

White paper

Learning through play at school

**A study of playful integrated pedagogies that foster children's
holistic skills development in the primary school classroom**



Rachel Parker and Bo Stjerne Thomsen

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Abbreviations

ACER	Australian Council for Educational Research
AP	Advanced Placement
CLAD	Collaborative Learning Assessment through Dialogue
CRC	Convention on the Rights of the Child
IB	International Baccalaureate
IT	Information Technology
PIRLS	Progress in International Reading Literacy Study
PISA	Programme for International Student Assessment
SDG	Sustainable Development Goals
SES	Socioeconomic Status
TIMSS	Trends in International Mathematics and Science Study
UK	United Kingdom
UN	United Nations
US	United States
VEYLDF	Victorian Early Years Learning and Development Framework

Executive summary

Background and rationale

This scoping study seeks to understand the role and impact of learning through play at school. Over the past five years, the LEGO Foundation and partners have examined the body of literature on learning through play and concluded that play is educational when it is joyful, meaningful, actively engaging, iterative, and socially interactive (Zosh et al., 2017). The LEGO Foundation takes a holistic view that learning comprises the full breadth of skills including cognitive, social, emotional, creative, and physical. These redefinitions of play and learning provide the frameworks for this study.

The evidence supporting learning through play's positive impact on child development is strong. Yet many education systems have reduced opportunities for playful learning and increased emphasis on didactic and structured approaches to learning for school readiness and achievement (Jay & Knaus, 2018). This recalibration is needless, as experts have established that

learning through play supports the development of early literacy and numeracy skills in an integrated approach, while also cultivating children's social, emotional, physical, and creative skills

(Marbina, Church & Tayler, 2011)

In the United States, England, and Australia, the prescribed curricula of formal schooling are being 'pushed down' into early learning contexts in place of play.

At the same time, a number of Southeast and East Asian education systems are seeking more child-centred pedagogic practices to foster holistic learning. They are expanding learning outcomes to include social, emotional, physical and higher order thinking skills, and recognising that holistic learning requires

integrative pedagogies such as project-based or inquiry-based learning (Cheng, Lam & Chan, 2008; Zhao, 2015). Global mandates regarding education quality such as the Sustainable Development Goals also reflect this thinking; that education quality is a broad notion involving the knowledge and skills for sustainable development and global citizenship (United Nations, 2016). As global standards and outcomes for learning increase to include holistic and transversal skills, curricula are becoming more crowded, and teachers' roles ever more demanding (Darling-Hammond, 2006). Systems need to adopt integrated pedagogic approaches as a more effective and efficient way to foster both holistic skills and content knowledge. Integrated approaches to teaching and learning are those that combine different levels of teacher and child-directedness, and value the development of a breadth of skills and knowledge, such as learning through play.

This study seeks to locate the role of play in education. If not play, then what? We distinguish the pedagogies that are the 'older siblings' of learning through play, arising from the same constructivist learning theories, and plot them against the key characteristics associated with learning through play as joyful, meaningful, actively engaging, iterative, and socially interactive (Zosh et al., 2017).

We identified eight pedagogical approaches, which we collectively term 'integrated', for the evidence of how they combine child-directed, teacher-guided, and teacher-directed learning and align with the characteristics of playful learning experiences. They were also selected based on the breadth and depth of available evidence regarding their effectiveness as strategies for educating children in primary school across a range of learning outcomes.

This study maps the territory of these integrated pedagogies. It defines and describes them, offers evidence of their impact, and presents the factors that make them work. It details the broader education system factors that underpin pedagogy and its relation

to curricula, teacher education and professional development, learners, parents and caregivers, and communities. It concludes with directions for future research.

Study design and method

This research uses a scoping study method to answer a broad, yet critical question, which included two main dimensions:

How has learning through play been applied in formal schooling, and what has been the impact on children's holistic skills?

We viewed the research question through the lens of the LEGO Foundation's established frameworks for learning through play and holistic skills. These provided us with the basis to organise and analyse evidence about pedagogies and outcomes. The LEGO Foundation, in partnership with experts from Penn State University, Temple University, University of Cambridge, and Harvard University, identified five essential characteristics of playful learning, namely joy, meaning, active engagement, social interaction, and iteration (Zosh et al., 2017). Further, the LEGO Foundation (2017) defines skills for holistic child development as encompassing emotional, social, cognitive, physical, and creative skills.

This framing underpins what we mean by learning through play, and what we mean by children's holistic skills in this study. A broad range of literature was reviewed against this framework with the applicable age range defined as 6–12 years. This range extended our focus beyond the early years to include the middle and upper primary years. As such, we examined the approaches used in these years to determine which of those bore similarities to learning through play. Restricting the focus to only the 'learning through play' pedagogy would have constrained this evidence review to the early years (ages 0–8). We found that uptake of learning through play was limited in formal primary school learning contexts, especially beyond the

Foundation/Preparatory year. This is largely because:

- Play and learning are often viewed as dichotomous constructs (Pyle & Danniels, 2017);
- Learning through play is generally associated with preschool (Jay & Knaus, 2018; Smith, 2015); and,
- Learning through play is often viewed as purely child-directed and unstructured (Smith, 2015).

This study seeks to bridge these dichotomies and extend understanding of playful learning beyond the early years. The search was guided by prior analysis of pedagogical approaches that were expected to be highly relevant to learning through play, including approaches such as active learning, collaborative and cooperative learning, experiential learning, guided discovery learning, inquiry-based learning, problem-based learning, project-based learning, and Montessori education. The study examined evidence about each approach's impact on children's holistic skills, and to what degree each approach included the five characteristics of learning through play.

Findings – Integrated pedagogies can be playful and highly effective

This study confirmed the hypothesis that the pedagogies examined in the study are highly relevant to learning through play, as defined by the LEGO Foundation. Further, learning through integrated pedagogies, namely active learning, collaborative and cooperative learning, experiential learning, guided discovery learning, inquiry-based learning, problem-based learning, project-based learning, and Montessori education, can positively affect student learning across social, emotional, physical, creative, and cognitive domains. We find that these pedagogies can altogether create learning experiences for children that are meaningful, actively engaging, iterative, socially interactive and joyful (LEGO Foundation, 2017). To build upon learner gains made in the early years through play-based pedagogies, educators can consider employing integrated pedagogies. This study also explores and presents a range of factors that underpin effectiveness.

In summary:

1. Active learning connotes cognitive, emotional, or behavioural activity, and leverages choice to foster student engagement.

- Impact: Includes fostering cognitive, social, and emotional development among primary school-aged learners.
- Success factors: Include collaborative professional learning, time and space for planning and implementation, and whole school support.

2. Cooperative and collaborative learning are approaches designed to maximise positive peer interactions through thoughtfully structured group or peer work.

- Impact: Includes a range of student learning outcomes including reading, maths, communication and self-efficacy.
- Success factors: Success largely depends on using cooperative learning strategies that make peer learning positively interdependent such as communicating feedback and group reflection.

3. Experiential learning was founded on the notion that quality experiences within and beyond the classroom promote meaningful learning.

- Impact: Includes mathematics, science, and writing learning outcomes, positive teacher and peer interactions, and increased learner engagement, motivation and self-efficacy.
- Success factors: Include appropriateness of experiences, teacher skills and knowledge, planning, and assessment design.

4. Guided discovery learning is to 'expect and be prepared to discover knowledge' (Bruner, 1961) with the support and scaffolding of a teacher.

- Impact: 'Guided discovery learning' over 'pure' discovery learning was found to be a more effective approach to generating positive learning outcomes for children, particularly for fostering durable science learning, mathematics and thinking skills.

- Success factors: Guided discovery learning does not involve leaving children to learn key concepts unassisted. As implied, teacher guidance is a critical success factor – teachers must make informed judgements about the type, quality and quantity of guidance required to achieve specific learning outcomes.

5. Inquiry-based learning involves interdisciplinary learning, organising a unit of work around relevant, authentic, open-ended questions, and is promoted by organisations such as International Baccalaureate.

- Impact: Scientific skills and concepts, mathematics learning, and strong learner engagement and motivation, establishing a positive inclination for lifelong learning.
- Success factors: As with discovery learning, the amount and type of guidance is key.

6. Problem-based learning involves structuring an integrative learning unit around a problem. As with inquiry and project-based learning, the central question, problem, or project, and its richness as a vehicle to explore concepts and generate new investigative threads, is key.

- Impact: It has been found to positively support student learning in mathematical problem solving and science learning, but must also include explicit teaching of problem-solving strategies, if this is also the intended outcome for learning.
- Success factors: Successful implementation depends on providing structure, guidance, and teachers' knowledge and skills regarding problem-based learning instructional design and assessment.

7. Project-based learning considers the project as the vehicle for delivering the curricula.

- Impact: Has been found to foster a range of learning outcomes related to knowledge, skills, motivation and self-efficacy regarding science, and information literacy skills.
- Success factors: Success is contingent on a supportive implementation context including having time and resources to administer, plan and manage classroom projects, and teachers' time, training, skills, and knowledge to implement this approach.

8. Montessori education is characterised by hands-on experiential learning, group and pair work, self-directed learning with teacher guidance, and lack of competition and extrinsic rewards or punishments.

- **Impact:** Despite its longevity, Montessori education has only been subject to a small number of high quality efficacy studies. Those reviewed here found it effective in generating positive outcomes related to all five domains of cognitive, social, emotional, physical, and creative skills. This does not suggest that Montessori is more effective than other approaches, rather, that the studies reviewed measured a broader range of skills.
- **Success factors:** Montessori is more effective when delivery adheres to the core Montessori principles.

A model for learning through play at school

By mapping integrated pedagogies onto the five characteristics of learning through play, we extended and augmented the descriptions of these characteristics to apply to the primary school learning context. Previous LEGO Foundation research (LEGO Foundation, 2017; Zosh et al., 2017) includes descriptors for these characteristics drawing largely upon research regarding learning through play and the early years. Here, we have consolidated research regarding integrated pedagogies to create descriptors relating to education contexts for children aged 6-12 years. We conclude that effective integrated pedagogies are:

Meaningful, when they integrate learners' experiences and knowledge from home and school. This gives a voice to learners' experiences and backgrounds and makes learning meaningful and culturally relevant to them. Integrated approaches are meaningful when they are designed to include relevant and engaging tasks, inquiry questions, problems or projects; that is, those that are self-sustaining and provocative, compelling learners to find out more. Integrated pedagogies are designed to include processes that enhance meaning, such as group reflection on learning, and scaffolding – guiding learners from what is known to what is unknown; from the concrete to the abstract.

Socially interactive, when they involve learners working together in groups, using strategies that have been designed to maximise the benefit of cooperative learning. When learning occurs in new and different settings and contexts, for example outdoors, on a field trip, or in a group around an activity or experiment, it can expand social networks and dissolve barriers between individuals and groups that are sometimes created in traditional classroom settings. These opportunities foster learners' interpersonal, communication, and social skills.

Actively engaging, when learners have choices – big or small – to make about the content or processes involved in their learning. Active engagement occurs when learners can rely on and support other learners. It occurs when teachers guide learners to formulate understandings and develop new skills through prompting and questioning rather than solely through explicit instruction. Active engagement comprises the three dimensions of feelings about learning (affective), conduct and actions towards learning (behavioural) and thinking and processing about and within the learning context (cognitive). The most effective integrated pedagogies attend to all three dimensions. Engaged learners demonstrate motivation and commitment towards their learning, often extending themselves beyond set goals and expectations.

Iterative, when learners have the opportunity to explore and investigate new concepts; to try, and fail, and try again. When learners share their ideas with each other and revise and recalibrate their thinking based on the inputs of the group, learners' abilities are extended and transformed. Teachers encourage iteration through guiding learners with targeted, encouraging questions, hints, and modelling.

Joyful, when learners have positive peer and teacher interactions and positive learning experiences. This is characterised by having and making choices, experiencing learning in a range of settings, personally relating to the content of their learning, and feeling able and confident about their learning.

An audit of skills for holistic child development

This study aimed to identify the impact of learning through play on children's holistic skills, that is, the development of cognitive, social, emotional, physical and creative skills. We examined and categorised studies regarding the impact of eight pedagogies that resemble learning through play used in primary school. Combined, the studies reviewed measured a greater number and type of cognitive learning outcomes such as mathematics, science and literacy achievement, over non-cognitive learning outcomes such as self-regulation, engagement, motivation, social, and interpersonal skills (see Table 1: Breadth of skills measured by research included in this study).

We suggest that the bias towards cognitive skills assessment and reporting is based on the security of tools and evidence as a more established field of assessment. Moreover, researchers of integrated pedagogies sought to rationalise their value on grounds related to cognitive achievement.

If emotional, social, creative, and physical skills are of equal value to cognitive skills, they must feature prominently in programming and assessment.

High quality assessment tools and rubrics must be available for systems to use to measure and report on the impact of learning programs on these domains. We propose further research is required to progress and strengthen these areas.

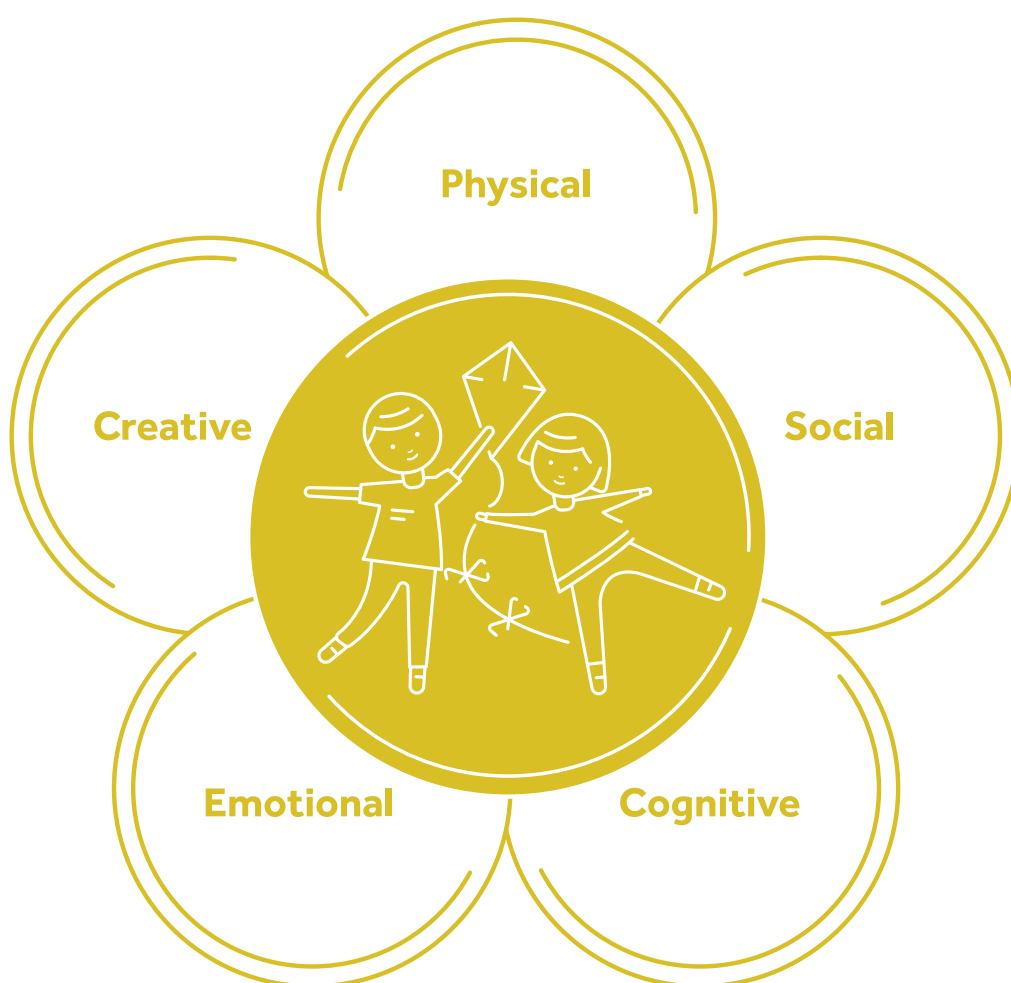


Table 1: Breadth of skills measured by research included in this study

Skill domain from What we mean by learning through play (LEGO Foundation, 2017)	Outcome as described in the literature reviewed	Integrated pedagogy as described in the literature reviewed
Cognitive skills	Cognitive achievement, Computer skills, Conceptual understanding, Conflict resolution, Decision making, Engineering concepts and skills, Essay writing, Explaining representations, Higher order thinking skills, Inductive and deductive reasoning, Interpreting, Knowledge transfer, Mathematics concepts and skills, Mathematics reasoning strategies, Metacognition, Negotiating skills, Planning skills, Problem solving skills, Reading comprehension, Reasoning strategies, Recall skills, Referential communication, Science concepts and skills, Study skills, Theory of mind, Thinking skills	Active learning Collaborative inquiry-based learning Collaborative learning Cooperative learning Guided discovery learning Inquiry-based learning Montessori education Peer tutoring Problem-based active learning Problem-based learning Project-based collaborative learning Scaffolding Socio-constructivist
Creative skills	Creativity, Divergent thinking, Inventiveness	Collaborative learning Montessori education
Emotional skills	Confidence, Emotional skills, Engagement, Enjoyment of learning, Executive function, Learner wellbeing, Listening skills, Motivation, Positive classroom behaviour, Science self-efficacy, Self-efficacy, Self-regulation	Active learning Collaborative active learning Cooperative learning Experiential learning Guided discovery learning Inquiry-based learning Montessori education Problem-based learning
Physical skills	Fine motor, gross motor	Active learning Guided discovery learning Montessori education
Social skills	Collaboration, Communication skills, Interpersonal skills, Negotiating skills, Positive peer play, Social connections, Social regulation, Social skills, Verbal/social skills	Active learning Cooperative learning Experiential learning Guided discovery learning Inquiry-based learning Montessori education

Integrated pedagogies and learner agency

This study uses the term 'integrated pedagogies' to connote the similarities between learning through play and the eight pedagogies reviewed in this study. Integrated approaches are those that combine child-directed learning, teacher-guided learning, and teacher-directed learning, a balance which results in the best learning outcomes for children (Marbina, Church & Tayler, 2011). 'Integrated teaching and learning' is also used to describe a focus on fostering a breadth of skills and knowledge including children's 'intellectual, physical, social, and creative abilities' (Department of Education and Training, 2016, p. 14). These concepts recurred in literature regarding the eight pedagogies described here, that;

- Learning goals for integrated pedagogies incorporated a range of skills and knowledge (see Table 1: Breadth of skills measured by research included in this study).
- Teachers successfully delivered integrated approaches using a combination of teacher-directed, student-led and teacher-guided learning (see Table 2: Implementation quality factors for integrated pedagogies).

