



Confirmatory Factors Analysis of the Learning Ecosystem Towards Desired Outcomes of Learners

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Abstract

This research aims to analyze the confirmatory components and verify the congruence of the model indicators of learning ecosystem towards desired outcomes of learners in basic education. The sample group consists of 500 individuals, including school administrators and teachers attached to the Basic Education Office, selected through stratified random sampling based on school sizes and geographical regions. The research tool is a questionnaire assessing factors influencing the desired outcomes of learners at the basic education level, employing a 5-point Likert scale. The validity of the questionnaire was confirmed through content validation by five experts in educational administration and measurement, yielding an index of congruence ranging from 0.80 to 1.00. The reliability coefficient using Cronbach's alpha was 0.969.

The results of the Confirmatory Factor Analysis (CFA) using Mplus program revealed two key findings: 1) The components of the learning ecosystem consist of 5 factors with their respective standardized factor loadings: Learning Culture ($\beta = 0.989$) emerged as the strongest factor, followed by Stakeholder Support ($\beta = 0.951$), Learning Resources ($\beta = 0.863$), Content ($\beta = 0.805$), and Educational Policy ($\beta = 0.709$), 2) The confirmatory factor analysis demonstrated that the model fits well with the empirical data, validating the theoretical framework of learning ecosystem components in basic education context. These findings suggest that learning culture and stakeholder support are crucial elements in developing an effective learning ecosystem for achieving desired learner outcomes in basic education.

Keywords: Learning Ecosystem, Desired Outcomes of Learners, Confirmatory Factor Analysis, Basic Education

Introduction

The contemporary era is marked by dynamic, rapid, and uncertain transformations across various domains encompassing science, technology, economics, politics, culture, and society. These changes unfold swiftly and wield profound ramifications on learning behaviors, facilitating the rapid exchange of knowledge irrespective of temporal or spatial constraints. Notably, the advent of artificial intelligence heralds a paradigm shift in the landscape of human labor, accentuating the imperative for a nuanced comprehension of evolving workforce requirements. As elucidated by the Megatrends Watch Institute (n.d.), the forthcoming workforce necessitates a synthesis of specialized expertise alongside adept analytical and integrative thinking capabilities. Indeed, empirical investigations conducted by the Thailand Development Research Institute (TDRI) underscore the multifaceted skill set demanded by contemporary employers, encompassing not only technical proficiency but also proficiency in English language, digital literacy, and critical cogitation (Wichitaksorn & Amarase, 2023).

The National Education Standards B.E. 2561 (2018) establish a framework for transforming Thailand's education system through three interconnected dimensions of desired outcomes. First, as Learner Persons, students develop lifelong learning capabilities and knowledge application to create quality of life and sustainable careers. Second, as Innovative Co-creators, they cultivate digital literacy, interdisciplinary skills, and creative thinking to generate technological and social innovations. Third, as Active Citizens, they embrace ethical leadership and democratic values to foster peaceful co-existence and sustainable development. These dimensions are grounded in

shared values of Pure Perseverance, Sufficiency, Democratic Path, and Equality, guiding learners to achieve both personal growth and national development in response to rapid global changes (Office of the Education Council, 2019). However, there exists a significant gap between these aspirations and current educational practices. While the Office of the Education Council emphasizes the need for education management to develop learners' ability to respond to future world changes (Office of the Education Council, 2021), recent surveys reveal concerning trends – only 30 percent of Thai youth believe their skills have lifelong applicability, and over 40 percent lack a growth mindset essential for adaptability and continuous learning (Rattanakhamfu, 2022).

The OECD learning framework (OECD, 2018) delineates a learning compass, illustrating that learners must possess competencies, knowledge, skills, and values to adeptly navigate life and the world. Meeting these competency needs is multifaceted, especially considering the evolving landscape of education in response to anticipated future world changes by 2040 (Office of the Education Council, 2021). Effective learning in the modern era focuses on cultivating lifelong learners through comprehensive learning ecosystems that establish supportive relationships between learners and their surrounding environment. Such ecosystems foster a conducive atmosphere for learning, preparing students to navigate a rapidly changing world and achieve desired educational outcomes (Office of the Education Council, 2019).

