Kasetsart Journal of Social Sciences 45 (2024) 725–736

Kasetsart Journal of Social Sciences

journal homepage: http://kjss.kasetsart.org

Fostering integrated STEAM-related CL in early childhood: Lessons learned from STEAM-related CL resources

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Article Info

Article history:
Received 21 November 2022
Revised 11 September 2023
Accepted 20 September 2023
Available online 30 August 2024

Keywords:
career exploration,
career learning resources,
STEAM-related CL

Abstract

This study addresses the need for innovative strategies to promote early STEAM-related CL among children. Early exposure becomes crucial as STEAM fields gain importance in today's society. Parents play a pivotal role in shaping their children's educational journeys and career aspirations, making their perspectives on STEAM CL imperative. The study aims to identify indicators for assessing STEAM career learning resource (CLR) potential and develop practical integration guidelines. A mixed-methods approach was employed, progressively refining research questions through sequential exploration. In-depth interviews with 12 parents of young children gathered insights into their views on STEAM CLR, and CL. An assessment tool evaluated the suitability of STEAM CLR, while on-site visits provided practical implementation insights. Data synthesis analyzed information related to STEAM CL, play-based learning, and experiential learning in early childhood. The study found that early exposure to STEAM CL is pivotal, with parents acknowledging its role in fostering STEAM literacy, essential skills, and career awareness in young children. The assessment tool effectively evaluated resource suitability, and on-site visits revealed challenges and opportunities in diverse educational settings, highlighting the need for adaptable approaches. The assessment and on-site insights provide practical tools and strategies for educators and policymakers to enhance early STEAM CL. Through play-based and experiential learning integration, this research lays a foundation for young learners to explore, understand, and aspire to STEAM careers. Ultimately, it advocates for a society that nurtures early STEAM literacy and career exploration, career awareness, ensuring a well-prepared workforce for the future.

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https://doi.org/10.34044/j.kjss.2024.45.3.04
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Introduction

As a revolutionary economic model for inclusive and sustainable growth, the Bio-Circular-Green Economic Model (BCG) has been proposed by the research community and supported by the Thai government. The BCG model uses technology and innovation to transform Thailand into a value-based and innovation-driven economy by leveraging the nation's biological diversity and cultural richness advantages. The model is designed to align with the Sufficiency Economy Philosophy, which is also the fundamental tenet of Thailand's social and economic growth and the UN Sustainable Development Goals (SDGs). The SDG aims to develop global citizenship that cares for three aspects: society, economy, and environment, causing the need to develop global citizens with cognitive and non-cognitive skills to cope with new challenges. A combination of knowledge, skills, attitudes and values should be successfully applied to international issues or cross-cultural situations to be considered globally competent (Korucu & Kabak, 2021). Therefore, it is a massively critical undertaking to teach the next generation of young learners the skills necessary to respond to the changing situations of the VUCA world, technology disruption (Nowacka & Rzemieniak, 2021), and global warming, which should start at early ages.

Science, technology, engineering, and mathematics (STEAM) education is learning that combines disciplines (Korucu & Kabak, 2021) so children can make links between them. STEAM education is concentrated on teaching children multidisciplinary skills for basic knowledge and skills. Thailand implemented a five-year STEAM Master Plan between 2015 and 2019 to increase the number of trained professionals to support STEAM education policies. STEAM education can be taught via CL that meets BCG's needs and connects to the real world. However, the linkage between schoolwork and the world of work has yet to be fundamentally established. Therefore, early childhood education should incorporate processes that align with the vocational skills demanded by 21st-century learning and real-world requirements (Welde et al., 2016). Applying the concept of STEAM education to integrating CL experiences at the early childhood level will help promote children's transversal skills: critical thinking, complex problem-solving skills, collaboration, and creativity (Johnson, 2000).

The STEAM-related CL expects to enable career development in early childhood. The project anticipates that STEAM-related CLs will provide career pathways and guidelines for designing CL activities and incorporate play-based learning and experiential learning to form appropriate characteristics and impart transversal skills through CL resources. STEAM-related CL will allow early childhood children to enjoy, play, and engage in hands-on experiential learning that helps them learn about and appreciate the value of careers. For these reasons, CLs should begin early with adequate knowledge and basic skills so young children can learn, enjoy, and develop positive attitudes toward work (Magnuson & Starr, 2000). Early childhood children engage in intensive academic learning, with rote memorization used to assess their performance and knowledge. The academic focus was inappropriate for early childhood development as it obstructed them from developing their imaginations. CL management allows children to think and act independently and with others, fostering play-based learning and experiential learning. When faced with problems and obstacles, children can learn through trial and error, make mistakes, and build knowledge independently.