The model for learning through play at school featured student agency as a way to actively engage with and draw meaning from learning. After reviewing evidence on the notion of learner choice within integrated pedagogy discourse, we concluded that effective approaches leveraged the benefits of student choice and voice for learning in the following ways:

- Learners made authentic and genuine choices (Fullan & Langworthy, 2014; Hixson, Ravitz, & Whisman, 2012; Verner & Lay, 2010, p. 68, as cited in Simmons et al., 2011)
- Learners asked teachers questions and offered opinions (Smith, 2015)
- There was high learner interaction, often through collaborative learning (Fitch & Hulgín, 2008)
- Learners had freedom of movement to seek resources and advice from teachers or peers (Smith, 2015)

- Learners and teachers allowed time for and overcame false starts and 'failures' when task choices needed revisiting or groups were reformed (Tan & Chapman, 2016)
- Authentic and genuine choices about what and how to learn were offered in combination with other instructional strategies (Tan & Chapman, 2016)
- Teachers guided and supported learners to make decisions about topics and working group membership (Smith, 2015)
- Teachers offered some degree of learner choice and voice around carefully planned, managed and assessed rigorous tasks (Hixson, Ravitz, & Whisman, 2012)
- Choice making was treated as a skill learned gradually and exponentially (Fullan & Langworthy, 2014).

Implementation quality factors

This study finds that learning via integrated pedagogies can positively impact learner's cognitive, social, emotional, creative, and physical skills and development. A wide range of factors underpinned the success of these pedagogies. We collated and organised these factors as 'implementation quality factors'.

It is vital that implementation quality factors are acknowledged and understood when implementing integrated pedagogies if we want to replicate positive results

Implementation quality factors regarding integrated pedagogies overlapped significantly. We collated the evidence and produced a summary of key effectiveness statements aligned to themes such as the design of the approach, delivery process, curricula and assessment, teachers, learners, schools and communities in Table 2: Implementation quality factors for integrated pedagogies.

Table 2: Implementation quality factors for integrated pedagogies

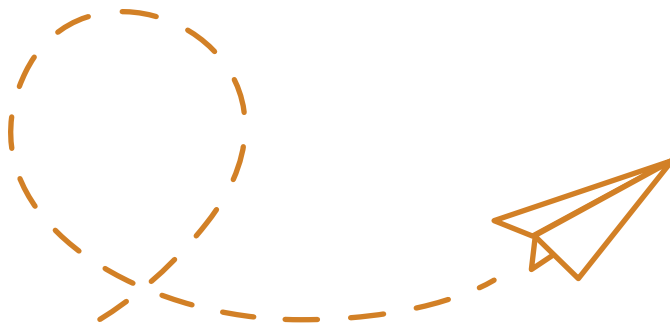
Theme	Integrated pedagogies are effective when:
Instructional design	Teachers design activities to: • Build on learners' experiences, knowledge, and learning needs • Include long and short-term learning goals in their instructional design • Incorporate evidence about what makes the approach successful in instructional design • Include the opportunity to orient learners at the outset, conduct the investigation, and reflect on the process and challenges • Include a combination of teacher-guided, learner-directed, and teacher-directed instruction • Foster higher order thinking and skills such as problem solving and critical and creative thinking.
Implementation process	Teachers consider implementation success factors such as: • Using essential strategies (e.g., cooperative learning) • How gender and social dynamics will influence how approaches work (e.g., working in groups, peer learning) • Revealing the lesson goal and scaffolding learning • The amount, type and quality of teacher guidance varies based on the activity, goal, learner' abilities and learning needs • Acting as learners' mentors: monitor, question, help resolve conflicts, facilitate equitable contribution, provide examples, and evaluate learning.
Curricula and assessment	Curricula and assessment: • Cover depth not breadth • Include multidimensional and integrated assessment. • Allow for some flexibility in implementation
Teacher initial education, skills, knowledge and professional development	Teachers have the education, skills, knowledge and professional development to: • Know how to implement integrated pedagogies and the sub-strategies that underpin their effectiveness • Hold positive views about and know the benefits of integrated pedagogies • Know that integrated pedagogies are not 'unguided instruction' • Have sufficient subject matter knowledge to guide and scaffold learners' investigations • Know how to design and implement formative and summative assessments for integrated pedagogies • Access research and professional learning on integrated pedagogies to maintain or improve practice.
Learner factors	Teachers implement integrated pedagogies so they: • Are staged in accordance with learners' prior knowledge, skills and experiences, acknowledging that they are demanding • Can promote inclusion and enhance performance of diverse learner cohorts.
Schools and school resources	Schools: • Provide implementation support via line managers, school leadership, planning and scheduling • Allow the requisite time for learners to learn using integrated pedagogies, which takes longer than when teacher-directed approaches are used • Allow the requisite time for teachers to manage, plan, administer and guide learners under integrated pedagogies • Provide physical space to conduct activities such as group and peer work • Ensure resources are available – internal and external to classrooms.
Parents, caregivers and communities	Parents, caregivers and communities: • Have beliefs and values that influence support for pedagogy • Are actively engaged to garner support.

Directions for future research

This study finds the LEGO Foundation framework for playful learning characteristics and skills has broad validity and application to primary school education contexts. The review also presents a number of opportunities for further research. These include the need:

- To understand the incremental and sequential steps required when systems embark on employing or scaling up more play-based or integrated pedagogies.
- For new metrics to evaluate the impact of non-cognitive skills.
- To review how and where digital technology is used to support effective implementation of integrated pedagogies in primary and or high school.
- To understand how integrated pedagogies support learners with special learning needs in order to understand critical enabling factors or adjustments required.
- To extend understanding about integrated pedagogies and learning through play at higher learning levels including middle and upper secondary school.
- To understand learning through play in the context of transition to school. When research finds this approach is best and it is not employed, why, and what can be done to support systems and schools to adopt high quality learning through play in the early primary years?
- To understand how resource constraints limit pedagogical choices. How can integrated pedagogies be employed in highly resource constrained or low income country contexts?
- For new and accessible evidence regarding integrated pedagogies in teaching and learning toolkits describing costs and benefits.
- For explicit and detailed guidance on how to implement these pedagogies, including enabling factors.
- For new systematic reviews and meta-analyses which incorporate new research about integrated pedagogies.

This study is broad in scope and intended to map the territory of integrated pedagogies. It does not gather all evidence regarding any particular approach (systematic review) or combine the effect sizes of quantitative experimental studies to determine the overall impact of an approach (meta-analysis). This study provides researchers and practitioners with summaries of recent evidence regarding integrated pedagogies, to advance understanding about the field.





1. Background and rationale

Current context

Schools, around the world, are more focused than ever on results. By this we mean a narrowed focus on academic achievement in areas that are readily quantifiable such as reading, writing and numeracy. By concentrating on what is measurable in education, many schools have reduced their emphasis on fostering less measurable, but no less important, holistic or transversal skills. Numerous learning environments in England, the United States, and Australia have been recalibrated in keeping with this change in focus. They have reduced recess times, play areas, and student-centred learning, and increased classroom instruction time, supervised recess, and didactic approaches to teaching and learning in order to cover a broad curricula (Hyndman, Benson & Telford, 2014; Jenkinson & Benson, 2010; Rhea, 2016). In some education systems, there is a 'push down' curriculum; an increased burden on children to master academic concepts at a younger age, negatively impacting child wellbeing and impacting play (Danniels & Pyle, 2018; Miller & Almon, 2009). When children enter school, opportunities to play, which may have been prevalent in preschool, are much less common (Cremin, Glauert, Craft, Compton, & Stylianidou, 2015). There is hence an international 'squeeze on play'.

At the same time, some Southeast and East Asian systems are transforming pedagogy, moving away from traditional didactic approaches of transmitting and memorising information towards 'constructivist approaches that are more learner centred and inquiry-based' (Zhao, 2015, p. iv). These efforts are designed to expand the notion of educational outcomes to include a breadth of skills including social (communication and collaboration), emotional (resilience and self-regulation), and physical (fine and gross motor), as well as cognitive skills. The People's Republic of China Ministry of Education's policy document All-Round Development of Every Student—China's Curriculum Reform of Basic Education in the New Century (April 2010) states:

The tendency to overemphasize the instilment of knowledge should be changed, and student's initiative in learning brought into full play....The undue importance attached to passive learning, rote memorization and mechanical drill should be amended. Students should be urged to take an active part in learning activities, be willing to explore the unknown and diligent in practice. They should also develop their abilities to collect and process information, acquire knowledge, analyze and handle problems, communicate and cooperate with others

(as quoted in Riley, 2013, p. 2).

Global policy mandates also reflect the need to view educational outcomes in this light. The United Nations Sustainable Development Goals (SDGs) reflect the growing consensus among education experts of the need for education to be of high quality and to foster learners' holistic development. Framed by the SDGs, education quality includes fostering empathic, socially aware, critically engaged global citizens that are capable of engaging with the serious problems facing societies. It is not enough for children to merely participate in education. The right of children everywhere is to access quality evidence-based education praxis and theory that will equip them to live more materially, socially and culturally meaningful lives in the future.

Research has demonstrated the value of holistic skills development. Education programs that involve study skills, metacognition, collaboration, and student-centred approaches to learning positively impact overall learner achievement and close the gap between low and high performers (Mannion & Mercer, 2016). Standards for what learners need to know and do are

ever increasing. Learners must know core concepts and content related to particular learning areas, such as mathematics and science, be able to apply these to specific learning area problems and processes, and ideally, to new areas and problems. To do so, learners have to be able and motivated to engage deeply with learning areas, and have opportunities to practice using new skills and knowledge.

In order to meet these needs, learning environments must cater to depth, not breadth. They must integrate learning between and across disciplines and connect concepts and content with their real-world applications. They need to actively engage learners, working together, to learn by doing. However, pedagogical guidance on how to foster these skills and the role of teachers and demands on learners is scant (Nichols, Burgh & Kennedy, 2017). Further, the impact of pedagogies that attempt to meet the need for learners to develop higher order thinking skills, such as inquiry and discovery-based learning, have been challenged in recent years (Hattie, 2008; Kirschner, Sweller & Clark, 2006).

Learning through play provides us with the appropriate starting point in the search for a pedagogy to foster 21st century learning in primary school. The case for learning through play for children aged zero to eight years has been strongly made, with evidence supporting its 'key role in healthy, positive development' and holistic skills development (Zosh et al., 2017, p. 12). The role, application and impact of play-based learning in primary school settings is, however, unclear (Moyle, Adams & Musgrove, 2002). Learning through play, as a developmentally appropriate pedagogy for early years' education, has a strong evidence base, but seemingly weak and inconsistent application in primary schools.

This study locates the 'play' in education. We identify which pedagogies can potentially carry forward the gains learners make via learning through play in the early years. This is important, as we seek to understand the implications when children shift to learning under different pedagogical approaches across the

different ages and stages of schooling. How important is continuity, and can continuity be provided when children move from learning through play in preschool to, for example, inquiry-based learning at school in the early grades and beyond? Further, when young children move from learning through play in preschool to more didactic approaches in primary school, how does this affect their transition into school and their emergent social, emotional and cognitive skills? What is lost or gained? Is there a middle ground and can it be effective? We find that there is, and it can be.

We identified eight pedagogies as the 'older siblings' of learning through play, as derived from the same constructivist learning theories. We relate these pedagogies to learning through play by successfully plotting them against learning through play's key characteristics. We define and describe each pedagogy, present evidence regarding their respective impact and essential factors that underpin their effectiveness. We describe the education system factors that influence pedagogy including curricula, assessment, teacher education, learners, schools (leadership and resources), and parents, caregivers, and communities, and conclude with directions for future research.

Learning through play

Learning through play is an enjoyable and appropriate way to transition from early childhood into the school years (Bjordi & Gardner, 2014). As a pedagogy, learning through play is described as combining playful child-directed activity with teacher or adult supported or guided learning objectives (Weisberg, Hirsh-Pasek & Golinkoff, 2013). Learning through play incorporates free or voluntary play, guided play, construction play, collaborative play, learning through games, physical play, and digital play, among others. Experts have sought to create a continuum of learning through play that spans from free play, to guided play, through to teacher-directed play (Weisberg, Hirsh-Pasek, & Golinkoff, 2013). Research has clearly established the benefits of learning through play in fostering child development and learning (Daniels & Pyle, 2018).

Learning through play is mandated in early years' education policy in numerous countries including Australia, Canada, Denmark, New Zealand, Scotland, and Sweden (Australian Government Department of Education, Employment, and Workplace Relations, 2009; The Ministry of Education, Government of Ontario, 2013; Martlew, Stephen & Ellis, 2011; Synodi, 2010; Schreyer & Oberhuemer, 2017). Generally these policies concern the education of children from the ages of zero to eight years. The Play Strategy for Scotland (Scottish Government, 2013) is more expansive in scope. As it is based on Article 31 of the United Nations Convention of the Rights of the Child (CRC), it applies to children up to the age of 18 years (United Nations, 1989).

However, there is frequently a disconnect between policy and practice. It seems unclear what becomes of learning through play, and the skills and competencies fostered under this learning condition, when children arrive at the school gates. There is strong evidence to support the role and benefits of learning through play in the early years of primary school. Play has been particularly linked to fostering foundational skills and knowledge, including supporting literacy, mathematics and science learning (Hill, 2010; Kefaloukos & Bobis, 2011; Mihaljevic, 2005; Stagnitti, Bailey, Hudspeth, Stevenson, Reynolds & Kidd, 2016). Further, as an integrated practice, learning through play also supports children to develop emotional, physical, social, and creative skills. If we know that evidence supports the role and value of learning through play at school in fostering holistic skills, why is it not adopted consistently and widely? What becomes of the burgeoning holistic skills learners foster under this condition when they enter a traditional and academically focused school?

When we search for explicit mention of 'play' or 'play-based learning' in school and education policies pertaining to children beyond the age of eight (around grade or year two), we generally do not find it. In early childhood education, play is described as the context for learning. (Australian Government Department of Education, Employment, and Workplace Relations, 2009). It performs a pivotal role for children to 'organise and make sense of their social worlds, as they engage actively with people, objects, and representations' (p. 6). In formal schooling, however, play does not always occupy a central role as the 'learning context'. It is often supplementary or implied;

used by teachers in support of a broader learning goal, or fostered as a disposition.

For example, in their review of age-appropriate pedagogies for the early years of schooling, the Queensland Government (n.d) summarised existing evidence and concluded with ten key messages including that 'Playfulness should pervade learning and teaching interactions' (p. 13). Briggs and Hansen (2012) suggest that play for children aged 5-11 years offers learners the opportunity to practice skills in different contexts across different subject domains. They propose that through play, primary school-aged children can act as learners who are autonomous, socially interactive, creative, investigative, and reflective problem-solvers. These learner roles align closely with the LEGO Foundation's characteristics and skills associated with learning through play.

This review investigates the role and application of learning through play in the primary school classroom. Numerous studies associate or conflate play-based learning with other approaches, for example, inquiry-based learning, or discovery learning, assuming that general or fundamental similarities exist across these approaches. This review unpacks these approaches, adds six more, maps them against learning through play, cites evidence of impact, and describes the various factors that underpin implementation quality. While in the main, the word 'play' may be missing from the later primary years, the elements that make play educational are most certainly present in the eight integrated pedagogies discussed in this review.

False dichotomies concerning pedagogies in education research

Research about learning through play provided clear signposts on the interrelatedness of the eight integrated approaches discussed in this review. Play-based learning and approaches such as inquiry-based learning, active, and experiential learning are founded on the same learning theories, drawing upon the work of Dewey, Piaget, Montessori and Vygotsky. Central to these theories is the idea that educators and learners work together in partnership to co-construct knowledge. Learning environments are intentionally designed to maximise opportunities to foster creativity, social interaction, experimentation, and a love of learning. Learners and teachers are active and engaged participants in the learning process, and interactions between teachers and learners are varied,

with learner and teacher taking turns at directing activity at the appropriate times.

