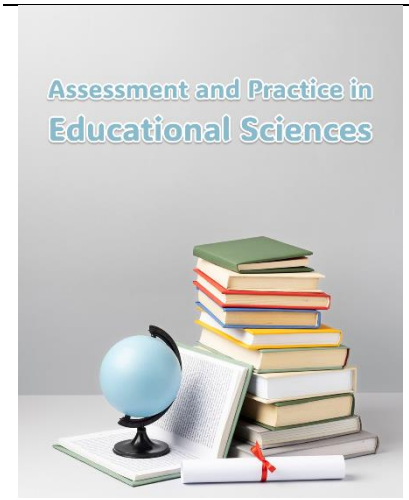
Assessment and Practice in Educational Sciences




# Designing and Developing a Professional Development Model for Physical Education Teachers in Secondary Schools in Iraq


## ABSTRACT

The objective of this study was to design and validate a professional development model for physical education teachers in secondary schools across Iraq using a mixed-methods approach. This research employed a developmental and descriptive-survey methodology within a mixed-methods design. In the qualitative phase, data were collected through semi-structured interviews with 15 educational experts selected through purposive sampling until theoretical saturation was achieved. Content analysis and open-axial coding techniques were used to extract themes. In the quantitative phase, a researcher-made questionnaire based on qualitative findings was distributed to 180 physical education teachers from Iraqi secondary schools, selected using Cochran's formula. Data were analyzed using descriptive statistics, Pearson correlation, exploratory and confirmatory factor analysis, and structural equation modeling (SEM), conducted via AMOS software. The initial model included six latent constructs: teacher characteristics, managerial characteristics, school infrastructure, educational policies, information technology, and ministry training programs. Correlation analysis revealed strong and significant relationships among most variables ($p < .001$), except for educational policies, which showed no significant covariance with other components ($p > .05$). The initial covariance model demonstrated poor fit indices (RMSEA = 0.179, CMIN/DF = 5.575), leading to model revision. After excluding the educational policies dimension, the revised model yielded acceptable fit (RMSEA = 0.081, CMIN/DF = 2.507, CFI = 0.938), confirming the structural validity of the five remaining constructs in modeling professional development. The validated model highlights the central role of teacher competencies, leadership, infrastructure, digital integration, and structured training in the professional development of physical education teachers. The results underscore the ineffectiveness of disconnected policy frameworks and reinforce the need for context-responsive, resource-supported, and teacher-centered development strategies in the Iraqi educational context.


**Keywords:** Professional Development, Physical Education Teachers, Structural Equation Modeling, Iraq, School Leadership, Educational Infrastructure, Teacher Training.



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## Introduction

In recent years, the professional development of teachers has emerged as a critical focal point in educational reform agendas worldwide, especially in the context of secondary education. Amidst sweeping pedagogical, technological, and socio-cultural

transformations, the need to build teacher capacity in sustainable, context-responsive, and dynamic ways is now widely recognized as essential for improving student outcomes and educational equity. Teacher professional development (TPD), as both a strategic tool and a structural imperative, enables educators to keep pace with evolving instructional demands, learner diversity, and institutional accountability frameworks (1, 2). This is particularly relevant for physical education (PE) teachers in secondary schools, who must not only engage in domain-specific skill acquisition but also integrate interdisciplinary competencies such as inclusive teaching practices, educational technologies, and student well-being approaches.

The complexity of educational ecosystems has led to a redefinition of TPD from a linear, one-time training model to a continuous, multi-dimensional process that is deeply embedded in professional practice and institutional culture (3, 4). Scholars argue that effective TPD goes beyond enhancing knowledge and skills; it also nurtures reflective thinking, adaptive expertise, and collaborative problem-solving among teachers (5, 6). Therefore, a successful professional development model must align with the systemic needs of the school, the evolving role of the teacher, and the broader objectives of education for sustainable development. In this context, the present study aims to design and validate a professional development model specifically tailored for physical education teachers in Iraqi secondary schools—an under-researched domain despite the crucial role of PE in adolescent health and holistic growth.

Evidence suggests that teachers' perceptions, motivations, and engagement in professional development are shaped by a myriad of factors, including school leadership, institutional infrastructure, national policy frameworks, and socio-cultural environments (7, 8). In developing contexts such as Iraq, where education systems often grapple with limited resources, fragmented policy implementation, and constrained access to global pedagogical trends, the design of an effective TPD model must account for contextual specificity while integrating global standards (9, 10). Moreover, the role of school principals as instructional leaders, the quality of in-service training, and the integration of ICT-based tools in professional learning are increasingly recognized as catalysts for meaningful change (11, 12).

One of the pressing concerns identified in contemporary literature is the disjunction between professional development policies and their practical enactment at the school level. According to (8), many policy initiatives fail to articulate clear targets, evaluation criteria, or contextual adaptability, which limits their impact on teacher learning and school improvement. In contrast, models grounded in teacher agency, localized needs assessment, and iterative feedback mechanisms are more likely to yield sustained professional growth (13, 14). This aligns with (7), who emphasizes the importance of professional learning communities (PLCs) and peer-driven inquiry as structures that can cultivate collective efficacy and innovation among educators. In the context of physical education, such models are even more necessary due to the evolving role of PE in promoting not only physical fitness but also social-emotional competencies, teamwork, and inclusive education.

