

## Integration of A Multisensory Formative Assessment Framework (MFAF) in Inclusive Classroom Practices (Integrasi Kerangka Penilaian Formatif Multisensori (MFAF) dalam Amalan Bilik Darjah Inklusif)

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### ABSTRACT

*Formative assessment is central to inclusive education as it allows teachers to continuously monitor, interpret, and support learners' diverse progress while promoting equitable participation. However, assessment practices in many classrooms still depend heavily on verbal or written responses, which can marginalise pupils with special educational needs (SEN) who demonstrate understanding through nonverbal, sensory, or alternative means. This paper introduces the Multisensory Formative Assessment Framework (MFAF), a conceptual model designed to strengthen inclusive classroom practices by integrating sensory engagement, formative feedback, assistive technology, authentic learning tasks, and reflective teacher practice into a coherent system. Grounded in constructivist, sociocultural, and Universal Design for Learning (UDL) principles, the MFAF positions assessment as a dynamic and responsive process that values how pupils learn as much as what they learn. It seeks to transform assessment into a multisensory, participatory, and empowering experience that enhances learner engagement and teacher reflection. Ultimately, the MFAF represents a meaningful step toward promoting an equitable, inclusive, and transformative assessment for all learners.*

*Keywords: Formative assesment, inclusive classroom, multisensory learning, Malaysia*

### ABSTRAK

*Penilaian formatif adalah teras kepada pendidikan inklusif kerana ia membolehkan guru memantau, mentafsir, dan menyokong kemajuan pelajar yang pelbagai secara berterusan sambil mempromosikan penyertaan yang saksama. Walau bagaimanapun, amalan penilaian di banyak bilik darjah masih sangat bergantung pada respons lisan atau bertulis, yang boleh meminggirkan murid berkeperluan khas (MBK) yang menunjukkan pemahaman melalui cara bukan lisan, deria, atau alternatif. Kertas kerja ini memperkenalkan Kerangka Penilaian Formatif Multisensori (MFAF), sebuah model konseptual yang direka untuk mengukuhkan amalan bilik darjah inklusif dengan mengintegrasikan penglibatan deria, maklum balas formatif, teknologi bantu, tugasan pembelajaran sahif, dan amalan guru reflektif ke dalam satu sistem yang koheren. Berteraskan prinsip konstruktivis, sosiobudaya, dan rekabentuk pembelajaran universal (UDL), MFAF meletakkan penilaian sebagai proses yang dinamik dan responsif yang menghargai cara murid belajar sama seperti apa yang mereka pelajari. Ia berusaha untuk mengubah penilaian menjadi pengalaman multisensori, partisipatif, dan memberdayakan yang meningkatkan penglibatan pelajar dan refleksi guru. Akhirnya, MFAF mewakili langkah bermakna ke arah mempromosikan penilaian yang saksama, inklusif, dan transformatif untuk semua pelajar.*

*Kata kunci: Penilaian formatif, bilik darjah inklusif, pembelajaran multisensori, Malaysia*

## INTRODUCTION

Inclusive education emphasises that every learner, regardless of ability, disability, or background, has the right to access quality learning opportunities within mainstream settings (UNESCO, 2023). A critical component of this vision is assessment, which guides teachers in understanding pupils' progress, needs, and potential (Black & Wiliam, 2018). Among the various approaches, formative assessment plays a central role as it provides continuous, constructive

feedback to support learning and participation for all pupils (Heritage, 2021). However, in many classrooms, assessment practices remain largely verbal or written, favouring linguistic and cognitive strengths over sensory or motor abilities. This often results in pupils with special educational needs (SEN) being excluded or misunderstood when they demonstrate knowledge through nonverbal or alternative means (Hwang & Hughes, 2021).

Despite global commitments to inclusive education, the implementation of assessment that truly reflects learner

diversity remains limited. Many teachers face challenges in designing and interpreting assessment tasks that capture the varied sensory, communicative, and cognitive profiles of learners with SEN. Conventional testing methods often overlook pupils' multimodal ways of expressing understanding, such as gestures, tactile responses, visual engagement, or use of assistive technology. This creates a gap between policy ideals and classroom realities, where pupils who rely on sensory or alternative modes of communication risk being marginalised in performance measurement and feedback processes (Florian & Spratt, 2013; Tomlinson, 2017).

To address this challenge, there is a need for an inclusive model that redefines assessment as a multisensory process rather than a single-mode evaluation. Such an approach recognises sensory diversity as a legitimate channel for demonstrating understanding (Shams & Seitz, 2008; Kraemer et al., 2023), encourages authentic engagement, and supports teachers in responding to varied learning profiles. The present paper introduces the *Multisensory Formative Assessment Framework (MFAF)*, a conceptual model that integrates sensory engagement, formative feedback, assistive technology, authentic learning tasks, and reflective teacher practice.

The MFAF aims to transform assessment into a process of empowerment and equitable participation, thereby aligning with Sustainable Development Goal 4 on inclusive and quality education for all (UNESCO, 2023). It offers a structured yet flexible guide for teachers and curriculum designers to embed multisensory strategies within formative assessment cycles. By bridging theory and practice, this framework contributes to inclusive pedagogy, advances equitable assessment innovation, and provides a foundation for future empirical research in inclusive classrooms.

