (Silinskas et al., 2023). It also complements broader findings that financial literacy interacts with self-efficacy, opportunity, and context in shaping behavior (Rehman & Mia, 2024). The present analysis adds a qualitative mechanism to that literature: social cues appear within the reasoning process as competing criteria. A relational response

would therefore not eliminate social considerations; it would place them alongside budget constraints, future obligations, needs, and alternatives within an explicit justification.

Priority setting was thus not merely a budgeting technique but an interpretive task. When learners can name several spending categories without articulating why one should take precedence, the reasoning remains additive. When they explain how urgency, necessity, available funds, future goals, and risk jointly determine the decision, the structure becomes more relational. This distinction links the thematic evidence directly to the SOLO lens without converting qualitative categories into pseudo-quantitative proficiency scores.

Experiential Reflection and Self-Regulation

A fourth pattern concerned learning from financial experience. The code 'running out of pocket money before the end of the month' represented episodes in which an undesirable outcome prompted reflection on previous choices. Such experiences were associated in the qualitative material with strategies such as setting spending limits, separating funds, or delaying purchases. These accounts do not establish that experience causes improved financial management, but they indicate that personally consequential events can become occasions for learners to compare intended and actual outcomes. Such reflection is educationally significant because it makes the consequences of an earlier decision available for reinterpretation.

Self-regulation also appeared in the food-literacy cluster. The code 'reading snack labels,' together with accounts of budgeting for food and resisting unnecessary purchases, suggested parallels between monitoring consumption and monitoring money. The evidence is insufficient to claim a causal cross-domain transfer from food literacy to financial literacy. A more defensible interpretation is that similar regulatory operations—monitoring, delaying, setting limits, and comparing alternatives—were visible across domains. In SOLO terms, an extended-abstract inference would require a learner to articulate and deliberately transfer a generalized principle to a new context; the current data indicate the possibility of such transfer but do not document it systematically.

Taken together, these results show why the article treats financial literacy as structured reasoning rather than a collection of isolated competencies. Conceptual knowledge, digital risk recognition, social context, and self-regulation entered the same financial-management problem, but they were not always integrated. The findings therefore create a clear instructional target: economics learning should make the relationships among these dimensions visible and require students to justify how they jointly shape a decision.

Discussion

The principal contribution of this study is the identification of conceptual integration as a plausible missing link between knowing financial terms and using them functionally. Financial-literacy research has long established that knowledge matters for economic outcomes, while intervention research shows that education can improve both knowledge and some behaviors (Lusardi & Mitchell, 2014; Kaiser et al., 2022). The qualitative evidence here adds a structural perspective. Students may possess several correct concepts and still produce weak financial reasoning when those concepts are not coordinated. This observation is consistent with SOLO's distinction between multistructural and relational understanding: the quantity of relevant information can increase without a corresponding improvement in the organization of that information. For economics education, this means that assessment should attend not only to whether

a learner mentions saving, risk, needs, or debt, but to whether the learner explains how those concepts constrain and modify one another in a decision.

The digital-finance findings sharpen that argument. Contemporary financial environments reduce transaction friction, which can be beneficial, but low friction also allows a decision to be completed before the user has represented its full financial consequences. The participants' operational familiarity with e-wallets, QR-based payments, and paylater therefore cannot be treated as evidence of digital financial literacy. Research in digital finance similarly conceptualizes literacy as a combination of financial knowledge, digital competence, awareness, practical know-how, and protection from scams or misuse (Koskelainen et al., 2023; Pak et al., 2026). The present data suggest that these components can be unevenly developed. For school instruction, the implication is concrete: students should be asked to unpack a digital transaction into present cost, deferred cost, fees, debt status, data-security exposure, and foregone alternatives before judging whether the transaction is advantageous.