The emergence of hybrid and blended learning environments, especially in the post-pandemic era, has further complicated the expectations placed on teachers. PE teachers now require training not only in physical skill instruction but also in using virtual tools, online performance assessments, and digital content creation (15, 16). As (17) highlights, differentiated instruction and universal design for learning (UDL) frameworks are increasingly being integrated into TPD programs to address student diversity. Furthermore, (18) underscores the potential of AI-powered educational tools to support active learning strategies, which, when integrated with teacher training, can radically reshape classroom dynamics. Therefore, a modern professional development model must be technologically inclusive and attuned to the differentiated learning needs of both students and teachers.

Recent studies have also emphasized the emotional, ethical, and psychological dimensions of professional development. As (5) points out, professional learning should not be confined to technical competency; it must also support the teacher's sense of identity, values, and moral commitment to equity and justice in education. Similarly, (19) suggests that positive behavior

support systems—when understood and applied by teachers—can contribute to a more supportive learning environment, especially in underserved contexts. In such settings, fostering empathy, resilience, and reflective practice among teachers becomes as vital as curriculum delivery.

From a structural standpoint, professional development efforts must be multi-tiered—incorporating policy-level mandates, institutional accountability, and classroom-level needs. Research by (20) demonstrates how empowerment through differentiated instruction training can lead to more sustainable professional learning outcomes. Likewise, the findings of (21) indicate that systemic efforts to enhance teacher training institutions and foster mentorship among teacher educators can significantly improve the quality of future instruction. In Iraq, where physical education remains an undervalued discipline in many secondary schools, adopting such a comprehensive and research-informed model is essential for elevating the status and efficacy of PE teachers.

Another key dimension involves the design and implementation of in-service training programs. Studies such as those by (22) and (23) argue that fragmented or poorly timed training efforts have little impact on instructional improvement. Instead, structured, cyclical, and well-supported professional learning opportunities—tailored to subject-specific needs—are more effective. In the case of physical education, this includes exposure to the latest developments in kinesiology, sports psychology, injury prevention, and curriculum integration with other academic subjects. Moreover, as shown by (6), the use of competitive and recognition-based strategies (e.g., teacher achievement contests) can enhance engagement and self-efficacy among teachers.

Importantly, the role of school leadership in supporting and modeling professional growth cannot be overstated. As (24) notes, one of the main challenges faced by teachers in professional learning is the absence of sustained administrative support and clear career advancement pathways. (25) adds that teachers in rural or resource-deprived areas often suffer from unequal access to developmental opportunities, thereby perpetuating inequities in teacher quality and student outcomes. Addressing these structural gaps through localized planning, resource allocation, and policy reform is necessary to ensure the scalability and equity of any proposed professional development model.

Finally, any model for teacher professional development must be evaluated against its capacity to generate real, observable changes in pedagogical practice. This requires rigorous monitoring, longitudinal tracking, and feedback loops that incorporate teacher voice and context-specific data (1, 3). Models that are rigid, top-down, or overly theoretical often fail to translate into meaningful classroom transformation. Instead, as (11) and (9) demonstrate, participatory and adaptive models grounded in practice-based research and stakeholder engagement tend to foster long-term professional growth.

Given this backdrop, the present study seeks to design and validate a context-specific, data-informed, and teacher-centered model for the professional development of physical education teachers in Iraqi secondary schools.

## Methods and Materials

This study is developmental in purpose, aiming to address practical challenges and devise effective interventions by constructing a new conceptual model for the professional development of physical education (PE) teachers in Iraqi secondary schools. Methodologically, the research follows a cross-sectional descriptive-survey design, which facilitates the collection and analysis of data at a single point in time to depict existing conditions and explore potential relationships among variables. The study adopts a mixed-methods strategy, integrating both qualitative and quantitative components to capture a comprehensive understanding of the phenomenon. In the qualitative phase, the research relies on descriptive analysis and content analysis techniques to extract in-depth insights, while the quantitative phase employs a descriptive-survey method to examine participants' opinions statistically.

In the qualitative part, the population consisted of experts and faculty members in curriculum planning, educational sciences, physical education, and educational management from Iraqi universities. Expert selection criteria included at least five years of faculty membership and a minimum of three years of teaching experience. For the quantitative section, the target population included all physical education teachers working in secondary schools across Iraq. Given the lack of precise information about the total population size, an adjusted Cochran formula was applied to determine the sample size. Using a standard deviation of 0.34, a 95% confidence level (Z = 1.96), and a margin of error of 0.05, the final sample size was calculated to be 180 participants.

In the qualitative section, 15 participants were selected through purposive sampling. The number of interviews was not predetermined but was determined according to the principle of theoretical saturation. Interviews continued until the twelfth interview, after which repetition in responses suggested saturation; however, three additional interviews were conducted to ensure comprehensive data coverage. In the quantitative section, the sample of 180 PE teachers was selected based on the standard deviation and reliability requirements of the Likert-scale questionnaire used.

In the qualitative phase, data were collected through semi-structured interviews and document analysis. Semi-structured interviews provided the flexibility to explore participants' insights while maintaining focus on key research questions. Interview questions were pre-formulated based on the objective of designing a conceptual model for professional development. These interviews allowed for dynamic interaction and exploration of the topic in greater depth. The researcher ensured that probing questions were used to deepen understanding, and note-taking during interviews helped with accurate transcription and capturing key insights. After each interview, the content was thoroughly reviewed to extract relevant themes and conceptual dimensions for model construction.

