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From Static Artifact to Living Organism: A Substantive Theory of the Thinking and Learning Curriculum

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ABSTRACT

Traditional curricula are known to go through a systemic stagnation during a period of rapid changes which implies that they cannot adjust to changing societal and epistemic demands. The paper outlines a substantive theory created as a way to resolve the issue of a new paradigm called the Thinking and Learning Curriculum (TLC). This study employs a grounded theory design which amalgamates the data gotten from the in-depth interviews with sixteen experts from different areas such as curriculum studies, philosophy, and computer engineering. The emergent theory attributes the TLC with characteristics of a self-governing, complex adaptive life form with an internal metacognitive core that endows the system with self-regulation and intelligent decision-making functions. The system of this nature is backed up by a heavily integrated neuro-technical infrastructure where AI is the cognitive partner and the system is located in a decentralized, democratic socio-managerial ecosystem. The research paper concludes by showing the TLC model as an innovative and robust theoretical framework to transcend the static, object-based portrayal of curriculum, thus, proposing a 21st-century education-field ontology that is dynamic, agent-based.

Keywords: Thinking and Learning Curriculum, Curriculum Theory, Substantive Theory

INTRODUCTION

The contemporary period can be defined as the rapid and exponentially growing knowledge production and the very quick technology adoption by the society which leads to a continually changing reality (Erstad & Voogt, 2018). It is a crisis from the point of view of education as well, the curriculum—its very basis for formal learning—is still more or less tailored for a world that is not changing. The curriculum, on the one hand, as the knowledge repository of the last century, is in a state of near-absolute stagnation, thus always inadequate in terms of its alignment with the pace of societal and epistemic changes (Law, 2022). Such a situation, called curriculum stagnation, is accompanied with a gap between the expected learning objectives specified in the educational domain and the actual learning outcomes that is getting larger with time (OECD, 2018). The reasons for this stagnation are so complicated that a wide variety of factors such as bureaucratic obstacles (Finney, 2000), the problems that come from the curriculum development process (Benavides, 2021; Hopwood, 2007; Rebele & Pierre, 2015), and the unwillingness of schools to adjust to economic or global crisis dramatically (Massé & Popovich, 2007) to the unexpected lack of resources and failure of the institution to go through a transformation (McMahon, 2022) are considered to be the reasons of this stagnation.

The symptoms of stagnation mentioned above indicate that there has been a failure of concepts that originate from an extremely simplistic version of the curriculum which understates the complexity of the curriculum product itself. The phrase is sometimes downgraded to mere numbers, an instrumentally defined list, and a plan to teach the listed topics. Although the curriculum may sometimes be seen from an instrumental perspective, it is still a "survival of the fittest" kind of system in the wild, an ecological system that attempts to secure the continuation of its existence by adjusting through complexity and self-organization (McLinden, Douglas, Cobb, Hewett, & Ravenscroft, 2016). The better understanding of curriculum should acknowledge it as infinite subsystems that are so deeply interwoven that most of their interactions even go unnoticed (Yang & Li, 2022). The open "climate of thinking" that is the hallmark of the successful instructional design heavily depends on the "climate of thinking" in the classroom - a subsystem that is seldom dealt with in the conventional climate management approach (Marangio & Heyting, 2023).

In addition, the main curriculum ideas that are mostly focused on do not really cover the big differences that affect learning, for example, the complex relationship between language and thought or the fight between technological determinism and learner independence. Even the most extreme paradigms like problem-centered design have some restrictions of the deeply rooted idea of "course" while a genuinely systemic approach could be learning through workshops, community projects, or nature studies that would no longer acknowledge "course" as the basic learning unit. Hence, curriculum is a very inconsistent and debated concept (Pratt, 2021). A new set of words is always needed when changing from one paradigm to another, so understanding curriculum in a different way requires a new vocabulary. Therefore, the theoretical framework of this article is based on the very idea that to overcome the stagnation, we need to first re-recognize the curriculum as a complicated, dynamic system rather than an end product.

Nevertheless, when these aspects are perceived as isolated factors, they hide a deeper and more basic problem in the design. The standard approach predominantly characterizes curriculum as a passive entity—a document that is designed, implemented, and periodically revised by external human agents. Such a mechanistic perspective does not recognize that curriculum is a complex, evolving, and living system, which is interdependent with the social, cultural, and political spheres in which it is situated. Consequently, reforms frequently become mere superficial changes to the curriculum components (for example, content and methods of teaching) without addressing the system's underlying dynamics, and thus they are not able to infuse any kind of functionality or innovation into the system (Erstad & Voogt, 2018; Toombs, 1980). Even the integration of progressive, learner-centered approaches was limited due to a systemic incapacity to provide the necessary autonomy for educators at the ground level of the implementation (Chiu, Meng, Chai, King, Wong, & Yam, 2022; Lintquist, 2017). The inability of current curriculum theories to deal with such complicated situations is becoming more and more obvious (Tunç Toptaş & Erdem, 2024), which means that they are at a theoretical deadlock (Muller, 2022). The issue to be dealt with is not the improvement of the existing paradigms, rather the establishment of a new one (Hooshmand, 2025).

The current research work marks the very axiomatic location of curriculum like a phenomenon, showing the way for a paradigm shift. We maintain that the remedy for inertia is the transition from a fixed, object-based design to a mobile one, controlled by agents (Kabanda, 2021; Rauf, Nadeem & Tahir, 2024). Looking at Dewey's (1916/1997) perspective that education should always change to meet the requirements of society and the individual, and accepting Turing's (1950) probing question of whether machines are capable of thought as our motivation, we argue for the indispensability of a curriculum that defines itself as "thinking and learning organism". This shift in viewpoint places the curriculum beyond the reach of any external "designers" or "agents" as it becomes an intricate network of autonomous and semi-autonomous "actors" involved in simultaneous interaction with one another as well as with the environment. Consequently, we come up with the proposal of a different theoretical model: the Thinking and Learning Curriculum (TLC)

In a conceptual sense, a TLC (Thinking and Learning Curriculum) is described as a system that is independent, self-regulating, and self-organizing. It carries out its functional intelligence and it is metacognitive as well. Such a curriculum is not the one developed for the purpose of being stable but one that would maintain itself constantly. Practically, it is similar to a living being that is always in conversation with the people it affects and its surroundings. By the support of artificial intelligence and the use of neural networks, such a system is not only able to handle difficult data streams but it can also find its weak spots, change its objectives and teaching methods according to the given feedback and even come up with new solutions to education-related issues (Alam & Benaida, 2022; Ejjami, 2024; Kasztelnik, 2024).