The CLR is one of the public and private partnerships (PPP) initiatives that could educate young children towards a career by giving them tools, resources, and information about specific jobs. It is necessary to provide guidelines for further development of STEAM-related CL management for early childhood and CL activities. In the initial process of career awareness development, there are five stages critical to effective career planning: awareness, exploration, decision-making, preparation, and implementation (Magnusson, 1995). It is vital to provide relevant materials, knowledge, and practical skills that are age-appropriate and understand the constraints of early childhood development. Therefore, CL activities and CLRs should be assessed, including physical and social factors, to analyze the appropriateness in determining activities that enhance the children's learning and career development understandings. In this manner, this information would provide an appropriate guideline for STEAM-related CLRs in early childhood development. The research gap is that no study examines CLR that could foster early childhood development. The research question is: How do parents perceive CL in early childhood children? What skills will STEAM-related CL activities foster children's required skills consistent with career development theory and experiential learning theory, and how can CL be integrated into the school-based curriculum? Parents are increasingly aware of the importance of instilling these skills in their children from an early age. Parents perceive CL in early childhood as vital for their children's future success,

and this perception is supported by research that emphasizes the long-term benefits of early career exploration and skill development (Bernes et al., 2016). By recognizing the interplay between skill development and the four aspects of early childhood development—physical, social, emotional, cognitive, and language—we create a holistic and enriching learning environment. This holistic approach acknowledges that skill development is not isolated but is intricately connected to the child's overall growth and readiness for future learning adventures. Understanding these parental perceptions can inform educational strategies and policies to better prepare children for their future careers.

Following the rationale mentioned above, the specific objectives of this research were to:

1. Explore parents' perspectives towards the necessity of STEAM-related CL and extracurricular activities for early childhood children,
2. Determine eight indicators for STEAM-related CLR potential and assess STEAM-related CLR potential, and
3. Propose guidelines for STEAM-related CL with play-based learning and experiential learning approaches in and out of schools' context.

The result of this study will provide an assessment of STEAM-related CLR potential that fosters children's career awareness and reaches parents' expectations concerning CL development.

Literature Review

Theory of Career Development in early Childhood

Researchers and professionals typically define early childhood as birth to age eight. Early childhood is a period when a child's development is across all areas. Young children acquire characteristics, communication skills, and social competence. Career education for young children, including those with visual disabilities, can begin in early childhood. The age at which children start learning about foundational knowledge and skills related to career education can vary, but it typically commences in preschool, around ages 3 to 5. During this time, children are naturally curious and eager to explore their environment, learn new things, and imitate the behaviors of adults and peers. For these reasons, skill development is the fundamental developmental objective of this stage. The early childhood characteristics development must start with play since it helps children improve their thinking, intellectual, resilience, adaptability, and problem-solving skills through career education (Manowaluilou & Nilsook, 2022). Career development theory suggests that children need many career options from the very beginning to make well-informed future decisions (Porfeli & Lee, 2012; Vondracek & Kirchner, 1974) and develop children's characteristics. As Vondracek and Kirchner (1974) suggested, a career development theory in early childhood could involve mastering the transversal skill of projecting oneself into the future and imagining oneself as achieving adult status one day. As career development in early childhood, career awareness and career exploration should be addressed (Bernes et al., 2016; Manowaluilou & Nilsook, 2022; Porfeli & Lee, 2012). According to qualitative studies, a career could begin as early as early childhood (Magnuson & Starr, 2000; Watson & McMahon, 2022).

Five stages of career development are critical to effective career planning: awareness, exploration, decision-making, preparation, and implementation. Pupils at all levels should be able to develop career awareness and career exploration (Ceka & Murati, 2016). In essence, career exploration aims to help young kids explore careers through observation, learning, and hands-on experiences so they can start a CL journey (Welde et al., 2016).

Experiential Learning for early Childhood Development

Experiential learning, a robust educational approach, enhances early childhood children's comprehension, knowledge, and the development of life skills, diverse attitudes, and values within an authentic learning environment. By immersing students in real-life experiences and encouraging them to reflect on these encounters, experiential education promotes growth in four crucial aspects of early childhood development—physical, social, emotional, cognitive, as well as language. Just as experiential learning propels students to actively engage with their surroundings, it also encourages young learners to participate in their holistic development journey actively. It aligns with the idea that as children flourish across these four dimensions, parents and teachers should create a holistic and enriching learning environment where every facet of their growth is nurtured and celebrated.

Career education theory emphasizes the significance of experiential learning in the developmental journey of young children. Young learners, particularly in their early childhood years, benefit immensely from experiential learning. This approach catalyzes the cultivation of cross-cutting, transferable, and traversal skills, indispensable in

navigating today's VUCA (Volatile, Uncertain, Complex, Ambiguous) world. Furthermore, it serves as a conduit for imparting a broad spectrum of fundamental career information to children, as elucidated by Nowacka and Rzemieniak (2022). In essence, by incorporating experiential learning into career education, we offer young learners a dynamic and immersive educational experience that equips them with essential career knowledge and the practical skills and adaptable mindset needed to thrive in an ever-evolving world.