The risk dimension also extends beyond overspending. Digitally mediated financial decisions can expose inexperienced users to product complexity, deceptive interfaces, fraud, and information asymmetries. Recent work connecting financial literacy with financial-crime exposure reinforces the importance of treating risk recognition as part of functional capability rather than as an optional extension of conventional financial knowledge (Freed & Hackney, 2026). Comparative evidence from Malaysia and Indonesia likewise shows that digital capabilities, financial inclusion, and financial resilience should be examined together rather than assumed to move in parallel (Sabri et al., 2026). For secondary economics education, this means that digital-finance cases should include negative and ambiguous examples—not only successful transactions—so that learners practice identifying red flags, distinguishing borrowing from available income, and articulating what evidence would be needed before accepting a digital offer. Such tasks would make consumer protection part of economic reasoning rather than a separate safety message.

The contrast between operational fluency and risk recognition is also relevant to Indonesia's current literacy landscape. National survey data show that financial inclusion exceeds financial literacy, and literacy among 15-17-year-olds remains below the national index (Otoritas Jasa Keuangan & Badan Pusat Statistik, 2025). The present study should not be generalized statistically to that population, but it provides a micro-level account of how an access-capability gap can appear in reasoning. A learner can participate confidently in a digital ecosystem while still under-representing debt or fraud risk. That pattern supports policy and curriculum approaches that do not equate adoption with competence and that integrate consumer protection and risk appraisal into financial education.

Social influence provides a second reason why factual instruction alone may be insufficient. Spending decisions among adolescents are embedded in peer relations, promotional environments, and immediate social rewards. The study's FOMO-related coding suggests that a financial choice often contains criteria that are not captured by a textbook calculation of price and budget. This does not invalidate rational analysis; it makes the analysis more realistic. Evidence that school and family environments contribute to adolescent financial confidence supports the view that financial capability

is socially situated (Silinskas et al., 2023). Deep learning-oriented economics tasks can use this insight by presenting dilemmas in which students must acknowledge social value while still making explicit the opportunity cost, affordability, and future consequence of the choice.

The experiential and self-regulatory findings further suggest that instruction should create opportunities for reflection without requiring students to incur real financial harm. When learners describe running out of pocket money and subsequently adopting limits or delayed purchasing, they are effectively comparing a previous strategy with its consequences. Active financial education has demonstrated advantages over passive delivery because learners practice decision processes rather than merely receive information (Kaiser & Menkhoff, 2022). Classroom simulations, annotated spending scenarios, decision journals, and retrospective error analysis could reproduce the reflective function of experience in a safer setting. Such activities should require students to explain which rule they would change and why, thereby turning experience into explicit relational knowledge rather than leaving learning to trial and error.

SOLO can support this instructional design as a formative rubric. A teacher could ask students to analyze whether to use paylater for a desired purchase. A unistructural response might mention only the fee; a multistructural response might list the fee, available pocket money, and saving goal independently; a relational response would explain how those factors jointly determine affordability and future budget constraints; and an extended-abstract response would formulate a transferable rule for evaluating other credit-like products. The value of SOLO in this context is diagnostic: it makes visible the structure of an explanation and offers a target for feedback. It should not be used as a substitute for validated financial-literacy measurement when the research question concerns population proficiency or intervention effects (Adeniji et al., 2022).

This diagnostic role also clarifies what is meant by deep learning-oriented instruction in the present article. Deep learning should not be reduced to an attractive label for problem-based or technology-rich teaching. Its defining educational value lies in requiring learners to connect ideas, generate explanations, monitor understanding, and transfer principles (Hattie & Donoghue, 2016; Kovač et al., 2025). Meta-analytic evidence indicates that digital technology can support deep-learning outcomes when it is embedded in learning designs that promote meaningful cognitive engagement rather than simple exposure to devices (Wu, 2024). In economics classrooms, therefore, using a fintech simulation would not by itself constitute deep learning. The task must compel students to explain relationships, compare alternatives, revise assumptions, and defend a decision using coordinated economic concepts.

The study also contributes to the emerging literature on digital financial literacy by emphasizing the moment of integration. Research has identified practical know-how, digital awareness, and self-protection as important components of digitally mediated financial capability (Pak et al., 2026), while studies of fintech users show that adoption can coexist with heterogeneous understanding and perceived needs for targeted education (Noveiri Delshad et al., 2026). The Tondano data suggest that curriculum design should connect those components explicitly. For example, a single scenario can require students to recognize a promotional trigger, calculate repayment obligations, identify fraud or privacy risks, distinguish need from want, and evaluate the effect on a saving target. The

analytic value lies in the explanation linking these dimensions, not in the number of terms a student can reproduce.