In the quantitative phase, a researcher-developed questionnaire was employed. The questionnaire was constructed based on themes and components identified through the literature review and qualitative interviews. Each item in the questionnaire was aligned with specific dimensions and indicators of professional development. To reduce respondent fatigue and potential response error, each component was assessed with a minimum number of items—at least three per construct—to ensure reliability and validity. The final questionnaire included 43 items measuring various dimensions of professional development. A five-point Likert scale was used, ranging from "very low" (1) to "very high" (5), with a theoretical mean of 3. This scale allowed for quantification of agreement levels among participants regarding the proposed model components.

Data analysis was conducted in two sequential stages, beginning with qualitative data. The qualitative data were analyzed using the method of theoretical coding. In this process, the fundamental elements—concepts and categories—were identified through open and axial coding. Initially, raw interview data were subjected to open coding to extract initial concepts. These were then grouped into broader categories based on their conceptual similarity. This iterative process of data reduction allowed the researcher to refine large volumes of qualitative information into manageable themes. The open and axial codes served to break down the data and reconstruct it conceptually, yielding a structured understanding of professional development components. Two approaches to theoretical coding were considered: line-by-line detailed coding and selective coding of key themes. Due to the time-consuming nature of the former, the researcher focused on key concepts and patterns that emerged consistently across interviews.

In the quantitative phase, data analysis was performed using both descriptive and inferential statistical techniques. Descriptive statistics, including frequency distributions, means, variances, and standard deviations, were calculated to summarize the characteristics of the sample and their responses. At the inferential level, several statistical tests were conducted. Pearson correlation analysis was used to explore relationships among variables. One-sample t-tests assessed whether participants' evaluations of model components significantly differed from the theoretical mean. The adequacy of the data for

factor analysis was confirmed using the Kaiser-Meyer-Olkin (KMO) test and Bartlett's test of sphericity. Further, Friedman's test was applied to rank components based on perceived importance. Structural equation modeling (SEM) and confirmatory factor analysis (CFA) were used to test the fit of the proposed conceptual model. The software AMOS was used to conduct these advanced analyses and to assess the covariance structure of the model, validating its internal consistency and structural robustness. This comprehensive analytical approach ensured that both the exploratory insights from the qualitative data and the confirmatory strength of quantitative evidence contributed to the final model of professional development.

## Findings and Results

The qualitative phase of this study aimed to extract the core dimensions and components necessary for designing a conceptual model of professional development for physical education teachers in Iraqi secondary schools. Through a rigorous process of semi-structured interviews and theoretical coding, the data were reduced, categorized, and synthesized into meaningful concepts. This process resulted in the identification of six overarching dimensions and eighteen primary components, each comprising several specific indicators. These categories reflect the multi-layered nature of professional development, integrating individual, institutional, structural, and technological aspects. The extracted model provides a holistic framework encompassing teachers' internal attributes, managerial qualities, infrastructure conditions, educational policies, technology integration, and targeted training programs.

**Table 1. Axial Coding Based on Open Codes for the Professional Development Model of Physical Education Teachers in Iraq**

| Dimensions | Components | Indicators |
|---|---|---|
| Teacher Characteristics | Teacher Interactions | Collaboration with colleagues, communication with parents, community relations |
| | Teacher Attitudes | Positive attitude toward physical education, attitude toward students, attitude toward teaching profession |
| | Teacher Knowledge | Knowledge in physical education, exercise physiology, sports pathology and psychology, familiarity with modern teaching methods, curriculum design skills, ability to use educational technologies, ability to conduct small-scale research, use of research findings for performance improvement |
| | Teacher Skills | Technical skills, teaching skills, managerial skills |
| School Leadership | Leadership Style | Transformational leadership, participatory leadership, moral support, instructional leadership |
| | Communication Skills of Principals | Effective communication, transparency, active listening |
| | Principal Knowledge | Subject-specific knowledge, familiarity with latest research findings, evaluation capabilities |
| School Infrastructure | Financial Resources | Financial support for teacher development, budget for sports equipment, budget for teacher training |
| | Educational Infrastructure | Access to sports equipment, capacity to host sports events, access to educational resources |
| Educational Policy | Structural and Organizational | Adequate resource allocation, creation of support structures, defining job standards |
| | Content and Educational Aspects | Curriculum diversification, focus on experiential learning, promoting research in physical education |
| | Evaluation and Monitoring | Ongoing performance evaluation, teacher self-assessment policies, identification of development needs |
| | Cultural and Social Dimensions | Promotion of physical activity culture, consideration of individual differences, role of sports in sustainable development |
| Information Technology | Innovative Training Design | Use of fitness apps, game-based learning, performance assessment tools |
| | Online Educational Resources | Blogs and podcasts, educational apps, online conferences and seminars |
| Ministry Training Programs | Digital Professional Development | Use of digital PE training, offline specialized training, self-learning and online participation |
| | Empowerment Courses | In-service training, specialized seminars, teaching educational approaches in sport |

| | | |
|---|---|---|
| | Specialized Professional Education | International training opportunities, event-based learning, comparative education |

The findings reveal that the proposed model comprises six primary dimensions, namely: teacher characteristics, school leadership, school infrastructure, educational policy, information technology, and educational training programs administered by the Ministry of Education. These dimensions are further broken down into 18 core components, encompassing a wide range of professional competencies and systemic enablers. Each component includes precise, observable indicators that detail the practical and theoretical requirements of professional development. This classification ensures that the model not only reflects the realities of physical education teaching in Iraq but also provides a structured basis for strategic planning, intervention design, and policy development in the domain of teacher capacity building.