STEAM-Related Careers

The fields of science, technology, engineering, and math are collectively referred to as STEAM, which aims to foster intellectual and practical skills and an appreciation for partnerships. Why is STEAM so popular and long-lived from the 90s until today? Because STEAM answers a question that arises at the beginning of the 21st century: What will change, and how will it be in the new century? History shows that humanity has always undergone significant changes in each century, such as the industrial revolution in the 19th century, and scientific advances in the 20th century, resulting in the development of industry, economy, technology, and innovations (Bybee, 2010). Therefore, many educators believe that preparing qualified citizens must be done regardless of changes. STEAM education is to prepare people for the world of technology in a world full of volatility, uncertainty, complexity, and ambiguity (VUCA) since the 21st century is full of complex problems. Unexpected natural phenomena (e.g., earthquakes, floods, epidemics); and human advancement (e.g., new technological advances, cybercrime) call for attention to revisit children learning. To live in this VUCA world, one must be not easily startled, flexible, adaptable, capable of being a creator, and proactive. Today, learning has evolved beyond separate subjects to more flexible and practical ones, not necessarily in a classroom (Manowaluilou & Nilsook, 2002).

STEAM-related careers refer to a variety of careers a person may hold in science and related fields, such as technology, engineering, and mathematics, throughout his or her lifetime. The shortage of STEAM professionals harms economic growth in many European countries (Estonia, Latvia, Croatia, and Germany). In contrast, Asian economies have the highest proficiency levels in science and math (based on the OECD Programme for International Student Assessment, 2018) and the most effective education (Kastberg et al., 2021). Our nation's children must be prepared to contribute knowledge and skills to solve issues, acquire information, and analyze evidence to make informed decisions in an increasingly complex environment (Manowaluilou & Nilsook, 2022; Niles & Bowlsbey, 2013).

STEAM-related Learning Activities to develop Necessary Skills

In CL activities, children learn from what they observe: behavior, mindset, career goals, ambitions, transversal skills, and social competence from their parents, family, and people in their proximity community (Ceka & Murati, 2016). Use of logic and reasoning (critical thinking); active listening; written and oral presentation skills; independent work; language skills; ability to search for information; making decisions and solving problems; interacting with computers (Nowacka & Rzemieniak, 2021); and updating knowledge are cited as the most critical competencies for managing work activities, which are attributes relevant for STEAM-related learning activities.

As the demand for digital skills increases, so does the need for soft skills such as communication, teamwork, problem-solving, and self-management, which are uniquely human and more complex to automate. Learning systems must help students gain the right soft and hard skills and prepare them for a lifelong learning journey. Learning systems must catch up, ensuring everyone leaves school with solid skills to transition smoothly into work and adulthood (Watson & McMahon, 2022). Early childhood education research has primarily focused on childcare, early childhood development, play-based learning, STEAM-related CL, inquiry, and career education.

Career Learning

Career exploration and career awareness can be embedded in the early childhood curriculum. Early childhood education aims to prepare young children for learning and provide multiple career-related learning activities to stimulate emotional, social, and mental development (Manowaluilou & Nilsook, 2022; Mohamed et al., 2020). For this reason, a play-based approach uses roleplay and imitation to provide a context for CL activities (Manowaluilou & Nilsook, 2022). In this setting, children can use their imagination and have fun while learning about various careers, grow their interests through experiential and play-based learning, and solve problems related to any career (Mohamed et al., 2020; Porfeli & Lee, 2012).

CL theory helps children understand the connection between school and activities and allows the development of skills, attitudes, progression, and knowledge through a structured learning program. CL can enhance cognitive, affective, and psychomotor skills, which are essential for preparing children's foundations of work (Lidyasari et al., 2022) and preparing them to face uncertainty as proposed by the SDGs (UN, 2015).

In addition, CL alone would not adequately prepare young children to understand their professional growth trajectories and the ever-changing demands of the 21st century. With the assistance of career exploration experiences and career development opportunities, the National Strategy 2018–2037, the National Economic and Social Development Plan, and the BCG model projected a revised direction toward CL. It raises the intriguing question of how much STEAM-related CLRs for children can help them discover careers.

STEAM-related CL Resources

A STEAM-related CLR could provide optional career awareness among children and provide play-based learning activities that allow children to practice necessary skills. Independent organizations, factories, entrepreneurs, and business organizations come together to form a career community. A STEAM-related CLR was introduced nearly ten years ago in Thailand via KidZania as an opportunity for children to explore careers through various career-related activities. Children learn and play from various CL activities and some essential practice job-specific skills through CL tasks and activities.

