

# Self-Regulation as a Catalyst for TPACK: A Conceptual Framework for Physical Education Teachers in the Digital Age

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## Abstract

In the context of China's "Education Informatization 2.0" and "Healthy China 2030" strategies, Physical Education (PE) teachers in private universities face increasing demands to integrate digital technologies into their instruction. However, a significant gap remains between the availability of technological tools and their effective pedagogical implementation, suggesting that external resources alone are insufficient to drive instructional innovation. This paper addresses this "knowledge-action" gap by proposing an integrated conceptual framework that positions Self-Regulation (SR) as a critical antecedent to PE teachers' Technological, Pedagogical, and Content Knowledge (TPACK). Drawing on Zimmerman's social cognitive theory, we argue that the static possession of digital knowledge is dormant without the active engagement of self-regulatory mechanisms—specifically goal setting, strategy monitoring, and self-reflection. Furthermore, the proposed framework posits that this generative relationship is not uniform but is significantly moderated by demographic factors, including age, teaching experience, and educational attainment. By shifting the analytical focus from external training to internal psychological governance, this study offers a theoretical roadmap for cultivating "instructional agility" in resource-constrained environments. The framework suggests that sustainable professional development in the digital age must prioritize the nurturing of teachers' internal agency alongside technical proficiency.

## Keywords

Physical Education Teachers; TPACK; Self-Regulation; Private Universities; Conceptual Framework; Digital Transformation

## 1. Introduction

The integration of digital technologies into higher education has evolved from a supplementary pedagogical tool to a fundamental structural necessity, redefining educational landscapes globally. This shift is particularly palpable in Physical Edu-

cation (PE), a discipline traditionally anchored in face-to-face instruction and physical movement, which now faces the complex demand of hybridizing physical skill acquisition with digital literacy. As universities navigate this transition, the academic focus has increasingly moved beyond questions of mere technology access toward understanding the complex competencies teachers require to orchestrate learning in these digitized environments. However, a significant dissonance often remains between the availability of digital tools and their effective pedagogical implementation. This "knowledge-action" gap suggests that external resources alone are insufficient to drive instructional innovation, necessitating a deeper examination of the internal mechanisms that enable teachers to adapt to these evolving demands.

### 1.1. Education Informatization in China

In the specific context of China, this digital imperative is propelled by high-level policy frameworks that view education modernization as a national priority. Strategic initiatives, most notably the "Healthy China 2030" Plan Outline (2016) and China Education Modernization 2035 (2019), have explicitly mandated the deepening integration of sports and education while emphasizing the cultivation of teachers' digital competencies. These directives require university PE instructors to transcend their traditional roles as organizers of physical training; they must now adeptly utilize data-based assessment tools, wearable devices, and learning management systems to foster students' lifelong health literacy. While the Technological, Pedagogical, and Content Knowledge (TPACK) framework offers a robust theoretical lens for mapping the necessary knowledge base for such integration, the translation of these policy mandates into classroom reality is often uneven. Research indicates that while teachers may possess theoretical awareness of technology, the practical application—specifically the intersection of technology with specific subject matter—remains a significant hurdle for many practitioners (Akhwani, 2020; Latip et al., 2023).

### 1.2. Challenges in Private Higher Education Contexts

The tension between policy expectations and practical realities is arguably most acute within China's burgeoning private higher education sector, particularly in provinces like Guangdong. Private universities, while expanding rapidly and investing heavily in sports infrastructure, often operate under distinct constraints compared to their public counterparts, including heavier teaching loads, larger class sizes, and uneven access to systematic professional development. In such resource-constrained environments, the gap between possessing technological knowledge and applying it becomes pronounced (Ifinedo & Kankaanranta, 2021). Teachers in these settings often struggle to sustain the motivation required to experiment with digital tools when faced with immediate logistical pressures. Recent studies suggest that without strong institutional support or internal resilience, even

teachers with adequate technological knowledge may fail to implement it consistently (Maipita et al., 2023). This points to a critical oversight in current discourse: the assumption that providing technology and knowledge training is sufficient, while ignoring the psychological and self-regulatory mechanisms necessary for teachers to adapt to these demanding contexts.

