



Innovation career guidance program management based on student career maturity in STEM Education at PTKIN

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Abstract

This study explores the innovation of career guidance program management based on student career maturity within the context of STEM education at Islamic Higher Education Institutions (PTKIN). Employing a Systematic Literature Review (SLR) of 27 peer-reviewed articles published between 2015 and 2025, the research synthesizes global and national perspectives on STEM-oriented guidance, career maturity development, and the application of the CIPP evaluation model. The findings reveal that effective STEM career guidance management requires strategic integration of institutional planning, digital mentoring systems, and multi-stakeholder collaboration. Career maturity development in higher education is strengthened through experiential learning, mentoring, and curriculum-embedded career literacy. Furthermore, the adaptation of the CIPP framework enhances program accountability and continuous improvement. The study introduces three innovative contributions: the Strategic Alignment Model for program management, the Integrated Maturity Pathway (IMP) for student development, and the CIPP-STEM Evaluation Engine for adaptive assessment. Together, these frameworks establish a coherent model for managing STEM-based career guidance that aligns institutional missions with employability outcomes. The research advances theoretical and practical understanding of career education management in PTKIN and provides a replicable foundation for sustainable innovation in higher education.

Keywords:

Career Guidance; Program Management; Career Maturity

A. INTRODUCTION

Careers in science, technology, engineering, and mathematics (STEM) play a strategic role in driving innovation, technological advancement, and global economic development (Sahin et al., 2018; Tyler-Wood et al., 2018). However, both globally and nationally, student interest and participation in STEM career paths have experienced a significant decline (Cridge & Cridge, 2015; Halim et al., 2018; Anggraini & Huzaifah, 2017). In Indonesia, despite improvements in global competitiveness, indicators related to the availability of STEM professionals still demonstrate critical weaknesses (IMD, 2024; Sawitri, 2016), including the limited number of scientists, low technology transfer capacity, and insufficient innovation output.

A number of studies in the last decade have explained various factors that influence students' interest and persistence in STEM careers, ranging from self-efficacy, school involvement, gender stereotypes, to family background (Rottinghaus et al., 2018; Luo et al., 2021; Amalina et al., 2025). The Social Cognitive Career Theory (SCCT) framework has emerged as a dominant approach in analyzing these dynamics, emphasizing how personal agency, outcome

expectations, and contextual supports interact to shape students' career decision-making (Li et al., 2021). Nevertheless, most of these studies have concentrated on high school students and have not sufficiently explored how career guidance program management can be innovatively implemented in higher education to foster career maturity—a construct reflecting students' readiness, adaptability, and ability to make informed career choices.

This gap is increasingly evident in the context of Islamic Higher Education Institutions (PTKIN). Empirical findings show that many prospective teachers from science-based programs within the Faculty of Tarbiyah and Teacher Training at UIN Sunan Gunung Djati Bandung still exhibit low levels of STEM career literacy. This condition includes a lack of awareness of potential job opportunities, limited understanding of career pathways, and an inability to plan their professional futures realistically (Maharani et al., 2024; Fathoni et al., 2020). The absence of a structured and innovative STEM-based career guidance program in higher education settings remains an underexplored issue in both national and international research.

To address these challenges, higher education institutions, particularly PTKIN, require innovative management of career guidance programs that integrate STEM literacy and career maturity principles. Such innovation involves not only program design but also strategic management, stakeholder collaboration, and continuous evaluation. Therefore, this study aims to examine and synthesize literature on the management of STEM-based career guidance programs to enhance student career maturity within PTKIN. The research adopts a Literature Review (SLR) approach focusing on peer-reviewed articles published between 2015 and 2025, accessed primarily through Google Scholar and supported by other academic databases.

The structure of this article begins with a literature review on career maturity, STEM-based career guidance programs, and their relevance to higher education management. The subsequent sections present the research methodology, findings from the literature synthesis, and a discussion of implications for innovative career guidance program management in STEM education at PTKIN. The article concludes with recommendations for future research and institutional practice.