KidZania (KZ) has developed facilities for the physical aspects of the STEAM-related CLR to encourage children's independence of thought and actions. The facility can accommodate up to 1,600–1,800 visitors at a time. The KZ entry fee for children was 150 Thai Baht (equivalent to four US dollars). In contrast, the minimum wage was 300 Thai Baht per day, which led to gaps between privileged and underprivileged children. On the one hand, accessing STEAM-related CLR is optional. Regarding the social aspect potential for CL development, a variety of CL activities on the site must meet the needs of early childhood children. Although children may not fully understand what science teachers, chemists, and engineers do for a living, they could get a better idea from CLRs. Secondly, the National Science Museum (NSM) is a government institution under the Ministry of Science and Technology established in 1995 to raise science awareness in Thai society. NSM is a lifelong learning resource in modern education, providing citizens' readiness for science and technology learning in an interactive format. People of all ages can learn, experience, and solve intriguing scientific problems. Lastly, Elephant POOPOOPAPER Park (EPP) is an eco-friendly, naturally constructed outdoor museum park. This site provides local tour guides and science learning via unique processes in producing world-famous paper goods from elephant dung fibers. The guided and interactive walking tour takes visitors through several pavilions that explain each stage of the paper production process (from collection and cleaning to product assembly) through animated visuals, educational signs, demonstrations by expert artisans, and tour guides.

STEAM-related CL Resource Assessment

The assessment of STEAM-related CLR potential is an essential foundation for CL destination management, helping related agencies and other stakeholders to allocate STEAM-related resources that are suitable for CL rationally. In the potential assessment of STEAM-related CLR, indicators must be determined to demonstrate the attributes of CL activities in each aspect. Three key elements indicate the criteria or indices applied in evaluating potential. Firstly, the area component is an important factor in attracting tourists to visit the area. This component can be determined by the characteristics of STEAM-related CLR, such as location, ease of access, environment, STEAM-related CL activities, and local participation (Singsaktrakul & Sermkarndee, 2013). The second components are safety and security, conditions of STEAM-related CL tools and equipment, and facilities. The third component is CL activities and visitor learning processes, which incorporate various CL activities, STEAM-related CL awareness, and education.

Therefore, assessing the potential of STEAM-related CLR attractions is necessary, contributing important information for CL development. It is necessary to analyze the appropriateness in determining CL activities that enhance early childhood career understandings and provide the guidelines for further development of STEAM-related CLR suitable for career development. More importantly, the potential of this STEAM-related CLR focuses on the educational impacts of early childhood CL activities. In this manner, this information would help teachers and parents plan for future career pathways and higher education.

Methodology

The research study followed a sequential exploratory approach, divided into four main phases. It employed a mixed research methodology, combining both quantitative and qualitative methods.

1. In the first phase, the research began with thoroughly examining reference documents, research publications, and academic literature. This step aimed to identify suitable career education frameworks for early childhood, particularly in the context of specific CL, parents' perspectives towards CL in early childhood children, career awareness, career exploration, play-based learning, career development stages, career-related curricular activities, fostering experiential learning, and STEAM-related CLRs. The synthesis of research articles focused on understanding how young children engage with career exploration, career awareness, and career choices.

2. The second phase involved structured interviews with 12 key informants, specifically parents with careers in STEAM fields. Data from the twelve parents' interviews regarding CL, CLRs, and STEAM-related CL were triangulated and used to create a STEAM-related CLRs' criterion assessment. These interviews were conducted using a snowball technique and a purposive sampling method (criteria such as occupation, age of children, geographic location, years of experience in STEAM and parental involvement). The structured interview questions were designed to gather insights into their perspectives on CL in early childhood, STEAM-related CL activities, and STEAM-related CLRs.

3. In the third phase, the research team developed assessment tools, which comprised of two dimensions: STEAM-related CL, with eight STEAM-related careers resources indicators, and assessment of STEAM-related CLRs for STEAM education development containing five indicators. A specific assessment tool for STEAM-related CLRs was created to measure three key aspects of STEAM-related CL. The appropriateness of each indicator item in the assessment tool was evaluated using the Delphi method.

4. The fourth phase adopted an exploratory sequential design and a situation analysis was conducted to assess the suitability of STEAM-related CLRs for STEAM-related CL. This on-site evaluation involved an on-site survey conducted by three investigators, including researchers and representatives from local government agencies. The survey aimed to evaluate STEAM-related CL activities and their potential effectiveness using the indicators developed in the previous phases, ultimately confirming the results.

Participants

In the initial stage, twelve parents were invited to participate in the research. Eligibility criteria for parents included having a profession in a STEAM-related field and having children between the ages of two and eight who had engaged with various public and private organizations and enterprises, including NSM, KZ, and EPP, to explore CLRs and STEAM-related CL. The chosen sampling technique employed was stratified sampling, which encompasses dividing the population into separate subgroups (strata) based on specific attributes, followed by selecting samples from each of these subgroups.