In response to these challenges, Chiang Mai University has established strategic initiatives to develop a comprehensive learning ecosystem that integrates education, research, and innovation (Planning Division, Chiang Mai University, 2021). Through CMU Lifelong Education (School of Lifelong Education, Chiang Mai University, n.d.), these initiatives aim to create environments that foster individual development and adaptability. Central to this approach is the dynamic interplay between learners and their surrounding learning environment, encompassing educational strategies, community engagement, learning resources, and institutional culture. These components collectively form systems that cultivate a conducive learning atmosphere, facilitating the holistic development of individuals to their fullest potential. However, successful implementation of such ecosystems remains limited nationally – among educational institutions in Thailand, only two learning centers have effectively structured and operationalized learning ecosystems, namely the Demonstration School of Thammasat University and the South-East Asia Center (Office of the Education Council, Ministry of Education, 2021).

Given these challenges and the critical importance of developing effective learning ecosystems, this research aims to investigate the constituent elements of the learning ecosystem and their role in facilitating desired learning outcomes among students in basic education. Through confirmatory factor analysis, this study seeks to validate the theoretical framework of learning ecosystem components and provide evidence-based guidelines for educational institutions to develop effective learning environments. The findings will contribute to both theoretical understanding of learning ecosystem dynamics and practical applications in educational management, ultimately supporting the development of learners equipped for future challenges as Learner Persons, Innovative Co-creators, and Active Citizens. Additionally, the research outcomes will help bridge the current implementation gap by providing concrete guidance for educational institutions seeking to establish comprehensive learning ecosystems aligned with national educational standards and contemporary workforce demands.

Objectives

1. To analyze the components and indicators of the learning ecosystem towards desired outcomes of learners in basic education.



2. To check the consistency and harmony of the indicator model. Components of the learning ecosystem towards desired outcomes of learners in basic education.

Research Conceptual Framework

This research, the researcher aims to study components of the learning ecosystem towards desired outcomes of learners in basic education. By studying concepts, theories, and related research about learning ecosystems. Then it was formulated into the research concept framework as follows Figure 1.