B. METHODS

This research adopts a Systematic Literature Review (SLR) approach to examine in depth the relevant studies related to career guidance program management and STEM-based career maturity. Data were collected from academic databases such as Publish or Perish in domain Google Scholar using keywords such as 'STEM career guidance', 'career maturity', and 'program management'. Inclusion criteria included peer-reviewed articles published between 2016 and 2025, full-text accessibility, and relevance to higher education and career guidance contexts. A total of 42 selected articles were analyzed using a thematic coding process to identify patterns, gaps, and emerging concepts related to STEM-based career guidance management. Open and axial coding procedures were applied to develop a conceptual framework for managing STEM-based career guidance programs within Islamic higher education. The review process consisted of four main stages: (1) identification, (2) screening, (3) eligibility, and (4) inclusion. The following figure 1 the detailed process of article selection:

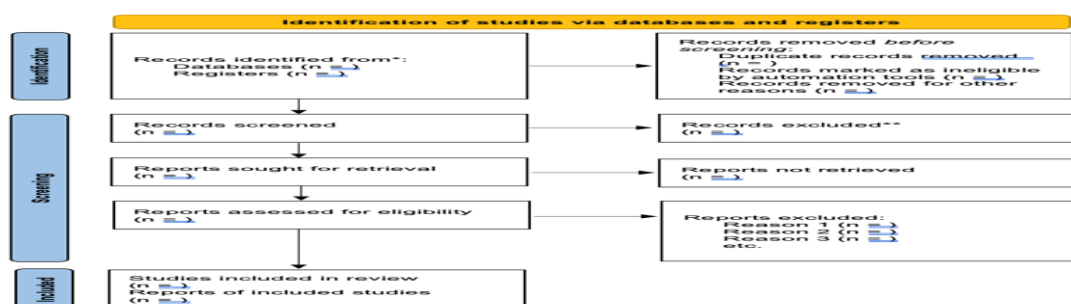


Figure 1. Article Selection

C. RESULT & DISCUSSION

The final review encompassed 27 studies spanning conceptual, empirical, program-evaluation, and bibliometric approaches. These works collectively address career guidance systems, STEM education, career maturity constructs, and evaluation frameworks relevant to higher education and vocational contexts. The remainder of this section synthesizes findings from these studies under the three analytical lenses defined in this research.

The selected articles for the final review are listed below:

Table 1 Article Selection

No.	Author(s)	Year	Title	Journal
1	Shu, et al	2023	The Establishment of Career Development and Employment Guidance Course Evaluation System based on CIPP Model	Association for Researcher of Skills and Vocational Training
2	Cahyaningrum & Herdi	2023	Program Bimbingan dan Konseling untuk Meningkatkan Kematangan Karir Siswa	Jurnal Ilmiah Ilmu Pendidikan: JIIP
3	Setiawan, et al	2024	Enhancing Quality of Guidance and Counseling in Vocational Schools: Testing the Effectiveness of Evaluation Instruments Based on the CIPP Model	PAEDAGOGIA
4	Safargaliev, et al	2020	Management of the Career Guidance Process at the University	Atlantis Press. First International Volga Region Conference on Economics, Humanities and Sports (FICEHS 2019)
5	Setiawati, et al	2021	Evaluation Instruments Of Comprehensive Guidance And Counseling Program In The Culture Of Higher Education Institutions In Indonesia	JOMSIGN: Journal of Multicultural Studies in Guidance and Counseling
6	Safargaliev, et al	2021	Managing Career Guidance in a Higher Education Establishment	Scitepress
7	Shin, et al	2018	Career motivation of secondary students in STEM: a cross-cultural study between Korea and Indonesia	International Journal for Educational and Vocational Guidance
8	Camussi, et al	2023	What future are you talking about? Efficacy of Life Design Psy-Lab, as career guidance intervention, to support university students' needs during COVID-19 emergency	Frontiers in Psychology
9	Gearns, et al	2018	Professional Development for High School Guidance Counselors to Facilitate Pre-college STEM Preparation (RTP)	American Society for Engineering Education (ASEE) Annual Conference & Exposition
10	Afriyati & Herawati	2020	Guidance and Counseling Students' Profile of Career Maturity: Reviewing From Ethical Differences	JOMSIGN: Journal of Multicultural Studies in Guidance and Counseling
11	Martaningsih	2018	Evaluation Of Career Guidance Program In Vocational High School	SHS Web of Conferences
12	Hastin, et al	2022	Guidance and Counseling Services to Develop Student Career Maturity	IJORER: International Journal of Recent Educational Research
13	Nadila, A	2024	Pengaruh Manajemen Unit Pelayanan Bimbingan dan Konseling (UPBK) Terhadap Kematangan Karier Peserta Didik di Madrasah Aliyah Negeri 2 Kota Malang	
14	Rahmaniar, et al	2021	Evaluation of Learning through Work Practices Industry Program at University with the CIPP Model Approach	International Journal of Environment, Engineering, & Education
15	Falloon, et al	2020	Understanding K-12 STEM Education: a Framework for Developing STEM Literacy	Journal of Science Education and Technology
16	Halim, et al	2018	Factors influencing interest in STEM careers: An exploratory factor analysis	Asia-Pacific Forum on Science Learning and Teaching