The demographic profile of the participants in the quantitative phase of the study, consisting of 180 physical education teachers from secondary schools in Iraq, reflects a relatively balanced distribution across gender, educational attainment, and work experience. In terms of gender, 88 participants (48.9%) were male and 92 participants (51.1%) were female, indicating a nearly equal representation. Regarding academic qualifications, the majority held either a bachelor's degree (40.6%) or a master's degree (39.4%), while a smaller proportion (20%) had completed a doctoral degree. As for teaching experience, 12.2% of the participants had between 3 to 5 years of experience, 26.7% had between 6 to 10 years, 31.7% had between 11 to 15 years, and 29.4% had more than 15 years of experience. This distribution suggests that the study sample includes a diverse range of perspectives from novice to highly experienced educators, which strengthens the representativeness and credibility of the findings related to professional development needs.

**Table 2. Descriptive Statistics of Professional Development Dimensions and Components (N = 180)**

| Variable | Mean | Median | Mode | SD | Skewness | Kurtosis | Min | Max |
|---|---|---|---|---|---|---|---|---|
| Teacher Interactions | 11.42 | 13 | 13 | 3.334 | 1.425 | 0.306 | 4 | 15 |
| Teacher Attitudes | 11.38 | 13 | 13 | 3.535 | -1.371 | 0.246 | 3 | 15 |
| Teacher Knowledge | 30.35 | 35 | 35 | 9.284 | -1.434 | 0.181 | 9 | 39 |
| Teacher Skills | 11.12 | 13 | 13 | 3.425 | -1.193 | 0.013 | 3 | 15 |
| Teacher Characteristics (Total) | 64.28 | 73 | 74 | 19.216 | -1.459 | 0.288 | 19 | 83 |
| Leadership Style of Principals | 14.41 | 16 | 17 | 4.271 | -1.091 | -0.035 | 4 | 20 |
| Principals' Communication Skills | 10.68 | 12 | 13 | 3.175 | -0.959 | -0.194 | 3 | 15 |
| Financial Resources | 10.14 | 11 | 11 | 2.945 | -1.059 | 0.306 | 3 | 14 |
| Educational Infrastructure | 10.44 | 11 | 11 | 2.951 | -1.010 | 0.065 | 3 | 15 |
| School Infrastructure (Total) | 20.58 | 22 | 22 | 5.661 | -1.156 | 0.307 | 6 | 29 |
| Structural and Organizational Policy Aspects | 10.73 | 12 | 13 | 3.515 | -0.909 | -0.652 | 3 | 15 |
| Content and Educational Policy Aspects | 10.83 | 12 | 13 | 3.358 | -0.898 | -0.684 | 3 | 15 |
| Evaluation and Monitoring Policy Aspects | 10.38 | 12 | 12 | 3.234 | -0.837 | -0.603 | 3 | 15 |
| Cultural and Social Policy Aspects | 10.84 | 12 | 12 | 3.469 | -0.769 | -0.727 | 3 | 15 |
| Educational Policy (Total) | 42.78 | 48.50 | 51 | 13.058 | -0.977 | -0.701 | 16 | 57 |
| Innovative Training Design | 11.23 | 13 | 13 | 3.191 | -1.047 | -0.142 | 3 | 15 |
| Online Educational Resources | 11.12 | 12 | 12 | 2.998 | -0.983 | -0.072 | 4 | 15 |
| Information Technology (Total) | 22.35 | 25 | 25 | 5.958 | -1.173 | 0.028 | 7 | 30 |
| Digital Professional Development | 10.43 | 11 | 12 | 2.657 | -0.953 | 0.165 | 3 | 14 |
| Empowerment Courses | 10.12 | 11 | 11 | 2.365 | -0.652 | 0.156 | 4 | 15 |
| Specialized Professional Education | 10.47 | 11 | 12 | 2.795 | -0.995 | -0.141 | 4 | 14 |
| Ministry Educational Programs (Total) | 31.02 | 33.50 | 36 | 7.148 | -1.255 | 0.203 | 12 | 40 |

The descriptive statistics provide a detailed overview of the professional development components among physical education teachers in Iraqi secondary schools. Among teacher-related variables, the highest mean was recorded for teacher knowledge (M = 30.35, SD = 9.28), reflecting the perceived importance of expertise in physical education, physiology, pedagogy, and research-based practices. Teacher attitudes and interactions both scored means above 11, with relatively

moderate variability, indicating generally positive perceptions of professional mindset and communication. The total dimension of teacher characteristics had a high overall mean (M = 64.28), affirming its central role in professional development.

In terms of school leadership, leadership style (M = 14.41) and principals' communication abilities (M = 10.68) received consistent scores, suggesting moderate support and engagement from administrative leadership. School infrastructure was evaluated across financial and educational aspects, yielding an aggregate mean of 20.58, with access to equipment and resources seen as moderately available.

Policy-related dimensions also played a significant role, with the total educational policy dimension scoring M = 42.78 (SD = 13.05). This includes structural, content-related, evaluative, and cultural policy elements, all with means around 10.5, showing recognition of policy structure but also suggesting room for development. Technological dimensions, especially information technology (M = 22.35), indicated increasing integration of innovative tools and online resources in teacher development. Lastly, ministry-level training programs scored M = 31.02, with digital education, empowerment workshops, and specialized international training showing moderate uptake and perceived relevance. Overall, the data reflect a multidimensional understanding of teacher development needs, with strengths in knowledge and attitudes, but highlighting areas such as infrastructure and technological access that require strategic support.