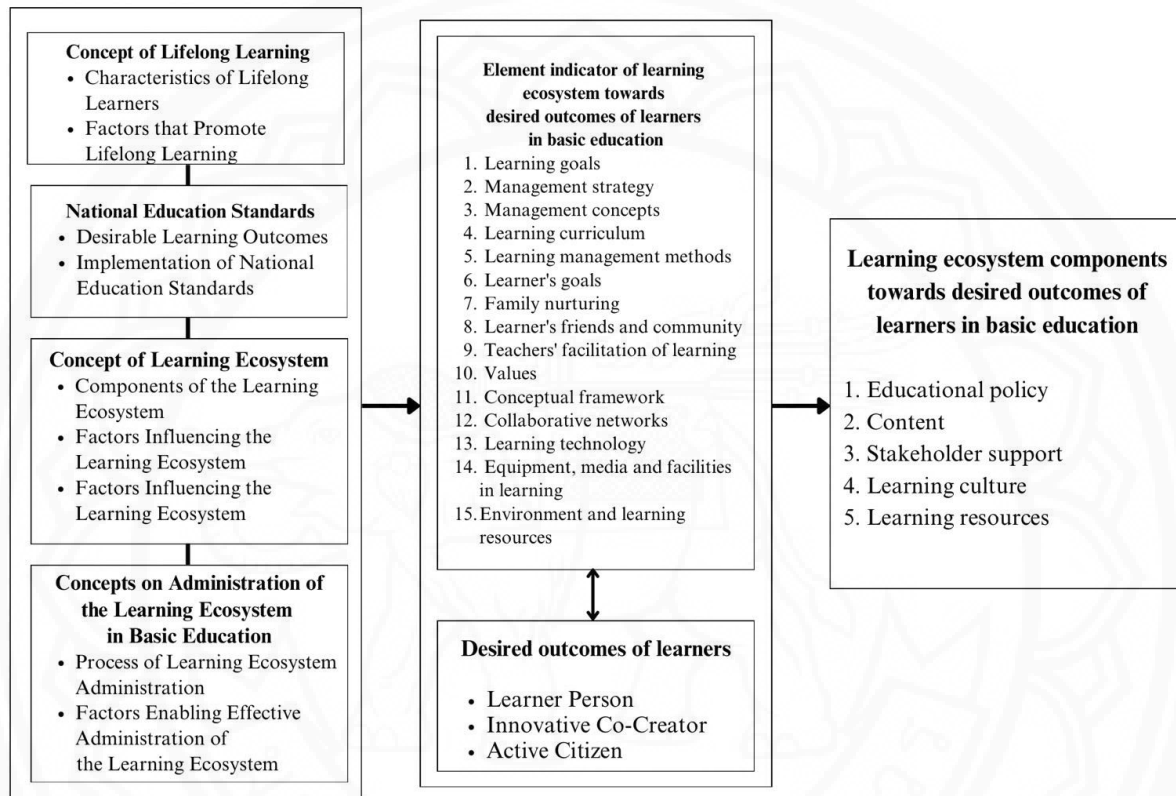


Figure 1 Conceptual Framework for Research on Education, Components of the Learning Ecosystem Towards Desired Outcomes of Learners in Basic Education.

Methods and Materials

Part 1 Analysis of components and indicators of the learning ecosystem towards desired outcomes of learners in basic education.

Resources

Documents, articles, and related research that explore learning ecosystem concepts. Concepts regarding the desired outcomes of learners and laws, strategies, and policies related to the management of the learning ecosystem.

Data Analysis

The researcher synthesizes the acquired data by counting the frequency of keywords to identify the components of managing the learning ecosystem towards desired outcomes of learners in basic education, consists of 15 indicators: 1) Learning goals, 2) Management strategy, 3) Management concepts, 4) Learning curriculum, 5) Learning management methods, 6) Learner's goals, 7) Family nurturing, 8) Learner's friends and community,



9) Teacher's facilitation of learning, 10) Values, 11) Conceptual framework, 12) Collaborative networks, 13) Learning Technology, 14) Equipment, media and facilities in learning, and 15) Environment and learning resources.

Part 2 Examining the harmony of the learning ecosystem component indicator model towards desired outcomes of learners in basic education.

Sample Group

Based on the synthesis of research documents, variables representing the components of the learning ecosystem, totalling 15 indicators, were identified to explore the structural relationships and causality among these variables. In estimating the appropriate sample size for analysis, it was essential to consider the number of parameter values within the hypothesized model. In the context of multilevel analysis, the total number of parameter values amounted to 50. Considered by the Rule of Thumb, a sample size approximately 10 times the parameter value should be used (Nunnally & Bernstein, 1967). Therefore, this research gathered data from a sample group of 500 people (50 value x 10 times). This sample group consisted of directors, deputy directors, and teachers affiliated with educational institutions under the purview of the Office of the Basic Education Commission (OBEC). The data were collected using stratified random sampling based on school sizes and geographical regions. Simple random sampling was employed to select two provinces from each region, and the samples were stratified by educational service areas and school types. Data were gathered from school administrators and teachers, with a sample comprising 100 school administrators and 400 teachers, selected through simple random sampling.

Tools Used in Research

The research instrument utilized in this study was a questionnaire designed to assess perceptions regarding factors influencing the desired outcomes among students at the basic education. The questionnaire comprised three distinct sections delineated as follows: **Part 1:** General information is a checklist. **Part 2:** Factors affecting the desired outcomes of educational level learners. The basic level is a 5-level rating scale consisting of 5 elements, 40 items, consisting of: 1) Educational policy, 8 items, 2) Content, 8 items, 3) Stakeholder support, 8 items, 4) Learning culture, 8 items, and 5) Learning resources, 8 items, and part 3, recommendations for developing guidelines for managing the learning ecosystem towards desired outcomes of learners in basic education. It's an open-ended question. Analysis results consistent index values from 5 experts is between 0.80 and 1.00 and the analysis results confidence value by finding the Cronbach's confidence coefficient. Complete tool is 0.969.