The creation of such a sophisticated and autonomous model cannot be conceptualized without the existence of a theoretical basis. Before building a TLC model that can be engineered, a foundational TLC theory of the first is necessary. This theory should depict the fundamental concepts, the very nature, and the activities that would enable a curriculum to function and learn on its own. As a result, this research is not aimed at presenting definite models but at engaging in the more basic work of theory development. Using a grounded theory method to build a substantive theory, this research aims to give a full answer to the main question: "What constitutes a Thinking

and Learning Curriculum?" The importance of this question is that it may provide a new theoretical framework for the field, which can be a strong alternative to the existing curriculum development models and also a more complex explanation of the changing variables that influence the educational scenario of the 21st century.

METHODOLOGY

Research Design

This research took up a qualitative study method, incorporating a grounded theory design to create a substantive theory of a Thinking and Learning Curriculum (TLC). More importantly, the goal of this research is the creation of a substantive theory rather than a formal one. It's interpretation of Glaser and Strauss (1967) that a substantive theory is dependent on the context, developed in order to elucidate the specific empirical area of inquiry, here, being the phenomenon of an intelligent, self-sufficient curriculum. Hence, it doesn't make the same assumptions as formal ones about the different areas of applicability that operate at a higher level of abstraction, and which are universal across different domains. It is very important to note that the classification of this research contribution is as a set of theoretical constructs that are focused, ground empirically, and developed for a new and specific problem rather than being represented as a grand, universal law of education. The research method of this kind was acknowledged as the best one to be used when the research work is directed towards the generation of a new theoretical framework that explains a new phenomenon better than currently available theories (Robson, 2015). The grounded theory is an example of a systematic but still adaptable method for theory development that is inductively derived from the study of the phenomenon which it represents (Glaser & Strauss, 1967; Strauss, 1987). Instead of starting off with a hypothesis, the TLC concept can be unfurled right from the experts' vibrant and vivid environmental data. The theory elaboration process was rigorous and reiterative, comprising the inclusion and an extensive review of the relevant literature, the conducting and analyzing of interviews with experts at multiple stages, and the constant application of the data analysis put forth in the procedural flowchart (see Figure 1).

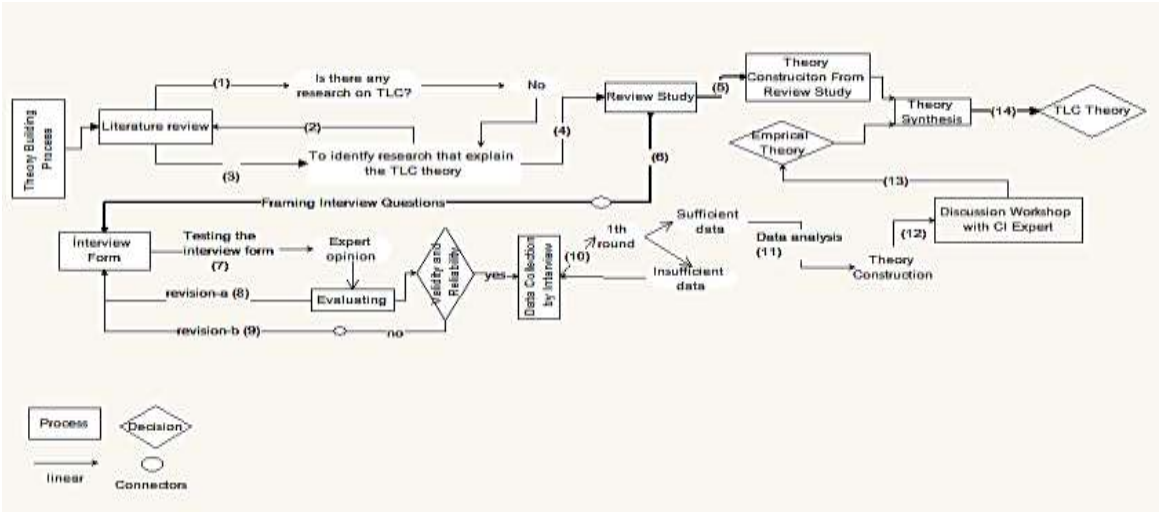

Figure 1: The flowchart of the theory development process

Participants

The selection of study participants was done through a dual-stage sampling strategy that aimed to cover both the depth and the breadth of the expertineris. In the beginning, purposive sampling was applied. As a result, professionals were recruited from such disciplines as the theoretical foundations of the curriculum, which is, correspondingly, the central point of the research (Creswell, 2011). This first group was, therefore, composed of sixteen experts from the areas of Curriculum and Instruction (CI, 5 experts), Educational Philosophy (EP, 3 experts), Educational Management (EM, 2 experts), and Educational Technology (ET, 3 experts). To extend beyond the boundaries of the existing interdisciplinary field of study and to encounter the topic from fresh viewpoints, the snowball sampling method was also introduced subsequent to the first stage of the research. Participants from the original group of experts were requested to recommend other experts whose work may offer new insights, a method that eventually resulted in the inclusion of specialists in Sociology (S, 1 expert), Computer Engineering (CE, 1 expert), and Psychological Counselling and Guidance (PCG, 2 experts) fields. In total,

voluntary experts (5 females, 11 males) 16 were involved in the study. The duration and the number of words spoken in each interview are summarized in Table 1.