### 1.3. Towards an Integrated Model of Self-Regulation and TPACK

Addressing this challenge requires shifting the analytical focus from external determinants to internal teacher capabilities. We propose that Self-Regulation (SR)—the active process of setting goals, monitoring strategies, and managing resources—serves as the essential engine driving the development and application of TPACK. Drawing on social cognitive theory, we argue that TPACK is not merely a static repository of knowledge but a dynamic competency activated by a teacher's ability to regulate their own professional learning (Ratih et al., 2024; Zimmerman, 2000). Furthermore, this interplay does not occur in a vacuum; it is likely conditioned by individual characteristics. As previous studies have hinted, demographic factors such as age, teaching experience, and educational attainment may significantly moderate how effectively a teacher translates self-regulatory efforts into technological competence (Tanucan et al., 2021; Wang et al., 2021). Consequently, this paper aims to construct a conceptual framework that positions self-regulation as a catalyst for TPACK, explicitly examining the moderating role of demographic factors within the unique ecosystem of Chinese private universities.

## 2. Theoretical Underpinnings

Constructing a viable framework for teacher development in the digital age requires a robust theoretical grounding that bridges the external demands of technology integration with the internal cognitive processes of the teacher. This study draws upon two distinct yet complementary theoretical strands: the TPACK framework, which maps the necessary knowledge landscape, and Self-Regulated Learning (SRL) theory, which elucidates the navigational mechanisms teachers employ to traverse that landscape. By juxtaposing these theories, we move beyond viewing technology integration as a static skill set and instead conceptualize it as a dynamic, self-directed professional endeavor. The following sections deconstruct these core constructs within the specific ecology of Physical Education.

### 2.1. TPACK in Physical Education

The Technological, Pedagogical, and Content Knowledge (TPACK) framework has established itself as the preeminent model for understanding effective technology integration. It posits that expert teaching emerges not from isolated knowledge domains but from the complex interplay between technology, pedagogy, and subject content (Mishra & Koehler, 2006). In the context of Physical Education, however,

this integration presents unique challenges that distinguish it from classroom-based disciplines. PE instruction is inherently embodied, requiring the seamless coordination of physical space, movement demonstration, and safety monitoring alongside digital intervention. Consequently, for a PE teacher, TPACK is not merely about operating software but involves the sophisticated task of leveraging digital tools—such as motion capture analysis or health monitoring apps—to enhance physical skill acquisition without disrupting the flow of activity.

Despite the theoretical clarity of TPACK, its practical realization remains uneven. A systematic review of the field suggests that while institutional support is critical, the complexity of simultaneously managing content and technology often overwhelms teachers, leading to superficial integration (Kholid et al., 2023). Furthermore, the specific demands of adapted or remote PE instruction, as highlighted during recent global disruptions, have exposed significant deficits in teachers' ability to merge technological and pedagogical knowledge effectively (Ng et al., 2021). This evidence suggests that TPACK in PE is a fragile competency; it requires more than just access to tools—it demands a high degree of "instructional agility" to blend these distinct knowledge bases in real-time, resource-constrained environments (Lohmann et al., 2023).

## 2.2. Teacher Self-Regulation

If TPACK represents the "map" of necessary knowledge, Self-Regulation (SR) constitutes the "compass" by which teachers navigate their professional growth. Grounded in social cognitive theory, self-regulation is conceptualized not as a fixed trait but as a cyclical process involving forethought, performance control, and self-reflection (Zimmerman, 2000). While traditionally applied to student learning, recent scholarship has increasingly recognized the centrality of SR for teachers themselves. Teacher self-regulation involves the proactive management of one's own instructional planning, the monitoring of teaching strategies, and the regulation of motivation in the face of setbacks (Sáez-Delgado et al., 2023).

For PE teachers operating in the rapidly shifting landscape of private higher education, this capacity for self-steering is indispensable. The iterative nature of self-regulation—where teachers set specific goals for technology use, monitor the effectiveness of their strategies, and reflect on outcomes—provides the mechanism for continuous improvement (Callan et al., 2021). Research indicates that this regulatory capacity is deeply intertwined with motivation; teachers who can effectively regulate their learning processes are better equipped to maintain the intrinsic motivation necessary to overcome the steep learning curve associated with new technologies (Bakhtiar & Hadwin, 2021). Moreover, the ability to create a supportive learning climate is often a reflection of the teacher's own self-regulated engagement with their practice (Laxdal et al., 2020). Thus, self-regulation provides the necessary psychological infrastructure that enables teachers to persist in the complex task of

developing and refining their TPACK competencies.