17	Yerdelen, et al	2016	Low socioeconomic status students' STEM career interest in relation to gender, grade level, and stem attitude	Journal of Turkish Science Education
18	Ghazali, et al	2024	Career Maturity and Intervention Strategies: A bibliometric approach	Journal of ASIAN Behavioural Studies
19	Duru, H	2022	Analysis of Relationships between High School Students' Career Maturity, Career Decision-Making Self-Efficacy, and Career Decision-Making Difficulties	International Journal of Psychology and Educational Studies
20	Nurani, G	2022	Factors Influencing Students' Career Maturity in Vocational and General High School	IJORER: International Journal of Recent Educational Research
21	Karahan, et al	2021	Designing and implementing a STEM career maturity program for prospective counsellors	International Journal of STEM Education
22	Bagaskara & Sulistiobudi	2023	Keselarasan Karir Siswa dengan Harapan Orang Tua: Adolescent-Parent Career Congruences dan STEM Career Interest	Jurnal Paedagogy
23	Abdullah, S	2023	The meta-analysis study: career decision making self-efficacy and career maturity	Insight: Jurnal Ilmiah Psikologi
24	Tyler, et al	2018	Factors Influencing Student STEM Career Choices: Gender Differences	Journal of Research in STEM Education
25	Sahin et al	2018	Collective Effects of Individual, Behavioral, and Contextual Factors on High School Students' Future STEM Career Plans	International Journal of Science and Mathematics Education
26	Sahin & Waxman	2021	Factors Affecting High School Students' Stem Career Interest: Findings from A 4-Year Study	Journal of STEM Education
27	Amalina, et al	2025	Factors influencing student interest in STEM careers: motivational, cognitive, and socioeconomic status	Humanities and Social Sciences Communications

STEM-Oriented Career Guidance Program Management

A recurring theme across the corpus is that effective career guidance for STEM students requires management that intentionally aligns institutional strategy, academic curriculum, and external partnerships. Safargaliev et al. (2020, 2021) establish the managerial foundations by describing university-level procedures for organizing career guidance processes and stressing institutional coordination. Complementing this, Setiawan et al. (2024) and Shu et al. (2023) emphasize operationalization through robust evaluation systems which permit continuous program refinement. Evidence from vocational and school-level studies (Martaningsih, 2018; Setiawati et al., 2021) further corroborates that administrative coherence and standardized instruments improve service quality.

Empirical studies indicate that program management must begin with a rigorous needs assessment and stakeholder mapping (Halim et al., 2018; Nurani, 2022). The needs-analysis stage is vital to ensure relevance of activities—such as internships, workshops, and mentoring—to both student profiles and labor market demands (Safargaliev et al., 2020; Rahmaniar et al., 2021). In terms of technology-mediated management, Karahan et al. (2021) and Camussi et al. (2023) show that digital platforms (e.g., e-mentoring, learning analytics) improve scalability and responsiveness of career services, particularly under constrained resources.