Table 1: Details of the Interviews on the Analysis of TLC Theory

Participants	Profession	Type of Recording	Recording Time		Word Count
			1. Round	2. Round	
P1	CI	Voice	34 min. 57 sec.		3598
P2	EP	Voice	38 min. 04 sec.	20min. 15sec.	3653
P3	CI	Voice	21 min. 05 sec.		2032
P4	CI	Voice	24 min. 56 sec.		2497
P5	CI	Voice	23 min. 32 sec.		2581
P6	EP	Voice	32 min. 16 sec.		3229
P7	EM	Voice	36 min. 01 sec.		4575
P8	EM	Voice	33 min. 35 sec.		2737
P9	ET	Voice	24 min. 56 sec.		3416
P10	CI	Voice	21 min. 20 sec.		2033
P11	ET	Voice	46 min. 07 sec.		5076
P12	ET	Voice	46 min. 06 sec.		5292
P13	CE	Voice	01 hrs. 40 min.		13515
P14	S	Voice	01 hrs. 01 min.		6561
P15	PCG	Voice	27min. 02 sec.		3253
P16	PCG	Voice	11min. 02sec.		1241

Note. The names of the interviewees have been masked; P: Participant; P1: First participant

Data Collection and Instrumentation

In-depth, semi-structured interviews that were conducted in either one or two rounds (depending on the saturation of the data) formed the main method by which data were collected. This particular format was selected as it could maintain a standard line of questioning among those interviewed, while still giving such flexibility to delve into the new concepts and in-depth reactions - a very important input for theory generation (Robson, 2015). The main tool was a semi-structured interview guide consisting of open-ended questions that were aimed at probing into the conceptual and operational aspects of a Thinking and Learning Curriculum (TLC) potential. The content validity of the instrument was established through an expert review by a senior academician of the Department of Curriculum and Instruction. Its reliability was confirmed through a pilot interview, which ascertained the clarity and understanding of the questions. Ethical approval (Decision No. 03/33, 09.03.2023) was obtained before the data collection. All participants signed verbal informed consent forms for the audio-recorded interviews, for which they were assured of strict confidentiality, and they consented to voluntary participation.

Data Analysis

The data analysis was a repeated process, which adhered to the principles of Grounded Theory. For each and every audio recording of the interviews, transcription was made word-for-word and careful accuracy check was conducted. The analysis was initiated by open coding, the first and essential stage of the analytical process (Strauss, 1987). It basically involved an exhaustive process of breaking down the interview transcripts to identify concepts, define their features and find out their extent as they were presented in the data. While the concepts were being defined, the research team used the method of constant comparison, i.e., comparing the relationships between concepts and their features, which in turn, provided new questions and hypotheses that could be verified in the next data gathering and analysis stages. By this iterative process, the initial codes were grouped into more abstract categories, which were then unified to identify the main themes that represent the common denominators of the TLC substantive theory.

Trustworthiness of the Study

To ensure the rigor of this qualitative study, several measures were implemented to establish its trustworthiness, focusing on credibility (validity) and dependability (reliability).

Dependability: The dependability of the findings was enhanced through the triangulation of data sources. By systematically gathering data from experts across eight distinct disciplines (e.g., CI, EP, CE, S), the study ensured that the emergent theory was not an artifact of a single perspective but was grounded in recurrent themes, patterns, and phenomena that appeared across diverse fields of expertise.

Credibility: The credibility of the research was established through two primary strategies. First, member checking was conducted during the interviews by asking clarifying and alternative questions to ensure that the researchers' interpretations accurately reflected the participants' intended meanings. Second, the study employed expert peer debriefing. A final validation workshop was conducted with a senior CI expert, wherein the findings derived from the interview data were systematically juxtaposed with the propositions developed from the initial literature review. This process confirmed a high degree of congruence between the empirical data and the theoretical propositions, thereby validating the final structure of the TLC theory.

FINDINGS: THE THEORETICAL ARCHITECTURE OF A THINKING AND LEARNING CURRICULUM

Substantive theory for the Thinking and Learning Curriculum (TLC) has been developed through the process of data analysis from interviews with 16 experts from various fields. The first, second, third, and fourth characteristics of this theory are four interrelated, conceptually simple but empirically distinct, and ontologically fundamental themes, which indicate the curriculum's nature, cognitive functions, contextual dynamics, and technological core respectively. These are: (1) The Curriculum as a Complex Adaptive Organism, (2) The Metacognitive Core: Autonomous Thinking and Learning Functions, (3) The Socio-Managerial Ecosystem: A Democratic and Decentralized Framework, and (4) The Neuro-Technical Infrastructure: Artificial Intelligence and Data Science Integration. The presentation and interpretation of each theme along with its constituent categories and codes follow here.

Theme 1: The Curriculum as a Complex Adaptive Organism

The main theoretical concept that comes first from the data is the change of the curriculum definition itself, an ontological shift. A traditional learning charter is not thought of as a fixed document or a sequential plan, but as a living, complex adaptive system with features similar to those of organic beings (Law, 2022). The TLC, being such a system, is in a dynamic balance with its surroundings, wherein all the processes of continuous interaction, self-organization and emergent properties take place (Kabanda, 2021).

Table 2: Conceptual Network for Theme 1

Theme	Categories	Codes from Literature Review	Codes from Expert Interviews (Emic)
The Curriculum as a Complex Adaptive Organism	**1. Systemic and Organic Structure**	- Complexity and non-linear interactions (Cliers, 1998) Self-organization in chaotic systems (Prigogine, Stengers & Toffler, 1984) System adaptation and transformation (Doll, 2008) Dynamic and interconnected components (Harden, 1986)	"*Creating a new organism*" (P5, P12) "*An organism capable of neural activities*" (P13, P1) "*Human-like learning capacity*" (P7) "*Dynamic, not static structure*" (P2, P8)
	2. Continuous Self-Renewal and Adaptation	- Continuous modification based on needs (Dewey, 1916/1997) Adaptation to environmental dynamics (Holland, 1992) Orderly disorder and chaos theory (Hayles, 1991) Reflexive response to change (Murphy, 2011)	"*Continuously analyzes and renews itself*" (P2, P3) "*Theory of continuous self-renewal and adaptation*" (P5, P7) "*Adapts to micro-level social institutions*" (P8) "*Revises itself based on feedback*" (P9)

	3. Multidisciplinary and Eclectic Nature	- Interdisciplinarity in curriculum design (Toombs, 1980) Delineating relationships within the curriculum field (Ornstein, 1987; Pinar, 2004) Integration of diverse knowledge structures (Jones, 2019)	"*Composed of various components from different disciplinary fields*" (General consensus across P1-P16) "*Connection to Philosophy, Sociology, Psychology, ICT, Data Science*" (P1-P16) " "*Interaction of CI field with multiple disciplines*" (P1, P8, P13)

Interpretive Analysis of Theme 1

The TLC theory is the main cause the dominant understanding of the curriculum as a ready-made, sequential, and foreseeable item to be essentially challenged. The specialists were always referring to the biological and systemic metaphors and were saying that the TLC is not a built thing but a grown and developed one. As P5 put it, the objective is the "production of a new organism", an idea that was also referred to by the others who were picturing a curriculum with its own "neural activities" and "human-like learning capacity". Such an inherent feature of life means, in fact, that the TLC is always changing or, in terms of Hayles (1991), being at the point of "orderly disorder". It does not prosper from its stability, but it still needs the constant communication with and feedback from the environment which enables it to perform its self-organization and extend its territory to the unforeseeable changes (Prigogine et al., 1984).

