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PEDAGOGICAL FOUNDATIONS OF CONCENTRIC EDUCATIONAL SOFTWARE DESIGN FOR DEVELOPING STUDENTS' PROFESSIONAL INTELLIGENCE

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Abstract

The accumulation of professional information does not necessarily enable a student to analyse an unfamiliar situation, select an appropriate action or improve a proposed solution. This article examines the pedagogical foundations of educational software organised through a concentric approach to the development of professional intelligence. The study uses conceptual analysis, comparison of educational models and functional systematisation of the theoretical materials presented in the first chapter of the dissertation. Professional intelligence is considered through four interconnected components: cognitive, operational, reflective and creative. Concentric software integration is explained in content-related, methodological and technological dimensions. The article compares traditional concentric, spiral and modular–concentric arrangements and identifies the role of a recurring conceptual core in progressively demanding professional tasks. An adaptive cycle connects the collection of learning evidence, interpretation of learner needs, selection of a task and presentation of feedback. Academic gamification is considered as support for participation, while rapid analysis and creative synthesis remain substantive learning objectives. A smart lighting problem illustrates how a common professional object can connect theoretical knowledge, practical decisions and interdisciplinary considerations. The principal outcome is a conceptual basis for software and instructional design, not a report of an implemented adaptive system or measured educational effectiveness.

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Keywords: Professional intelligence; concentric approach; educational software; modular learning; personalised learning trajectory; academic gamification; learning analytics; creative synthesis.

Introduction

Professional preparation involves more than reproducing a previously demonstrated solution. Students need to identify the essential features of a problem, select relevant knowledge, organise practical actions and reconsider their decisions when conditions change. The theoretical materials of this study describe these interconnected capacities through the concept of professional intelligence. The corresponding pedagogical question is how educational content and software can support their development without separating theoretical learning from professional problem solving.

The proposed answer is based on a concentric organisation of learning. A central concept or professional problem is revisited with increasing depth, complexity and contextual breadth. Educational software is considered a means of maintaining this continuity, differentiating tasks and documenting student activity. The purpose of the article is to clarify the components of professional intelligence, the dimensions of concentric software integration and the relationships among task progression, personalisation and feedback. The analysis focuses on design principles rather than on claims that digital technology automatically produces professional competence.

Literature Review

N.A. Muslimov examines the theoretical and methodological foundations of professional development in vocational teacher education [1]. E.F. Zeer addresses the psychological dimensions of professional education [2]. These works support consideration of professional preparation as an integration of knowledge, action and personal development. Sternberg's account of successful intelligence draws attention to analytical, practical and creative abilities in the solution of life problems [3]. Within the present framework, these perspectives

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inform the distinction between accumulated information and the capacity to use it in purposeful activity.

Bruner's discussion of the educational process provides a foundation for returning to important ideas in increasingly demanding forms [4]. Jonassen considers computers as tools for engaging students in thinking rather than merely delivering information [5]. Koehler and Mishra explain the relationship among technological, pedagogical and content knowledge [6]. Their contributions are relevant to different aspects of the proposed approach: recurrence organises content, cognitive tools support activity, and pedagogical–technological integration relates the tool to the intended learning outcome.

Shute and Zapata-Rivera examine adaptive educational systems [7], while Deterding and colleagues conceptualise gamification through the use of game-design elements in non-game contexts [8]. Baker and Inventado discuss the relationship between educational data mining and learning analytics [9]. These foundations support the proposed coordination of monitoring, task selection and motivational support. They do not, however, establish that the particular software configuration considered here has been implemented or that its effects have been measured. That distinction is retained throughout the analysis.

Methodology and Research Design

This is a conceptual–methodological study based on the first chapter of the dissertation. The materials address the pedagogical possibilities of concentric software integration, approaches to developing professional intelligence and models for organising concentric learning. Conceptual analysis clarified the principal terms. Comparative analysis differentiated traditional concentric, spiral and modular–concentric arrangements. Functional systematisation then connected the proposed software functions with intended student activities and forms of learning evidence. The literature review is selective rather than systematic.

The resulting tables condense the relationships already developed in the theoretical account. The smart lighting example is used as an instructional illustration of those relationships, not as an intervention with reported

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participants or outcomes. The analysis does not introduce a software performance test, a completed adaptive algorithm, a psychometric instrument or an experimental comparison. The term "result" below refers to a conceptual clarification or a pedagogical design relationship.

Research Results

Result 1. Professional Intelligence as an Integrated Educational Construct

Professional intelligence is understood as a dynamic integration of knowledge, practical operations, reflection and the capacity to construct a new response to a professional problem. It is distinguished from professional competence as demonstrated performance: the former concerns the resources and reasoning supporting an action, while the latter concerns their use in a particular task. The distinction is useful for instructional design, because a completed product does not by itself reveal how a student selected or evaluated the solution.