In the subsequent phase following the development of the CLRs assessment tool, the search commenced for CLRs suitable for young children. During this process, three CLRs, well-known among parents of preschoolers for their hands-on STEAM-related activities, were investigated. These establishments encompass KZ, a privately operated facility in Bangkok; NSM, a government-funded institution in Pathum Thani province; and EPP, another privately owned establishment in Chiang Mai province.

Research Tools

A potential assessment tool based on tourism components (5As) and STEAM-related CL was created to assess the potential for STEAM-related CLR. Content validity and reliability of research tools were assessed through a review by three experts, ensuring the quality and consistency of the instrument. With experts' views, the Delphi technique is used to determine the content validity and reliability of an assessment form.

The research tool is shaped by its ability to attract users, its accessibility to a broad audience, its accommodation of diverse needs, and the interactive activities it facilitates, all of which are essential aspects in the conceptualization of a research tool. A well-designed research tool that excels in these dimensions is more likely to yield high-quality data and enhance the research process. Weighted scoring means that different response options carry different numerical values or weights. For example, "Strongly Agree" might be assigned a higher weight (e.g., 5), while "Strongly Disagree" could have a lower weight (e.g., 1). This allows for a more nuanced assessment of respondents' opinions. The questionnaire consisted of three sections regarding STEAM-related CL: General potential (attractions, accessibility, accommodation, and activities), comprised of 11 items, potential for STEAM-related career awareness in

early childhood, comprised of eight items, and STEAM education development, comprised of five items. In addition, structured interview approaches were conducted with key informants regarding STEAM-related CL activities and their attitudes and perceptions toward future CL.

Data Collection

We synthesized research studies and developed assessment criteria for STEAM-related CLR in two dimensions: STEAM-related CL and CLR potential.

We gathered insights into parents' perspectives on early childhood CL development and the importance of CL through one-on-one in-depth interviews, which last approximately 15–20 minutes.

To create indicators for evaluating the potential for STEAM-related CL in early childhood, we collected, reviewed, and analysed secondary data from various sources, including documents, research studies, books, websites, and online media.

By visiting each site, the three STEAM-related CLR were assessed based on factors such as career prominence, diversity, tool and equipment availability, uniqueness, career communication potential, educational value, potential for organizing CL activities, accessibility, safety, collaboration potential with public and private sectors, and relevance to STEAM-related careers.

An on-site survey was conducted to gather additional information on STEAM-related career awareness, exploration, and CL activities. The duration of each site visit was one to one and a half hour.

This process allowed us to evaluate STEAM-related CLR for early childhood education comprehensively.

Data Analysis

A content analysis was used to synthesize STEAM-related career activities, experiential learning, and play-based learning through CL activities and to develop a STEAM-related career LR criteria assessment tool. The information acquired from in-depth interviews was analyzed using content analysis to identify the parents' perceptions of STEAM-related CL development to determine the potential indicators for STEAM-related CL development and propose an integration of STEAM-related CL in early childhood.

For assessing the potential for STEAM-related CLR, an assessment was constructed and assessed using the Delphi method as a forecasting technique based on the consensus of a panel of early childhood experts. Each indicator assesses the potential of each CL development of each facility and CL activities and proposed STEAM-related CL activities for early childhood. The potential of each CLR was calculated using a Weighting Score Equation (WSE) to determine the potential scores from 0–5. The more points earned, the better. The details of the assessment for the potential for STEAM-related CLR using WSE are as shown in Equation (1) below.

$$\text{The potential score of STEAM-related CLR} = \frac{W1R1 + W2R2 + W3R3 + \ldots\ldots WnRn}{W1 + W2 + W3 + \ldots\ldots\ldots Wn} \quad (1)$$

R1...Rn = Potential score value for each indicator, rated from 0 (no potential) to 5 (very high potential)

W1..Wn = Priority value or the importance of each indicator from 1 (low importance) to 3 (very important).

The potential score values were divided into five levels as follows: A potential score of 0.00–0.99 indicates very low potential for CL, a potential score of 1.00–1.99 indicates low potential for CL, a potential score of 2.00–2.99 indicates moderate potential for CL, a potential score of 3.00–3.99 indicates high potential for CL, and a potential score of 4.01–5.00 indicates very high potential for CL.

Investigating different CLRs could give information on STEAM-related career development. The STEAM-related CLRs had to provide knowledge about STEAM education applicable to STEAM-related careers, provide hands-on experience, and include any play-based learning activities. Each STEAM-related CLR was assessed using a STEAM-related CLR assessment tool. Later, each STEAM-related career LR was visited.

Results

The synthesis of research articles revealed that STEAM-related CLRs could develop early childhood children's CL through experiential learning and play-based learning activities provided by LR that provide career knowledge and exploration and would be a source of STEAM-related CL.

The STEAM-related CL Perspectives

According to in-depth interviews, parents indicated that schoolteachers did not have adequate occupational knowledge. Therefore, parents and guardians preferred supportive ways to assist young children in learning extracurricular activities, transferable skills, and real-world experiences beyond the knowledge taught in the classroom.