Research concerning teaching strategies abounds with dichotomies and assumptions. Play and learning are often viewed as dichotomous constructs (Pyle & Danniels, 2017). Teacher-directed learning is often cast as inherently passive and unengaging, and inquiry-based or discovery learning as unguided or unstructured, leaving learners to work out key concepts on their own. We propose that any approach can be implemented poorly, generating low learner engagement and passivity, low achievement, and misconceptions.

The key is knowing what enabling factors and conditions make the strategy successful in achieving its purpose, and implementing it with full acknowledgement of these.

This is important when considering ‘magic bullets’ for educational improvement. An intervention’s success is contingent on numerous enabling factors: knowing and addressing these is critical to replicating positive results.

This study asserts that there are instructional design features that must be present for integrated pedagogies to achieve their purpose (see Table 6: Implementation quality factors for integrated pedagogies). For example, the type and degree of guidance provided by teachers substantially contributes to the success of integrated pedagogies. The reviewed literature framed ‘guidance’ in numerous ways, including: explaining key concepts; providing formative feedback; providing learners with opportunities for reflection; emphasising relevant information; scaffolding; questioning; framing activities at the lesson outset; revealing lesson goals; and using a simple structure comprising framing, activity, and reflection. There was limited evidence to suggest that minimal guidance was effective in fostering specific competencies. This is not to say that there is no place for minimally guided learner activity at school – learners should experience some degree of choice and freedom within their schedule every day (see chapter four for a more detailed discussion on this topic). The overwhelming finding was that using a combination of design features and teacher-student directedness encourages both learners and teachers to be actively engaged in learning. This yields the best results in a wide range of educational outcomes.



2. Study design and method

The design and method for this scoping study was guided by the research question:

How has learning through play been applied in formal schooling, and what has been the impact on children's holistic skills?

This scoping study aimed to:

1. Investigate the type and range of research evidence currently available to help answer this question, including identifying any gaps in the evidence base;
2. Synthesise the available evidence into possible answers to the research question; and,
3. Derive insights from this synthesis that can guide the implementation of learning through play in schools.

In order to answer the research question, we addressed the implicit questions of:

- What do we mean by 'learning through play' at school?
- What ages and stages are implied in 'formal schooling'?
- What do we mean by 'children's holistic skills'?

This scoping study framed these sub-questions using the LEGO Foundation's key resources: Learning through play: a review of the evidence (Zosh et al., 2017), and What we mean by learning through play (LEGO Foundation, 2017).

'Learning through play at school'

To establish what we mean by 'learning through play' at school, we use the 'characteristics of playful learning experiences', based on the theory developed by Jennifer M Zosh, Emily J Hopkins, Hanne Jensen, Claire Liu, Dave Neale, Kathy Hirsh-Pasek, S Lynne Solis and David Whitebread, as detailed in Learning through play: a review of the evidence (Zosh et al., 2017, p. 16).

These are:

- Joyful
- Meaningful
- Actively engaging
- Iterative
- Socially interactive

We use these characteristics as a framework to review pedagogies for how they incorporate them in instructional design or as outcomes of the teaching and learning process.

'Children's holistic skills'

The broad set of holistic skills associated with learning through play is defined by the LEGO Foundation (2017) as:

- Emotional skills – understand, manage and express emotions by building self-awareness and handling impulses, as well as staying motivated and confident in the face of difficulties
- Cognitive skills – concentration, problem solving, and flexible thinking by learning to tackle complex tasks and building effective strategies to identify solutions
- Physical skills – being physically active, understanding movement and space through practising sensory-motor skills, developing spatial understanding and nurturing an active and healthy body
- Social skills – collaborate, communicate and understand other people's perspectives through sharing ideas, negotiating rules and building empathy
- Creative skills – coming up with ideas, expressing them and transforming them into reality by creating associations, symbolising and representing ideas and providing meaningful experiences for others.

(Quoted from the LEGO Foundation, 2017, p. 18)

'Formal schooling'

The scope of this study was defined as formal (primary/elementary) schooling pertaining to children aged 6–12 years. The Foundation or Preparatory year was largely excluded from this review, as we wanted to explore the extent learning through play was implemented and to what effect beyond the early years.

Method

The study was undertaken in two stages. First we conducted a general search for literature about the impact of learning through play on children's holistic skills using 'learning through play', 'play-based learning', and the five characteristics of play and holistic skills as key search terms. This initial search revealed 145 relevant papers which we used to narrow the scope of the review. This search revealed key pedagogies and terms for 'playful' approaches to teaching and learning, from which we created a glossary of 28 key terms (see Glossary).

The second search concentrated on key pedagogies identified from the first search that were often used by researchers when discussing 'playful' learning in primary school. These were discovery-based learning, inquiry-based learning, project and problem-based learning, experiential and active learning, and cooperative and collaborative learning, and Montessori education. These approaches were selected because there was sufficient empirical evidence regarding their impact on student learning outcomes, and descriptions of the strategy that aligned to learning through play. The second stage drew on evidence from 76 papers. The evidence reviewed in stage two was a combination of empirical experimental or quasi-experimental studies, and systematic literature reviews, regarding the impact of these approaches on cognitive and non-cognitive outcomes. Many studies used a mix of both qualitative and quantitative research methods, and most concerned implementation of integrated pedagogies at the school, school cluster, district and regional level. No national studies were included, however this study does discuss the results of the Teaching and Learning International Survey (OECD, 2014).

Exclusions and limitations

The decision to include an approach in this study was based on:

- The availability of recent and substantial empirical evidence regarding the impact of the approach on learners' holistic skills (cognitive and non-cognitive/transversal), pertaining to the learner age range of the review (6–12 years)
- The availability of a number of distinct, clear, and comparable definitions of the approach
- The alignment of the approach to the characteristics of learning through play.

Accordingly, approaches were excluded if these conditions could not be met. Approaches excluded from this scoping study (which are often associated with learning through play) were: authentic instruction, participatory learning, the Reggio Emilia Approach, tactile or kinaesthetic learning, blended learning, connected learning, design thinking, minimally invasive education, and 21st century pedagogies (see Saavedra & Opfer, 2012).

The review does not include studies regarding the impact of digital technology in fostering holistic skills development using the approaches included. It does not address the applicability of these approaches to special needs education as these areas require further separate and specific investigations.



Key terms used in this review

Education research is replete with jargon. For the purposes of this review, we use certain terms in the following ways.

- **Approach:** a strategy or pedagogical method employed by teachers and systems to influence learning in others. It applies to the interaction between teacher and learner and aspects of the learning environment (Siraj-Blatchford, Sylva, Muttock, Gilden & Bell, 2002). In this review, we use 'approach', 'teaching and learning strategy', 'instructional strategy' and 'pedagogy' interchangeably. We acknowledge that, in practice, teachers often combine approaches.
- **Integrated pedagogy:** is a collective 'best-fit' term we use to combine the approaches reviewed in this report, namely: active learning, experiential learning, cooperative and collaborative learning, guided discovery learning, inquiry-based learning, problem-based learning, and project-based learning and Montessori education. We do not imply that these approaches are identical and interchangeable; we group them together as they share common features, as examined in this study:
 - They align with the five characteristics of learning through play
 - They offer opportunities to foster a breadth of skills, including cognitive, social, emotional, creative and physical.
 - Their effectiveness depends on how they combine child-directed, guided, and teacher-led learning in quantities and types according to the learning task and other context specific features. This construct is explained further in chapter four.



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3. Integrated approaches to teaching and learning

What does it look like when children learn playfully at school? Over the next chapter we introduce eight approaches to teaching and learning and describe how they incorporate the five characteristics of learning through play. We also present evidence of their impact on children's learning and some of the essential factors that underpin their success as strategies for teaching and learning.

There is clearly much overlap across the approaches described in this chapter. However, we address each approach separately as this enables us to see the similarities, rather than just assume them. It enables education stakeholders to locate different approaches, including those used by their system or school, to compare descriptions and evidence, and draw informed conclusions about the efficacy and enabling factors that support successful implementation. Additionally, we can identify small, yet often crucial pedagogical differences, and avoid making generalisations where they do not apply.

Integrated pedagogies are ubiquitous and framed by researchers and practitioners ranging from techniques (for example, the act of inquiry) to detailed strategies (inquiry-based learning). Many appear to be delivered in combination (see Table 4: Breadth of skills measured by research included in this study). Fidelity – that is, the loyalty of the delivery when compared to the design – is cited as an issue when comparing approaches (Hixson, Ravitz, & Whisman, 2012).

However, definitions are sometimes inconsistent or lacking, which means evaluations or research studies cannot be combined and generalised when it is unclear which 'version' of the approach the researcher is referring to. Comparing and contrasting approaches could therefore be a flawed exercise, given that definitions are contested and intertwined (Hood Cattaneo, 2017). What makes project-based learning work in Singapore might be the ability of teachers to collaboratively and innovatively deliver the curricula in novel ways. It might also stem from a greater access to resources, support and policy guidance from sub-national educational administrators. This means that, in this context, project-based learning is effective. It does not, however, mean that project-based learning as a strategy is inherently effective. We make these distinctions here.

The eight approaches described in this chapter are related to learning through play, as they are derived from the same learning theories of social constructivism. Being members of the same family, it was possible to map them on to learning through play, and find common features. Mapping these eight pedagogies against the five characteristics of learning through play enabled us to identify how 'play' is helping children develop important cognitive and non-cognitive skills.



Active learning



Cooperative and collaborative learning



Experiential learning



Guided discovery learning



Inquiry-based learning



Problem-based learning



Project-based learning



Montessori education



Active learning

What is it?

Active learning is an approach where learners are actively involved or engaged in the learning process. Active involvement is characterised by learner choice or autonomy regarding the task itself, as well as how and when learners respond. Active learning leverages learners' own interests to engage them in the learning process. It uses hands-on, authentic, real-world-related activities with teachers occupying the role of facilitator rather than didactic instructor (Martlew, Stephen & Ellis, 2011).

Smith (2015) describes the teacher's role in active learning as 'ask[ing] questions, to focus on teachable moments and encourage sharing of knowledge with other children, to record anecdotal observations and to provide materials and resources to enhance learning experiences' (p. 141).

Active learning aligns with the LEGO Foundation's five characteristics of learning through play in the following ways:

- Meaningful learning opportunities are created when learners' experiences from home and education settings are integrated. When concepts are reinforced across different learning contexts and activities, relevance and meaning become attached to the concept leading to deeper, more durable learning (Marbina, Church & Tayler, 2011; Sinnema, Sewell & Milligan, 2011). Some examples of the integration of activities and contexts include learning about seed life cycles while planting seedlings in a school garden program, and learning through open, learner-led classroom discussions.
- Social interaction transpires as active learning and commonly uses group work and peer learning. Further, active learning makes use of learners' own experiences, knowledge and lives and therefore generates positive teacher-learner interactions; an essential ingredient for beneficial social interaction (Haßler, Hennessey, Cross, Chileshe & Machiko, 2015).

- Learners are actively engaged as they have had some degree of freedom and choice in the learning activity, which has motivated them to participate (Martlew, Stephen & Ellis, 2011).
- Learners iterate by investigating and exploring new concepts and ideas in active learning environments.
- Active learning environments were often described in the literature as enjoyable, fun, and positive, (Burris, 2011; Cefai et al., 2014) generating empathic teacher-learner and peer-learner relationships (Castano, 2008; Sinnema, Sewell & Milligan, 2011).

Evidence of impact

Researchers have found active learning to positively influence learning outcomes in the following ways:

- Cognitive and socio-emotional: Castano (2008) examined the use of constructivist active learning strategies in her science teaching research in Colombia. She found that when learners have the opportunity to discuss socio-scientific dilemmas related to the science concepts they had learned, they described concepts more accurately, made better connections between the concepts, their lives, and nature, and expressed concern for related global issues.
- Achievement and growth mindsets: In a project introducing interactive pedagogy in Zambia, Haßler et al. (2015) found that when teachers tried open-ended classroom questioning, peer learning, and hands-on activities, they saw learners demonstrate higher levels of achievement. Teachers then revised previously held views about learners' capability. Active learning is demonstrative and multidimensional and offers opportunities for learners to display abilities that might not be revealed in traditional classroom settings.

- Social and emotional skills: A simple active learning strategy, Circle Time (Cefai et al., 2014), was examined in Italy, where learners and teachers sit in a circle and use an object to determine speaking order, to solve problems, discuss events, play a game, talk about feelings and tell stories. This strategy was found to foster improvements in pro-social behaviours such as listening, collaboration, and peer relationships, and reduce behavioural problems among Grade 1-5 learners.

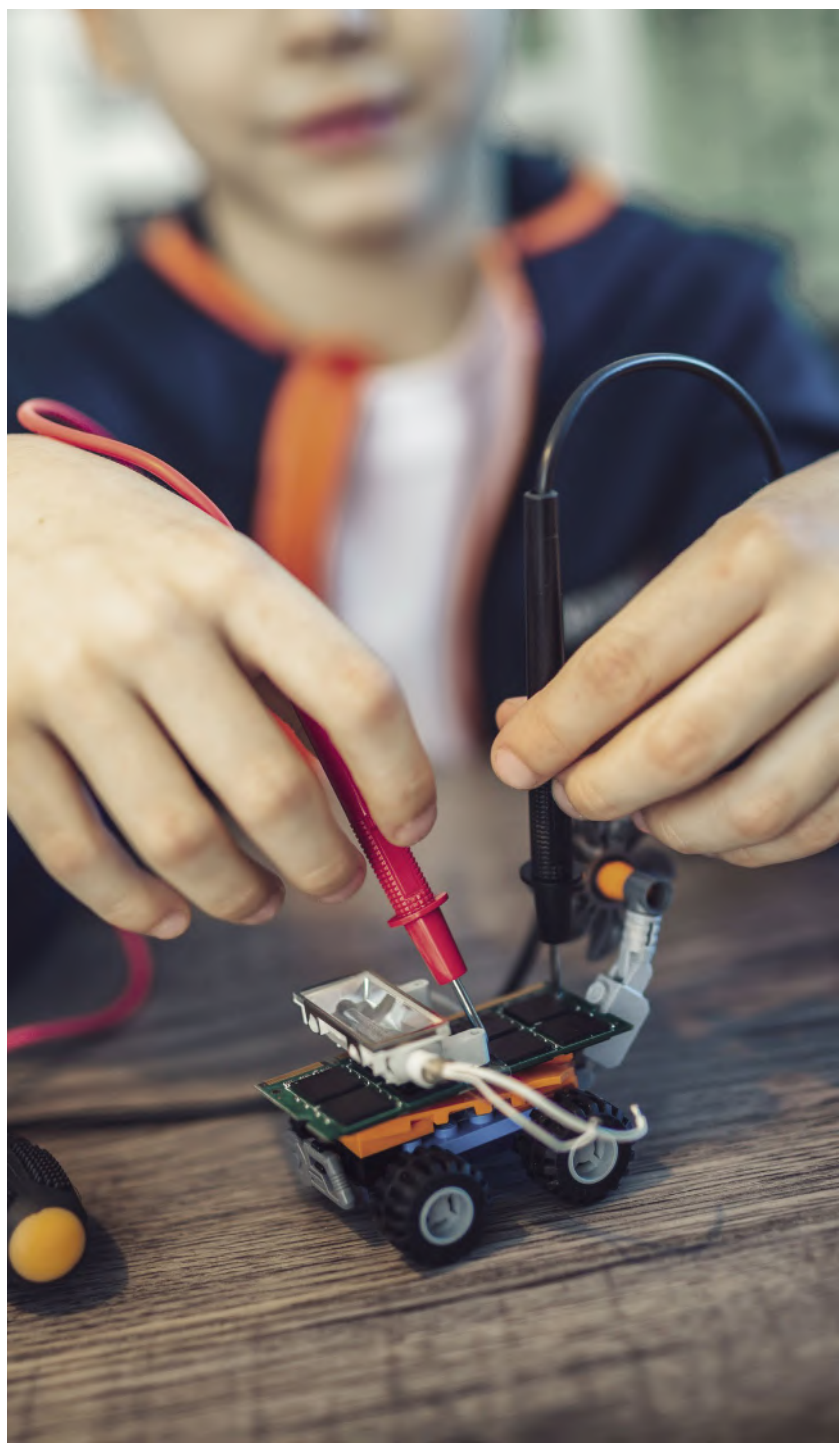
Enabling factors

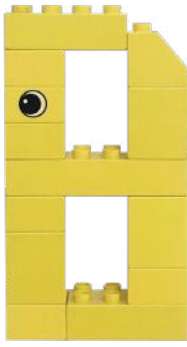
Successful implementation of active learning approaches depended on a number of factors including:

- Regular and ongoing reflective dialogue between teachers in professional learning groups. This supports long-term improvements in classroom practices. Haßler et al. (2015) found that one-off programs are not effective as efforts must be sustained over time in order to create lasting change.
- Use of evidence was valuable in linking changed classroom practices to improved learning outcomes for learners. Sinnema, Sewell and Milligan (2011) described how teachers and researchers worked collaboratively to design, implement, and reflect on pedagogical improvements based on evidence.
- Even simple activities like Circle Time (Cefai et al., 2014) require time in the curriculum, physical space in which to conduct the activity, and planning to ensure they are implemented in a way that generates positive outcomes.
- Whole school level support, for example, peer support and mentoring, creating communities of practice, leadership support, and resources, is integral for consistent uptake of new pedagogical approaches like active learning (Cefai et al., 2014; Davison, Galbraith, & McQueen, 2008).

