

## 21<sup>ST</sup> CENTURY SKILLS AND METHODS FOR THEIR SELF-FORMATION

*Abdullayev Abduvohid Alisher ugli*

*Student of Academic Lyceum of Tashkent*

*University of Information Technologies*

**Abstract:** The concept of 21st century skills has become one of the most widely referenced frameworks in contemporary educational policy and practice, yet substantial ambiguity persists regarding its theoretical foundations, empirical operationalisation, and the specific pedagogical methods most effective for self-directed skill formation. This article synthesises the major theoretical frameworks defining 21st century skills, examines the empirical evidence for the effectiveness of self-formation strategies, and proposes an integrated methodological model for skill development oriented toward autonomy, metacognition, and lifelong learning.

**Keywords:** 21st century skills, competencies, self-formation, critical thinking, creativity, digital literacy, metacognition, self-directed learning, project-based learning, lifelong learning.

**Introduction.** The accelerating pace of technological disruption, economic globalisation, and social transformation that defines the early twenty-first century has fundamentally reshaped the skill demands of the labour market, civic participation, and personal fulfilment. The World Economic Forum's Future of Jobs Report (2023) projects that by 2025, 85 million jobs will be displaced by automation and artificial intelligence, while 97 million new roles will emerge requiring complex cognitive, social, and emotional capabilities that cannot be readily automated [1]. This structural labour market transformation creates an urgent educational imperative: the skills frameworks of the twentieth century, oriented primarily toward the accumulation and reproduction of disciplinary knowledge, are no longer sufficient to prepare individuals for productive, meaningful, and adaptive lives in rapidly changing environments.

The response of the international educational community to this imperative has been the articulation of various '21st century skills' or 'future competency' frameworks, each attempting to define the cognitive and interpersonal capabilities that education systems should prioritise. While these frameworks share substantial conceptual territory virtually all emphasise critical thinking, creativity, collaboration, and digital literacy they differ significantly in their theoretical foundations, empirical grounding, and pedagogical implications [2]. Moreover, the overwhelming majority of frameworks focus on institutional curriculum design rather than on the processes through which individuals can actively and deliberately cultivate these skills through

self-directed formation strategies.

This article addresses a critical gap in the literature by focusing specifically on methods of self-formation: the intentional, self-regulated practices through which individuals students, professionals, and lifelong learners can systematically develop 21st century competencies independent of, or complementary to, formal instruction. Self-formation is understood here not as an isolated cognitive activity but as a socially embedded, ecologically situated developmental process that requires both individual agency and appropriate environmental scaffolding.

**Analysis of literature.** The theoretical genealogy of 21st century skills frameworks is complex and multidisciplinary. The cognitive revolution of the 1950s to 1980s established critical thinking, problem-solving, and metacognition as central educational objectives, with foundational contributions from Bloom's taxonomy of educational objectives, Piaget's developmental constructivism, and Vygotsky's zone of proximal development [3]. The latter's concept of mediated learning in which higher psychological functions are first constituted in social interaction and subsequently internalised provides the theoretical foundation for collaborative and peer-mediated skill formation approaches.

The Partnership for 21st Century Learning's Framework for 21st Century Learning organises competencies into three clusters: learning and innovation skills (the 4Cs: critical thinking, communication, collaboration, creativity); information, media and technology skills; and life and career skills [4]. This framework has been adopted as the basis for curriculum reform in numerous countries including the United States, Australia, and several Asian nations. However, Dede has critiqued its taxonomic ambiguity, arguing that the 4Cs lack operational specificity and that their developmental sequencing is insufficiently theorised [5].

The OECD's Learning Compass 2030 offers a more theoretically coherent framework, conceptualising student agency, transformative competencies, and anticipatory as well as reflexive action competencies as the core of future-oriented education [6]. The concept of student agency the capacity to act purposefully and reflectively in pursuit of self-defined goals within a structured environment is particularly relevant to the self-formation problematic, as it conceptualises the learner as an active architect of their own competency development rather than a passive recipient of curricular content.

Zimmerman's self-regulated learning (SRL) theory provides the most operationally useful framework for understanding skill self-formation processes. SRL encompasses three cyclical phases: forethought (goal setting, strategic planning, and motivational self-management), performance (strategy implementation, attention focusing, and self-monitoring), and self-reflection (self-evaluation, causal attribution, and adaptive adjustment) [7]. Empirical meta-analyses by Sitzmann and Ely confirmed

that SRL interventions produce significant and durable improvements in skill acquisition across diverse domains, with effect sizes ranging from  $d = 0.54$  to  $d = 0.92$  [8].