The understanding of various occupations found that they wanted their children to be doctors, nurses, or government officials. However, preparing children to learn and adjust quickly is necessary. For the understanding of careers, parents have high expectations of their future children's careers, such as doctors, nurses, or government officials. Moreover, two parents stated that "*some transferable and transversal skills were not taught well in the classroom*," which makes them concerned about preparing young children for the future.

The results of the interviews with parents led to the conclusion that teaching STEAM-related CL must focus on four factors: the child's interest, aptitude, personality, and career appreciation. Providing children with the opportunity to explore as many careers and career-related activities as possible could assist them in discovering what interests them. Additionally, the early development stage must consider the variety of STEAM-related CL activities the teachers can arrange.

Based on Table 1, it is evident that parents' perspectives regarding the importance of STEAM-related CL and extracurricular activities significantly influence early childhood children's development and career exploration. Parents play a pivotal role as influential factors that could impact children's choices toward STEAM CL, shaping the trajectory of their career development and, consequently, influencing the CLRs that parents provide for their children. Four aspects emerged from analyzing the parents' interview data, as follows.

1. CL Interests: A child is often interested in many things at the same time, and they never stop being interested in other things. However, they may have yet to connect or have not had people or situations to motivate them to try and be curious. A child's attention should be kept as a minor issue, not abandoned, but not taken as an essential point.

2. Ability: Parents require clarification regarding the distinction between interest and ability. Occasionally, a child may be interested in art but have room for improvement. Therefore, children should connect with STEAM-related CL activities to explore which fields they are interested in, such as the mechanical field, and learn additional math or physics instruction.

3. Personality: Parents would understand a child's personality, how the children were raised, and the environment they were in that shaped their personalities and interests. Therefore, a family influences children's decision.

4. Career appreciation: Career appreciation is a concern because parents tend to choose careers based on their interests rather than their children. For instance, parents' beliefs in certain professions and incomes influence children's future career pathways.

Assessment of STEAM-related CLR Potential

Assessing STEAM-related CLR potential is necessary and vital for shaping children's career awareness in their early years (Manowaluilou & Nilsook, 2022). It is a fundamental step in ensuring children are exposed to meaningful and enriching leg experiences that contribute to their career development. By carefully evaluating the attributes and characteristics of CLRs, we can provide children with valuable opportunities to explore their career interests and talents. The insights gained from parents' interviews have been instrumental in shaping our criteria for assessing STEAM CLRs.

Table 1 Parents' perspectives of STEAM-related CL in early childhood

Parent's perspectives	STEAM-related CL Categories			
	CL Interest & Experiences	Connected with STEAM-related CL activities	Personality	Support appropriate CL
N	10	8	7	7
Examples	Parent A *"Children can play using careers as a means that could inspire children. It's a win-win situation."*	Parent B *"Since schools are quite academic-oriented, I would take my child to go to all kinds of learning activities"* Parent C *"All difficult subjects like physics and electrical engineering can be taught using tools. I think children can learn to use them and gain further understanding of what they are learning."*	Parent D *"I know a man pursuing civil engineering, but he wanted to quit the final year because he was unhappy with his studies. He struggled with it, and his mom did not understand him... He told me that he was an extrovert and enjoyed talking to other people, so engineering might not suit his personality."*	Parent E *"Schools should have CL tools."*

Note: N represents the frequency parents discussed each category.

These criteria reflect parents' aspirations for their children's STEAM journeys and align with the broader goal of making high-quality CLRs accessible to all children, with public and private sector support.

As we move forward, it is essential to recognize the unique attributes of STEAM-related CLRs that make the world of science, technology, engineering, arts, and mathematics come alive for young minds. These CLRs help children uncover the hidden wonders of these fields and inspire them to connect with specific career paths. By prioritizing the development and evaluation of STEAM-related CLRs, we can empower our children to discover their passions, hone their skills, and embark on a journey of early career exploration that will shape their future endeavors. The collaboration between educators, parents, and CLR providers is the key to ensuring that every child receives the best possible foundation for their future careers.

According to Table 2, the assessment of STEAM-related CLR's potential for career exploration in early childhood shows that KZ has the highest potential (with 4.95 potential level points) to develop children's career awareness, career exploration, career-value learning, and adequate CL tools.

According to Table 3, STEAM-related CLRs provided CL associated with STEAM education, including KZ, NSM, and EPP. Using the STEAM-related CLRs assessment, we found that KZ was highly appropriate (with 3.5 potential level points) for CL as it supported career awareness and career exploration for early childhood to elementary children.