The ability for continuous self-renewal and adaptation remains the core of their existence. An expert (P5) described this as the curriculum's basic 'theory of continuous self-renewal and adaptation'. The TLC differs from the traditional models which undergo changes in multi-year, top-down cycles. It is, however, a more reflexive self-revision based on a very frequent feedback (P9), and hence capable of adapting from societal changes at the macro level to classroom changes at the micro-level (P8). This transformational power is not an extraordinary feature but the most definite mode of the institution, which is the one that allows it to stay innovative in the changing world.

This complicated organism, besides all its other characteristics, is essentially multidisciplinary and eclectic. The exposed data reveal that a curriculum with such characteristics cannot be confined within the usual educational sciences borders. According to the TLC idea, the curriculum is the meeting place of different fields, the philosophy that defines its goal, the sociology that shows its range, the psychology that provides its learning, the management science that gives its guidance, and, most importantly, the information technologies and data sciences that make up its cognitive infrastructure. Because of this unusual combination, the TLC is not only operating as a systemic mechanism but also as a dynamic one, which can draw both the power and the flexibility from the mix of different knowledge domains (Holland 1992). Therefore, it is a complete and integrated system, a very different and less fragmented and component-based view of the traditional curriculum design (Harden, 1986).

Theme 2: The Metacognitive Core: Autonomous Thinking and Learning Functions

The TLC concept is not only based on its natural design, but also on its functional aspect, which includes cognitive and metacognitive skills. The information shows that the curriculum is represented as a self-governing entity that has the ability to control, observe its own thinking processes, and partake in higher-order thinking. This motif clarifies the interplay which the curriculum "think" and "learn" through these operations.

Table 3: Conceptual Network for Theme 2

Theme	Categories	Codes from Literature Review	Codes from Expert Interviews (Emic)
The Metacognitive Core: Autonomous Thinking and Learning Functions	**1. Autonomous Self-Regulation**	- Setting and achieving self-set goals (Schunk, 2009) Monitoring and debugging one's own thinking (Johnson, 2022) Self-assessment and solution-oriented thinking (Pennachin & Goertzel, 2007)	- "*Possess an autonomous, self-regulated structure*" (P1, P10) "*Sets goals, develops strategies, evaluates achievement*" (General consensus) "*Curriculum evaluation generates data for self-revision*" (P5) "*Exercises autonomy to enhance its own quality*" (P1) *"Recognizing the most relevant information and being able to reorganize itself"* (P2) *"Monitoring, self evaluating, self-competence"* (P15)

	2. Metacognitive Performance and Awareness	- Metacognition as monitoring and correcting errors (Johnson, 2022) Adaptive and reflective learning environments (Ornstein & Hunkins, 2017) Cognitive processes of consciousness and perception	- "*Possession of metacognitive skills is imperative*" (P1, P2, P4, P10, P15) "*Self-awareness and self-management*" (P15) "*Determining information needs and making inclusions/exclusions*" (P4, P5, P6, P10) "*Systematically filtering outdated or irrelevant data*" (P13)
	3. Higher-Order Cognitive Structures	- Cognitive habits varying across cultures (Nisbett, 2004) Synthesis of information into ontological datasets Inferential and predictive capabilities (Ornstein, 1987)	- "*Holistic, intuitive, and analytical thinking*" (P1, P2, P10) "*Making inferences, organizing, analyzing*" (P4, P10) "*Anticipating future knowledge needs of society*" (P13, P14) "*Creating alternative instructional designs*" (P1, P12)
	4. Motivational Structures	- The productivity and output of organisations is contingent on the performance of individual employees (Haque, Haque & Islam, 2014). -The hierarchy of needs and motivation are effective in shaping management policies applied in organizations developed for the work activities, needs, and sources of motivation of individuals assigned tasks in the program system (Durmus, 2024; Maslow, 1943).	- "*The evaluation of the efficacy of the review program is contingent upon the identification of motivation-related variables.* " (P15) - "*The concepts of motivation and goal setting are intrinsically linked to the fulfilment of fundamental needs.* " (P16)

Interpretive Analysis of Theme 2

TLC theory is a major conceptual change that involves the curriculum with cognitive agency. All experts, without a shadow of doubt, agreed that the truly dynamic curriculum should be "an autonomous, self-regulated structure" (P1, P10). The latter, however, is not just the automation of tasks but the capacity for real self-governance. The TLC in this situation not only sets the new objectives for the curriculum and the learners but also outlines the ways to go to the objectives and, what is more, decides the degree at which these objectives are met. As one of the experts mentioned, "curriculum evaluation produces data..." which the TLC uses to "reconsider itself" (P5). This continuous loop of setting goals, checking and changing is the very core of its self-governing nature, a machine designed to be actively "raising its own quality" (P1).

Metacognitive performance is the self-governance main feature that is put in practice here. Metacognition, basically "thinking about the way we think", is the base mechanism that enables the TLC to act in a clever way. Within the curriculum scope, this does not represent just a mere sign. It is a procedure with certain functions:

Self-Awareness (Monitoring): In general, the TLC is a self-aware ystem of its functioning which means that it is always on its different part's status, the correctness of the content, the suitability of the pedagogical methods, and the learners' progress. It is aware of what it knows, what it does not know, and where its weak points are.

Error Detection (Debugging): Through this monitoring, it is locating unexpected results, low effectiveness, and failures—"bugs" in the system. This, for instance, may be a learning goal that is hardly ever accomplished in a certain group of students or a piece of content that is no longer valid due to new scientific facts.