Data Collection

The researcher investigated the constituents of the learning ecosystem pertaining to the desired outcomes of learners in basic education, employing a questionnaire to solicit opinions regarding factors influencing student learning outcomes at the basic education level. Data collection involved the distribution of questionnaires to directors, deputy directors, and teachers from educational institutions under the purview of the Basic Education Commission (OBEC). Utilizing an online platform (Google Form), participants were required to log in with a single account to complete the questionnaire once. This study was approved by the Research Ethics Committee on Human Research at Chiang Mai University, under the reference number CMUREC No. 66/321. Ultimately, responses were gathered from a sample of 460 individuals, representing a response rate of 92 percent. This is considered a good response rate and sufficient for conducting confirmatory factor analysis using second-order confirmatory factor analysis techniques.



Data Analysis

The quality assessment of the data and preliminary statistical assumptions included the following: descriptive statistics—mean ($\bar{x}$), standard deviation (SD), maximum and minimum values, skewness (which should range between ± 2), and kurtosis (which should range between ± 2) (George & Mallery, 2010). Pearson's Product-Moment Correlation was used to analyze indicators and components, along with the Kaiser-Meyer-Olkin (KMO) statistic, where the KMO value should range from 0 to 1. Bartlett's test of sphericity was conducted to verify whether all indicators formed an identity matrix, with results required to show statistical significance at the .05 level (Bartlett, 1954).

To evaluate the validity of the measurement model for students' adaptive learning in a new paradigm, second-order confirmatory factor analysis was employed. Model fit indices were considered to ensure consistency with empirical data. These indices included Chi-square (χ^2), with a non-significant result at the .05 level; Root Mean Square Error of Approximation (RMSEA) < 0.05; Standardized Root Mean Square Residual (SRMR) < 0.05; Comparative Fit Index (CFI) > 0.95; Tucker-Lewis Index (TLI) > 0.95; and Goodness-of-Fit Index (GFI) > 0.90 (Byrne, 2010; Kline, 2015).

Results

The research results are in accordance with the research objectives as follows.

Part 1 Results of indicator analysis components of the learning ecosystem towards desired outcomes of learners in basic education

Table 1 Number and Percentage of Results, Synthesis of Indicators of Components of the Learning Ecosystem Towards Desired Outcomes of Learners in Basic Education

Indicators of Components of the Learning Ecosystem	Frequency	Percentage
1. Learning goals	5	25.00
2. Management strategy	9	45.00
3. Management concepts	5	25.00
4. Learning curriculum	12	60.00
5. Learning management methods	9	45.00
6. Learner's goals	11	55.00
7. Family nurturing	10	50.00
8. Learner's friends and community	9	45.00
9. Teachers' facilitation of learning	13	65.00
10. Values	8	40.00
11. Conceptual framework	7	35.00
12. Collaborative networks	9	45.00
13. Learning technology	15	75.00
14. Equipment, media and facilities in learning	8	40.00
15. Environment and learning resources	11	55.00

From Table 1, it is found that the indicators of the components of the learning ecosystem towards desired outcomes of learners in basic education. From the synthesis of elements from 20 data sources, there are a total of 15 indicators. The indicator that has the greatest impact on learning ecosystem management is learning technology at 75.00 percent, followed by teachers at 65.00 percent and learning curriculum, 60.00 percent.

Part 2 Results of checking the consistency of the indicator model. Components of the learning ecosystem towards desired outcomes of learners in basic education

The study analyzed descriptive statistics, showing mean values of indicators ranging from 4.192 to 4.543 and standard deviations between 0.567 and 0.688. Skewness values ranged from -0.736 to -0.190, indicating normal distribution within the acceptable range of -2 to 2, while Kurtosis values (1.07–5.98) suggested distributions close to a normal curve. Pearson's Product-Moment Correlation revealed significant positive correlations among all indicators at the .01 level, with coefficients from 0.312 to 0.930. The KMO index was 0.952, and Bartlett's Test showed $\chi^2 = 7161$, $df = 105$, $p = 0.000$, confirming that the correlation matrix was not an identity matrix. The findings demonstrate that the indicators are significantly correlated and suitable for second-order confirmatory factor analysis.

1. The researcher checked the harmony of the model according to the specified criteria of Hu and Bentler (1999). It was found that the harmony index of the model measuring indicators of components of the learning ecosystem towards desired outcomes of learners in basic education. It meets the specified criteria and is consistent with the empirical data as shown in the Table 2.