Propose Guidelines for STEAM-related CL in Early Childhood Children

Figure 1 proposes career linkage guidelines for STEAM-related CL through integrating STEAM-related CLRs to foster experiential learning, career awareness, and career exploration. CLRs could be any PPP (i.e., organizations, schools, childcare) to support CL in early childhood. STEAM-related CLRs are STEAM-related tools and equipment and STEAM-related understandings of careers. STEAM-related CL activities are an excellent way to promote and develop transversal and transferable skills among young children.

Table 2 Results of the assessment of STEAM-related career resources potential for career exploration in early childhood

Indicators	Weight	EPP	NSM	KZ
1. Careers' specific skills	3	4	2	5
2. Career variety for students to explore	2	1	2	5
3. Quality of CL tools	1	4	5	5
4. Facility identity	3	5	5	5
5. Attractiveness of the facility	2	5	4	5
6. Career interpretation quality	3	4	5	5
7. Appropriateness learning conditions for learning	2	2	5	5
8. Career-value learning	2	5	5	5
Total (weighted value x Score) $(W_1R_1 + W_2R_2 + W_3R_3 + \ldots\ldots W_{10}R_{10})$	❶	78	83	99
Total weighted value $(W_1 + W_2 + W_3 + \ldots\ldots\ldots W_{10})$	❷	20	20	20
Potential Level Points	❶/❷	3.9	4.15	4.95
Potential level		High	High	Highest

Table 3 An assessment of STEAM-related CLRs for STEAM education development

Indicators	Weight	EPP	NSM	KZ
1. Variety of CL activities	2	1	1	5
2. Ease of access	2	5	5	2
3. Safety of CL activities	2	5	5	5
4. Potential to develop CL resources from public and private sectors	3	3	5	3
5. Careers related to STEAM Education	3	2	3	3
Total (weighted value x Score) $(W_1R_1 + W_2R_2 + W_3R_3 + \ldots\ldots W_{10}R_{10})$	❶	37	46	42
Total weighted value $(W_1 + W_2 + W_3 + \ldots\ldots\ldots W_{10})$	❷	12	12	12
Potential Level Points	❶/❷	3.08	3.83	3.5
Potential level		Moderate	High	High

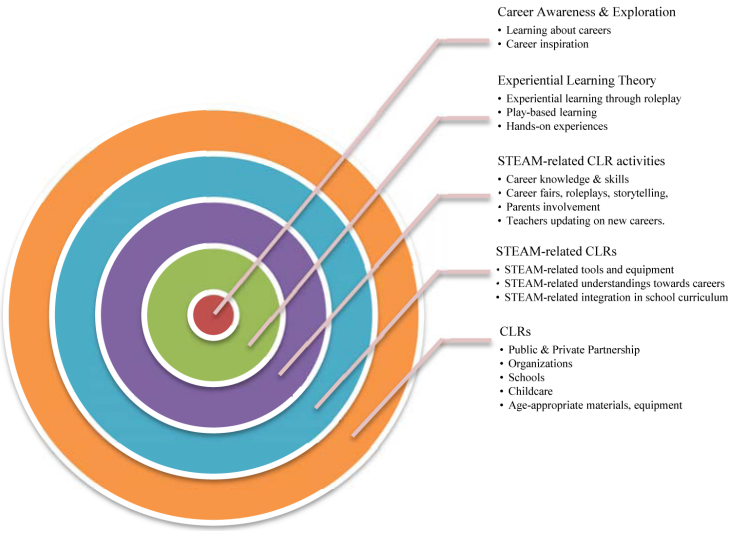

Figure 1 A proposed STEAM-CL model to foster experiential learning, career awareness, and career exploration

CL objectives should focus on career awareness and exploration rather than students' academic success. STEAM-related CL activities for preschoolers should concentrate on practicing transversal and transferable skills through experiential learning, teaching preschoolers to be focused, persistent, and have grit and a positive attitude toward friends, along with practicing fine motor skills and emotional intelligence. Preschool teachers encourage young children to participate in roleplay, dialog, parental involvement, and career exploration. A corner of STEAM-related CL tools, age-appropriate materials, and equipment should be provided for young children to experiment and learn some skills.

Discussion

Parents' perspectives regarding the importance of STEAM-related CL and extracurricular activities for early childhood children play a pivotal role in shaping children's educational journey. These perspectives are instrumental in guiding parents' decisions when selecting their children's CL activities and engagement opportunities. By understanding their children's interests and preferences and considering their own aspirations for their offspring, parents can make informed choices about the types of activities that align with their children's aptitudes and inclinations. This thoughtful selection process helps children explore their STEAM-related career interests and assists parents in providing the necessary career skills and opportunities at crucial developmental stages. Ultimately, it fosters a collaborative and supportive environment that empowers early childhood children to embark on a learning, discovery, and skill acquisition path tailored to their unique interests and future career aspirations.