Strategic Action (Correction): First of all, the TLC will go through a thorough decision-making process to select the correct action to fix the error when it is found. This process includes "determining the information to be integrated into TLC" (P4, P5, P6, P10), "strategically removing from the current data which are obsolete or irrelevant" (P13) and changing the procedures of the TLC to move further than the problem that has been found.

This metacognitive engine is supported by various higher-order cognitive structures. The experts emphasized that the TLC should not be just a basic information processor but rather a unit that can involve 'holistic, intuitive, metacognitive, self-regulation, and self-efficacy' (P1, P2, P4, P10, P15). It has to be able to 'make inferences, create

and summarize' complex datasets not only to solve the existing problems but also to foresight the future needs ones. The foremost cognitive function that was mentioned is the capability of forecasting which knowledge among the collective consciousness of a society is going to be the essential one in the future thus, enabling it to become unconditionally flexible (P13, P14). Through the process of integrating the knowledge into flexible and ontologically compatible datasets, the TLC actually explicates its highest cognitive feature, which is the coming into existence of 'alternative instructional designs' that are specifically designed for different learners and the ever-changing contexts (P1, P12).

Theme 3: The Socio-Managerial Ecosystem: A Democratic and Decentralized Framework

A thinking curriculum through its very nature is not compatible with an administrative system that is in a closed space or a strictly regulated, top-down chain of command. Data shows that the teacher learning community (TLC) demands and promotes a particular type of milieu: a decentralized, democratic, and humanistic ecosystem. This thematic issue examines the mutual dependency of the TLC's freedom from management and its situatedness in the managerial and sociological environment.

Table 4: Conceptual Network for Theme 3

Theme	Categories	Codes from Literature Review	Codes from Expert Interviews (Emic)
The Socio-Managerial Ecosystem: A Democratic and Decentralized Framework	**1. Decentralized and Autonomous Governance**	- Localized decision-making and competencies (York, 1984) Centralized structures inhibiting autonomy (Aksit, 2007) Advantages of micro-level, localized focus	*A centralized structure can inhibit autonomy*" (P8) " A managerial approach directly affects our ability to create autonomous curriculum" (P8) " *A more autonomous local structure is needed*" (P8) Ineffectiveness of centralized school system approach (Expert consensus)
	2. Humanistic and Inclusive Management	- Organizational humanism perspective (Hussain, Haque & Baloch 2019) Fostering social cohesion and teamwork (Mugambwa, Mutumba, W. W., Kyambade, Kayongo, & Ogwang, 2025) Balancing needs and motivation (Durmus, 2024; Maslow, 1943) Active citizen cultivation (Ellis, 2004)	*A democratic management model...all stakeholders have a voice*" (General consensus) "*Fosters active involvement and comprehensive development of all its components*" (P7, P9) "*Does not involve only the most skilled... fosters development of all*" (P9) "*Continuous interaction with its stakeholders in the decision-making process*" (P5, P7, P9, P12, P16)
	3. Adaptation to Sociological and Cultural Contexts	- Open systems adapting to feedback (Prigogine et al., 1984) Multicultural learning environments (Banks, 2009, 2016) Aligning with the organic structure of society (Durkheim, 1977) Integrating social needs and chaotic fluctuations (Murphy, 2011)	*Must align with the organic structure of society... an open system*" (P14) "*Sensitive to diverse interests and needs of various social structures*" (P14) "*Adapts to different social structures, multicultural learning environments*" (P14) "*Supports positive interactions between stakeholders, teams, implementers*" (P7)

Interpretive Analysis of Theme 3

The existence of the TLC live and in full is closely connected to its management system. The experts understandably refused to accept that a traditional, centrally managed regime is compatible in any sense with a curriculum that was self-organized. According to P8, "A centralized structure can definitely hold back autonomy," and, "our ability to generate autonomous curriculum is directly affected by the managerial approach." Hence, the TLC calls for a change of perspective towards decentralized and autonomous governance. It is made to be flexible at the micro-level, thus allowing local institutions, be it schools or districts, to develop the curriculum that fits their specific needs and contexts. With this model, the institution no longer needs to adhere to a one-size-fits-all approach, rather it is considered the advocate of a core framework that lets locals have more significant activities in terms of flexibility and decision-making.

This is the fully decentralized system that thrives owing to the belief in humanistic and inclusive management. Within the framing of "an all-inclusive, democratic, management model that not only recognizes the stakeholder's rights to speak but also reflects these rights in practice by the method used", the TLC is seen. The very nature of the system is founded on constant contact and correspondence. Instead of efficiency-focused systems that concentrate on the most capable only, the TLC model takes a more nurturing approach and this is evident in it by the fact that it "engages the active participation and holistic development of all its units, as well as all those who are actively involved in the system". The wide circle includes learners, teachers, and administrators. The management process of the organization aims at satisfying the needs and motivations of all participants, knowing fully well that the health of the entire organism depends on the well-being and growth of each part (P5, P7, P9, P12, P16).

The managerial philosophy at the TLC is that the adaptation to different sociological and cultural contexts is its greatest function. The curriculum is being described as an "open system" (P14), one which is very much reliant on its social surroundings and responds to its changes and various needs (Murphy, 2011). Its flexibility/adjustment to the environment enables the institution to design learning programs that take into account the existence of different cultures, social structures, and learner viewpoints (Banks, 2016). The last goal, however, is definitely not to force the learners to behave in a certain way, but to facilitate the extensive use of their knowledge and potential in their own social and cultural milieus. The TLC is to be a vehicle of social and cultural change that will lead to the next generation of citizens who will be involved and committed as it researches, uncovers, and resolves the issues that the world faces today, thus, it will be a direct vehicle of societal development and progress (Ellis, 2004).

Theme 4: The Neuro-Technical Infrastructure: Artificial Intelligence and Data Science Integration

The organic and metacognitive functions of TLC were previously thought only as mere abstractions or intangibles goals, but now the experts are in full agreement that a definite technological base exists which enables them. All the experts' (P1-P16) interviews disclose one feature which is put beyond doubt, such as the whole idea of the TLC: the extreme use of AI and data science being combined is the very condition which determines the TLC's existence and operation. This topic shows the technological design which forms the TLC's nervous system.