**Table 3. Pearson Correlation Matrix of Main Research Variables**

| Variable | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| 1. Teacher Characteristics | 1 | | | | | |
| 2. Managerial Characteristics | .883 ($p < .001$) | 1 | | | | |
| 3. School Infrastructure | .798 ($p < .001$) | .904 ($p < .001$) | 1 | | | |
| 4. Educational Policies | .003 ($p = .964$) | .050 ($p = .503$) | .078 ($p = .298$) | 1 | | |
| 5. Information Technology | .817 ($p < .001$) | .871 ($p < .001$) | .851 ($p < .001$) | .058 ($p = .438$) | 1 | |
| 6. Ministry Training Programs | .848 ($p < .001$) | .919 ($p < .001$) | .879 ($p < .001$) | .073 ($p = .331$) | .900 ($p < .001$) | 1 |

The Pearson correlation analysis revealed significant and strong positive relationships among the core dimensions of the professional development model, with the exception of educational policies, which showed no statistically significant correlations with the other variables. The highest correlation was found between managerial characteristics and ministry training programs ($r = .919$, $p < .001$), followed closely by the relationship between school infrastructure and managerial characteristics ($r = .904$, $p < .001$), suggesting that effective school leadership is closely linked to both resource availability and institutional support for teacher development. Teacher characteristics also correlated strongly with managerial characteristics ($r = .883$, $p < .001$), information technology ($r = .817$, $p < .001$), and training programs ($r = .848$, $p < .001$), indicating that well-supported and technologically integrated environments contribute substantially to the growth of teaching competencies.

Moreover, school infrastructure demonstrated strong correlations with both information technology ($r = .851$, $p < .001$) and training programs ($r = .879$, $p < .001$), emphasizing the interdependency between resource availability and the implementation of effective training. In contrast, educational policies showed weak and nonsignificant correlations with all other variables, such as teacher characteristics ($r = .003$, $p = .964$) and managerial characteristics ($r = .050$, $p = .503$), highlighting a potential disconnect between policy frameworks and practical development initiatives at the school level. These findings underscore the critical importance of school leadership, infrastructure, and training strategies—supported by digital tools—in fostering meaningful professional growth among physical education teachers.

**Table 4. Kaiser-Meyer-Olkin (KMO) and Bartlett's Test of Sphericity for Main Research Variables**

| Variable | KMO | Bartlett's Test $\chi^2$ | df | Sig. (p-value) |
|---|---|---|---|---|
| Teacher Interactions | 0.752 | 363.677 | 3 | 0.000 |
| Teacher Attitudes | 0.765 | 449.045 | 3 | 0.000 |
| Teacher Knowledge | 0.953 | 1938.445 | 28 | 0.000 |

| | | | | |
|---|---|---|---|---|
| Teacher Skills | 0.762 | 399.716 | 3 | 0.000 |
| Principals' Leadership Style | 0.852 | 554.403 | 6 | 0.000 |
| Principals' Communication Skills | 0.748 | 363.178 | 3 | 0.000 |
| Principals' Knowledge | 0.755 | 344.599 | 3 | 0.000 |
| Financial Resources | 0.748 | 300.757 | 3 | 0.000 |
| Educational Infrastructure | 0.742 | 287.582 | 3 | 0.000 |
| Structural and Organizational Policy Aspects | 0.762 | 403.233 | 3 | 0.000 |
| Content and Educational Policy Aspects | 0.732 | 417.325 | 3 | 0.000 |
| Evaluation and Monitoring Policy Aspects | 0.760 | 374.432 | 3 | 0.000 |
| Cultural and Social Policy Aspects | 0.764 | 700.409 | 3 | 0.000 |
| Innovative Training Design | 0.722 | 247.477 | 3 | 0.000 |
| Online Educational Resources | 0.730 | 276.414 | 3 | 0.000 |
| Digital Professional Development | 0.720 | 255.032 | 3 | 0.000 |
| Empowerment Courses | 0.721 | 242.913 | 3 | 0.000 |
| Specialized Professional Education | 0.695 | 185.056 | 3 | 0.000 |

To assess the suitability of the data for factor analysis, the Kaiser-Meyer-Olkin (KMO) measure and Bartlett's test of sphericity were conducted for all the primary components of the research model. The results show that all variables met the minimum criteria for sampling adequacy, with KMO values ranging from 0.695 to 0.953. The highest KMO value was observed for the variable "Teacher Knowledge" (KMO = 0.953), indicating excellent sampling adequacy and strong inter-item correlations within this construct. Other constructs such as "Principals' Leadership Style" (KMO = 0.852), "Teacher Attitudes" (KMO = 0.765), and "Structural and Organizational Policy Aspects" (KMO = 0.762) also demonstrated high adequacy for factor analysis.

In addition, Bartlett's test of sphericity was statistically significant ($p < 0.001$) for all variables, confirming that the correlation matrices are not identity matrices and thus suitable for structure detection through factor analysis. The significance of the test for all constructs, coupled with acceptable to high KMO values, supports the use of factor analytic methods in subsequent steps of model validation. These results indicate that the dataset possesses the necessary psychometric properties for reliable extraction and interpretation of underlying factors in the development of the professional development model.

To evaluate the fitness of the proposed structural covariance model for professional development of physical education teachers in Iraqi secondary schools, six latent variables were included: teacher characteristics, managerial characteristics, school infrastructure, educational policies, information technology, and ministry training programs. The structural relationships among these constructs were analyzed using structural equation modeling (SEM), and both the initial and modified models were tested for goodness of fit.