The discussion on parents' perspectives of STEAM-related CLRs in early childhood education is crucial in understanding the impact of CLRs on young learners. Parents' perspectives vary significantly based on their background information, including their education, cultural beliefs, and socio-economic status. For example, parents with a strong STEAM background may place greater importance on choosing particular STEAM-related CLRs, believing they provide a strong foundation for future academic success. Conversely, parents with limited exposure to STEAM fields may have reservations or need more familiarity with the benefits of STEAM-related CLRs.

In essence, the constraints to STEAM-related career education include limited resources, inadequate teacher training, rigid curricula, equity and access issues, and societal perceptions, despite literature indicating that STEM and STEAM education can lead to desirable career outcomes and fulfilling life in the 21st century (Bybee, 2010). Therefore, it is essential to connect, integrate, educate for career exploration and career awareness, and apply knowledge in the real world, which corresponds to the objective of STEAM education. However, STEAM-related career education has yet to be integrated into the mainstream curriculum, which hinders the proper development and understanding of career development when growing up. In this matter, STEAM-related career education curricula must be offered differently and designed appropriately and harmoniously with early childhood children's development.

Career aspiration can show a person's sense of self, hope for the future, and belief in their abilities, all of which are important. Career awareness and exploration resulted from the CL process involving play-based learning experiences, roleplays, and CL representations. Some STEAM-related CLs could be integrated into the existing curricula, whereas CLRs could provide CL activities. Young children develop necessary skills through CL inspired career guidance and embrace STEAM-related CL activities in the classroom. The data promoted educators to be aware of children's interests (e.g., nature-based, social-oriented distribution, and economy-driven), which guides curricula to focus on a person's interests.

The results confirmed that young children demonstrated STEAM-related career understanding, posited dispositional skills, and achieved some transversal skills. While early childhood children learn and practice job-specific skills, they logically solve complex problems. We argued that career knowledge should be mapped in preschool, and appropriate STEAM-related career information should be designed (Brolin, 1995). Additionally, the early childhood development stage must consider the variety of CL activities, the CL integration process, career interests, children's personalities, career appreciation, and CL objectives.

Additionally, the CLR can be assumed to support STEAM-related CL, transversal skills, and practices via various STEAM-related CL activities. According to the list of CLR assessment tools developed, it must be determined where CLRs were best addressed within the integrated STEAM-related career education curricula. The STEAM-related CLRs assessment tool could also assist parents and teachers in determining which STEAM-related CLRs promote CL and aspire to early children's career interests. When children enter higher education, they will become more interested in STEAM-related fields of study.

Various CL activities can be considered necessary for early childhood development since they could gain a better understanding of careers. However, local governments, public and private sectors, businesses, and schools could organize STEAM-related career fairs, display career tools, and equipment, and encourage children's exploration and experimentation. Teachers examine the knowledge and skill statements (i.e., the foundation standards, performance elements, and transversal and transferable skills) for CL activities (Magnuson & Starr, 2000).

The integrated CL curriculum would lead to STEAM integration practices. Nevertheless, preschool teachers often need to understand their career teaching roles, provide play-based CL activities and need updates on career information so that they can inform appropriate transversal skills in early childhood children. Moreover, underprivileged, hill tribe, interim, minority, and disabled children cannot participate in STEAM-related CL activities outside school. Unfavorable economic conditions obstruct children's participation in extracurricular activities, especially CL (Maftei et al., 2023). The development of school-based STEAM-related CL activities should be promoted in schools so that all children can access STEAM-related CL activities. As a result, proper STEAM-related CL activities would encourage young children to understand the professions, practice various career-specific skills, and adequately understand STEAM-related careers.

Conclusion and Recommendation

The study aimed to determine the impact of career exploration derived from using STEAM-related CLRs in early childhood. The procedures included synthesizing research articles and documents and designing questions regarding career awareness, experiential learning activities, play-based learning, and career development. Data from the twelve parents' interviews regarding CL, CLRs, and STEAM-related CL were triangulated and used to create a STEAM-related CLRs' criterion assessment. Three STEAM-related CLRs (i.e., KZ, NSM, and EPP) were assessed and determined the appropriateness of career awareness towards STEAM-related careers, career awareness, career knowledge, and information. However, KZ has the highest potential for STEAM-related CL with various CL hands-on activities, whereas NSM has the highest potential to promote science and technology education. The recommendation for further study is to study how social mechanisms, government agencies, and private sectors can collaboratively work to develop early childhood children into quality human capital in the future.

Given that the data were collected from small groups, it is essential to acknowledge potential limitations in generalizing the findings. Expanding the research to a more extensive and diverse target group could yield different results. A larger sample size might capture a broader range of perspectives, allowing for a more comprehensive understanding of how parents from various backgrounds perceive STEAM-related CLRs. Additionally, it could reveal additional factors influencing parents' perspectives that needed to be more evident in the initial smaller sample. Therefore, conducting research with a broader participant pool may provide a more robust and nuanced insight into this critical topic.

Conflict of Interest

The authors declare that there is no conflict of interest.

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