Table 5: Conceptual Network for Theme 4

Theme	Categories	Codes from Literature Review	Codes from Expert Interviews (Emic)
The Neuro-Technical Infrastructure: AI and Data Science Integration	**1. AI as a Core Cognitive Component**	-AI performing cognitive tasks (Baker Smith, & Anissa, 2019) -AI as a critical actor in learning processes (Korteling, Van de Boer-Visschedijk, Blankendaal, Boonekamp & Eikelboo, 2021) -AI providing effective feedback mechanisms (Dogan et al., 2025) -Use of artificial neural networks (Warwick, 2013)	"*Creating a new organism is possible with artificial intelligence*" (P5) "*AI must support decision-making and curriculum design*" (P1-P16 consensus) "*AI has a voice among decision makers*" (P5) "*Build upon existing AI technologies*" (P12) "*Future potential of quantum computing*" (P13)
	2. Systematic Data Processing and Mining	- Educational Data Mining (EDM) (Baker & Yacef, 2009) Discovering information about learner characteristics Uncovering knowledge structures of disciplines	"*Systematically gather data from stakeholders and target audience*" (P9, P12, P13) "*Employing diverse data collection tools and techniques*" (P9, P13) "*Algorithms control artificial neural networks*" (P13)

	3. Knowledge Transformation and Pedagogy	- Transforming subject matter knowledge (Deng, 2007) -Transferring content knowledge effectively Classification of information (Warwick, 2013)	"*Transforms data into multidimensional information by employing unique pedagogies*" (General consensus) "*Restructuring knowledge by linking to other disciplines*" (P1, P13) "*Designing appropriate instructional processes*" (P12)

Interpretive Analysis of Theme 4

The TLC theory says that AI is really not just a simple tool or something extra to the curriculum but that it is a part of its very basic and essential cognitive architecture. As P5 declared in no uncertain terms, "the invention of a new living entity is remarkably feasible with the use of artificial intelligence". The whole panel of experts shared this opinion. Hence, it was acknowledged that AI is one of the main cognitive components of the TLC that can do both functions, the one of the definer of the situation and the other as the co-designer in the continuous working of the curriculum. Here, AI is not an aide that is inactive but an agent that is active having "the voice among decision makers" (P5). The production metacognitive activities of Theme 2 are those AI does as it carries out the delicate analysis, identification of patterns, and the usage of the curriculum that it self-monitors and adapts. But this technological core is what makes reality from the very normal and "thinking" curriculum the abstract one.

This particular cognitive function needs and is still supplied with information but its processing and mining are managed through systematic data. The TLC is structured to "collect data from different stakeholders and the target audience in the most systematic way using different data collection tools and techniques" (P9, P13). The system is immensely interested in this raw data. The TLC turns to the examples of Educational Data Mining (EDM) for its own decision-making processes to uncover the learning characteristics and requirements of the target group, establish the basic knowledge structures for different subject areas and determine which educational supports are best suited for different learners (Baker and Yacef, 2009; Iweuno,Orekha, Ojediran, Imohimi & Adu-Twu, 2024). The artificial neural networks that are powered by the algorithms found at the heart of the system are the ones who perform the operations part of the process and further distribute the information that enables the whole scheme to do learning when interacting with the environment.

In the end, data processing on a large scale is about knowledge conversion and the creation of adaptive pedagogy. The TLC is not only a data unit for collection and storage; it "transforms data into multidimensional i nformation by applying different pedagogies". This is the system's brilliance showing up. Essentially, the system is carrying out the operation of obtaining raw data, identifying the patterns, linking the knowledge from different scientific branches, and, at last, merging them into the instructional designs and learning experiences that are both productive and suitable for the context of use. If it is further beyond human cognitive abilities, then it is the information classification that functions as a basis for the creation of structured and adaptable knowledge sets (Warwick, 2013). Through this neuro-technical architecture, the TLC is fulfilling its very nature, a curriculum which not only visualizes its own processes but, in fact, learns and changes itself so as to provide the maximum quality of service to its users and the society.

DISCUSSION AND CONCLUSION

This research was primarily aimed at solving the issue of curriculum stagnation, which keeps recurring and is systemic by developing new theoretical dimensions of the paradigm of the Thinking and Learning Curriculum (TLC). These research findings out of a grounded theory analysis of the experts' data across various fields of knowledge are not only a different model of curriculum development; they, in fact, represent a democratisation call of a radical ontological reconceptualization both of what we understand from and of a curriculum. Here we can look at the integration of the study's major themes, passing from the outline done for the core theory of TLC which has been newly inducted, and conjecturing on the enormous effects in the educational field in the future.

Before integrating the major themes of this research, it is essential to first functionally define the central metaphors of "thinking" and "learning" as they pertain to the curriculum. A curriculum with cognitive functions requires a very careful explanation on how these human-like traits are given to a non-living system. According to the TLC model, the term 'learning' refers not to the comprehension of the semantics but to the system's ability to adapt itself in an optimal way. It depicts the performance of the TLC as closely connected with machine learning in that the TLC keeps on restructuring its own models and updating its parameters based on the newly introduced data in order to increase the accuracy of its pedagogical strategies (Anderson, 2000). "Thinking", however, is the system that heightens the cognitive activities; it is the capability of the system to go beyond recognizing a pattern and then engaging in the integration of analysis, synthesis, and inferential reasoning to solve new and complex problems.

Besides that, the naming of 'metacognition' is reasonable by referencing the area of computational metacognition (Cox, 2005). Here, metacognition is not an individual's aware, subjective experience (Flavell, 1979), but rather a system design that allows the system to keep track of its learning performance, identify the errors that have been input, and change its strategies dynamically to become more efficient.

Discussion: From Static Artifact to Living Organism

The TLC theory is quite notable because it introduces the concept of a curriculum as a "living" and "complex" system rather than just a human artifact (Hooshmand, 2025). Hence, the shift to treating curriculum as an independent and complex adaptive organism from a static and human-authored artifact curriculum is the primary argument of the TLC theory. Such a change is not simply a step in the lexicon; it is the theoretical core that directly addresses the roots of the stagnating problem. Stagnation, according to our research, is the natural outcome of a passive and inert object in a changing environment. Unlike the TLC, which is a model that the adaptation and the auto-renewal are the default states (Alam & Benaida, 2022). The four seminal themes uncovered by the present research—organic structure, metacognitive core, socio-managerial ecosystem, and neuro-technical infrastructure—are not separate parts of the curriculum but the living quarters that are inseparably connected in this most complex and fascinating entity.