The Scottish Government's move towards a play-based learning pedagogy in the early years of schooling is called 'active learning'

(Martlew, Stephen & Ellis, 2011).





Cooperative and collaborative learning

What is it?

Cooperative learning and collaborative learning are instructional strategies designed to make the most of positive peer social interactions by grouping learners together to complete an assignment or task. As the definitions for both cooperative and collaborative learning are largely interchangeable, we address them together here. Distinguishing features of these approaches are that they include meaningful tasks, active participation of learners, and learners working together and helping each other. Effective groups can be comprised of mixed or homogenous ability or age of participants, depending on the task requirements or the learning context. In addition, groups can work individually on tasks that contribute to a shared goal, or together on a shared task. What is most important about cooperative and collaborative learning approaches is that certain essential strategies underpin their effectiveness. Using these strategies provides greater assurance that intended learning goals, and associated skills and knowledge, can be achieved, irrespective of group composition (Cheng, Lam & Chan, 2008).

These strategies are:

1. **Positive interdependence:** This condition exists when learners know that they are linked with their group members in such a way that they cannot succeed unless their group members do. Positively interdependent groups see their work as benefiting each other; they share resources, provide mutual support and share in joint success. There are no 'free riders' as each group member makes unique contributions.
2. **Face-to-face promotive action:** When learners help, support, praise, and encourage each other in groups, they promote the above condition of positive interdependence, foster verbal and interpersonal skills, motivate, and get to know each other. The teacher is responsible for describing, modelling, and reinforcing this condition throughout the group work activity.

3. **Individual accountability and personal responsibility:** Group work activities need to be structured to ensure that individual performance can be easily identified, assessed, and fed back to the group and individual, for example, via individual quizzes or random selection of individual work to present.
4. **Interpersonal and small group skills:** The ability to interact effectively is a learned skill fostered through explicit teaching. Teachers must intentionally teach social skills for effective group work.
5. **Group processing:** When group members reflect on and discuss how well they achieved their goals and maintained effective working relationships, they deepen cognitive and metacognitive learning and establish the groundwork for improved future performance.

(Summarised from Johnson & Johnson, 1991, p. 54-59).

Cooperative and collaborative learning closely align with the LEGO Foundation's five characteristics of learning through play as follows:

- Meaningful learning is achieved through collaborative or cooperative learning strategies when they are applied to meaningful tasks, and by scaffolding which builds on and extends learners' social and interpersonal skills. In addition, learners derive deeper understanding of the cooperative activity content, concepts, process, and their own self-efficacy through group processing.
- Social interaction is the cornerstone of cooperative or collaborative learning. Improved communication, social, and interpersonal skills are frequently cited outcomes of these strategies (Johnson & Johnson, 1991; Barron & Darling-Hammond, 2008). These skills are highly transferrable to new social situations and contexts outside the classroom, and remain relevant and useful for a lifetime.

- Active engagement in collaborative or cooperative learning is predicated on positive interdependence and individual accountability. When learners know they can depend on each other and have a clear sense of their own responsibilities.

learners exhibit identifiable signs of engagement, such as their heads being close together over their work, and talking about, and sharing answers and materials about the work

(Johnson & Johnson, 1991)

Fitch and Hulin (2008) similarly found that active engagement means 'Learners have a strong vested interest in the outcome of the group and are motivated to engage in a higher level of interaction' (p. 430).

- Iteration in collaborative or cooperative learning occurs when learners formulate ideas, share, revise, and recalibrate their thinking based on the inputs of the group (Fitch & Hulin, 2008; Nichols, Gillies & Hedberg, 2016). 'As children disagree, discuss, explain, and persuade one another, new positions, new ideas, and new thinking occurs' (Fitch & Hulin, 2008, p. 428).
- A number of studies reported that learners enjoyed cooperative or collaborative learning based on the process and the opportunity for positive social interaction (Fitch & Hulin, 2008; Christensen, Wallace & Arnott, 2008).

The purpose of cooperative learning groups is to make each member a stronger individual'.

(Johnson & Johnson, 1991, p. 58).

Evidence of impact

Professor John Hattie (2008) acknowledges that peers are powerful to learning. There are numerous strong examples of the positive impact of cooperative and collaborative learning regarding the following learning areas:

- Reading comprehension: Using a quasi-experimental design, Fitch and Hulin (2008) measured the effectiveness of Collaborative Learning Assessment through Dialogue (CLAD) on reading achievement in inclusive third grade classrooms in the US. CLAD involves learners reading a passage of text, forming small groups, and then taking two multiple choice tests; first individually, then as a group, discussing possible choices and seeking consensus. The CLAD approach employed all five cooperative learning strategies described above. Fitch and Hulin (2008) found the intervention group, which used CLAD, showed significantly greater growth in reading achievement than the control group. Furthermore, they implemented their study in a historically low performing school. Their findings suggest CLAD could be a preferable method to raise learner performance over more targeted one-on-one deficit-based methods (for example, removing children from class to participate in remedial coaching).
- Mathematical problem solving: Asha and Hawi (2016) found that sixth grade learners in Jordan made better decisions to solve mathematical problems when working cooperatively based on the feedback they received from learners within and outside their group.

- Self-efficacy and growth mindsets: Burke and Williams' (2012) study found that primary school learners in Scotland aged 11-12 years, who participated in a collaborative learning intervention, demonstrated greater improvement in their understanding of concepts related to intelligence than learners who worked individually.
- Classroom ethos: Using cooperative learning strategies can catalyse a shift from teacher-directed to learner-centred learning. Davison, Galbraith and McQueen (2008) reported that using cooperative learning structures had enabled teachers to transition to the role of facilitator, rather than a director of learning, in year two classrooms in the UK.
- Understanding the benefits and possessing the ability to deliver cooperative or collaborative learning is important to realise its potential positive outcomes. Both factors must be considered for teacher training to be effective.
- Gender dynamics will influence collaborative or cooperative learning. One US study investigated playful talk in collaborative group learning among sixth grade students. The study found that girls generally exhibited greater concern for interpersonal relationships and more frequently engaged in high affinity talk (Strough & Meehan, 2001, as cited in Sullivan & Wilson, 2015). Teachers should consider how social conditioning will influence the ability of group members to negotiate roles, suggest alternatives, and correct and support each other.

Enabling factors

Research suggests that successful implementation of cooperative or collaborative learning depends on the following factors:

- Small group sizes (two to six members) leads to greater individual accountability, and less redundant effort (Johnson & Johnson, 1991).
- Use of specific cooperative learning strategies is essential. It is not enough to group learners together and tell them to cooperate; the conditions for effective group work need to be explicitly created and reinforced by teachers. Group work which is not thoughtfully structured is described as one of the least effective approaches in teaching and learning (Bennett, 2001, in Christensen, Wallace & Arnott, 2008). However, structure does not imply total teacher control.
- Cooperative and collaborative learning are superior to individualistic or competitive learning for conceptual or complex tasks, for example, to foster problem solving, creativity, critical thinking, high level reasoning, and higher order thinking skills. Competitive learning is appropriate for skill practice, knowledge recall and review; individualistic learning is well suited to simple skills development and knowledge acquisition (Johnson & Johnson, 1991). Teachers must select the most appropriate strategy for the skills and knowledge learning gains they wish to foster.





Experiential learning

Experiential learning can act as a 'natural site for curriculum integration, offering children the opportunity to 'play' while learning fractions through 'measuring ingredients and cutting up fruit into portions'; practice writing via journaling about the program; and learn concepts related to science and the natural world such as 'seed life cycles, nitrogen fixation, the role of insects, and how to tell whether an egg is fresh'

(Block et al., 2012, p. 424)

What is it?

Experiential learning is an umbrella term covering a range of educational theories and practices which share common principles about the value of experience, within and beyond the classroom, to meaningful learning. John Dewey was credited with the term, originating from his 1938 book *Experience and Education*. Essentially, engaging experiences perpetuate learning, moving learners' beyond known boundaries, fuelled by their interest and motivation. For Dewey (1938), quality experiential learning comprised meaningful experiences, important or intriguing inquiry topics, and interaction between peers, and between teachers and learners.

David A Kolb (1984) subsequently developed a theory of experiential learning as a four-stage cycle comprising concrete experience, reflective observation, abstract conceptualisation, and active experimentation. Researchers have since identified incongruities in Kolb's theories and models, which are partially unfounded by emergent neuroscience research (Schenck & Cruikshank, 2015). Contemporary models combine the benefits of experiential learning to cognitive and socio-emotional development with understanding about neurobiology and effective teaching practices (Schenck & Cruikshank, 2015).

In addition to classroom-based experiential learning, programs and activities commonly associated with experiential learning include outdoor learning, outdoor adventure education, service learning, excursions and incursions, environmental education, kitchen garden programs, local and international community development initiatives, and creative arts programs.

Experiential learning aligns with the LEGO Foundation's five characteristics of play in the following ways:

- Experiential learning provides learners with the 'opportunity to create meaning from their direct experience and hence optimise their learning outcomes' (Block et al., 2012, p. 428). Meaning can be further enhanced when children self-select experiential learning activities (Falk, 2001).
- Experiential learning has been found to foster social and interpersonal skills and 'expand social networks beyond [learner's] immediate friendship groups' (Block et al. 2012, p. 425). Experiential learning can be designed and delivered to dissolve barriers that may exist between individuals and groups in the classroom. It can allow learners to demonstrate abilities that are not brought to light in traditional classroom settings.
- Experiential learning can be actively engaging for children who are at risk of disengagement (Block et al., 2012). Learning is actively engaging when educators provide hands-on learning in conjunction with rich group discussion and reflection (McBride, Chung & Robertson, 2016).
- Experiential learning is iterative when learners have the opportunity to investigate, explore or experiment with different phenomena in context. Teachers can invite iteration by 'letting [learners] decide how an activity is performed and when a product is finished' (Laevers, 2000, p. 27).
- Burris (2011) and Block et al. (2012) both described how learners enjoyed enriched experiential learning, saying 'I love this book' or 'I can't wait to [undertake the hands-on activity]' (Burris, 2011,

p. 41). Learners discussed their learning at home, and made home-to-school connections about their learning, demonstrating their motivation and interest in the topics.

Evidence of impact

A small sample of evidence regarding the positive impact of experiential education includes:

- Science content knowledge and engagement: Djonko-Moore, Leonard, Holifield, Bailey, and Almughyirah (2017) found that when US children in grades 3–6 participated in a week-long experiential learning program about the natural world and climate change through lessons supported by site visits, they demonstrated increased knowledge about and interest in science topics such as emergency preparedness and composting. Site visits included a Nature and Science Museum, botanic garden, Rocky Mountain National Park, and lessons included compost making, soil labs, and planting a community garden.
- Learner, school and community benefits: A mixed methods evaluation of the renowned Australian Stephanie Alexander Kitchen Garden program by Block et al. (2012) found that participation resulted in increased learner engagement and confidence, teamwork and social skills, and increased connections between schools and communities.
- Positive teacher-learner relationships: Block et al. (2012) reported that teachers witnessed previously unseen capabilities in their Australian learners as they 'wielded big knives' and 'prepared multicourse meals' (p. 423). Correspondingly, learners appreciated their teachers' trust and confidence in them equipment appropriately.
- Learner engagement and motivation: Burris (2011) found that first grade learners in the US who participated in a week-long nutrition themed learning enrichment program demonstrated greater interest in and motivation towards the curriculum, as well as a decrease in behavioural problems.
- Mathematics, science and writing: Block et al. (2012) found that experiential learning can act as a 'natural site for curriculum integration, offering children the opportunity to 'play' while learning fractions through 'measuring ingredients and cutting up fruit into portions'; practice writing via journaling about the program; and learn concepts related to science and the natural world such as 'seed life cycles, nitrogen fixation, the role of insects, and how to tell whether an egg is fresh' (p. 424).

Enabling factors

Successful implementation of experiential learning depends on a range of factors including:

- Acknowledging learners' prior knowledge and experience of the topic or activity. Like Castano (2008), Burris' (2011) intervention commenced with targeted questioning and a class discussion about the enrichment activity topic. This method served to activate children's prior knowledge, preparing them for learning.
- Structure, setting, and preparation are key to successful implementation of experiential learning. Block et al.'s (2012) evaluation of the Stephanie Alexander Kitchen Garden program revealed how learners were versed in the program structure, their roles, and expectations of them. This enabled learners to self-direct and complete tasks without close supervision.
- Skilled and knowledgeable teachers: specialist instructors were found to add value to programs, and enhance and extend student learning (Block, 2012).
- Measuring learning gains made under experiential learning conditions is difficult, usually requiring rubrics, portfolios, learner journals or performances, demonstrations, or displays of learners' work. Teachers must know how to create high quality formative and summative assessment tools for experiential learning projects or units of inquiry.



Guided discovery learning

What is it?

Discovery learning is frequently attributed to Jerome Bruner (1961), who proposed that it is through a process of discovery that learners will develop a sense of ownership over their own learning. Bruner stated, 'I do not restrict discovery to the act of finding out something that was unknown to mankind, but rather include all forms of obtaining knowledge for oneself by the use of one's own mind' (p. 21). He maintained that prior knowledge of the area provides the basis for the discovery; it does not occur out of nowhere, suggesting the key role of guidance in discovery learning. Bruner posited that when learners expect or are prepared to 'find regularities and relationships in [their] environment', they will 'devise ways of searching and finding' (p. 23). He described experiments where prior to testing, subjects were advised that there was a pattern to identify, or that they were expected to relay the knowledge they gained to another person. This suggests subjects were primed to assume a 'discovery mindset' for the task. There are great rewards to learning when adopting this perspective.

Discovery learning has attracted much scrutiny in recent years from education researchers who have argued that it equates to minimal or no teacher guidance, which is ineffective (Alfieri, Brooks, Aldrich & Tenenbaum, 2011; Hushman & Marley, 2015; Kirschner, Sweller & Clark, 2006; Klahr & Nigam, 2004; Mayer, 2004). In response, researchers have classified and described different discovery learning types, their associated level of teacher guidance, and their effectiveness in fostering learning. The literature distinguishes between approaches such as guided, assisted, enhanced, and enriched discovery learning as distinct from 'pure' discovery learning. Alfieri et al. (2011) stated that pure 'discovery learning occurs whenever the learner is not provided with the target information or conceptual understanding and must find it independently and with only the provided materials' (p. 2). Conversely, guided, assisted, or enriched discovery learning occurs when teachers provide a range of support such as hints, direction,

coaching, feedback, worked examples, scaffolding, and elicited explanations. Guided discovery learning appears to offer learners the best opportunity to adopt a discovery mindset; to expect and be prepared to discover knowledge for themselves, as Bruner described in The Act of Discovery (1961).

There is strong evidence, as presented below, to suggest that guided discovery is superior to instructional approaches that are unguided, minimally guided or fully teacher-guided. Alfieri et al. (2011), in their meta-analysis of 164 studies of discovery learning, found the order of positive impact as firstly guided discovery learning, followed by explicit instruction, and lastly, unassisted discovery learning.

Guided discovery learning aligns with the LEGO Foundation's five characteristics of play in the following ways:

- Meaningful learning is promoted when learners are guided to integrate new information with their existing knowledge base. This active sense-making of new information is described by Zosh et al. (2017) as when 'children find meaning in an experience by connecting it with what they already know' (p. 21).
- Guided discovery learning often relies on social interaction; leveraging the benefits for learners when learning in groups. Hotulainen, Mononen and Aunio (2016) provided enriched discovery learning activities to small groups of Grade 1 children to foster thinking skills.
- Guided discovery learning is reported to yield higher levels of active learner engagement than direct instruction (Hushman & Marley, 2015). Hushman and Marley (2015) attribute this to the emphasis on particular information through guiding questions, hints, feedback and modelling, as opposed to direct explication of what is required to be known.

- Discovery learning is often used to foster scientific skills development, such as designing sound experiments (Hushman & Marley, 2015). This skill, in guided discovery, is based on iteration and trial and error. Incorrect responses are met with prompts and further questioning by teacher facilitators to nudge learners towards understanding.
- Hushman and Marley (2015) found that children who had received guided discovery instruction demonstrated greater achievement and reported greater positive changes in science self-efficacy than those who had received direct or minimal instruction. Self-efficacy is associated with interest, motivation, and enjoyment of learning.

Evidence of impact

A sample of skills and knowledge gained through guided discovery learning includes:

- Durable science skills: Dean and Kuhn's (2007) study of discovery learning compared the ability of US fourth grade learners to design sound experiments when receiving direct instruction, direct instruction plus practice, and practice only. They found that learning gains made via direct instruction without the opportunity to practice were not sustained beyond 12 weeks post instruction. Alternatively, learners in the two practice conditions, who spent greater time on task, made significant and lasting learning gains over a four-month period.
- Mathematics learning and transfer: Gagne and Brown (1961) found that grade nine and ten learners in the US, learning under guided discovery learning conditions, outperformed learners in pure discovery and direct instruction learning conditions when solving mathematical computations and problems. Purpura, Baroody, Eiland and Reid (2016) found similarly, in the US, that well-structured highly guided instruction featuring explicit questions was more effective

than minimally guided instruction in fostering first graders' reasoning strategies about basic sums. For basic sums, 'guided-discovery learning has unique beneficial effects on achieving transfer to novel problems' (p. 90).