Table 2 Harmony Index of the Component Model the Learning Ecosystem Towards Desired Outcomes of Learners in Basic Education

Harmony Index	Criterion	Analysis Results	Consideration Results
χ^2 -Test	$P > 0.05$	$\chi^2 = 48.762$, $df = 35$, $p = 0.0611$	Pass
χ^2 / df	< 2.00	1.393	It blends in well
RMSEA	≤ 0.05	0.029	It blends in well
SRMR	≤ 0.08	0.031	consistent with the data
CFI	≥ 0.95	0.998	It blends in well
TLI	≥ 0.95	0.994	It blends in well

From Table 2, it is found that the results of checking the consistency and harmony of the component indicator model are construct validity. The variance matrix of the empirical data is consistent with the theory.

2. The results of the second order confirmatory factor analysis of the learning ecosystem towards desired outcomes of learners in basic education. It was found that the elements in the standard score with the highest weight were learning culture ($\beta = 0.989$), followed by stakeholder support ($\beta = 0.951$), learning resources ($\beta = 0.863$), content ($\beta = 0.805$) and educational policy ($\beta = 0.709$) respectively, as shown in Table 3 and Figure 2.

Table 3 Results of the Second Order Confirmatory Factor Analysis of Learning Ecosystem Towards Desired Outcomes of Learners in Basic Education

Component	Observable Variables	$\bar{X}$	S.D.	b	β	SE	Z	R^2
First Order Component Analysis								
Educational Policy	Learning goals	4.550	0.616	1.000	0.909	0.017	53.696	82.60
	Management strategy	4.521	0.608	1.063**	0.979	0.014	69.339	95.80
	Management concepts	4.558	0.592	0.944**	0.888	0.016	55.284	78.90
Content	Learning curriculum	4.476	0.562	1.000	0.899	0.016	55.267	80.80
	Learning management methods	4.505	0.572	1.030**	0.912	0.016	58.503	83.20



Table 3 (Cont.)

Component	Observable Variables	$\bar{X}$	S.D.	b	β	SE	Z	R ²
Stakeholder Support	Learner's goals	4.209	0.669	1.000	0.743	0.028	26.314	55.10
	Family nurturing	4.079	0.750	1.067**	0.706	0.030	23.757	49.80
	Learner's friends and community	4.122	0.704	0.997**	0.703	0.030	23.463	49.40
	Teachers' facilitation of learning	4.360	0.586	0.914**	0.766	0.026	29.256	58.70
Learning Culture	Values	4.314	0.594	1.000	0.906	0.014	62.670	82.00
	Conceptual framework	4.174	0.659	0.887**	0.728	0.035	20.874	53.00
	Collaborative networks	4.318	0.669	1.091**	0.879	0.035	57.389	77.20
Learning Resources	Learning technology	4.322	0.645	1.000	0.794	0.023	34.548	63.00
	Equipment, media and facilities in learning	4.244	0.669	1.052**	0.804	0.024	33.813	64.70
	Environment and learning resources	4.218	0.717	1.265**	0.906	0.020	45.802	82.00
Second Order Component Analysis								
Learning Ecosystem	Educational policy	4.543	0.605	1.000	0.709	0.028	25.485	50.30
	Content	4.491	0.567	1.028**	0.805	0.023	34.515	64.90
	Stakeholder support	4.192	0.688	1.190**	0.951	0.023	41.535	90.40
	Learning culture	4.269	0.645	1.344**	0.989	0.017	58.803	97.80
	Learning resources	4.261	0.679	1.113**	0.863	0.025	35.206	74.50

Note: b = Coefficient, β = Standardized Score, S.E. = Standard Error, Z-value = Standard Test Statistic, R² = Chi-Square Value, Z > 1.96 means p < .05, Z > 2.58 means p < .01, ** mean p < .01.