The metacognition facet of the curriculum is self-regulation, process debugging, and strategic decision-making, which are the features that give the curriculum the power to 'think'. Nonetheless, such a capacity is not just a distant dream; it turns into a tangible reality through its neuro-technical infrastructure. AI, in this case, is absolutely not an addition but a core cognitive partner whose operating, similar to the curriculum's central nervous system, consists of the data reception and the facilitation of higher order functions like thinking. It is the last phase in the metamorphosis of educational technologies where they have gone beyond the traditional tools that only assist the teacher's role, which is now seen as a technology that is one of the actors in the learning process and the revolution further in the concept of 'human-simulated' artificial intelligence.

Furthermore, the study emphasizes that a smart system like this cannot be suddenly imposed on a normal, traditional, and vertically structured administrative unit. The main point here is that the educational agency is an organism that requires a specific type of environment in order to be able to survive and grow: a democratic, decentralized, community-based management system, which is humane. Curriculum autonomy alone, though, would not mean that humans have no say in it; rather it changes the role of control entirely (Rauf, et al. 2024). In such communities, teachers become "facilitators, data interpreters, and architects of learning environments" (Iweuno et al., 2024) instead of "content deliverers". Staff members would be the tutors who guide students through the constantly changing environment, make instructional decisions based on data provided by the TLC, and work with the system for designing learning pathways. To the students, however, the role of information recipients is removed as they are empowered and turned into agents who, through participation, keep the curriculum vibrant and evolving (Ibeh, 2021). This close-knit relationship removes the traditional separation between designers and implementers, thus, allows a co-evolutionary dynamic to be in place where the TLC's emergent intelligence is continuously updated, integrated, and supplemented with human wisdom and experience (Sawyer, 2008).

Critical Considerations and Ethical Frontiers of an Autonomous Curriculum

Even though the TLC model significantly removes the blocking of curricula, portraying it as a fully autonomous AI-driven character would still require a thorough, pre-emptive moral assessment. The thought of an AI being granted 'a voice among decision-makers' is a whole new set of issues relating to governance, fairness, and human control, which are all subject to detailed examination (Kasztelnik, 2024). Algorithmic bias is the first problem that comes into the spotlight. AI systems are built by data-driven learning, and if this data reflects existing prejudices in society (such as those based on race, gender, or wealth), the TLC may inadvertently recreate or even deepen these gaps, thereby producing interaction cycles that lower education quality for certain children (Ejjami, 2024; O'Neil 2016). Therefore, the democratic ecosystem of the TLC must be comprehensively designed with not only measures for checking the fairness of algorithms but also for verifying the transparency of its decision-making procedures.

Another essential area of the future is the problem of balancing autonomy of the system with control of the human. In the case where the data-oriented advice of the TLC conflicts with that of an educator, which one should be relied upon first? Although the concept is based on the humanistic framework and its collaborative aspects, the practical steps needed to fix these conflicts must be elaborated in order to insecureify teachers and not let their educational freedom decrease (Selwyn, 2019). A system should be thought of as a means to facilitate human empowerment but not as an authority governing without any questioning.

Obviously, the continuous way in which a TLC system gathers and processes the personally identifiable data of students will most likely be a cause of some big privacy and surveillance concerns (Ejjami, 2024). The detailed level of information that the system requires to operate if it gets into the wrong hands it would be a new phenomenon of control and monitoring, which, apart from being different, would also change the teacher-student relationship (Zuboff, 2023). Therefore, any TLC implementation must be based on the 'privacy by design' principle, which is characterized by transparent and user-friendly data policies, and ethical considerations not only safeguarding the normal functioning of the system but also, security and liberty of the learners as their foremost responsibility. This moral code is not a mere list of items; it cannot be separate, the most important, the non-negotiable part of the TLC system.

Conclusion: A Substantive Theory of the Thinking and Learning Curriculum

The process of theory development is one of continuous refinement and restructuring. This study has contributed to this process by establishing a substantive theory grounded in empirical data. In answer to the primary research question, "What constitutes a Thinking and Learning Curriculum?", the findings of this study can be synthesized into the following theoretical statement:

The substantive theory of the Thinking and Learning Curriculum (TLC) defines curriculum as an autonomous, complex adaptive organism characterized by an organic and multidisciplinary structure. This organism possesses an internal metacognitive core that enables it to perform higher-order cognitive functions, including self-awareness, goal-setting, strategic planning, and adaptive self-regulation. Its cognitive and learning processes are powered by a deeply integrated neuro-technical infrastructure, where artificial intelligence and data science function as a central nervous system for processing feedback and transforming data into pedagogical knowledge. This entire system operates within, and is sustained by, a decentralized, democratic, and humanistic socio-managerial ecosystem that fosters continuous interaction, development, and co-evolution among all stakeholders.

Exceeding the sluggishness of existing systems, this conceptual framework not only drastically changes the very nature of curriculum theory but also significantly changes the very nature of curriculum theory, its most famous point being the transition of those early works which were entirely about defining the relationships of fixed elements (Beauchamp, 1975; Oliva & Gordon, 2013) to the understanding of the fundamental principles of a dynamic, self-sufficient and intelligent system. The material theory emerging from this research gives the definition of an innovative curriculum model, the Thinking and Learning Curriculum (TLC), as a living complex adaptive system with a high degree of autonomy. The metacognitive core is the faculty of this organism which is the center of the heart thus making self-regulation possible; the cognitive processes are facilitated by a brain-technological setup where artificial intelligence is the co-pilot of the human brain; and, it is a democratic ecosystem that supplies energy from which the coevolution among all stakeholders takes place. The whole theory and the principles that regulate its nature can be exemplified by three fundamental axioms.

I. The Axiom of Systemic Organismality: The Curriculum as a Complex Adaptive System

The first axiom of the theory explains that the curriculum is a living being, an ecosystem, that is an organism with a complex adaptive system. The whole set of ideas that give the theory is based on this ontological redefinition. As an organism, the TLC is at its most inefficient when it is stable but at its dynamic equilibrium, which is maintained by a continuous exchange of energy and information with its environment (Hooshmand, 2025). The concept of the TLC is by its origin a combination of different disciplines and it also borrows from different fields of knowledge to come up with a holistic method that is the same as a biological organism that is dependent on several subsystems that are interconnected. A machine, which is put together, is different from the TLC in that it changes over time. The main function of the latter is not to follow a pre-roled script but to adapt to, thus, survive and make a successful environment. With this axiom, the TLC is also able to overcome the stagnation period: the reason being, as is the case with any living being, that the primary function of its core is incessant self-renewal and change upon receiving feedback from the environment. The system's design is one that is always in the process of becoming and it never stays still.