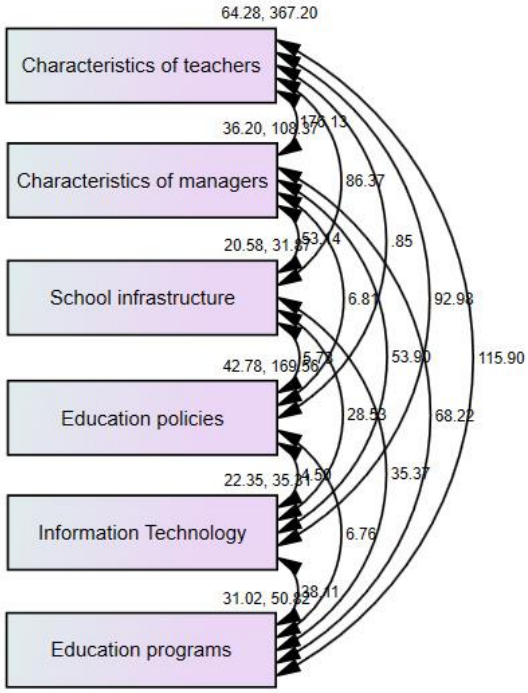


**Figure 1. Unstandardized Covariance Model of Professional Development of Physical Education Teachers in Iraqi Secondary Schools**

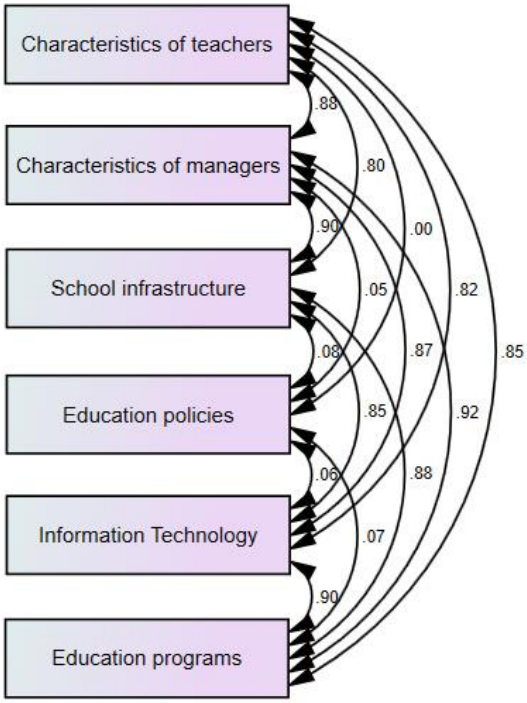


**Figure 2. Standardized Covariance Model of Professional Development of Physical Education Teachers in Iraqi Secondary Schools**

**Table 5. Goodness-of-Fit Indices for the Initial Covariance Model**

| Chi-square | df | P-value | CMIN/DF | RMSEA | NFI | CFI | IFI |
|---|---|---|---|---|---|---|---|
| 626.83 | 15 | 0.128 | 5.575 | 0.179 | 0.985 | 0.941 | 0.937 |

The initial covariance model revealed a Chi-square value of 626.83 with a non-significant p-value (p = 0.128), which alone would suggest acceptable fit. However, other indicators such as the Chi-square to degrees of freedom ratio (CMIN/DF = 5.575) and the RMSEA value of 0.179 exceeded the recommended thresholds, indicating poor model fit. While incremental indices such as NFI (0.985), CFI (0.941), and IFI (0.937) exceeded the 0.90 cutoff and were considered acceptable, the elevated RMSEA and high CMIN/DF point to the need for model modification.

**Table 6. Covariance Coefficients among Main Constructs of the Initial Model**

| Covariance Between Constructs | Estimate | S.E. | C.R. | p-value |
|---|---|---|---|---|
| Managerial ↔ Teacher Characteristics | 176.133 | 19.890 | 8.855 | *** |
| Teacher Characteristics ↔ School Infrastructure | 86.374 | 10.347 | 8.348 | *** |
| Teacher Characteristics ↔ Educational Policies | 0.849 | 18.650 | 0.046 | .964 |
| Teacher Characteristics ↔ Information Technology | 92.981 | 10.987 | 8.462 | *** |
| Teacher Characteristics ↔ Ministry Training Programs | 115.901 | 13.390 | 8.656 | *** |
| Managerial ↔ School Infrastructure | 53.136 | 5.922 | 8.973 | *** |
| Managerial ↔ Educational Policies | 6.810 | 10.145 | 0.671 | .502 |
| Managerial ↔ Information Technology | 53.902 | 6.132 | 8.790 | *** |
| Managerial ↔ Ministry Training Programs | 68.219 | 7.534 | 9.055 | *** |
| School Infrastructure ↔ Educational Policies | 5.732 | 5.511 | 1.040 | .298 |
| School Infrastructure ↔ Information Technology | 28.535 | 3.292 | 8.669 | *** |
| School Infrastructure ↔ Ministry Training Programs | 35.365 | 4.004 | 8.832 | *** |
| Educational Policies ↔ Information Technology | 4.498 | 5.793 | 0.776 | .437 |
| Educational Policies ↔ Ministry Training Programs | 6.759 | 6.956 | 0.972 | .331 |
| Information Technology ↔ Ministry Training Programs | 38.105 | 4.258 | 8.948 | *** |

The covariance matrix showed that most constructs were significantly correlated (p < .001), particularly those involving managerial characteristics, teacher characteristics, and ministry training programs. However, the educational policies variable did not demonstrate statistically significant covariance with any other variable (p-values > .05), indicating its weak contribution to the structural integrity of the model. Therefore, it was deemed necessary to exclude this construct and re-estimate the model for improved fit.