When considering standard component weight coefficients of learning ecosystem variables in the second confirmatory factor analysis, it was found that the standardized component weight coefficients of all 5 components were between 0.740 – 0.921 and were statistically significant at the .01 level. All of them (Z > 2.58) could be sorted. The standard component weights from highest to lowest are as follows: learning culture (β = 0.989), followed by stakeholder support (β = 0.951), learning resources (β = 0.863), content (β = 0.805) and educational policy (β = 0.709), respectively with co-variation with the model. Measuring the learning ecosystem in order as follows: 97.80, 90.40, 74.50, 64.90 and 50.30 percent.



Figure 2 A Model for Measuring the Components of the Learning Ecosystem Towards Desired Outcomes of Learners in Basic Education.

Discussion

1. Study of components and indicators of the learning ecosystem towards desired outcomes of learners in basic education

The findings of the study on the components and indicators of the learning ecosystem, aimed at achieving desired outcomes among learners in basic education, reveal five principal components: **Component 1:** Educational Policy, comprising three indicators, **Component 2:** Content, consisting of two indicators, **Component 3:** Stakeholder Support, encompassing four indicators, **Component 4:** Learning Culture, comprising three indicators, and **Component 5:** Learning Resources, comprising three indicators.



This conceptualization of the learning ecosystem components aligns with previous research conducted within similar educational contexts. For instance, EdTech Center World Education (n.d.); Spencer-Keyse et al. (2020) and Theodotou (2020) proposed a similar framework consisting of 5 elements: People or personnel, Content used in learning, Technology, Learning culture, and Strategies employed in the organization to foster effective learning, directly or indirectly influencing each other according to student learning objectives. Furthermore, it parallels the elements outlined in a report by the Office of the Education Council, Ministry of Education (2022) on the study of the learning ecosystem model facilitating the development of the potential of Thai people 4.0. This report posited 6 elements: Operational strategy, Resources, Learning management methods, Creation of new curricula and activities, Utilization of technology, and Network cooperation. However, there are slight discrepancies, as the synthesized components in our study have led to specific indicators. For instance, the organization of learning and creation of new curriculum and activities have been amalgamated into the learning content component, while resource and technology indicators have been consolidated into a single component termed learning resources. Additionally, an essential element, learning culture, has been incorporated, encompassing learners' attitudes, beliefs, mindsets, and values in learning, emphasizing the importance of self-directed learning and personal development—an imperative concept in fostering lifelong learners among students.

2. Checking the harmony of the ecosystem component indicator model learning towards desired outcomes of learners in basic education

From the research results it was found that model for measuring indicators of components of the learning ecosystem towards desired outcomes of learners in basic education are consistent with empirical data. When considering harmony, it is $X^2(15, n = 460) = 48.762$, $p\text{-value} = 0.0611$, $X^2/df = 1.393$, $RMSEA = 0.029$, $SRMR = 0.031$, $CFI = 0.998$ and $TLI = 0.994$, when sorted according to the weight of the elements (factor loading), there were findings that were discussed as follows:

2.1 The learning culture component exhibits the highest weight value, indicating its paramount importance in steering learning toward desired outcomes among learners in basic education. This prominence underscores the pivotal role of cultivating a conducive learning culture, wherein learners embody attitudes, beliefs, mindsets, and values conducive to self-directed learning and personal development aligned with both individual and institutional educational objectives. Moreover, fostering a collaborative network encompassing various stakeholders at the community, educational, provincial, ministerial, and private sector levels is imperative, as it profoundly influences student learning outcomes. These findings are corroborated by the research of Khacha and Thawinkarn (2023), who emphasize the necessity of adapting learning development strategies to contemporary needs. They posit that the learning culture within educational institutions must evolve to remain pertinent and to facilitate institutional success in attaining predefined objectives. Consequently, the establishment of a digital learning culture within schools becomes imperative, entailing the cultivation of behavioural patterns, attitudes, and values among educational personnel that embrace and endorse the integration of digital technology within educational practices.

2.2 The component of Stakeholder support, this group encompasses learners, family members, friends, and teachers, collectively serving as crucial stakeholders in fostering and sustaining motivation, cultivating positive learning attitudes, and providing guidance and support to learners. They play pivotal roles as mentors, advisors, and facilitators, offering valuable learning experiences and assisting learners in achieving their educational objectives. This perspective is corroborated by the research of Khongcharoen et al. (2023), which underscores the significance of learning management strategies that incorporate real-world experiences within community



settings. Engaging students in knowledge-sharing activities with parents or community members possessing professional expertise not only enriches learning experiences but also fosters student innovation and creativity.