II. The Axiom of Computational Cognition: The Symbiosis of AI and Metacognition

The second TLC axiom outlines the mental process of the TLC's smart, giving a detailed account of how it understands and learns. Briefly, the second axiom introduces the concept of TLC as an information processing machine, which is fundamentally computational, wherein cognition is the outcome of a conjoined operation of the neuro-technical infrastructure and the metacogitative core. The neuro-technical infrastructure, which is greatly propelled by Artificial Intelligence and Data Science, is the system of the curriculum that performs the role of the central nervous system. It is the medium through sensation (data collection), memory (knowledge structuring) and neural processing (algorithmic analysis). The infrastructure is the one which is empowering the curriculum through "learning" that is defined as the continuous update of the internal models by data analysis.

On the other hand, the metacognitive core, which is the "mind" of the system, among other things, the director of the AI's raw processing power, being in charge of higher-order cognitive functions—what the theory calls "thinking". Through the AI outputs, the core carries out self-awareness (also called performance monitoring), error detection (performance inefficiency diagnosis), and strategic planning (formulating new pedagogical solutions). Thus, the theory maintains that a curriculum is not considered to be thinking as it would have a consciousness similar to that of a human but, its design is rather a continuous feedback loop: the AI supplies the computational power to learning, and the metacognitive framework utilizes that learning to implement strategic, goal-directed thinking. One could not function without the other (Vilalta & Drissi, 2002).

III. The Axiom of Relational Emergence: Intelligence as an Ecosystemic Property

The last one, the third axiom, describes in detail the native conditions of the smart TLC's intelligence being revealed. According to it, the curriculum's intelligence is not something from the technical side only but it is a property that 'emerges' from the whole curriculum ecosystem. An intricate AI operating within a rigid hierarchy would still be only a complex tool. A cleverly designed TLC can only attract the intellect coming from the vibrant, living and unstable dealings within its democratic and human-friendly socio-managerial ecosystem.

Such an ecosystem, therefore, is providing two absolutely crucial functions. The first one is that it constitutes the source of all the different and meaningful feedback, which are like the main dynamic in the whole cognitive process. The wisdom, experience, and needs of students, educators, and the community at large, are the essential nutrients for the organism's learning. The human stakeholders, in return, are the ones who, through the ethical and pedagogical oversight, give the system the power to make its own decisions, thus they also prevent the system from being a deterministic, biased and a dehumanizing force. Hence, the theory ends up pinpointing that the 'mind' of the curriculum is not the code but the whole network of human and artificial agents that the curriculum is distributed across. It is the AI of the curriculum that makes it smart if it doesn't have strong but rich relationships, robust feedback loops, and genuinely collaborative governances.

IMPLICATIONS AND FUTURE DIRECTIONS: NAVIGATING A PARADIGM SHIFT

The research results are significant as the TLC has been presented as a radically new concept rather than just a mere improvement of the existing models. The primary effect of characterizing the TLC as a substantive theory is the necessity for the very first practical use and empirical checking. A theory of that kind, founded on experimental data, already yields the indicative scheme to provide the implementation, the further development, and the testing of functioning TLC prototypes in the educational setting.

Despite all, such a model or even the implementation of a TLC would most probably have an incredibly hard time trying to get through the boundaries of the present curriculum paradigm. One of the main points of this theory is the fact that the TLC can never be properly understood, designed, or assessed if it is looked at from the perspective of a static, mechanistic worldview. Therefore, if the adaptive organism is seen just as a "smarter" kind of traditional fixed curriculum, the misunderstanding of its principles is inevitable along with the failure of its potential. The change from a static artifact to a living system requires the same change in the mindset of the researchers, the policymakers, and the practitioners. The question of the degree of centralized control is, however, raised by the policy which instead proposes such regimes that are capable of ensuring a higher degree of local autonomy. The role change of educators from content suppliers to facilitators, data interpreters, and living system co-creators is what practice gets as a result of this transformation.

This paradigm shift illuminates a clear and critical path for future research, framed by the following inquiries:

Model Development and Validation: Among different functions, the one that is most related to the practical application of the model is the transition from theoretical to actual practice. The proper future research, for sure, would be the actual functional design, development, and piloting of a TLC prototype. Such an endeavor can be the lead by the below-mentioned research question: What are the design principles and computational architectures that are required for building a scalable TLC model which not only simplifies the autonomous curriculum revision but also co-ordinates the feedback of stakeholders and student data in an educational setting beyond the lab efficiently?

The Epistemology of a TLC: The fundamental notion behind this concept is a curriculum that not only comes into existence but also changes the existing one. Consequently, this opens a whole bunch of deep-rooted epistemological questions that people involved in research have to resolve: How diverse is the process of knowledge validation typical for a TLC as an independently operating one compared to known, human-centric, traditional types of epistemologies and what does it imply about the characteristics of "truth" and "authority" in the curriculum?

The Pedagogy of a TLC: The educator, within this model, has undergone a transformation such that his/her position is completely changed. The future pedagogical inquiries should focus primarily on researching this new

relationship: What new pedagogical qualities and practices and what pedagogical developments must educators acquire for successful TLC implementation, for data comprehension, and for the facilitation of a co-adaptive environment within a TLC ecosystem?

The Ethics of Autonomy: Indeed, there are ethical issues in large numbers, as mentioned. The question of how we govern and direct the ethical part should be the most important issue in this field. What would be the ethical governance frameworks and the procedures that would be the most assuring in terms of algorithmic fairness, data privacy, and the provision of meaningful human oversight in a TLC? Furthermore, would they be able to successfully reconcile system autonomy with the professional agency of educators and the rights of learners?

By pursuing these avenues, the theory of a Thinking and Learning Curriculum can stimulate the rigorous inquiry and innovation needed to navigate this paradigm shift and shape a more dynamic, responsive, and intelligent future for education.

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