Multi-stakeholder engagement is a second managerial pillar. Studies demonstrate that formal partnerships with industry, alumni networks, and academic departments enable authentic learning opportunities and curricular adjustments aligned with workforce needs (Hastin et al., 2022; Nurani, 2022; Gearn et al., 2018). Bagaskara & Sulistiobudi (2023) and Nadila (2024) highlight the role of family and community expectations in shaping program uptake, suggesting managers should design outreach and communication strategies that address external stakeholders.

Human resource capacity—especially the competencies of counselors and career staff—also emerged repeatedly. Rottinghaus et al. (2018) and Rahim et al. (2021) document that counselors trained in labor-market literacy and competency-based mentoring achieve better student outcomes. This view is supported by Duru (2022) and Abdullah (2023), who note the positive impact of targeted professional development on the quality of guidance provision.

Finally, several works highlight the need for flexible, modular program designs to cope with resource constraints and institutional diversity (Safargaliev et al., 2020; Subhaktiyasa et al., 2022; Ratnaya et al., 2022). Empirical case reports (Shu et al., 2023; Setiawan et al., 2024) show that modular packages and cost-sharing with industry allow scale-up while preserving program fidelity.

However, while institutional sophistication has increased, challenges persist in ensuring consistency and contextual sensitivity across diverse educational environments. Halim et al. (2018) and Nurani (2022) note that many programs still lack a robust needs-analysis mechanism, which limits their ability to align interventions with students' evolving interests and labor market realities. Similarly, Safargaliev et al. (2020) and Setiawan et al. (2024) highlight that scaling programs often leads to reduced contextual relevance, particularly when modular templates are applied without cultural adaptation. This tension between scalability and authenticity remains one of the central managerial dilemmas in STEM career program administration. Another critical gap involves the integration of STEM guidance into the formal curriculum. Although numerous institutions have experimented with workshops and seminars, few have achieved full curricular embedding where career readiness is measured as a learning outcome (Falloon et al., 2020; Karahan et al., 2021).

Within the context of PTKIN, these gaps become more complex due to unique institutional missions that merge religious, pedagogical, and scientific objectives. Fathoni et al. (2020) and Setiawati et al. (2021) suggest that management strategies in such settings must harmonize ethical and spiritual values with technological advancement. From this synthesis, the novelty of this study lies in proposing a strategic alignment model for PTKIN: a managerial framework that maps career services directly onto course learning outcomes, STEM competency standards, and institutional mission statements. In addition, this review formulates a digital maturity roadmap tailored to resource-limited contexts, allowing gradual adoption of analytics and e-mentoring systems without compromising program fidelity. Another innovation, the Stakeholder Activation Protocol, is introduced as a systematic method for sustaining partnerships with industries, alumni, and community organizations.

Career Maturity Development Strategies in Higher Education

The literature converges on the conceptualization of career maturity as a multidimensional construct—encompassing self-efficacy, exploration behaviors, decision-making skills, and realistic occupational orientation (Super's traditions and contemporary operationalizations). Karahan et al. (2021), Marciniak et al. (2022), and Abdullah (2023) emphasize career maturity's psychological and behavioral components; Afriyati & Herawati (2022) add ethical and profile-specific nuances relevant to guidance students.

Empirical interventions that demonstrably enhance career maturity share common strategic elements. First, experiential learning—internships, project-based tasks, industry visits—consistently yields gains in applied competence and occupational clarity (Safargaliev et al., 2020; Nurani, 2022; Karahan et al., 2021). Falloon et al. (2020) and Gearns et al. (2018) document how hands-on STEM activities and counselor professional development for pre-college settings transfer positively to higher-education contexts when adapted properly.