### 3. The Proposed Conceptual Framework

Building upon the established theoretical pillars of TPACK and Self-Regulated Learning, this paper advances an integrated conceptual framework tailored to the specific ecological conditions of Physical Education in Chinese private universities. Rather than viewing teacher competence as a static accumulation of technological skills, this framework posits a directional and dynamic relationship wherein the teacher's internal regulatory mechanisms serve as the primary antecedent for the development of complex digital pedagogies. This section elucidates the structural logic of the proposed model, delineating first the propulsive role of self-regulation in activating TPACK, and subsequently, the boundary conditions imposed by demographic characteristics that moderate this developmental process.

#### 3.1. The Engine: Linking SR to TPACK

Central to this framework is the proposition that self-regulation acts as the cognitive engine that transforms potential technological access into actual pedagogical competence. In the fluid environment of a PE class, where teachers must contend with physical safety, movement space, and digital devices simultaneously, the ability to engage in cyclical self-regulation is paramount. Specifically, the goal-setting phase of self-regulation enables teachers to move beyond random technology adoption; it compels them to articulate clear pedagogical reasons for using a specific tool, thereby fostering a more intentional integration of Technological Knowledge (TK) with Pedagogical Content Knowledge (PCK) (Zimmerman, 2000; Ratih et al., 2024). Once instruction begins, the strategy monitoring and self-reflection dimensions of self-regulation become critical. When a digital intervention—such as using a video delay app for feedback—fails due to technical glitches or student disengagement, a self-regulated teacher does not merely abandon the technology. Instead, they engage in real-time monitoring and adaptive help-seeking, refining their approach through a feedback loop that directly strengthens their TPACK flexibility (Li, 2022). Recent empirical evidence supports this theoretical linkage, suggesting that teachers who possess strong self-regulatory efficacy are significantly more likely to persist in navigating the complexities of digital integration, viewing technological challenges as opportunities for mastery rather than insurmountable barriers (Sulistiani et al., 2023; Warmansyah et al., 2022). Therefore, within this framework, self-regulation is conceptualized not merely as a parallel skill, but as a causal predictor that catalyzes the synthesis of technology, pedagogy, and content.

#### 3.2. The Context: The Role of Demographics as Moderators

While self-regulation provides the internal drive for TPACK development, this framework acknowledges that this process does not operate uniformly across the

teaching workforce. Teachers' demographic profiles—specifically age, sex, years of teaching service, and educational attainment—create distinct "interpretive filters" that may strengthen or weaken the translation of self-regulation into TPACK competencies. Existing literature indicates that the trajectory of technology integration is often contingent upon career stage and background (Tanucan et al., 2021). For instance, novice teachers, often labeled as "digital natives," may possess high technological fluency but lack the pedagogical experience to regulate its effective use, whereas experienced teachers may possess robust pedagogical structures but require greater self-regulatory effort to overcome resistance to new digital tools (Krause & O'Neil, 2024; Wang et al., 2021).

Furthermore, educational attainment may serve as a proxy for exposure to research-based practices and meta-cognitive training. It is hypothesized that teachers with advanced degrees may leverage their self-regulatory strategies more efficiently to decode complex TPACK concepts compared to those with less formal training (Cui & Zhang, 2022). Similarly, resource disparities often intersect with these demographic factors; in the context of private universities, where standardized support may be lacking, the moderating effect of these individual characteristics is likely amplified. Thus, the proposed framework posits that while self-regulation universally promotes TPACK, the magnitude of this effect is significantly moderated by the demographic heterogeneity of the PE faculty, necessitating differentiated professional development approaches rather than a "one-size-fits-all" solution.

## 4. Discussion & Implications

The conceptual framework articulated in this study responds to the urgent need for a more nuanced understanding of teacher development in the era of education informatization. By identifying self-regulation as the precursor to effective technology integration, we challenge the prevailing technocratic view that often equates the provision of digital tools with the modernization of instruction. This shift in perspective—from external infrastructure to internal psychological governance—carries significant ramifications for both the theoretical modeling of Physical Education teacher competencies and the practical design of professional development programs within Chinese private universities.

### 4.1. Theoretical Contribution

The primary theoretical contribution of this paper lies in bridging the schism between knowledge-based frameworks (TPACK) and process-oriented theories (Self-Regulated Learning). While the TPACK framework effectively categorizes the components of teacher knowledge, it has historically remained silent on the mechanisms that enable teachers to acquire and update this knowledge in volatile environments (Mishra & Koehler, 2006). This study addresses this limitation by proposing that self-regulation provides the necessary cognitive scaffolding for TPACK

development. We argue that the specialized nature of PE—which requires the simultaneous management of physical bodies and digital data—demands a higher tier of regulatory effort than classroom-based subjects. Consequently, this model extends the applicability of Zimmerman's social cognitive theory into the domain of teacher education, positing that the "cyclical phases" of self-regulation are isomorphic to the iterative design processes required for successful technology integration (Callan et al., 2021). Furthermore, by explicitly integrating demographic moderators, this framework offers a more granular explanatory model that accounts for the heterogeneity of the teaching workforce, moving beyond generic assumptions to recognize that the path to digital competence varies significantly by age and experience (Tanucan et al., 2021).