**Table 7. Goodness-of-Fit Indices for the Modified Covariance Model (Educational Policy Removed)**

| Chi-square | df | P-value | CMIN/DF | RMSEA | NFI | CFI | IFI |
|---|---|---|---|---|---|---|---|
| 25.067 | 10 | 0.036 | 2.507 | 0.081 | 0.944 | 0.938 | 0.911 |

The modified model, excluding the educational policies variable, yielded significantly improved fit indices. The Chi-square value was reduced to 25.067 with a significant p-value (p = .036), which, although statistically significant, is acceptable due to the small degrees of freedom. The CMIN/DF ratio dropped to 2.507—well within the acceptable threshold of 5. The RMSEA decreased to 0.081, falling below the 0.10 cutoff and indicating reasonable error approximation. Moreover, the incremental indices NFI (0.944), CFI (0.938), and IFI (0.911) all exceeded the 0.90 benchmark, suggesting good model fit. These improvements confirm that the revised model, focused on five core constructs, more accurately represents the structural relationships influencing the professional development of physical education teachers in Iraqi secondary schools.

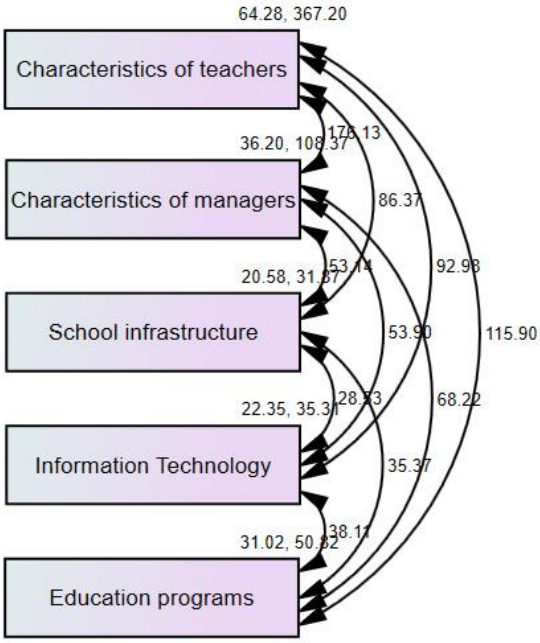


**Figure 3. Unstandardized Modified Covariance Model of Professional Development of Physical Education Teachers in Iraqi Secondary Schools**

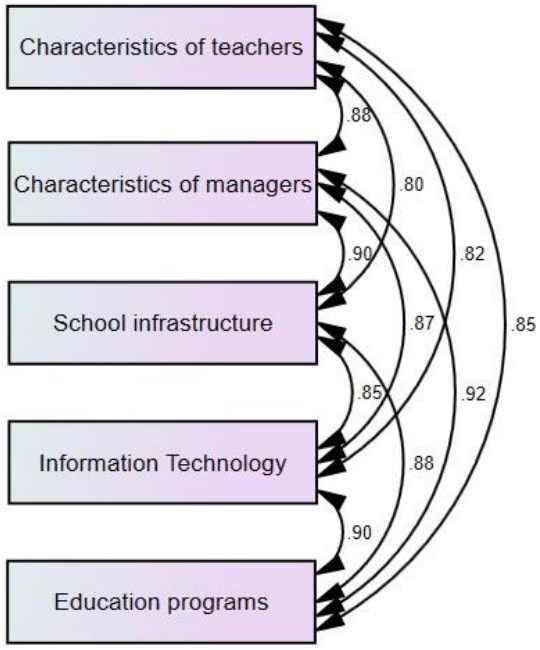


**Figure 4. Standardized Modified Covariance Model of Professional Development of Physical Education Teachers in Iraqi Secondary Schools**

## Discussion and Conclusion

The findings of this study led to the development and partial validation of a multi-dimensional professional development model for physical education teachers in secondary schools in Iraq. This model, derived through mixed methods and grounded

in empirical data, includes six central dimensions: teacher characteristics, managerial characteristics, school infrastructure, educational policies, information technology, and ministry-led training programs. However, structural equation modeling revealed that the dimension related to educational policies lacked significant covariance with other variables, ultimately leading to its exclusion in the modified model. The revised model, consisting of the remaining five dimensions, demonstrated acceptable goodness-of-fit indices, indicating a more empirically robust structure for understanding and facilitating professional development in the Iraqi context.

The strong and significant correlations found between teacher characteristics and other constructs, such as managerial support, school infrastructure, technology integration, and in-service training, highlight the interdependence of individual and institutional factors in professional development. This supports previous assertions that teacher improvement cannot occur in isolation and must be scaffolded by leadership, institutional resources, and relevant training opportunities (7, 12). The significant covariance between teacher and managerial characteristics, in particular, reaffirms the role of school leadership in promoting and sustaining meaningful professional growth (11). As (9) emphasized, leadership styles that are participatory and instructional, rather than merely administrative, contribute substantially to teachers' engagement in development initiatives.