Theoretically, the findings support a modest but useful proposition: functional financial literacy can be examined as the structural integration of domain knowledge, contextual cues, risk representations, and self-regulatory rules within a decision. This proposition does not replace established multidimensional definitions of financial literacy; it adds an account of how their components may become coordinated in reasoning. SOLO provides the structural vocabulary for this account, while thematic analysis identifies the substantive domains that require coordination. Combining the two approaches therefore links the content of students' concerns with the organization of their explanations. This is the study's principal novelty, and it is intentionally narrower than claiming a new causal theory of financial behavior.

The practical contribution can therefore be stated as a design principle: require coordination before evaluation. A learner should not receive full credit simply for listing relevant financial concepts; the task and rubric should reward an explanation of how the concepts interact under the constraints of a specific decision. This principle can be implemented without adding a new subject to the curriculum because existing economics topics already contain the relevant conceptual resources. What changes is the cognitive demand placed on students: from recalling definitions to constructing and defending an integrated judgment.

Several limitations constrain interpretation. The sample was purposive, small, and drawn from three public high schools in one locality, with prior digital-finance experience included in the selection logic; transferability to students with different access, socioeconomic backgrounds, or schooling contexts must therefore be evaluated cautiously. Participant-level demographic distributions and a complete numerical distribution of SOLO classifications were not reported, so the study cannot estimate the prevalence of particular reasoning levels in the wider student population. The thematic findings are interpretive rather than frequency-based, and the qualitative design cannot establish causal relationships among social influence, self-regulation, digital-finance practices, and financial behavior. Most importantly, the study did not implement a Deep Learning intervention, so no claim of instructional effectiveness or improvement is warranted. Future research should report fuller participant profiles, preserve transparent case-level evidence, and test the proposed design principles through design-based, longitudinal, or quasi-experimental studies using validated financial-literacy outcomes.

CONCLUSIONS

This study shows that the financial reasoning of the participating high school students cannot be adequately characterized by the presence or absence of individual financial concepts. Across problem-based tasks, interviews, and think-aloud activities, students could refer to saving, consumption, investment, digital payments, and financial risk, yet those elements were not always integrated into coherent decision rules. Operational familiarity with QRIS, e-wallets, and paylater was particularly important because it sometimes coexisted with incomplete recognition of fees, debt obligations, fraud, or digital-security risks. Financial choices were also shaped by peer and promotional contexts, while reflection on previous spending experiences and self-regulatory practices appeared to create opportunities for more connected reasoning. These findings support

a structural interpretation of functional financial literacy: what matters educationally is not only which concepts students know, but how they relate those concepts when a decision requires trade-offs. SOLO provides a useful diagnostic language for distinguishing additive from relational reasoning, while the thematic evidence identifies the substantive domains that economics instruction should connect. The practical implication is to design authentic tasks that require students to explain affordability, opportunity cost, risk, social pressure, future obligations, and alternative choices within a single justification. Such instruction is proposed as a direction for subsequent testing, not as an intervention whose effectiveness has already been established. Future studies should preserve participant-level evidence, strengthen ethical and analytic documentation, and evaluate whether SOLO-informed, deep learning-oriented economics instruction produces durable gains in validated measures of financial literacy and real-world financial decision-making. A subsequent intervention should therefore retain the diagnostic strength of the present qualitative design while adding transparent participant profiles, task-level SOLO coding, preserved verbatim evidence, and validated outcome measures. A design-based sequence could first refine authentic digital-finance problems with teachers and students, then examine whether explicit prompts to connect fees, debt, risk, social pressure, and opportunity cost produce more relational explanations. A later quasi-experimental or longitudinal phase could test whether these changes in reasoning are accompanied by sustained improvements in financial-literacy performance and behavior. This staged agenda is preferable to assuming that the label Deep Learning itself guarantees better outcomes; the instructional mechanisms and the evidence of transfer must be demonstrated empirically.

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