Table 1. Components of professional intelligence and their instructional expression

Component	Intended student activity	Evidence in learning work
Cognitive	Identify relevant concepts, organise knowledge and explain relationships within a professional problem.	Conceptual explanation, structured information and the stated basis of a decision.
Operational	Select and carry out procedures, use tools and adapt actions to the requirements of the task.	Action plan, simulation or practical record, and a completed task product.
Reflective	Examine errors, compare the result with the objective and reconsider the chosen strategy.	Explanation of difficulties, self-assessment and a reasoned revision.
Creative	Combine available knowledge in an alternative solution or improve an existing professional product.	Alternative proposal, design justification and an improvement supported by analysis.

The components in Table 1 are not treated as isolated abilities or as a fixed sequence in which one disappears when another develops. A student

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constructing a new solution still needs an adequate conceptual basis and a feasible procedure. Reflection may reveal a gap in either, requiring a return to an earlier task. Creative synthesis consequently depends on what has been analysed, not simply on producing an unusual answer.

This interpretation has an assessment implication. Knowledge checks can reveal part of the cognitive component, but they cannot provide the whole account of professional intelligence. The task system must also make procedures, decisions and revisions visible. These forms of evidence express the intended construct; they are not presented here as a validated diagnostic scale or as calibrated indicators with established numerical weights.

Result 2. Three Dimensions of Concentric Software Integration

The expression "concentric integration of educational software" refers to the coordination of learning content, instructional methods and technological functions around a recurring professional core. It does not mean reducing the size of a software package or simply collecting links in one interface. The central question is whether the next resource and task develop the same professional understanding at a more demanding level (Table 2).

Table 2. Dimensions of concentric integration

Dimension	Pedagogical function	Design implication
Content-related	Revisit a core concept through progressively broader and more demanding professional problems.	Connect foundational explanations with applied cases, exceptions and interdisciplinary tasks.
Methodological	Change the character of activity as understanding develops.	Move from supported explanation and reproduction to inquiry, problem solving and creative project work.
Technological	Maintain continuity among resources, submissions, monitoring and feedback.	Coordinate learning modules, simulation tools and assessment records within an accessible environment.

Content-related integration preserves the conceptual core while extending its application. Methodological integration changes what the student is asked to do

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with that core. Technological integration makes the relationship manageable across tasks and modules. These dimensions are mutually dependent: an integrated interface without a connected task sequence remains an organisational convenience, while a coherent sequence without accessible resources and feedback may be difficult to sustain.

The source approach identifies continuity, recurrence, increasing complexity and adaptivity as organising principles. Continuity means that earlier work provides a basis for subsequent action. Recurrence gives students another opportunity to examine the core idea. Increasing complexity introduces additional conditions or a less prescribed solution. Adaptivity concerns the selection of support and challenge in relation to demonstrated readiness. Repetition therefore becomes developmental only when the purpose or demand of the new encounter is made explicit.

A single interface is not itself evidence that these principles have been achieved. The content and assessment records need to remain connected to the same learning objectives. The proposed architecture is consequently pedagogical before it is technical: decisions about progression, feedback and expected student products must be defined before they can be represented in software functions.

Result 3. A Modular–Concentric Organisation of Learning

The theoretical account compares three related ways of organising recurring content (Table 3). Their differences are used as a functional design comparison rather than as mutually exclusive categories. Traditional concentric organisation emphasises a return to core material with additional content. Spiral organisation emphasises increasingly demanding representations and conceptual relationships. Modular–concentric organisation combines defined module outcomes with the continued development of core ideas across modules.

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Table 3. Educational arrangements considered in the concentric approach

Arrangement	Main organisational emphasis	Implication for software-supported learning
Traditional concentric	Return to important topics and expand the material around them.	Make the added content visible so that recurrence does not become unchanged repetition.
Spiral	Revisit fundamental ideas through increasingly demanding conceptual treatment.	Link successive representations and tasks to previously established understanding.
Modular–concentric	Organise assessable modules while carrying a common conceptual core into later work.	Connect module results, individual progression and increasingly complex professional tasks.

The modular–concentric arrangement is selected as a design basis because it relates the relative independence of a module to continuity across the programme. Each module has an identifiable objective and product, but it does not close the core idea permanently. A later module can require the student to use the same knowledge under different conditions, combine it with another subject or defend a more independent solution. This is a rationale for the arrangement, not proof of its superiority over all alternatives.

The associated pedagogical model contains five components: goals, content, methods, tools and outcomes. The goal identifies the intended professional capacity; content supplies the conceptual core; methods organise the student's activity; tools enable that activity; and outcomes provide evidence for feedback. A software function is justified by its place within this relationship. For example, a simulation is relevant when it allows a student to examine a professional decision, not merely because it makes a module visually attractive.

The smart lighting problem used in the theoretical materials illustrates this organisation. Physics and mathematics provide the basis for understanding and comparing technical choices, while landscape design, usability and environmental considerations broaden the professional context. A concentric treatment retains the same lighting problem while requiring increasingly integrated explanations. The resulting product is not only a proposed

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arrangement of equipment, but also an account of why the selected solution meets the stated purpose and what limitations remain.