- Thinking skills and academic achievement for low performers: Hotulainen, Mononen, and Aunio (2016) compared the impact of a guided discovery thinking skills intervention on low and high performing first grade children in Finland. The intervention was delivered over eight weeks and each lesson followed the same sequence: orientation – seeking children's prior knowledge on the topic; problem – the main activity of the lesson; and reflection – discussing what was challenging about the activity and how these challenges were overcome. The intervention led to the improvement of thinking, mathematics, listening comprehension and reading fluency skills in low achieving first grade learners. The intervention closed the gap between high and low performing students, as revealed by post-test results. The study design attempted to address concerns raised by Fuchs and Fuchs (2008) that children with special learning needs require strong lesson framing and scaffolding to succeed in discovery learning settings.

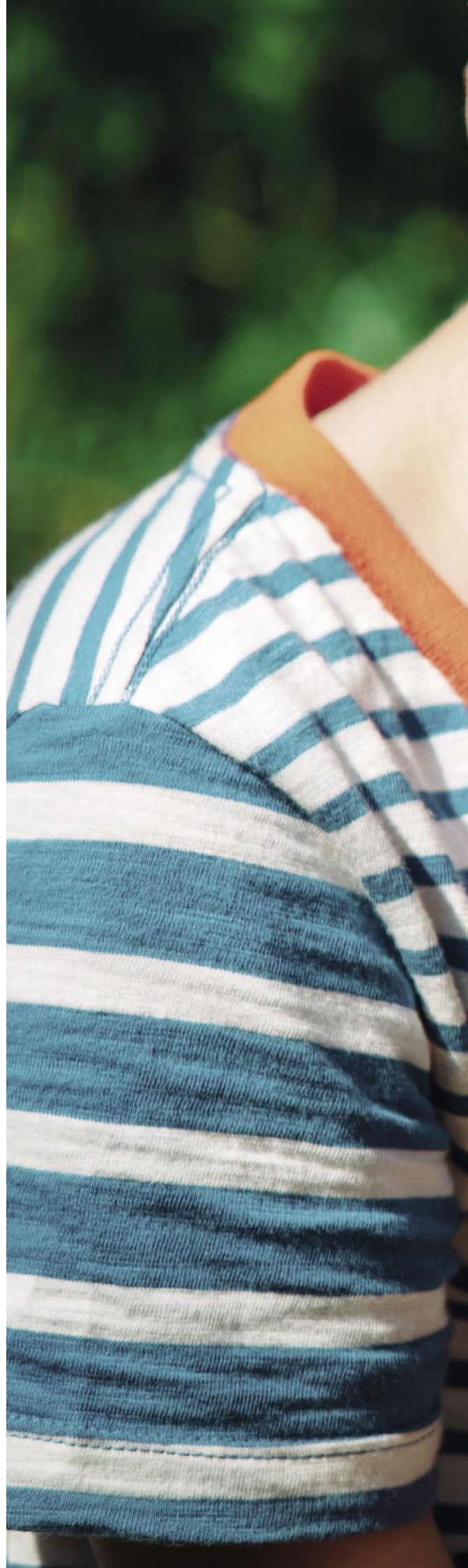
'Discovery, like surprise, favours the well prepared mind'

(Bruner, 1961, p. 21).



Enabling factors

- Teachers using guided discovery methods need to make informed judgements about the type and quantity of guidance to provide their learners, and how to specify the intended outcome of learning. In some instances, direct instruction provides the optimal conditions for cognitive processing, but in others, a mix of guidance and exploration is required (Mayer, 2004).
- Dean and Kuhn's (2007) study investigated the depth and durability of learner knowledge gains with practice, rather than the speed of knowledge gain. Learners who demonstrated competency well after instruction spent more time on task. This has implications for curricula and scheduling; if it takes time to foster deep learning there will be a cost to content coverage.
- Teachers must view effective guided discovery methods as those which activate and prepare the mind to make a discovery, rather than those which abandon the child to discover purely on their own.
- The results of Hotulainen, Mononen and Aunio's (2016) study hinge partly on the structure and sequence of the intervention, and the skills of the teacher delivering the program. The thinking skill intervention supported previously low performing learners to demonstrate 'remarkable improvements' (p. 370) across many measures. However, the authors suggested that the quality of instructional design and delivery might have positively influenced children's learning habits and motivation.







Inquiry-based learning

What is it?

Inquiry-based learning is a student-centred approach to teaching and learning where a unit of work is organised around relevant, authentic, open-ended questions. It is characterised by its emphasis on process, questioning, student voice, building on prior knowledge, active learner involvement, the involvement of internal and external school-community resources, iterative or recursive learning, reflection and deep thinking, ongoing assessment, and learning leading to action (Lutheran Education Queensland, n.d).

There is substantive evidence to suggest that inquiry-based learning is an effective strategy to foster a range of skills and knowledge. Researchers such as Hmelo-Silver, Duncan and Chinn (2007) argue that teachers using inquiry-based learning 'provide extensive scaffolding and guidance to facilitate student learning' (p. 99) and that these provisions underpin effectiveness. However, like discovery learning, the efficacy of inquiry-based learning has been challenged in recent years (Hattie, 2008; Kirschner, Sweller & Clark, 2006; Mayer, 2004). Claims about the ineffectiveness of inquiry-based learning are tied to the false notion of minimal guidance. Detractors suggest that inquiry-based learning does not guide learners 'as to the content, scope or standards required for satisfactory completion of a task' (Dinham, 2017, p. 18). This claim is commonly refuted by inquiry-based learning researchers (Di Mauro and Furman, 2016; Furtak, Seidel, Iverson & Briggs, 2016).

Inquiry-based learning has been adopted widely by educators and systems around the world. It is employed as a strategy to foster scientific thinking skills such as experimentation, evaluating evidence, and inference. The US National Science Education Standards (National Research Council, 1996) emphasise the centrality of inquiry to science learning, both to scientists undertaking research, and to learners' understanding of scientific knowledge. Inquiry is also helpful to teachers both as a strategy

to transmit scientific knowledge and as a tool to talk about the important work of scientists to their learners. Inquiry-based learning is mandated by the Australian Science Curriculum to foster scientific skills (Nichols, Burgh & Kennedy, 2017).

Inquiry-based learning is also used by systems to foster critical thinking, interdisciplinary and social studies learning. Friesen and Scott (2013) said that in Alberta, Canada, 'most of the major subject-specific curriculum documents contain the term inquiry and it holds a central place in both the science and social studies programs of study' (p. 3). The International Baccalaureate Organization's Primary Years Program includes a number of transdisciplinary themes around which units of inquiry are organised (Campbell, Chittleborough, Jobling, Tytler, & Doig, 2014). The Teaching and Learning International Survey of 34 countries and sub-national identities conducted in 2013 (OECD, 2014) reported that most teachers surveyed believe that it is their role to facilitate students' own inquiry (94%), and that students should be allowed to think of solutions to practical problems themselves before teachers show them how they are solved (92%) (p. 164).

Inquiry-based learning aligns with learning through play as defined by the LEGO Foundation in the following ways:

- Meaningful, authentic questions are key to effective inquiry-based learning and inquiry skills development (Goldstein, 2016).

Relevant, meaningful, and authentic open-ended questions such as 'how can we turn our classroom into a museum?' or 'what does it mean to make a wise choice?' are at the heart of quality inquiry-based learning

(Murdoch, 2014).

- Barron and Darling-Hammond (2008) describe how inquiry-based learning frequently involves learners working in groups or pairs to solve problems, complete projects, or design and build artefacts. Nichols, Burgh and Kennedy (2017) agree that cooperative learning is often built into inquiry to leverage the benefits of peer and group learning to foster social and interpersonal skills.
- Hmelo-Silver, Duncan and Chinn (2007) describe how learners are 'cognitively engaged in sense-making, developing evidence-based explanations, and communicating their ideas' in inquiry-based learning.
- Inquiry-based learning is designed to emphasise exploration, open-endedness and iterative trial and error. Using inquiry-based learning has been found to explicitly recalibrate learner expectations, offsetting anxiety about not succeeding (Fielding-Wells, O'Brien & Makar, 2017).
- Fielding-Wells, O'Brien and Makar's (2017) study found learners revealed their enjoyment of and interest in inquiry-based learning through increased motivation. Motivation inspired learners to learn more; to go beyond the task requirements.
- Scientific inquiry skills: Inquiry-based learning, and its role in fostering scientific thinking skills, such as experimentation, evaluating evidence, and inference, was tested by Di Mauro and Furman (2016) in a quasi-experimental longitudinal study of fourth grade learners in Argentina. Di Mauro and Furman found that only learners in the experimental group, who participated in guided inquiry-based instruction, were able to reach advanced ability levels in experiment design.
- Scientific concepts and skills: Furtak et al., (2016) conducted a meta-analysis of 22 empirical studies regarding inquiry-based learning and found that it is particularly effective when it provides opportunities for learners to learn about and practice:
 - The procedures related to scientific knowledge and skills such as experiment design and data collection
 - The nature of knowledge in science; drawing conclusions from evidence and generating and revising theories
 - Working in groups, participating in class discussions and presenting ideas or projects.
- Mathematics learning engagement and motivation: Fielding-Wells, O'Brien and Makar (2017) conducted a qualitative study exploring the use of inquiry-based learning to foster motivation and engagement in mathematics learning for 9-10 year old Australian learners. They found that learners in guided inquiry classrooms recalibrated their expectations about learning, accepting trial and error and failure as essential to extend their learning and improve performance. They concluded that inquiry-based learning can promote mathematics learning self-efficacy.

Evidence of impact

A sample of recent evidence of the impact of inquiry-based learning is as follows:

- Strong learner engagement and motivation: Alford, Rollins, Stillisano, and Waxman (2013), in their qualitative study of 85 International Baccalaureate (IB) classrooms in Texas, revealed that instruction was active and engaging. It involved learners fostering new skills and understandings of new concepts through processes such as explaining, elaborating and evaluating. Learners were observed spending a far greater amount of time on task in IB classrooms than in classrooms in other observational studies.



Enabling factors

The specific features of inquiry-based learning that contribute to its effectiveness as a strategy include:

- **Planning:** Successfully implementing inquiry-based learning 'requires planning and well thought-out approaches to collaboration, classroom interaction and assessment' (Barron & Darling-Hammond, 2010, p. 213).
- **Teacher guidance:** The level of teacher instructional guidance required will be determined by both the grade level and depth of scientific knowledge required to solve the problem. In Di Mauro and Furman's study (2016), the teacher's role in the inquiry unit was to 'closely guide' learners through key questions and interventions.
- **Integration:** Di Mauro and Furman (2016) found that inquiry-based learning was effective in fostering fourth grade learners' experiment design skills when it included the following:
 - Everyday problems or inquiry topics with low conceptual load
 - Combination of independent learner work, teacher guiding questions, and moments of explicit instruction.
- **Teacher training:** Shymansky, Hedges and Woodworth (1990) found that learners whose science teachers had received training in inquiry-based learning methods outperformed learners in traditional learning environments. The latter were characterised as those that emphasised the knowledge of scientific facts, laws and theories, and used laboratory activities to supplement learning rather than as the basis for learning.
- **Program design:** Inquiry-based science programs should include short and long-term learning goals, content and curricula aligned with interests, knowledge, understanding, experiences and abilities of learners, and collegiate collaboration across grades and disciplines (National Research Council, 1996).



Problem-based learning

What is it?

Problem-based learning involves working through and reflecting on problems in small self-directed groups, with guidance from teachers as facilitators (Maudsley, 1999). In problem-based learning, the context for learning is set via a real-world problem with multiple dimensions, around which a unit of work is planned. This is similar to inquiry-based learning, where units are planned around questions.

Problem-based and project-based learning are often referred to as a subset of inquiry-based learning (Barron & Darling-Hammond, 2010). Like inquiry-based and discovery learning, problem-based learning has been cast as minimally guided and less effective than more teacher-directed approaches. Researchers have responded with descriptions of the structures and scaffolding that surround effective problem-based learning, including whiteboard narration of the key problem solving outputs such as facts, hypotheses, learning issues, and action plans, as maintained by learners (Hmelo-Silver, Duncan & Chinn, 2007).

Problem-based learning is often posed as a strategy to foster problem solving skills. Evidence suggests that this outcome can only be achieved if problem solving strategies, processes, and subordinate skills, such as collaboration, are explicitly taught, not self-discovered (Mills & Kim, 2017). In addition, an individual's ability to solve problems rests on the organisation of their existing knowledge, what they notice, and how they represents problems (Bransford, 2000).



Problem-based learning aligns with the five features of the LEGO Foundation's learning through play in the following ways:

- Meaningful problems are at the heart of effective problem-based learning; they must 'resonate with learners' experiences, promote argumentation, provide opportunities for feedback, and allow repeated exposure to concepts' (Barron & Darling-Hammond, 2010, p. 205).
- Problem-based learning is usually facilitated by small group or peer work (Barron & Darling-Hammond, 2010; Ortiz, 2015) which, in turn, positively influences learners' social skills, including cooperation, group decision making skills, and teamwork (Akinoğlu & Tandoğan, 2007).
- Akinoğlu and Tandoğan (2007) found that their problem-based active learning intervention positively influenced learners' academic achievement and attitudes towards science learning. Self-efficacy, motivation, and engagement are closely associated.
- Iterative cycles of reflection, action, and ongoing improvement of work underpins effective problem-based learning (Barron & Darling-Hammond, 2010).
- Akinoğlu and Tandoğan (2007) found that problem-based learning taught Turkish students self-control, planning and how to express their emotions. Learners in their study reported finding problem-based learning to be enjoyable, specifically citing the use of stimulus materials, scenarios, and group work as creating a positive learning environment. Further, enjoyment and motivation are not incompatible with challenging learning – in other words, they can co-exist. Cotič and Zuljan (2009) reported that their problem-based learning intervention was more demanding and difficult, yet learners' motivation and confidence did not decline.

Evidence of impact

Evidence of the positive impact of problem-based learning on student learning achievement includes:

- **Mathematical problem solving:** Responding to the issue identified in international mathematics studies, that Slovenian learners are skilled at mathematical computations but struggle with solving mathematical problems, Cotič and Zuljan (2009) designed a problem-based instructional model and study to investigate mathematical problem solving ability in nine year old learners. They found that learners who received the problem-based instructional model were able to solve more difficult mathematical problems than learners who received the conventional instruction.
- **Science concepts, skills and attitudes to learning:** Akinoğlu and Tandoğan (2007) compared the achievement of seventh grade learners in Turkey who received science instruction using a problem-based active learning method with those who received instruction using traditional teaching methods. Learners in the experimental group demonstrated significantly higher achievement than learners in the control group. Also, learners in the experimental group exhibited fewer misconceptions and greater self-efficacy in relation to science concepts and problem solving skills.

Enabling factors

- **Structure and guidance:** When teachers reveal the lesson goal and guide and deliver scaffolded instruction to support children to undertake experiments, problem-based learning is more likely to cater to the needs of all learners (Hotulainen, Mononen, & Aunio, 2016).
- **Teachers' skills and knowledge:** Implementing effective problem-based learning design has been found to depend on teachers' skills and knowledge (Barron & Darling-Hammond, 2010).
- **Instructional design and teacher guidance:** For problem-based learning environments to be effective, they must feature descriptive feedback, opportunities for learner reflection, and explicit design with learner engagement in mind (Hmelo-Silver, Duncan & Chinn, 2007).
- **Teachers' role:** According to Akinoğlu and Tandoğan (2007), in problem-based learning environments, the teacher is a mentor that guides learners. They do this by monitoring discussions, asking questions, assisting to resolve conflict, enabling equitable contribution, providing examples, and conducting evaluations.
- **Applicability:** Problem-based learning is well suited to deeper learning, where learners already have surface level knowledge about the problem context (Hattie, 2008).
- **Assessment:** As with other integrated pedagogies, assessment of problem-based learning is also challenging, requiring rubrics, portfolios, demonstrations or displays.



Project-based learning

What is it?

Project-based learning is a type of inquiry-based learning where the output – a project – is the central idea around which learning is planned and structured (Hood Cattaneo, 2017). Key features of the pedagogy include learning by doing – undertaking complex tasks and producing realistic products culminating in events, or presentations to an audience (Barron & Darling-Hammond, 2010). Thomas (2000) listed five distinguishing features of project-based learning as:

- Projects are central, not peripheral, to the curriculum
- Projects are framed around driving questions or ill-defined problems
- Projects must involve learners in constructive investigations which challenge learners to generate new understanding and skills, not only using existing knowledge and skills
- Projects are learner-driven to some degree, not teacher-led, scripted or packaged
- Projects are realistic, not 'school-like', in that they feel authentic to learners as determined by the roles they play, their collaborators, the products, audience, and the performance or assessment criteria.

(Summarised from Thomas, 2000, p. 3-4).

Project-based learning aligns with the LEGO Foundation's five characteristics of play in the following ways:

- When projects are meaningful, that is, they require sustained learner engagement, collaboration, research, management of resources and the development of an ambitious performance or product, they successfully support development of learners' higher order thinking skills (Barron & Darling-Hammond, 2010).