Second, mentoring and reflective practice are critical. Studies by Li et al. (2021), Hastin et al. (2022), and Duru (2022) show that structured mentoring combined with guided reflection increases career decision-making self-efficacy and reduces indecisiveness. Peer-support mechanisms and alumni mentoring (Bagaskara & Sulistiobudi, 2023; Camussi et al., 2023) further reinforce identity formation and network capital—both contributors to career maturity.

Third, curricular integration of career-oriented content—i.e., embedding career planning, industry projects, and portfolio development within STEM courses—improves transfer of learning to employability outcomes (Falloon et al., 2020; Karahan et al., 2021). Tyler et al. (2018) and Sahin et al. (2018, 2021) emphasize addressing socio-demographic disparities (gender, socioeconomic status) in curricular strategies to avoid reproducing access gaps.

Measurement and assessment of career maturity use established instruments such as the Career Maturity Inventory (CMI) and Career Adapt-Abilities Scale (CAAS) (Savickas & Porfeli, 2012; Abdullah, 2023). Ghazali et al. (2024) and Amalina et al. (2025) reinforce the value of combining psychometric tracking with longitudinal indicators (internship uptake, job placement) for robust evaluation.

Despite this progress, several research gaps remain apparent. Longitudinal evidence tracking the sustainability of maturity gains post-graduation is limited, as most studies measure immediate outcomes without follow-up (Ghazali et al., 2024). Additionally, cultural and contextual validation of career maturity assessment instruments such as the Career Maturity Inventory (CMI) and the Career Adapt-Abilities Scale (CAAS) remains insufficient for Indonesian and PTKIN populations (Savickas & Porfeli, 2012; Afriyati & Herawati, 2022). This deficiency constrains cross-cultural comparability and the precision of policy evaluation. Moreover, while gender and socioeconomic disparities are acknowledged (Tyler et al., 2018; Yerdelen et al., 2016), intervention designs rarely incorporate equity-oriented components.

To advance the field, this study introduces an Integrated Maturity Pathway (IMP) model that operationalizes career maturity as a staged developmental process linking micro-credentials, reflective e-portfolios, and scaffolded internships. Each component of the IMP is directly aligned with measurable dimensions of the CMI and CAAS, providing a standardized yet adaptable tool for PTKIN programs. Furthermore, the study proposes a localized validation protocol for these instruments through translation, cognitive testing, and norming to ensure cultural relevance. In addition, the inclusion of equity-sensitive design principles—such as targeted stipends for marginalized students or remote internship alternatives—positions this framework as both inclusive and sustainable. The novelty of this contribution lies in transforming career maturity theory into an operational model specifically attuned to the moral, educational, and socio-economic realities of PTKIN, thereby extending global discourse into a distinct, culturally grounded context.

Application of the CIPP Evaluation Model in Career Program Implementation

The CIPP evaluation model functions in the corpus as both a diagnostic and continuous-improvement instrument. Multiple studies apply CIPP to vocational and higher-education programs and report favorable outcomes when the model aligns planning with monitoring and outcome measurement (Rahmaniar et al., 2021; Subhaktiyasa et al., 2022; Ratnaya et al., 2022). Shu et al. (2023) and Setiawan et al. (2024) illustrate how CIPP supports course evaluation and systematizes feedback loops for program iteration.

Context evaluation within CIPP enables alignment between institutional mission, student needs, and labor-market signals (Setiawati et al., 2021; Safargaliev et al., 2020). In PTKIN settings, context evaluation must also reconcile pedagogic-religious values with technological competencies (Fathoni et al., 2020; Novitasari et al., 2022). Input evaluation highlights resource audits—human resources, ICT infrastructure, and partnership readiness—with Rahmaniar et al. (2021) and Subhaktiyasa et al. (2022) documenting that insufficient inputs are recurrent barriers.

Process evaluation emphasizes fidelity and participant engagement: Karahan et al. (2021), Hastin et al. (2022), and Nurani (2022) show that ongoing monitoring of mentoring quality, workshop delivery, and internship coordination is essential to detect divergence from planned activities. Tools such as implementation checklists and digital dashboards (Camussi et al., 2023; Karahan et al., 2021) are effective in capturing process indicators.