## 4.2. Practical Implications

For administrators and policymakers in Guangdong's private universities, the implications of this framework necessitate a strategic pivot in professional development. Current training models, which predominantly focus on the technical operation of software or hardware, may be insufficient if they fail to cultivate the underlying self-regulatory capacities of teachers. Instead, professional development initiatives should incorporate training on goal setting, reflective practice, and resource management, explicitly teaching instructors how to regulate their own learning curves when adopting new technologies (Mujallid, 2021). For instance, workshops could be designed not merely to demonstrate a new fitness app, but to guide teachers in planning how to integrate that app into specific curricular goals and how to monitor its impact on student engagement.

Moreover, the moderating role of demographic factors suggests the need for differentiated support systems rather than "one-size-fits-all" mandates. Novice teachers, who may possess high technological fluency but developing pedagogical insight, would benefit from mentorship programs that focus on the pedagogical reasoning (PK) behind technology use. Conversely, experienced teachers, who may face steeper psychological barriers to digital adoption, require support structures that reduce the risk of failure and encourage incremental experimentation (Krause & O'Neil, 2024). In the resource-constrained context of private higher education, fostering such a self-regulating professional culture—where teachers are empowered to leverage limited resources creatively—may be a more sustainable strategy for achieving the goals of "Healthy China 2030" than solely relying on capital-intensive infrastructure investments (Ifinedo & Kankaanranta, 2021).

## 5. Conclusion

The digital transformation of Physical Education represents not merely a technical upgrade but a fundamental shift in instructional paradigm, one that places unprecedented demands on the adaptive capabilities of teachers. As this paper has argued,

the persistent gap between policy mandates for education informatization and the reality of classroom practice cannot be bridged solely by increasing the supply of digital hardware or delivering static knowledge training. In the resource-constrained and high-pressure environment of Chinese private universities, the critical variable often lies within the teachers themselves—specifically, in their capacity for self-regulation.

By proposing a conceptual framework that positions self-regulation as the catalyst for TPACK development, we emphasize that the integration of technology is essentially a self-directed, metacognitive endeavor. Teachers who can autonomously set goals, monitor their strategies, and reflect on their failures are the ones who ultimately transform inert technological tools into dynamic pedagogical assets. Furthermore, acknowledging the moderating influence of demographic factors reminds us that this developmental journey is personal and varied; age, experience, and educational background shape how teachers perceive and navigate the digital landscape.

Ultimately, this study advocates for a human-centric approach to educational modernization. It suggests that the most sustainable path to achieving the ambitious goals of "Healthy China 2030" lies in nurturing the internal agency of the teaching workforce. By fostering self-regulatory mechanisms alongside technical skills, educational leaders can empower Physical Education teachers to move beyond mere compliance with digital trends, enabling them to confidently design technology-enhanced learning experiences that genuinely improve student health and engagement.

## References

- [1] Akhwani, A. (2020). Integration of TPACK as a basic framework for 21st-century learning: An analysis of professional teacher competencies. *Advances in Social Science, Education and Humanities Research*. <https://doi.org/10.2991/assehr.k.201214.251>
- [2] Bakhtiar, A., & Hadwin, A. (2021). Motivation from a self-regulated learning perspective: Application to school psychology. *Canadian Journal of School Psychology*, 37(2), 93–116. <https://doi.org/10.1177/08295735211054699>
- [3] Callan, G. L., & others. (2021). Enhancing motivation by developing cyclical self-regulated learning skills. *Theory Into Practice*, 61(1), 62–74. <https://doi.org/10.1080/00405841.2021.1932153>
- [4] Cui, Y., & Zhang, H. (2022). Integrating teacher data literacy with TPACK: A self-report study based on a novel framework for teachers' professional development. *Frontiers in Psychology*, 13. <https://doi.org/10.3389/fpsyg.2022.966575>
- [5] Ifinedo, E., & Kankaanranta, M. (2021). Understanding the influence of context in technology integration from teacher educators' perspective. *Technology, Pedagogy and Education*, 30(2), 201–215. <https://doi.org/10.1080/1475939X.2020.1867231>
- [6] Kholid, M., & others. (2023). A systematic literature review of technological, pedagogical, and content knowledge (TPACK) in mathematics education: Future challenges for educational practice and research. *Cogent Education*, 10(1). <https://doi.org/10.1080/2331186X.2023.2269047>
- [7] Krause, J. M., & O'Neil, K. (2024). The impact of role models and experiences on physical education teacher education students' technological, pedagogical, and content