2.3 The component of Learning Resources encompasses various learning facilities, including technology, media, equipment, and resources utilized both within and outside educational institutions, tailored to the specific needs of each learning context. These resources play a pivotal role in supporting and enhancing learning experiences, enabling students to realize their full potential and attain their learning objectives. The accessibility and availability of learning resources in the learner's environment significantly impact their learning development. This perspective resonates with the research conducted by Kongmanus (2018), who highlights the significance of education in the digital age, emphasizing technology-enabled learning as a crucial pedagogical approach. Digital tools and technologies serve as essential assets for both students and educators, facilitating seamless access to knowledge sources and empowering them to create meaningful work. Similarly, Maneehaet and Wannapiroon (2019) advocate for the integration of digital technologies and artificial intelligence into the management of learning, envisioning a digital learning ecosystem designed to foster smart learning environments.

2.4 The component of Content is characterized by weighted values assigned to its elements. Notably, the highest weighted indicator, the learning curriculum, underscores the pivotal role of developing learning content tailored to meet the diverse needs of students, thereby serving as a cornerstone in student development. Crafting a learning curriculum involves the systematic organization and presentation of learning materials and methodologies aimed at fostering a comprehensive and coherent learning experience. It necessitates adherence to educational standards and alignment with predetermined student learning objectives, necessitating the formulation of a structured learning plan and the design of a curriculum that encompasses various teaching methods, technology integration, learning resources, skill development, and student assessment and reflection. These findings align with the research of Jankham (2023), who advocates for the adaptation of school curricula to integrate content and promote vocational skills that are flexible and relevant to students' interests. Similarly, Phueadkhilai (2022) emphasizes the importance of curriculum development principles, skill-building strategies, and meaningful learning management practices to facilitate students' learning and the realization of their full potential.

2.5 The component of Educational Policy involves the formulation of vision, mission, goals, core values, operational strategies, and evaluation mechanisms aimed at guiding the attainment of students' objectives and fostering a conducive learning culture within educational institutions. Central to this component is the management strategy indicator, which carries the highest weight and underscores the importance of translating policies into actionable initiatives that promote student learning. This emphasis on strategic management serves to cultivate an environment conducive to nurturing students' lifelong learning aspirations and facilitating their holistic development. This perspective aligns with the findings of Junphengphen et al. (2023), who underscore the pivotal role of school administrators' leadership in shaping various facets of educational institutions. School administrators wield considerable influence by influencing, motivating, or persuading stakeholders, thereby playing a crucial role in articulating and disseminating the institution's vision, executing strategic initiatives, and serving as exemplars of effective leadership.

In summary, all 5 elements encapsulate the pivotal mechanisms propelling students toward realizing their full learning potential and achieving their educational objectives. It is imperative to orchestrate an environment and learning milieu conducive to fostering student development, commencing with the formulation of educational policies and strategies. This process entails establishing a vision and shared learning goals, delineating content,



curriculum, learning methodologies, and assessment criteria tailored to the learners' needs. Such necessities require collaborative efforts across various sectors, including learners, educators, parents, communities, and peers, in cultivating a conducive learning culture. By fostering an environment conducive to learning, augmented by the judicious utilization of media and technology both within and beyond the confines of the classroom, each element must be systematically driven to facilitate comprehensive student development.

Recommendations

Recommendations for Using Research Results

Based on the research findings that learning culture and stakeholder support have the highest influence on the success of the learning ecosystem, recommendations for implementation at different levels are proposed.

1. At the policy level, the Office of Basic Education Commission should establish clear policies and strategic plans for developing learning ecosystems. This includes setting specific goals and indicators for developing school learning culture, creating mechanisms to support family and community participation, and allocating sufficient budget and resources.

2. At the educational service area level, systems should be established to promote and support the development of school learning ecosystems through supervision focusing on learning culture development, building collaborative networks, and organizing platforms for knowledge sharing among schools.