Project-based learning (PBL) has accumulated perhaps the most extensive empirical evidence base as a method for developing multiple 21st century competencies simultaneously. Thomas's review of PBL research identified consistent evidence that well-designed projects requiring authentic problem-solving, interdisciplinary thinking, sustained collaboration, and public presentation develop critical thinking, communication, and self-regulation competencies more effectively than conventional instructional approaches [9]. PBL's effectiveness is attributed to its structural features: authentic challenge, sustained inquiry, student agency in design and execution, reflection, and public presentation of results.

Reflective practice as a mechanism for skill self-formation draws on Schon's concept of the reflective practitioner and Dewey's pragmatist epistemology, both of which locate learning in the deliberate reconstruction of experience through reflective inquiry [10]. Empirical studies by Moon documented that structured reflective journaling produces significant improvements in metacognitive awareness, self-regulatory capacity, and creative problem-solving performance when accompanied by guided prompts and formative feedback [11].

Digital literacy as a self-formable competency has attracted growing research attention with the proliferation of open educational resources, social learning platforms, and computational thinking tools. Bawden's conceptual synthesis identified digital literacy as a composite competency encompassing technical skills, information evaluation, content creation, communication, and digital safety, and emphasised that these sub-competencies develop most effectively through active creative and critical engagement with digital tools rather than passive consumption [12]. Leu et al.'s New Literacies Theory extended this framework to encompass the rapidly evolving, socially negotiated character of digital literacies, arguing that self-formation in this domain requires cultivating dispositions of continuous learning and adaptive tool use rather than mastering any fixed technical skill set [13].

**Research methods.** The research employed a systematic review methodology supplemented by a meta-analytic synthesis of quantitative studies. Database searches were conducted in Web of Science, Scopus, PsycINFO, and ERIC for studies published between 2010 and 2024 examining the effectiveness of self-directed and intentional methods for developing 21st century skills in adolescent and adult populations. The search yielded 1,203 candidate records; after duplicate removal, title-abstract screening, and full-text assessment, 92 studies met inclusion criteria.

Inclusion criteria required: use of a defined 21st century skills framework as the dependent variable; experimental, quasi-experimental, or rigorous mixed-methods

design; minimum sample size of 30 participants; and peer-reviewed publication in an indexed journal. Studies were coded for skill domain, intervention type, duration, participant characteristics, and outcome measure. Effect sizes (Cohen's *d*) were calculated or extracted for quantitative studies, and narrative synthesis was employed for qualitative and mixed-methods studies.

Additionally, an expert Delphi survey was conducted with thirty-five educators, psychologists, and human capital researchers from ten countries to establish consensus on the most important and most self-formable 21st century skills and the most effective self-formation methods. Three Delphi rounds achieved consensus (defined as  $\geq 70\%$  agreement) on fourteen skill prioritisation and twelve methodological effectiveness statements.

Implementation evidence from pilot programmes in three Uzbekistani secondary schools and one Kazakhstani university indicated that students who followed the ISFM protocol over an academic year demonstrated significant pre-post improvements in measured critical thinking ( $d = 0.68$ ), creative self-efficacy ( $d = 0.74$ ), and self-regulatory capacity ( $d = 0.81$ ). Teacher-reported improvements in collaborative behaviour and communication quality were also documented, though with lower effect magnitudes. These pilot results, while preliminary, align closely with the meta-analytic findings and support the ecological validity of the ISFM in Central Asian educational contexts.

**Conclusions and suggestions.** This study establishes that 21st century skills are not innate traits but developable competencies amenable to systematic self-formation through evidence-based methodological strategies. The most effective self-formation methods project-based learning, self-regulated learning, collaborative peer engagement, digital creation, and structured reflective practice share a common structural principle: they position the learner as an active, self-determining agent who constructs knowledge and skill through iterative cycles of challenge, action, reflection, and refinement.

Educational institutions are recommended to integrate explicit self-formation skill development into curriculum design, providing students with validated competency frameworks, metacognitive tools, and structured opportunities for autonomous project work. National curriculum standards should include measurable 21st century skill outcomes alongside content knowledge objectives, supported by formative assessment frameworks that capture competency development trajectories over time.

At the individual level, learners are encouraged to adopt the ISFM framework as a practical tool for intentional self-development, beginning with systematic competency self-assessment and progressing through goal-directed practice, metacognitive monitoring, and public performance. Digital platforms offering project collaboration, reflective portfolio tools, and peer feedback mechanisms should be

actively utilised as scaffolding environments for self-formation.

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