- Projects are usually completed in small groups, where the teacher's role is to guide the group process and participation. Under these conditions, healthy, positive social interactions occur and social skills are developed.
- Project-based learning is engaging and associated with positive changes to learners' motivation and attitude towards learning (Barron & Darling-Hammond, 2008).
- Project-based learning involving designing or creating an artefact requires iteration; where learners create, assess, and redesign their product (Barron & Darling-Hammond, 2008).
- Goldstein (2016) described how project-based learning improved learners' 'attitudes towards learning physics, reducing fear, and increasing their self-efficacy and enjoyment of learning' (p. 1). Often, successful and productive partner or group work is the source of joy in project-based learning.

Evidence of impact

- Knowledge, skills, motivation and self-efficacy regarding environment studies: Kaldi, Filippatou and Govras (2011) conducted a study in Greece on the impact of project-based learning on Grade 4 learners' knowledge, skills and self-efficacy regarding the topic of ocean life. They found that learners demonstrated greater content knowledge and self-efficacy about environment studies, a preference for group work over individual learning, and positive attitudes towards learners with different ability levels and learners from different ethnic backgrounds.
- Information literacy and technology skills: Chu, Tse, and Chow (2011) conducted a study investigating the impact of a collaborative inquiry project-based learning approach on grade four learners' information literacy and IT skills in Hong Kong. They found that learners demonstrated general improvements in information literacy and

IT skills according to pre and post intervention tests. In addition, learners reported valuing these skills and their contribution to completing projects. Chu, Tse, and Chow concluded that project-based learning is, in part, self-directed, and learners with higher motivation and engagement are more likely to be higher achievers, and therefore motivated to gain the skills associated with the intervention.

To develop higher-order skills, students need to take part in complex, meaningful projects that require sustained engagement, collaboration, research, management of resources, and the development of an ambitious performance or product

(Barron & Darling-Hammond, 2008, p. 3)

Enabling factors

- A supportive implementation context is essential to successfully implement project-based learning. Management, planning, and administration of classroom projects can be challenging for teachers, and require time and resources to ensure teachers and learners working under the project-based learning condition have the best chance to succeed.
- When learning through projects, learners often need to initiate an inquiry, direct an investigation, manage their time, and use technology productively. Teachers must have the time, training, resources, and skills to support and guide learners to undertake such endeavours.





Montessori education

What is it?

Montessori education, often described as the Montessori Method, was developed by Dr Maria Montessori in Italy in the early 1900s based on her observations and experiments with methods appropriate for educating young children with special needs or those who had experienced disadvantage (Marshall, 2017). Montessori education recognises the interplay between teacher, child, and the environment, and the role of each in facilitating learning. The learning materials and the prepared environment for learning are particularly important in Montessori education. Other key features include hands-on learning, group and pair work, self-directed learning with teacher guidance, and lack of competition and extrinsic rewards or punishments (Marshall, 2017).

Montessori education aligns with the LEGO Foundation's five characteristics of play in the following ways:

- Children move and manipulate learning objects and materials which provide the concrete foundation that prepares them to engage with more abstract concepts (Marshall, 2017). This closely aligns with the definition of meaningful learning in Learning through play: a review of the evidence (Zosh et al., 2017)
- Montessori education capitalises on the benefits of positive social interactions. 'Montessori education is characterized by multi-age classrooms, a special set of educational materials, student-chosen work in long time blocks, collaboration, the absence of grades and tests, and individual and small group instruction in both academic and social skills' (Lillard & Else-Quest, 2006, p. 1893).
- Hands-on activities, educational materials and the learning environment as the third teacher, are characteristics of Montessori associated with active engagement and motivation (Marshall, 2017). Rathunde and Csikszentmihalyi (2005)

found when compared with their peers in traditional middle schools, young adolescents in Montessori middle schools demonstrated greater intrinsic motivation.

- Learning materials support iteration in that each has 'a "control of error" which alerts the child to any mistakes, thereby allowing self-correction with minimal teacher support' (Marshall, 2017, p. 11).
- Joyful learning can be perceived in Montessori education by positive relationships with peers, teachers and within families. 'On a questionnaire regarding their feelings about school, Montessori children indicated having a greater sense of community, responding more positively to items such as, "Students in my class really care about each other" and "Students in this class treat each other with respect"' (Lillard & Else-Quest, 2006, p. 1894).

Evidence of impact

Despite the existence of Montessori education for over 100 years, few high quality efficacy evaluations exist. Those that do provide evidence of positive impact on the following learning areas:

- Reasoning skills, positive shared play, and creativity in writing: Lillard and Else-Quest (2006) found that Montessori-educated children in Wisconsin, US, demonstrated a higher level of reasoning than non-Montessori-educated children in their study. Montessori-educated children were observed to more frequently engage in positive shared play and less likely to engage in rough play than non-Montessori-educated children. On measures of creative essay writing, Montessori-educated and non-Montessori-educated children performed similarly with regard to spelling and punctuation, but Montessori-educated children demonstrated more creativity in their responses.

- Self-regulation, positive work habits, and reading and mathematics performance: Ervin, Wash and Mecca (2010) conducted a three-year study of the self-regulation abilities of over 250 children at Kindergarten, Grade 1, and Grade 2, comparing those educated in Montessori classrooms and non-Montessori classrooms, in South Carolina, US.

Montessori-educated learners more frequently demonstrated positive work habits than learners educated in non-Montessori classrooms, and these skills increased year on year

(Ervin, Wash & Mecca, 2010).

In contrast, children educated in non-Montessori classrooms demonstrated a decrease in teacher-reported self-regulation skills or showed no change as they progressed from kindergarten through to second grade. Parents of Montessori-educated children more frequently reported that their children could solve everyday problems independently, and talk about the feelings of others, than did parents of children educated in non-Montessori classrooms (Ervin, Wash & Mecca, 2010). Children educated in Montessori classrooms achieved higher average scores on reading and mathematics than children educated in non-Montessori classrooms.

- Creativity: Besancon and Lubart (2008) found that learners educated in alternative pedagogy schools achieved higher results on creativity measures compared with children educated in schools using traditional pedagogy. Further, they found that the creativity skills demonstrated by children educated in Montessori schools exceeded those demonstrated by children in non-Montessori schools.

Enabling factors

Most studies do not isolate the factors that differentiate the efficacy of Montessori education over other 'traditional' or 'conventional' approaches to education, as they are described in the research. The main enabling factor was found to be:

- Fidelity to the method: There were considerable differences between implementation environments, and varying degrees of adherence to the Montessori Method. Studies comparing schools that adapted the method with schools that implemented the method faithfully have generally found high-fidelity Montessori schools to be more effective (Lillard, 2012).



4. A model for learning through play at school

The five characteristics associated with learning through play map onto the eight pedagogical approaches in the following way. This confirms the hypothesis that these approaches are related to learning through play, and the characteristics are valid within and relevant to the primary school learning context.

Approach	Meaningful	Socially interactive
Active learning	Integration of home and school, and seeing learners' experiences, knowledge and interests as central to learning	Group work, peer learning Positive teacher-learner interactions
Cooperative and collaborative learning	Meaningful tasks, scaffolding Group reflection/processing	Group work using cooperative learning strategies, fostering positive peer learning relationships
Guided discovery based learning	Integrating new information with existing knowledge base	Group work for positive social interactions
Experiential learning	Having and using experiences as basis for understanding, and selecting learning activities	Regrouping learners to learn in novel situations, such as outdoors etc. expands social networks and breaks down established dynamics
Inquiry-based learning	Meaningful, authentic questions to guide inquiry. Questions are self-sustaining, provocative, and important to learners, and compel them to find out more, e.g. 'to what extent does art reflect or shape our culture?'	Inquiry-based learning usually involves working in groups or pairs to research and investigate issues or questions
Problem-based learning	Meaningful problems that resonate with learner experiences, and promote argumentation	Usually uses group or peer work to foster social skills
Project-based learning	Meaningful projects require sustained engagement, collaboration, research, management, and an ambitious product or performance	Usually completed in groups
Montessori education	Moving from concrete to abstract, use of learning objects	Multi-age classrooms, free movement and freedom for social interaction

Table 3: Integrated pedagogies and the five characteristics of learning through play

Active engaging	Iterative	Joyful
The notion of freedom or choice related to learning activities	Investigating and exploring concepts	Enjoyable based on positive peer and learner-teacher relationships
Positive interdependence and individual accountability leads to vested interests and engagement	Learners sharing, revising and recalibrating thinking based on group inputs	Positive social interactions make learning enjoyable
Guidance – relevant information is emphasised, not explicated, so learner engagement remains high	Trial and error used in scientific skills development such as designing non-confounded (sound) experiments	Agency and active disposition in guided discovery leads to self-efficacy and enjoyment of learning
Engages children who are at risk though involving them in novel activities enabling them to use skills and knowledge potentially concealed in traditional settings	Investigate, explore and experiment with different phenomena in context	Learners enjoyed experiential learning for its novelty – new books or experiences, or new capabilities – performing acts, making connections, doing things that they did not know they could do
Active engagement combines affective, behavioural and cognitive dimensions. When inquiry-based learning is structured to foster self-efficacy and active bodies and minds in pursuit of a deep learning objective, it combines all three	Encourages exploration, open-endedness, and iterative trial and error (Fielding-Wells, O'Brien & Makar, 2017) when teachers use targeted, guiding and encouraging questions. Learners take risks and see 'failure' as a process	Active engagement in learning leads to increased motivation, self-efficacy and enjoyment of learning
The use of prepared problem scenarios that related science concepts to learners' daily lives cognitively engaged learners. The experience of working in groups engaged them affectively (Akinoğlu & Tandoğan, 2007)	Includes cycles of reflection, action and ongoing improvement	Learners report enjoyment of learning when they can relate to problem scenarios, and when they work well with peers
Engagement is perceptible from increased motivation, due to interest in project content, roles, and structure	Learners create, assess, and redesign their product in project-based learning conditions	Associated with increased self-efficacy and enjoyment of learning
Hands-on activities, educational materials and supportive learning environment associated with engagement and motivation	Learning materials supporting self-correction	Positive interactions with peers and teachers

In Table 3 we located and consolidated descriptors within each approach that align with each of the LEGO Foundation's characteristics of playful learning. This was undertaken by reviewing the evidence for each integrated pedagogy, locating the key characteristic term, reviewing its definition within this context, and then checking this definition against the LEGO Foundation's description of this characteristic (Zosh et al., 2017).

By mapping integrated pedagogies onto the five characteristics of learning through play, we have extended the descriptions of these characteristics to apply to the primary school learning context. Previous LEGO Foundation research (LEGO Foundation, 2017; Zosh et al., 2017) includes descriptors for these characteristics drawing largely upon research regarding learning through play in early years education (ages 0-8 years). Here, we have consolidated research regarding integrated pedagogies to create descriptors relating to education contexts for children aged 6-12 years.

As it was possible to identify all five characteristics in literature for all eight integrated pedagogies, we suggest that the characteristics may work as a system, or model. The hypothesis of interdependence between characteristics requires further investigation in future studies. It would be beneficial to understand how the characteristics reinforce and relate to each other, and to the learning outcomes that are often associated with integrated pedagogies.

Characteristics of learning through play at school

Based on Table 3: Integrated pedagogies and the five characteristics of learning through play, we conclude that effective integrated pedagogies are:

Meaningful when they integrate learners' experiences and knowledge from home and school. This gives a voice to learners' experiences and backgrounds and makes learning meaningful and culturally relevant to them. They are meaningful when they are designed to include relevant and engaging tasks, inquiry questions, problems or projects; that is, those that are self-sustaining, and provocative, compelling learners to find out more. Integrated pedagogies are designed to include processes that enhance meaning, such as group reflection on learning, and scaffolding – guiding learners from what is known to what is unknown; from the concrete to the abstract.

Socially interactive, when they involve learners working together in groups, using strategies that have been designed to maximise the benefit of cooperative learning. When learning occurs in new and different settings and contexts, for example, outdoors, on a field trip, or in a group around an activity or experiment, it can expand social networks and dissolve social dynamics established in traditional classroom settings, developing interpersonal, communication, and social skills.

Actively engaging, when learners have choices – big or small – to make about the content or processes involved in their learning. Active engagement occurs when learners can rely on and support other learners, and receive guidance, rather than explication from their teachers to formulate understandings and develop new skills. Active engagement comprises the three dimensions of feelings about learning (affective), conduct and actions towards learning (behavioural) and thinking and processing about and within the learning context (cognitive). The most effective integrated pedagogies attend to all three dimensions. Engaged learners demonstrate motivation and commitment towards their learning, often extending themselves beyond set goals and expectations.

Iterative, when learners have the opportunity to explore and investigate new concepts; to try, and fail, and try again. When learners share their ideas with each other and revise and recalibrate their thinking based on the inputs of the group, learners' abilities are extended and transformed. Teachers encourage iteration through guiding learners with targeted, encouraging questions, hints, and modelling.

Joyful, when learners have positive peer and teacher interactions and positive learning experiences. This is characterised by having and making choices, experiencing learning in a range of settings, personally relating to the content of their learning, and feeling able and confident about their learning.

Within each descriptor there are aspects of the instructional design, teacher disposition and role and learner disposition and role that create the positive enabling environment for an integrated pedagogy.

Skills and learning outcomes

This review scoped evidence regarding the impact of integrated pedagogies on fostering holistic skills. Below we tabulated and summarised this range of skills, attitudes, behaviours, and learning outcomes, which were exemplified in chapter three.

Included are the main outcomes, competencies, or skills measured by the research interventions reviewed, as they align with the LEGO Foundation

holistic skills categories. However, it is important to note that integrated pedagogies are often blended in practice; for example, teachers might combine approaches such as inquiry and collaborative learning to foster reading comprehension. Also, researchers anecdotally observed additional learning-related benefits, such as enhanced learner engagement and motivation. When the research design did not include measurement of these gains, they were not included here.

Table 4: Breadth of skills measured by research included in this study

*Exact duplicates were deleted

Skill domain from What we mean by learning through play (LEGO Foundation, 2017)	Outcome as described in the literature reviewed	Integrated pedagogy as described in the literature reviewed
Cognitive skills	Cognitive achievement, Computer skills, Conceptual understanding, Conflict resolution, Decision making, Engineering concepts and skills, Essay writing, Explaining representations, Higher order thinking skills, Inductive and deductive reasoning, Interpreting, Knowledge transfer, Mathematics concepts and skills, Mathematics reasoning strategies, Metacognition, Negotiating skills, Planning skills, Problem solving skills, Reading comprehension, Reasoning strategies, Recall skills, Referential communication, Science concepts and skills, Study skills, Theory of mind, Thinking skills	Active learning Collaborative inquiry-based learning Collaborative learning Cooperative learning Guided discovery learning Inquiry-based learning Montessori education Peer tutoring Problem-based active learning Problem-based learning Project-based collaborative learning Scaffolding Socio-constructivist
Creative skills	Creativity, Divergent thinking, Inventiveness	Collaborative learning Montessori education
Emotional skills	Confidence, Emotional skills, Engagement, Enjoyment of learning, Executive function, Learner wellbeing, Listening skills, Motivation, Positive classroom behaviour, Science self-efficacy, Self-efficacy, Self-regulation	Active learning Collaborative active learning Cooperative learning Experiential learning Guided discovery learning Inquiry-based learning Montessori education Problem-based learning
Physical skills	Fine motor, gross motor	Active learning Guided discovery learning Montessori education
Social skills	Collaboration, Communication skills, Interpersonal skills, Negotiating skills, Positive peer play, Social connections, Social regulation, Social skills, Verbal/social skills,	Active learning Cooperative learning Experiential learning Guided discovery learning Inquiry-based learning Montessori education

This audit suggests that the studies reviewed were more likely to measure the impact of integrated pedagogical interventions on cognitive skills. There was a greater range and differentiation within the cognitive skills domain, and types of tests used. This could indicate that measuring cognitive achievement is a more advanced field than the measurement of non-cognitive domains, and therefore frameworks and instruments were more readily available. It finds that researchers are more likely to rationalise the value of integrated pedagogies on their contribution to cognitive over non-cognitive outcomes and skills. Further, inquiry-based and discovery learning have traditionally been associated with fostering science-related skills and processes, which explains the greater extent of cognitive learning outcomes measured against these interventions.

While this is not an exhaustive review of integrated pedagogies, it suggests that additional research regarding the impact of integrated pedagogies on non-cognitive skills would be beneficial to extending understanding about the broad contributions these pedagogies could make to holistic skills development.

Integrated pedagogies

This study uses the term 'integrated pedagogies' to describe how learning through play is an incorporated approach with similarities to the eight approaches reviewed in this study. This term is explained in Marbina, Church, and Tayler's (2011) evidence paper regarding integrated teaching and learning approaches, and was incorporated into the Victorian Early Years Learning and Development Framework (VEYLDF) (Department of Education and Training, 2016). Marbina, Church, and Tayler describe integrated teaching and learning to mean **combining** child-directed learning, teacher-guided learning, and teacher-directed learning.

The best learning outcomes occur for children when there is a balance between different types of direction, and opportunities for all types are planned and provided for

(Marbina, Church & Tayler, 2011)

The combination of these guidance and direction types are presented as a triple helix, below.