3. At the school level, administrators should translate the discovered components of the learning ecosystem into action plans by creating awareness and shared understanding of learning culture development, developing student support systems emphasizing participation, arranging environments and learning resources conducive to lifelong learning, and developing curricula and learning processes aligned with learner contexts.

4. At the classroom level, teachers should apply learning management approaches consistent with the learning ecosystem by designing activities that promote self-directed and collaborative learning, creating learning atmospheres conducive to skill development and desired characteristics, utilizing diverse technologies and learning materials, and implementing assessment that emphasizes development and reflection. Systematic and continuous implementation of these recommendations will help develop an effective learning ecosystem, ultimately contributing to the development of learners with desired characteristics according to educational goals.

Recommendations for Future Research

The researcher offers the following recommendations for future research. First, qualitative research should be conducted in educational institutions that have successfully established a learning culture. This research would aim to extract lessons about success factors, development processes, and best practices, leading to the development of effective guidelines for managing learning ecosystems. Second, research and development should focus on collaborative models between schools, families, and communities in developing learning ecosystems. This includes studying roles, collaborative mechanisms, and approaches to building sustainable partnership networks. Third, longitudinal research should be conducted to continuously monitor the impact of learning ecosystem development on learners. This research would examine the relationship between the development of various learning ecosystem components and the changes occurring in learners, encompassing knowledge, skills, and desired characteristics. Such longitudinal studies would provide clear insights into the long-term effects of learning ecosystem development.

Conclusion

The learning ecosystem represents a complex network of interrelated components that collectively foster and support the process of learning. It encompasses a dynamic environment where students actively engage, enabling them to maximize their learning potential and achieve their educational goals. Extending beyond traditional classroom boundaries, this ecosystem integrates various interconnected elements. In the context of basic education, the primary components of the learning ecosystem include: 1) Educational policy, 2) Content, 3) Stakeholder support, 4) Learning culture, and 5) Learning resources (illustrated in Figure 3). A comprehensive understanding and strategic management of these essential components allow educational institutions to create a supportive and empowering learning environment, thereby promoting the holistic development of learners.

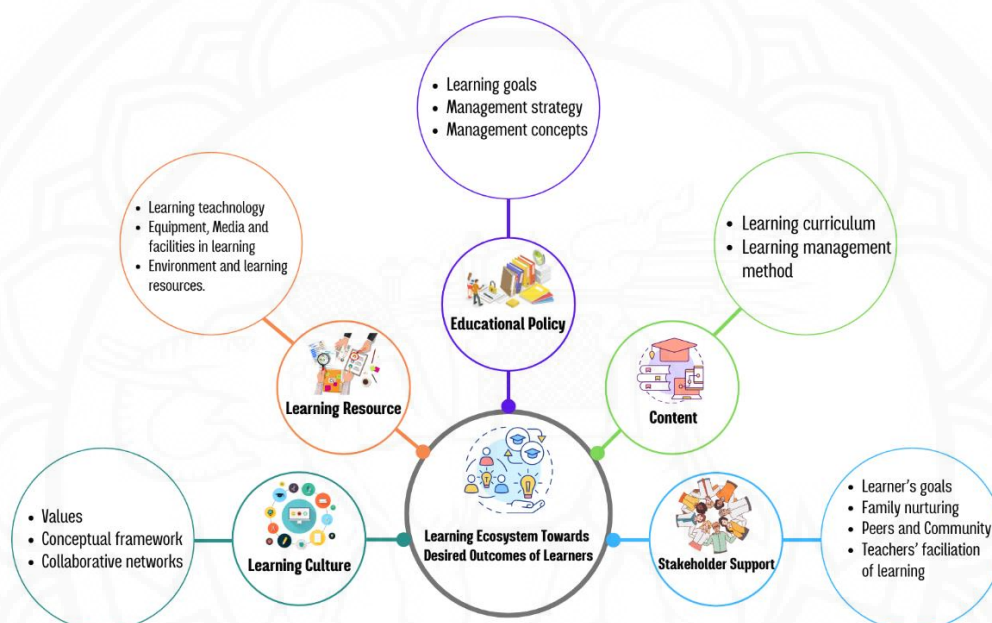


Figure 3 Components of the Learning Ecosystem Towards Desired Outcomes of Learners in Basic Education.

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