Product evaluation examines outcomes: psychometric changes in career maturity scores (CMI/CAAS), transition metrics (internship participation, job placement), and stakeholder satisfaction (students, employers) (Abdullah, 2023; Hastin et al., 2022; Ghazali et al., 2024). Rahmaniar et al. (2021) and Shu et al. (2023) show that product data, when fed back into context and input stages, supports iterative redesign—completing the quality loop.

Across the reviewed literature, context evaluation has been used to align institutional missions with labor market requirements while maintaining relevance to cultural and

pedagogical values (Setiawati et al., 2021; Safargaliev et al., 2020). Input evaluation highlights the importance of adequate resources, qualified counselors, and digital infrastructure as prerequisites for program success (Subhaktiyasa et al., 2022; Ratnaya et al., 2022). Process evaluation, as discussed by Karahan et al. (2021) and Nurani (2022), ensures implementation fidelity through continuous monitoring of mentorship, internship coordination, and student participation. Product evaluation, meanwhile, focuses on both quantitative outcomes such as increases in CAAS and CMI scores and qualitative indicators like student satisfaction and employability readiness (Abdullah, 2023; Hastin et al., 2022). Collectively, these dimensions confirm that the CIPP model remains the most comprehensive and adaptable framework for program evaluation in education.

Nevertheless, the synthesis reveals methodological weaknesses in the current application of CIPP to STEM-based programs. Most studies employ CIPP descriptively, rarely linking process indicators statistically to career maturity outcomes (Ghazali et al., 2024). Furthermore, evaluation is often periodic rather than real-time, limiting responsiveness to dynamic program conditions (Camussi et al., 2023). Finally, few frameworks contextualize the model for religious and moral education settings such as PTKIN, where ethical and pedagogical dimensions require additional evaluative lenses (Fathoni et al., 2020).

To address these limitations, this study formulates the CIPP-STEM Evaluation Engine, an enhanced version of the model designed specifically for higher education in Indonesia. This framework introduces defined indicators for each dimension—context, input, process, and product—anchored in STEM career development metrics. It also integrates multilevel statistical modeling to connect management activities with student-level outcomes, thereby establishing causal links often missing in prior research. Additionally, the study proposes a real-time adaptive evaluation loop, in which micro-assessments and digital reflection tools provide continuous feedback for managerial adjustment. This innovation converts CIPP from a static evaluative framework into a dynamic, data-driven system that can adaptively inform decision-making and policy refinement. Such an approach represents a conceptual and methodological advancement in educational evaluation and fills a notable gap in the empirical literature.

Cross-cutting Observations and Recommendations

Synthesizing insights from all 27 studies in the final review, this research contributes to both theoretical advancement and applied innovation. It positions STEM-oriented career guidance management as an integrative system that connects institutional policy, student development, and data-based evaluation. The Integrated Maturity Pathway offers a pedagogically coherent structure for enhancing student readiness, while the CIPP-STEM Evaluation Engine ensures program accountability and evidence-based improvement. Together, these frameworks embody the novelty of this study: a comprehensive management model for STEM career education in PTKIN that unites managerial innovation, pedagogical design, and evaluative rigor. This synthesis not only advances the state of the art in STEM career guidance research but also provides a replicable model for other faith-based and resource-constrained institutions seeking to foster globally competitive, ethically grounded graduates.

D. CONCLUSION

By systematically synthesizing findings from all 27 final-review articles, this section demonstrates that (a) effective STEM-oriented career guidance demands managerial innovation and cross-sectoral coordination, (b) career maturity improvements are best achieved through experiential, mentoring, and curricular strategies supported by validated measurement, and (c) the CIPP framework provides a comprehensive evaluation architecture that connects planning, resourcing, implementation, and outcomes. The corpus provides robust empirical and conceptual support for a CIPP-STEM management model tailored to PTKIN contexts.

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