Figure 4: Integrated teaching and learning approaches



(Reproduced from the Victorian Early Years Learning and Development Framework, Department of Education and Training, 2016, p. 15).

The triple helix symbolises three strands of activity working in harmony together. All three are essential components and the structure is weaker for the absence of one. Marbina, Church and Tayler (2011) explain that learning environments dominated by one approach are not effective, and the teacher must make judgements about when and how to provide opportunities for a mix of each.

The concept of 'integration' is also used in the VEYLDF to connote how learning through play offers opportunities to foster the full array of holistic skills, including cognitive, social, emotional, creative and physical (Department of Education and Training, 2016). This notion also relates to this study and the pedagogies included here.

While the VEYLDF policy was created for the early years up to approximately Grade 2, it has broad relevance. Literature reviewed for this study consistently described how teachers successfully implemented pedagogies by providing learners with opportunities for:

- **Child-directed learning:** making choices about the content and process of learning
- **Teacher-guided learning:** providing scaffolded learning at appropriate points
- **Teacher-directed learning:** providing initial framing and explicit instruction when needed.

More research is required to expand descriptions of each of these direction/guidance types as they apply within the primary school learning context (within and beyond the early years).

Learner choice and agency

A number of studies referred to 'learner choice' as a central or essential feature of integrated pedagogies. Choice in learning, as in what learners do and or how they do it, was seen as distinguishing passive teacher-led from active learner-centred environments (Martlew, Stephen & Ellis, 2011). Autonomy was also apparent in freedom of movement. Integrated pedagogies were more likely to involve learners' moving around classrooms, seeking out and retrieving resources and assistance from teachers or peers,

as required to complete tasks or projects (Friesen & Scott, 2013). Mannion and Mercer's (2016) UK study of the impact of 'Learning to Learn' (learning strategies) on learner performance was intentionally designed to involve learners choosing the content and format of their projects. This element was associated with fostering engagement, motivation and positive disposition towards learning.

Autonomy was also described as the goal for learning to work towards making informed decisions about how to achieve project or inquiry goals, how to research, communicate, and solve problems (Tan & Chapman, 2016). Independence is fostered through experiential practice by a learner continually making choices about their learning, and choice-making ability growing in accordance with a learner's ability and skills (Fullan & Langworthy 2014).

Making choices within a fairly structured formal learning environment, that is, a primary school classroom, is very different to the notion of free play. Free play, in early childhood education, is described as child-directed, voluntary, and flexible (Fisher, Hirsh- Pasek, Newcombe, & Golinkoff, 2013). However, it appears that within the discourse of integrated pedagogies, learner choice in school is a notion related to free play, particularly when considering the similarities in associated benefits. Free play is beneficial for social competence and self-regulation, fostering problem solving skills, impulse control, self-expression, understanding of social rules, and supporting the emotional wellbeing of others (Danniels & Pyle, 2018). Correspondingly, learner choice and voice in learning is associated with a similar range of skills, competencies, and characteristics, as outlined below:

- Culturally responsive, inclusive education (Djonko Moore et al., 2017; Lillemyr, Søbstad, Marder & Flowerday, 2011)
- Meaningful learning (Djonko Moore et al., 2017; Leat, 2017; Verner & Lay, 2010, p. 68, as cited in Simmons et al., 2011)
- Personalised learning (Hixson, Ravitz, & Whisman, 2012)
- Holistic skills (Lillemyr, Søbstad, Marder & Flowerday, 2011)

- Ownership of learning (Fullan & Langworthy, 2014)
- Communication skills and self-expression (McBride, Chung & Robertson, 2016; Smith, 2015)
- Empowered learners (Smith, 2015)
- Self-actualised learners (Smith, 2015)
- Executive function (Rhea and Rivchun, 2018)
- Planning and problem solving skills (Rhea and Rivchun, 2018)
- Resetting brain for learning (Rhea and Rivchun, 2018)
- Motivation, engagement and increased focus (Lillemyr, Søbstad, Marder & Flowerday, 2011; McCombs, 2011, in Briggs & Hansen, 2012; Siew, Amir & Chong, 2015; Tan & Chapman, 2016)
- Iterative skills (Biordi & Gardner, 2011)
- Citizenship identity and skills (Hart, 1994, as cited in Biordi & Gardner, 2011)
- Equitable learner achievement (Zhao, 2015)
- Achievement in traditional learning areas (e.g., reading), when enhanced with strategy instruction (Hmelo-Silver, Duncan, & Chinn (2007).
- Differentiated learning (Verner & Lay, 2010, p. 68, as cited in Simmons et al. 2011).

Viewing learner choice and voice as related to learning through play and its associated benefits enables us to connect these notions. Further investigation is needed to determine the value, benefits, and possibilities for choice in learning as a playful or essential element in integrated pedagogies, and also whether 'freedom' is an essential corresponding characteristic of learning through play.

On the following page we present some of the features of learning environments that are effective in providing opportunities for learners to make and foster decision making skills and self-expression skills, compared with those learning environments that are emergent or do not provide these opportunities. These features were derived specifically from evidence regarding the eight approaches included in this study.

Additional research is required to understand the successive changes, stages, or degrees when moving from low to high choice effective teaching and learning environments.



Table 5: Integrated pedagogies and learner agency

Effective integrated pedagogies	Ineffective integrated pedagogies
Features	
Learners can make authentic and genuine choices (Fullan & Langworthy, 2014; Hixson, Ravitz, & Whisman, 2012; Verner & Lay, 2010, p. 68; as cited in Simmons et al., 2011)	When learners make choices, they are arbitrary; they make little difference to learning outcomes and therefore do not motivate and engage learners (Leat, 2017)
Learners ask teachers questions, offer opinions and make choices (Smith, 2015)	Teachers make decisions for and conduct learning tasks for children (Smith, 2015)
High learner interaction, often through collaborative learning (Fitch & Hulin, 2008)	Learners do not ask meaningful questions; they 'receive' over 'create' knowledge and have no control or choice (Leat, 2017)
Learners have freedom of movement to seek activities, resources and advice from teachers or peers (Smith, 2015)	Low learner interaction (Westbrook, Durrani, Brown, Orr, Prior, Boddy & Salvi, 2013)
Learners and teachers allow time for and overcome false starts and 'failures' when task choices need revisiting or groups are reformed (Tan & Chapman, 2016)	Learners sit at desks or are instructed to move to new stations by teachers (Smith, 2015)
Authentic and genuine choices about what and how to learn are offered in combination with other instructional strategies (Tan & Chapman, 2016)	Covering breadth of content is favoured over depth with little time to engage in deep exploration of a single topic (Schwartz, Sadler, Sonnert & Tai, 2008)
Teachers guide and support learners to make decisions about topics and working group membership (Smith, 2015)	Teachers create detailed weekly, even termly programs filled with teacher-directed activities and experiences aligned with key learning areas, leaving little to chance or choice (Weimer, 2011, in Smith, 2015).
Teachers offer some degree of learner choice and voice around carefully planned, managed and assessed rigorous tasks (Hixson, Ravitz, & Whisman, 2012)	
Choice making is treated as a skill learned gradually and exponentially (Fullan & Langworthy, 2014)	
Some enabling factors	

- High choice learning environments are associated with learner centredness and teacher collaboration (Smith, 2015)
- When systems support teachers to make choices regarding their teaching methods and practices they, in turn, foster
- high learner choice learning environments (Henriksen, 2012)
- Associated with self-efficacy – learners make choices based on what they believe they can do (Zimmerman, 2000, in Kaldi, Filippatou & Govaris, 2011): teachers must attend to learner confidence and self-belief in choice-offering learning environments
- Decision making is considered an essential skill – teachers are preparing learners to make safe and ethical choices in the future by making choices about their learning at school (McBride, Chung & Robertson, 2016).

5. Implementation quality factors

Successfully implementing integrated pedagogies in different contexts depends on a range of factors, many of which have been included above, organised by the relevant pedagogy. Here, we discuss in greater detail the common factors that enable or challenge implementation of integrated pedagogies, as they relate to specific features of education systems. These include curricula, assessment, teachers and teacher professional learning, and features of the learning context such as schools, communities, and cultural contexts. This discussion is intended to support greater understanding about what makes integrated pedagogies work in different contexts. It acknowledges that pedagogy is intertwined with theories of learning, curricula, teachers, teacher education, schools, and education bureaucracies, and must be considered within these systemic contexts.

Curriculum and assessment:

Depth not breadth

Empirical studies of the impact of inquiry-based, discovery learning, and project-based learning cited in this study describe how fostering deep and durable learning takes time. Studies reviewed here found that learning gains made under guided inquiry-based and guided discovery learning conditions were sustained over a longer time period than those made under explicit or unguided learning conditions. However, learners under the former conditions spent more time on task designing experiments, projects and investigating problems (Dean & Kuhn, 2007; Di Mauro & Furman, 2016; Goldstein, 2016).

Accordingly, if curricula are broad in content and scope, covering a large amount of content areas and do not allow for flexible implementation, implementing an integrated approach to teaching and learning like project or problem-based learning may pose a challenge. Goldstein (2016) noted that 'meaningful learning takes place at the expense of the scope of the content' (p. 9). There is potentially a 'content cost' and a 'deeper skills and knowledge gain' when implementing project, problem or inquiry-based

pedagogical approaches. Pieratt (2010) described this scenario similarly, in her review of the High Tech High model in San Diego, California. High Tech High was founded by Larry Rosenstock in 1999 on the educational principles of 'personalisation, teacher as designer, adult world connection, and a common intellectual mission' (Pieratt, 2010, p. 53). High Tech High schools use a project-based learning model which focuses on 'depth not breadth'; an approach that diverges from an increasing focus in the US on content standards and accountability. While outcomes for learners who attend High Tech High schools are excellent (Pieratt, 2010), they do not, and cannot cover the range of content covered in Advanced Placement (AP) classes and examinations. Similarly, Schwartz, Sadler, Sonnert and Tai (2008) found a positive relationship between studying one major topic in depth at high school and learners' performance in college science. However, certain approaches, such as collaborative learning, may foster holistic skills within a broad curriculum.

Multidimensional and integrated assessment

Barron and Darling-Hammond (2010) described the importance of assessment in inquiry-based teaching and learning approaches including project and problem-based learning. They suggest that good assessment design can reveal the many benefits of these approaches over traditional instruction, such as a learner's ability to apply their knowledge and demonstrate reasoning skills. Accordingly, Barron and Darling-Hammond (2010) present three aspects to quality assessment of integrated pedagogies:

- Intellectually ambitious performance assessments
- Evaluation tools, guidelines and rubrics that are made visible and explained to or even developed with learners
- Formative assessments during project design and development in the form of feedback

Thoughtfully structured assessments can also improve instructional design and delivery (Barron & Darling-Hammond, 2010). Collaborative Learning Assessment through Dialogue (CLAD) (Fitch & Hulgín, 2008) is an instructional strategy which combines collaborative peer learning and formative assessment to improve learners' reading comprehension skills, as described below.

The Collaborative Learning Assessment through Dialogue Approach

First, learners organise into small groups and read a text. Then, they take an individual multiple-choice test about the text and turn it in for scoring. Subsequently, they take a test as a group, discussing each question and possible answers and seeking consensus, with one learner acting as group leader. The intervention was found to improve learner comprehension, and has multiple positive learning by-products including improved interpersonal skills, communication, self-efficacy, metacognition, reasoning, and decision-making skills (Fitch & Hulgín, 2008). Central to this evidence about assessment, and integrated pedagogies more broadly, is the notion that they are multidimensional, involving teaching, learning and, ideally, assessment of multiple areas.

Teacher education and training:

Teacher training, skills, knowledge and experience of integrated pedagogies

Many of the studies reviewed discussed the changes to teachers' initial education, professional learning, and practices that need to occur to help teachers shift their focus from delivering content to facilitating learning (Haßler et al., 2015). Riley (2013) reported that while teachers in China most liked the hands-on aspects of her active child-centred music pedagogy, they did not feel adequately prepared to deliver instruction of this kind. Similarly, Cotič and Zuljan (2009) described how

Slovenian teachers' undergraduate education does not prepare them to teach based on constructivist learning theory, as they view teaching largely through a transmission model. Effective delivery of integrated pedagogies generally requires additional training (Davison, Galbraith & McQueen, 2008). The specific skills and knowledge required by teachers to deliver integrated pedagogies are:

- Content or subject matter knowledge (Goldstein, 2016). Block et al. (2012) also found a positive relationship between student engagement and teachers' subject matter knowledge in an experiential learning program.
- Adequate training in or knowledge of specific strategies, structures and assessment requirements for integrated pedagogies such as guiding, scaffolding, questioning, or cooperative learning (Cefai et al., 2014; Goldstein, 2016). Barron and Darling-Hammond (2010) concurred that teachers must be aware that these approaches are not 'unstructured'. Cefai et al. (2014) cautioned that without adequate training, teachers could use an activity to control learners or modify behaviour, which contradicts the activity's intention.
- Class management techniques specific to integrated pedagogies, such as time management, supporting learners to work together effectively and remain motivated, particularly when facing difficulties (Barron & Darling-Hammond, 2010).

Teachers' prior experiences will influence how they view and enact their teaching practice. Haßler et al. (2015) described how teachers in Zambia use the same methods that were used to teach them. Westbrook et al. (2013) concurred that prior experiences of teaching and learning can prevent teachers from accepting new content and concepts. Given the sway of experiential learning in determining teacher practice, it is important that teachers themselves have the opportunity to experience integrated pedagogies such as project or

inquiry-based learning in their initial teacher education or professional learning programs. Goldstein's (2016) study of physics education for Israeli teachers using project-based learning revealed that teachers enjoyed learning via 'a new approach' and were convinced of its value in fostering deep and durable learning. A number of teachers described plans to use project-based learning in their own teaching practice. One teacher said:

'You learn better when you yourself are investigating and then you remember it. I will never forget what I learned in my project!

(Student teacher respondent, Goldstein, 2016, p. 5)

Learner factors

The relationship between learners' abilities and backgrounds and their performance when learning via integrated pedagogies was discussed briefly in several of the papers reviewed. A number of factors were raised for consideration, including learners' level of familiarity with integrated pedagogies, the cognitive and socio-emotional demands they placed on learners, and how applicable they are to learners of all learning profiles and backgrounds.

Demands of integrated pedagogies

Learners can sometimes find it difficult to generate or evaluate meaningful questions or they lack prior knowledge to extend the inquiry (Krajcik et al., 1998; Edelson, Gordon & Pea, 1999, in Barron & Darling-Hammond, 2010). Tan and Chapman (2016) describe the demands and expectations that project work placed on learners in Singapore. They stated that, in particular, making choices about project types, roles, and responsibilities was unfamiliar to learners. Further, they had to sustain interest in the project content through difficulties and ambiguities. This challenged even the most diligent learners. This evidence points to learner dispositions and skills relating to all three areas of engagement: affective, behavioural and cognitive. A learner reported, '[w]e had to spend three long hours counting bacteria. This is very tiring. You must be really resilient to finish the project' (Tan & Chapman, 2016 p. 89). This example illustrates that even when learning via integrated pedagogies with opportunities for

agency and choice, learners can encounter difficulty. This notion is described within the characteristic 'joy' in the LEGO Foundation's White Paper What we mean by learning through play (Zosh et al., 2017), where it states that learning through play can involve neutral or negative emotions, and '[s]ometimes frustration with a problem is necessary to feel the joy of breakthrough when it is finally solved' (p.19).

A number of studies describe the positive impact of integrated pedagogies in classrooms that included learners with a range of achievement levels in mathematics and reading, ranging from high to low, as described by researchers, including the following study of first grade learners in Finland.

Enriched discovery learning and cognitive skills development in Finland

Hotulainen, Mononen and Aunio (2016) found that low performing learners who participated in a thinking skills intervention delivered via guided discovery activities reached the achievement level of their high performing peers in thinking skills, mathematics, reading comprehension and fluency at the end of the intervention. The researchers intentionally included design features to address concerns about the appropriateness of the intervention to all learners. These features included framing, revealing the lesson goal, and delivering scaffolded instruction to learners. It appears that the structure of the intervention is an important condition for high achievement for all learners.

Diverse learner backgrounds

There is evidence to suggest that integrated pedagogies can promote inclusion and enhance the performance of diverse cohorts of learners, as described on the following page.

Using research for better implementation of integrated pedagogies

Sinnema, Sewell and Milligan (2011) used evidence-informed collaborative inquiry to improve teaching practice for diverse learners (aged 6-14 years) in New Zealand. In particular, their study was designed in response to the issue of the achievement gap between Maori and Pasifika learners and learners from the majority European descent cultural background and drew on evidence favouring culturally responsive pedagogy. The researchers present two detailed vignettes of how teachers incorporated evidence into their teaching practice. While one teacher chose her learners' texts for them, she did so based on her knowledge of her learners, their backgrounds and learning needs. She aimed to connect their learning with their family and culture and encouraged children to speak to their family about aspects of their culture and heritage relevant to their inquiry. The teacher said 'you live with experts, you need to go to those experts and find out' (2011, p. 254). This, in turn, strengthened her learners' cultural identity, pride and confidence, making a positive contribution to social and emotional development. Building the activity around learners' knowledge and experience made learning meaningful for them.