The illustration also clarifies the relationship between rapid analysis and creative synthesis. Analysis identifies the relevant information and separates the different requirements of the problem. Synthesis reconnects those requirements in a proposed solution. Their educational value lies in the quality and justification of the decision. Speed alone is not treated as sufficient evidence of professional intelligence, and novelty alone does not demonstrate that a proposal is technically or pedagogically adequate.

Result 4. Personalised Progression, Feedback and Academic Gamification

Personalisation is described through three connected functions: identifying the student's starting point, organising an individual learning route and monitoring progress towards the intended outcome. Initial tasks and diagnostic questions provide information about existing preparation. Subsequent activities are selected in relation to that information. The route is then reconsidered when the student's work reveals a new difficulty or readiness for a more demanding task. The theoretical materials distinguish this from changing only the pace of a common, otherwise unchanged sequence.

Step 1 – collect learning evidence. The proposed adaptive cycle begins with records of task responses, completion, errors and use of the learning environment. The purpose is to document activity relevant to the learning objective. A record that a task was opened is different from evidence that the underlying concept was understood.

Step 2 – interpret the learner's needs. The evidence is used to update the account of the student's current preparation. A difficulty may concern conceptual knowledge, the choice of procedure or the explanation of a decision. The interpretation should remain connected to the actual task rather than assign a permanent label to the student. At this conceptual stage, the detailed computational rules for making that judgement remain to be specified.

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Step 3 – select the next instructional action. The proposed system chooses a supporting resource, a further practice task, a more demanding problem or a form of feedback. A return to an earlier concentric layer is intended to address an identified difficulty, not simply to repeat the whole module. A student who demonstrates readiness may progress to a task requiring greater independence.

Step 4 – present the task and renew the cycle. The selected material is made available through the learning environment. The student's response generates new evidence, which informs the next decision. The cycle links monitoring to action and makes adaptation an ongoing instructional relationship rather than a single initial allocation of students to fixed routes [7].

Academic gamification supports this progression through points, rankings, badges and challenge-based tasks. These elements are intended to make progress visible and sustain participation during repeated encounters with a problem. Their role remains motivational and organisational. A badge can indicate that an activity was completed, but the educational meaning of that completion depends on what the student actually demonstrated. Reward mechanisms cannot replace the analysis of a solution or the explanation of an error [8].

The proposed use of learning analytics connects records with feedback for students and teachers [9]. Students can examine their progress and identify recurring difficulties; teachers can consider whether a task needs clarification, additional support or revision. The relevant result of monitoring is an informed instructional decision. The present account does not establish that ordinary activity records directly measure internal cognitive states, nor does it report the accuracy of an automated diagnostic model.

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Discussion

The contribution of the concentric approach lies in coordinating recurrence with a change in intellectual demand. Reopening the same material without a new analytical purpose is different from returning to a professional problem with additional conditions and a requirement to justify an alternative solution. Likewise, the integration of software has educational value when it preserves the relationship among content, action and feedback, rather than merely reducing the number of applications used.

The distinction between professional intelligence and demonstrated competence also prevents a narrow interpretation of digital success. A high activity count or an attractive project may coexist with weak explanation. Conversely, a student's revision after identifying an error may provide important evidence of reflective development. The framework therefore requires attention to the process of reaching a result as well as to the final product. These are design implications of the conceptual analysis, not findings from a completed effectiveness study.

Practical Recommendations

Course designers should first identify a professional core problem and specify what becomes more demanding when it reappears. Each module should connect its objective, task, expected product and feedback. Software functions should then be selected to maintain that relationship, with clear rules for progression and return to supporting material. Gamification should recognise meaningful learning actions, while monitoring should preserve access to the work behind an indicator. Before deployment, the proposed adaptive decisions and assessment criteria need to be made explicit and examined in realistic teaching conditions.

Limitations and Directions for Further Research

The analysis is limited to the theoretical chapter. It does not provide a completed software specification, an implemented adaptive engine, validated measures of professional intelligence or experimental results. The proposed benefits of personalisation and gamification are therefore design expectations rather than demonstrated effects of this system. Further work should operationalise the four

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components, define progression rules, examine task feasibility and evaluate whether students transfer their reasoning to new professional situations. The interpretation of platform records and the consistency of assessment also require investigation.

Conclusion

Concentric educational software design is understood as the integration of content, methods and technological functions around a recurring professional core. Its intended contribution is to connect cognitive, operational, reflective and creative activity through increasingly demanding tasks, rather than to deliver a larger volume of information.

The modular–concentric arrangement provides a conceptual basis for linking module outcomes with continued development across the programme. An adaptive feedback cycle and academic gamification support this organisation only when they remain connected to substantive learning evidence. The resulting framework clarifies what should be designed and assessed; implementation and empirical validation remain necessary to establish its educational effectiveness.

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