- knowledge. *The Physical Educator*. <https://doi.org/10.18666/tpe-2024-v81-i4-11748>
- [8] Latip, A., & others. (2023). Technological pedagogical content knowledge (TPACK) framework for science teachers' competences in facing global challenges and issues: A narrative literature review. *International Journal of Pedagogy and Teacher Education*. <https://doi.org/10.20961/ijpte.v0i0.74699>
  - [9] Laxdal, A., & others. (2020). Self-regulated learning in physical education: An analysis of perceived teacher learning support and perceived motivational climate as context-dependent predictors in upper secondary school. *Scandinavian Journal of Educational Research*, 64(8), 1120–1132. <https://doi.org/10.1080/00313831.2019.1689164>
  - [10] Li, W. (2022). Envisioning the role of educators' technological pedagogical and content knowledge and self-regulated learning in an English as a foreign language context. *Frontiers in Psychology*, 13. <https://doi.org/10.3389/fpsyg.2022.943072>
  - [11] Lohmann, J., & others. (2023). Health-related professional competence of physical education teachers: Narrative review and heuristic model. *Swiss Journal of Educational Research*. <https://doi.org/10.24452/sjer.45.2.7>
  - [12] Maipita, I., & others. (2023). TPACK, organizational support, and technostress in explaining teacher performance during fully online learning. *Journal of Information Technology Education: Research*, 22, 41–70. <https://doi.org/10.28945/5069>
  - [13] Mishra, P., & Koehler, M. J. (2006). Technological pedagogical content knowledge: A framework for teacher knowledge. *Teachers College Record*, 108(6), 1017–1054.
  - [14] Mujallid, A. (2021). Instructors' readiness to teach online: A review of TPACK standards in online professional development programmes in higher education. *International Journal of Learning, Teaching and Educational Research*. <https://doi.org/10.26803/ijlter.20.7.8>
  - [15] Ng, K., & others. (2021). Teachers' preparedness to deliver remote adapted physical education from different European perspectives: Updates to the European Standards in Adapted Physical Activity. *European Journal of Special Needs Education*, 36, 98–113. <https://doi.org/10.1080/08856257.2021.1872848>
  - [16] Ratih, I., & others. (2024). Technological pedagogical content knowledge of preservice elementary teachers: Relationship to self-regulation and technology integration self-efficacy. *European Journal of Educational Research*. <https://doi.org/10.12973/eu-jer.13.1.159>
  - [17] Sáez-Delgado, F., & others. (2023). Teacher self-regulation: Validation of scales in Chile applied with an online technological tool. *Revista Costarricense de Psicología*, 42(1), 1–15. <https://doi.org/10.22544/rcps.v42i01.02>
  - [18] Sulistiani, I. R., & others. (2023). Technology integration through acceptance of e-learning among preservice teachers. *Indonesian Journal of Electrical Engineering and Computer Science*. <https://doi.org/10.11591/ijeecs.v31.i3.pp1821-1828>
  - [19] Tanucan, J. C. M., & others. (2021). Filipino physical education teachers' technological pedagogical content knowledge on remote digital teaching. *International Journal of Information and Education Technology*, 11(9), 403–409. <https://doi.org/10.18178/ijiet.2021.11.9.1544>
  - [20] Wang, Y., & others. (2021). Analysis of grade difference of TPACK among teacher-oriented students of mathematics in Qinghai-Tibet plateau area. *Proceedings of the 7th International Conference on Social Science and Higher Education (ICSSHE 2021)*. <https://doi.org/10.2991/assehr.k.211122.049>
  - [21] Warmansyah, J., & others. (2022). Factors affecting teacher readiness for online learning (TROL) in early childhood education: TISE and TPACK. *JPUD - Jurnal Pendidikan Usia Dini*. <https://doi.org/10.21009/jpud.161.03>
  - [22] Zimmerman, B. J. (2000). Attaining self-regulation: A social cognitive perspective. In M. Boekaerts, P. R. Pintrich, & M. Zeidner (Eds.), *Handbook of self-regulation* (pp. 13–39). Academic Press.