Moreover, the high correlation between school infrastructure and both managerial support and teacher characteristics underscores the central role of material and structural conditions in enabling development. These findings align with the work of (3), who argues that without adequate physical and financial infrastructure, even the most well-designed professional development programs may falter. Specifically, access to appropriate sports facilities, instructional materials, and digital learning platforms is vital for PE teachers, whose instructional effectiveness is often constrained by the physical environment. This finding is echoed by (23), who noted that the professional development of arts and physical education teachers demands differentiated material and environmental support compared to core subject teachers.

The technological dimension emerged as a robust component of the model. Its strong relationship with teacher characteristics, managerial qualities, and training programs confirms that digital tools and platforms are increasingly central to teacher development ecosystems. As (15) demonstrated, online platforms for professional learning not only increase access but also empower teachers to take control of their own growth through asynchronous and self-paced engagement. This is especially critical in Iraq, where regional and infrastructural disparities pose barriers to equal access to training. The inclusion of game-based learning, digital physical education apps, and online seminars in the model reflects a necessary evolution toward blended learning paradigms, aligning with the findings of (18) who examined the transformative impact of AI and active learning technologies on teacher effectiveness.

Ministry-led training programs also proved to be a statistically significant and structurally stable element within the model. This validates the position of centralized, policy-backed training initiatives in scaling teacher development across broad systems. However, these programs must avoid the pitfalls of rigidity and standardization. According to (22), the effectiveness of national training systems often hinges on their adaptability to teacher context, subject specificity, and ongoing feedback mechanisms. The inclusion of offline and online formats, event-based learning, and even international exposure in the Iraqi model suggests a progressive orientation that is consistent with successful case studies from other countries (20, 21).

Interestingly, the exclusion of the educational policy dimension from the final model due to its lack of significant relationships with other variables reveals a gap between policy formulation and implementation. This finding is consistent with the criticisms articulated by (8), who emphasized the disconnection between policy documents and actual school practices in many developing systems. In Iraq, it seems that although educational policies exist nominally to support teacher development, they may lack clarity, enforcement, or alignment with the real needs of teachers on the ground. Similarly, (10) highlighted how

overly theoretical or top-down models of supervision and development tend to be dismissed by educators unless they are grounded in practical, observable benefits.

Additionally, the strong internal relationships between teacher-related variables (knowledge, skills, attitudes, and collaboration) support the argument that TPD must be holistic and not limited to isolated competency areas. (1) and (25) both stressed the importance of considering the psychological and motivational aspects of teaching when designing development programs. This is particularly relevant in the context of physical education, where teacher-student relationships, motivation, and role-modeling are vital to educational success. The present model's emphasis on reflective practice, use of research, and attitudinal factors reinforces the idea that effective development includes cognitive, behavioral, and emotional domains (5).

Furthermore, the results illustrate the value of combining top-down and bottom-up strategies in professional development. While ministry programs and leadership support represent centralized approaches, components like teacher collaboration, self-directed learning, and technology-mediated engagement reflect decentralized, teacher-driven strategies. (14) found that when professional development encourages pedagogical design capacity and creativity, teachers become more invested and effective in their practice. The combination of structured institutional frameworks and flexible, teacher-led opportunities in the proposed model reflects an integrated approach aligned with this perspective.

In summary, the findings offer empirical confirmation for much of the existing theoretical literature on TPD, particularly regarding the importance of leadership, infrastructure, digital integration, and personalized learning pathways. However, they also contribute new insights by highlighting the limited practical influence of policy frameworks in certain contexts and the strong interdependence between school-level and teacher-level variables in the professional growth process. The validated model serves as a practical and research-based roadmap for improving the competencies and impact of physical education teachers in Iraqi secondary schools and, potentially, in similar educational settings.

Despite its methodological rigor and empirical contributions, this study is not without limitations. First, the cross-sectional design limits the ability to observe long-term impacts and changes in teacher behavior or performance as a result of professional development interventions. Second, the reliance on self-reported data in the quantitative phase may introduce bias, as participants might overstate their engagement or capabilities. Third, while the qualitative component provides rich insights, the relatively small expert sample may not capture the full diversity of perspectives across Iraq's varied educational regions. Furthermore, the exclusion of the educational policy dimension from the final model, although empirically justified, suggests a need for more detailed investigation into how policies are perceived and enacted by stakeholders.

Future studies should adopt longitudinal designs to evaluate the lasting effects of professional development programs and track teacher progress over time. Comparative research could be conducted across disciplines (e.g., comparing PE with science or language teachers) to identify whether the same development model applies across fields or needs to be adapted. Further exploration is also needed into the educational policy component—specifically, qualitative case studies of how policies are interpreted and implemented at school levels. Moreover, future research could explore the role of teacher professional identity, emotional resilience, and cultural variables in shaping engagement with professional development programs.

Policymakers and school administrators should prioritize leadership development as a foundational element of teacher growth, ensuring that principals act as mentors and instructional guides. Infrastructure investment—both physical and digital—must be aligned with development initiatives to remove operational barriers for teachers. Training programs should be diversified to include hybrid formats, context-specific content, and opportunities for peer collaboration. Regular feedback and formative assessment mechanisms should be integrated into training cycles to maintain relevance and responsiveness. Finally, development initiatives should emphasize teacher agency, giving educators ownership over their learning while ensuring institutional support structures are in place.

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## Authors' Contributions

All authors equally contributed to this study.

## Declaration of Interest

The authors of this article declared no conflict of interest.

## Ethical Considerations

All ethical principles were adheried in conducting and writing this article.

## Transparency of Data

In accordance with the principles of transparency and open research, we declare that all data and materials used in this study are available upon request.

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