A second teacher who participated in that study drew on research about culture and sense-making to address the issue of learners' lack of engagement in her classrooms which was characterised by withdrawing from discussions and looking to the teacher for the answers. She demonstrated her lesson objective by sharing her own family tradition of needlework and sewing which had been passed down through four generations, and catalysed learners' own sharing of diverse cultural practices and traditions. This broke down the teacher-learner power distance relationship to one of co-learners. These conditions inspired deeper learning and greater connections between knowledge among learners.

Block et al. (2012) found that experiential learning was particularly valuable for engaging at risk learners in primary schools in Australia. The learners benefited from the leadership roles assigned to them during the program and exhibited qualities and skills that the traditional classroom did not allow for. Children described as being unable to stay on task for more than three minutes were deeply engaged in cooking and gardening activities for long periods, and as much as any other child participant. Children learned fractions while measuring ingredients, they 'wrote about the program because they enjoyed it, and science was observed to be present in all activities...including learning about seed life cycles, nitrogen fixation, the role of insects, and how to tell whether an egg is fresh' (p. 424). Volunteers were cited as a success factor to teaching and reinforcing these concepts, which cannot be individually reinforced in classrooms with high learner-teacher ratios. Barron and Darling-Hammond (2010) concurred, stating 'some learners who do less well in traditional instructional settings excel when they have the opportunity to work in a PBL [project-based learning] context' (p. 204).

Cooperative learning has been found to promote considerable affability among learners irrespective of sex, ability level, disability status, ethnicity and social class. Learners in collaborative learning groups have been found to develop compassion for and commitment to each other, despite initial impressions (Johnson & Johnson, 1991).

Schools and school resources:

Supportive line managers, school leadership, planning and scheduling

A number of factors were reported as enabling effective implementation of integrated pedagogies related to school leadership, management, and planning. Teachers reported that a supportive line manager who understood and championed play-based learning pedagogies in junior primary was a critical success factor (Jay & Knaus, 2018). Davison, Galbraith, and McQueen (2008) reported that the leadership of the head teacher, in establishing cooperative learning, was a critical success factor. For their study, the head teacher monitored the implementation of cooperative learning, and undertook observations of staff throughout the school.

Davison, Galbraith and McQueen (2008) cited three other success factors which may have broader relevance for other contexts:

- Whole of school and systemic commitment to the cooperative learning approach: Elements of the project were written into the School Development Plan, and in particular teachers' medium term performance plans. A staff members' title was adjusted to include cooperative learning coordination.
- Collaborative professionalism:
 - Encouraging a small group of teachers to use a few simple techniques contributed to the project's success, '[s]tarting with the simpler techniques, such as active listening... facilitated the learning of more complex cooperative learning structures later in the project' (p. 315).
- Working with champion schools: The project school had previously implemented an emotional literacy project. This prior experience was described as paving the way for the success of the collaborative learning project. This has important implications for the selection of pilot or intervention schools or systems.

Physical learning environments and material resources

Learning environments and their conduciveness to active engagement is a critical factor in this review. As stated, Montessori classrooms are intentionally designed to maximise opportunities for learners to explore, create, investigate and engage with learning objects, and with other learners. To encourage learner cooperation and creativity, it is important that there is space to move bodies and or desks (Bancroft, Fawcett & Hay, 2008). Barron and Darling-Hammond (2010) mentioned that resources, such as models, public forums, tools, books, films and field trips can support and scaffold both teachers and learners in inquiry and project-based learning.

Westbrook et al. (2013), however, in their rigorous review of pedagogy, curriculum, and teaching practices in developing countries, found that many learning

environments do not have these enabling features. They said that teachers might be aware of group learning, but were unable to implement it due to lack of material resources, or class sizes. They said that 'having large numbers of children in cramped classrooms, often with immovable desks, mitigated against group work, with even pair work creating unacceptable and unworkable noise levels' (p. 63). Westbrook et al. (2013) pointed to particular practices as effective in developing countries, which align with this review, such as group and pair work and using resources beyond the textbook. However it is unclear how these practices take shape in severely resource constrained environments. Further investigation on how to promote integrated pedagogies in these environments is needed.

Parents, caregivers, and communities: Pedagogies and family values

Parents and caregivers are also teaching their school age children, in their homes, through their interactions with children, modelling behaviour and espousing values and beliefs. Parents hold views on the purpose of education, what it should look like, and what constitutes quality. These views will inform their support for or opposition to particular approaches and how willing they are to support them in the home. Ervin, Wash and Mecca (2010) found alignment between parents and teachers approaches to discipline in Montessori classrooms. Parents of Montessori-educated children were more likely to model and explain when teaching discipline. In contrast, parents of non-Montessori-educated children were more likely to use punishment to teach discipline.

Actively engaging parents, caregivers, and communities

Parents' and caregivers' support for pedagogies and programs can be enhanced through school-community partnerships. Smith (2015) conducted a study on fostering learner and teacher engagement in a low socio-economic status school in Australia in mathematics and science through play-based learning. She established a parent stakeholder group to bring the school and community together, increase engagement, and involvement of parents in their children's learning. Smith found that most parents initially held negative views of play and learning; that

it was extraneous to schoolwork and classrooms. However, parents' views were transformed through their engagement with their program and they eventually were able to articulate the skills learners gained through the program including problem solving, fine and gross motor skills, imagination, and engagement. Smith invited parents into the classroom and their involvement progressed from initial observers to active participants and advocates for the approach. It is worth noting that Smith intentionally titled her program 'Active Learning', to counter teachers' lack of confidence in and negative views and experiences of play-based learning.

Block et al. (2012) found that the Australian Stephanie Alexander Kitchen Garden program naturally integrated parents, caregivers, and communities. The

school kitchen garden setting was enhanced through close integration of community and families. Parents and grandparents were motivated to volunteer, as were community members with no connection to the school, such as local businesses and university students. Parents and caregivers from non-English speaking backgrounds, who might not ordinarily help in the classroom, volunteered in kitchen gardens and were valued for sharing diverse cultural perspectives.

Summary of implementation quality factors and enablers

Many of the factors that enable successful implementation of the integrated pedagogies described in chapters three and five were similar or identical. We combine and group them thematically on the next page.



Theme



Instructional design



Implementation process



Curricula and assessment



Teacher initial education, skills, knowledge and professional development



Learner factors



Schools and school resources



Parents, caregivers and communities

Table 6: Implementation quality factors for integrated pedagogies

Effective integrated pedagogies

Teachers design activities to:

- Build on learners' experiences, knowledge, and learning needs
- Include long and short term learning goals in their instructional design
- Incorporate evidence about what makes the approach successful in instructional design
- Include the opportunity to orient learners at the outset, conduct the investigation, and reflect on the process and challenges
- Include a combination of teacher-guided, learner-directed, and teacher-directed instruction
- Foster higher order thinking and skills such as problem solving and critical and creative thinking.

Teachers consider implementation success factors such as:

- Using essential strategies (e.g., cooperative learning)
- How gender and social dynamics will influence how approaches work (e.g., working in groups, peer learning)
- Revealing the lesson goal and scaffolding learning
- The amount, type and quality of teacher guidance varies based on the activity, goal, learners' abilities and learning needs
- Acting as learners' mentors: monitor, question, help resolve conflicts, facilitate equitable contribution, provide examples, and evaluate learning.

Curricula and assessment:

- Cover depth not breadth
- Include multidimensional and integrated assessment.
- Allow for some flexibility in implementation

Teachers have the education, skills, knowledge and professional development to:

- Know how to implement integrated pedagogies and the sub-strategies that underpin their effectiveness
- Hold positive views about and know the benefits of integrated pedagogies
- Know that integrated pedagogies are not 'unguided instruction'
- Have sufficient subject matter knowledge to guide and scaffold learners' investigations
- Know how to design and implement formative and summative assessments for integrated pedagogies
- Access research and professional learning on integrated pedagogies to maintain or improve practice.

Teachers implement integrated pedagogies so they:

- Are staged in accordance with learners' prior knowledge, skills and experiences acknowledging that they are demanding
- Can promote inclusion and enhance performance of diverse learner cohorts.

Schools:

- Provide implementation support via line managers, school leadership, planning and scheduling
- Allow the requisite time for learners to learn using integrated pedagogies, which takes longer than when teacher-directed approaches are used
- Allow the requisite time for teachers to manage, plan, administer and guide learners under integrated pedagogies
- Provide physical space to conduct activities such as group and peer work
- Ensure resources are available – internal and external to classrooms.

Parents, caregivers and communities:

- Have beliefs and values that influence support for pedagogy
- Are actively engaged to garner support.

6. Directions for future research

This study finds the LEGO Foundation's framework for playful learning characteristics and skills has broad validity and relevance to primary school learning contexts. The review also presents a number of opportunities and gaps for further research. These are summarised below.

- Range of study sample types:** Identifying what components of a program contribute to its success is essential when taking programs to scale (Bleses et al., 2018). This review scoped the evidence base for integrated pedagogies by looking at a large range of school- and classroom-level studies comparing different approaches. It identified a range of factors that underpin successful implementation of integrated pedagogies. It did not review or include any large state or system-level evaluations or studies. If we are interested in influencing uptake or scale up of learning through play, we need to better understand systems that have made, or are in the process of making, this change. Most studies of system performance or improvement use the Programme for International Student Assessment (PISA), Progress in International Reading Literacy Study (PIRLS) or Trends in International Mathematics and Science Study (TIMSS) to underpin discussions about system performance improvement. These studies compare student performance across cognitive domains of reading, writing, mathematics and science. They do not use internationally comparable metrics or rubrics related to student engagement, or enjoyment of learning, nor do these exist.
- Breadth of skills:** Further research regarding the impact of integrated pedagogies on non-cognitive skills would be beneficial to extending understanding about the broad contributions these pedagogies could make to holistic skills development.
- Good practice examples: It is important that we identify and compare a small number of diverse cases** where learning through play or associated integrated pedagogies have been adopted. Detailed case studies are necessary to understand the complexity of implementing these approaches. These studies can then be used to meaningfully inform the scaling up of integrated learning approaches system-wide.
- Digital play:** The use of digital tools and resources is commonly associated with new or playful pedagogies (Fullan & Langworthy, 2014). The way they are used – to support deep learning tasks and help learners master the learning process – is key. We need to review how and where digital technology is used to support effective implementation of integrated pedagogies in primary school and beyond.
- Special learning needs:** This review does not include research about the impact of integrated pedagogies in schools on learning outcomes for children with special learning needs. This is clearly a topic worth investigating further to consolidate the evidence and understand key enablers or required modifications.
- Play and secondary education:** A number of studies were located that investigated the role and impact of play and integrated pedagogies in secondary schools. It is important to further investigate this topic to understand primary to middle school and upper primary transitions, how and where integrated approaches feature in these environments, and what they look like.

- **Play and transitions:** The transition from early childhood education to primary school was not explicitly addressed by this review. We know that learning through play evidence is strong for the zero to eight year old's cohort which incorporates the early years of elementary school. However, we also know that learning through play is not consistently or widely adopted in these years. A review of learning through play from Preparatory/ Foundation to Grade 2 in a range of contexts would illuminate the implementation issues and challenges regarding these years, and support informed responses to addressing them.
- **Applicability to low and low to middle income country contexts:** This review touched on pedagogies in developing countries and the challenges specific to resource-constrained environments. Further review of the impact evidence of integrated pedagogies in primary schools in low and low to middle income countries is warranted, to understand the broader application of these pedagogies and how important well-resourced environments are as a critical success factor.
- **Good practice guides:** Given that there are critical enabling factors concerning integrated pedagogies, it is important that these are conveyed alongside intervention designs. It would be valuable to design a series of good practice guides for implementing integrated approaches to address misconceptions and describe enabling conditions.
- **New systematic and meta-analyses:** This review revealed that teachers and other education stakeholders are at cross-purposes regarding pedagogies. When they disagree about direct instruction, for example, sometimes it is because they hold differing views about what it entails. Adams and Engelmann (1996) state that 'the result is a non-productive discussion' (p. 10). Naming and defining approaches correctly is important, as is comparing like with like. A number of the systematic reviews and meta-analyses on integrated pedagogies assume that they are minimally guided forms of instruction. Additionally, many, such as Professor John Hattie's Visible Learning (2008), are more than 10 years old. In light of the results of this review, updated meta-analyses on a number of pedagogical approaches would further illuminate their effectiveness.



Glossary

Many of the terms used in this report are defined in different ways by various bodies of educational research. This glossary clarifies how each term is used in this study.

Active learning: Teaching approaches that cater to learners' interests, understanding, and development by engaging them in the learning process rather than them passively consuming information. When referring to engagement, we mean affective, behavioural and cognitive.

Active learning environment: A physical context designed to encourage learners to interact with the environment to construct meaning and knowledge through their own experiences and interactions.

Authentic instruction: Teaching that is meaningful to learners, focused on higher order thinking skills, real-world applications, and social interactions.

Collaborative and cooperative learning: Strategies that emphasise the importance of positive social interactions among learners working with one another.

Constructivist learning theory: The theory that humans construct knowledge and meaning from their experiences, rather than knowledge being a product of an independent external reality.

Constructivist teaching and learning: A student-centred approach focused on learning conversations to construct knowledge. This is done through scaffolding and regular feedback, as well as self and peer evaluation.

Discovery learning: A broad approach to learning through various collaborative, learner-centred activities in which learners play an active part in the process of knowledge discovery or acquisition.

Domain: As applied to education, an area, skill, or competency which has been defined and scoped.

Executive functioning: A suite of higher order skills that underpin our mental capacity to focus attention, filter out distractions, control impulses and complete goals.

Experiential learning: Theories and practices that value the role of experience in fostering meaningful learning.

Hidden curriculum: The values, procedures, norms and behaviours that are not explicitly visible or discussed, that influence classroom practices.

Higher order thinking skills: Transferable skills, critical thinking, and problem solving skills.

Inclusive learning environment: An environment that takes into consideration all children's social, cultural and linguistic diversity, and caters for them both physically and pedagogically.

Inquiry-based learning: Inquiry-based learning is a student-centred approach to teaching and learning where a unit of work is organised around relevant, authentic, open-ended questions.

Instructional design: Using knowledge of how people learn to design content, strategies, and processes to meet learner's needs and achieve prescribed learning outcomes.

Learning through play: A pedagogy that combines playful, child-directed activity with intentional facilitation on the part of the educator to foster a broad range of learning outcomes. There are numerous categories of play, including pretend; voluntary; physical; rough and tumble; construction; digital; collaborative; and free play. Researchers have sought to describe each in terms of the teacher and child's activity and role, interaction with peers, and the physical environment.

Metacognition: Monitoring and controlling one's mental performance in perception, memory, learning, reasoning and communicating.

Minimally invasive education: Unguided instruction based on allowing children to discover knowledge and create their own learning with minimal intervention from teachers.

Montessori education: An educational approach developed by Maria Montessori, which considers children as active, motivated learners, and stresses the links between physical, emotional, social, and cognitive development.

Pedagogical content knowledge: How teachers relate their overall knowledge on theories of learning to their subject matter knowledge.

Pedagogy: A system of thought informed by values and theories, and which informs techniques, and strategies that teachers adopt to influence learning in others.

Problem-based learning: An active learning pedagogy that involves designing learning around a meaningful problem, which enables learners to grasp content, develop strategies, and build self-reliance and confidence.

Project-based learning: An active learning pedagogy that involves designing learning around a meaningful project which is usually completed collaboratively, with scaffolding provided by teachers to shift more responsibility for the learning process to the learner.

Scaffolding: The process of teachers guiding and supporting learners to progress and take control of their own learning, for example, by questioning, guiding, and providing examples, templates, and structures.

Self-regulation: The ability to regulate own thoughts, feelings, and behaviours to set goals, and plan and evaluate own progress, and adapt to changing circumstances.

Social and emotional development: A person's ability to empathise, understand and control their own feelings and behaviours in order to collaborate and build meaningful relationships.

Student-centred learning (see also 'learner-centred'): Instruction that focuses on the learners' needs in order to determine the approach, assessment, delivery mode, content, and task design, with the teacher acting as a facilitator.

Worked example: A step-by-step demonstration of how to solve a problem or apply a technique.



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About the authors

Rachel Parker

Rachel Parker is a Senior Research Fellow at the Australian Council for Educational Research. She is currently working with the LEGO Foundation on key research about learning through play and global measures of play experiences. Rachel also directs a six-year UNICEF-funded longitudinal study on children's cognitive, social, and emotional skills and growth in the Philippines. Rachel specialises in early childhood education, assessment, policy analysis, curricula review, and education research methodologies. Rachel draws upon near 20 years' experience working across the Asia-Pacific region on educational improvement programs for development partners such as ADB, DFAT, UNICEF and World Bank. These experiences inform her understanding about education quality in different contexts.

Bo Stjerne Thomsen

Bo Stjerne Thomsen is Global Head of Research at the LEGO Foundation. He is responsible for the research and partners in the LEGO Foundation focused on the long-term impact of children's play on creativity and lifelong learning. He is also Head of the Centre for Creativity, Play and Learning, to drive the long-term research agenda on children's creativity, play and learning across the LEGO entities. The Research Centre is reflecting the commitment of the LEGO Foundation to be a leading authority on learning through play, by collaborating with international research labs and partners to integrate knowledge into the work with international NGO's, corporates and public partners.



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LEGO Fonden

Koldingvej 2

7190 Billund, Denmark

CVR number: 12 45 83 39

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