## LITERATURE REVIEW

This section reviews the theoretical, empirical, and conceptual foundations that inform the development of the Multisensory Formative Assessment Framework (MFAF). The review synthesises perspectives from learning theories, inclusive education principles, and sensory-based pedagogies to establish a coherent base for designing formative assessment practices that embrace sensory diversity. It first discusses the theoretical underpinnings of multisensory and inclusive assessment, followed by empirical studies that support this approach, and concludes with the presentation of the conceptual framework.

### THEORETICAL FOUNDATIONS OF MULTISENSORY AND INCLUSIVE ASSESSMENT

The development of the Multisensory Formative Assessment Framework (MFAF) is grounded in four key theoretical perspectives: constructivist learning theory, sociocultural theory, Universal Design for Learning (UDL), and sensory integration theory. Together, these frameworks explain how learning occurs through active engagement, social mediation, and sensory processing, and how assessment can be designed to accommodate individual differences in learning pathways.

Constructivism posits that learners actively construct knowledge through interaction with their environment and experiences (Piaget, 1971; Bruner, 1986). Within inclusive assessment, this implies that pupils make meaning not by passively receiving information but by engaging with tasks that allow exploration, manipulation, and reflection. Multisensory engagement—through tactile, auditory, visual, or kinaesthetic experiences—enhances meaning-making by allowing pupils to internalise concepts through multiple cognitive channels. Formative assessment, when aligned with constructivist principles, thus shifts focus from product to process, valuing how pupils think, reason, and respond during learning rather than relying solely on outcomes (Fosnot & Perry, 2005).

In addition, Vygotsky's (1978) sociocultural theory emphasises that learning is mediated through social interaction and cultural tools. In the context of assessment, this underscores the role of scaffolding and feedback within pupils' *zones of proximal development*. Formative assessment becomes a dialogic process where teachers and peers co-construct understanding through shared sensory and communicative experiences (Lantolf & Thorne, 2007). For pupils with special educational needs (SEN), sensory-based tools, visual cues, and assistive technologies act as mediating artefacts that support participation in joint meaning-making activities. The sociocultural perspective therefore strengthens the MFAF's focus on feedback, reflection, and collaboration in assessment practices.

The principles of UDL, on the other hand, extend these ideas by advocating for proactive, flexible instructional design that accommodates learner variability from the outset (Meyer, Rose, & Gordon, 2014). UDL provides a framework for offering multiple means of engagement, representation, and expression—principles that align directly with the multisensory nature of MFAF. Within assessment, UDL encourages teachers to diversify how pupils demonstrate understanding, shifting from uniform testing to varied, accessible methods such as performance tasks, oral responses, or technology-supported submissions (CAST, 2018). Through UDL, formative assessment becomes an inclusive tool that validates different modes of communication, supporting equity and reducing barriers to participation (Al-Azawei, Serenelli, & Lundqvist, 2016).

Finally, Ayres' (1972) sensory integration theory further enriches the theoretical grounding by explaining how the brain organises sensory information to produce adaptive responses. When assessment engages multiple senses—visual, auditory, tactile, or proprioceptive—it strengthens neural connections that enhance memory and concept formation (Schaaf & Mailloux, 2015). For learners with sensory processing differences, providing multisensory pathways can improve concentration, self-regulation, and task completion. This theory validates the inclusion of sensory-rich activities within formative assessment, ensuring that assessment reflects how diverse pupils actually learn and respond.

In combination, these theoretical perspectives frame assessment as an active, interactive, and sensory-driven process rather than a static evaluation. Constructivism and sociocultural theory provide the cognitive and social bases, while UDL and sensory integration ensure accessibility and sensory inclusivity. The integration of these frameworks within the *MFAF* allows teachers to assess pupils' learning authentically by valuing multisensory engagement as both a learning process and an evidence source for formative decision-making.

#### EMPIRICAL STUDIES ON MULTISENSORY LEARNING AND FORMATIVE PRACTICES

A growing body of empirical research underscores the importance of multisensory engagement and formative assessment in enhancing learner participation, understanding, and motivation. Studies across various educational contexts have demonstrated that learning experiences that involve multiple sensory modalities such as visual, auditory, tactile, and kinaesthetic channels improve memory retention and conceptual understanding (Shams & Seitz, 2008; Mayer, 2021). When paired with formative assessment strategies, multisensory methods also promote active participation and equitable opportunities for pupils with diverse needs (Hwang & Hughes, 2021; Poon, Lau, & Lam, 2020).

Research in cognitive psychology and neuroscience has shown that multisensory instruction supports deeper learning by activating parallel neural pathways and strengthening cognitive connections (Kraemer, McDowell, & Schaefer, 2023). For instance, studies involving visual–auditory integration reveal that learners are more likely to retain concepts when they experience synchronised sensory input (Moreno & Mayer, 2019). In inclusive classrooms, multisensory approaches provide alternative channels for pupils with sensory impairments or processing difficulties to access and express knowledge. Empirical studies have

found that sensory-rich learning improves attention span, task performance, and emotional engagement among children with autism spectrum disorder (Tomchek & Dunn, 2007; Schaaf et al., 2018).

The role of formative assessment in inclusive classrooms has been widely explored. Black and Wiliam (2018) highlight that formative assessment supports learning by making pupils' thinking visible and informing timely feedback. Heritage (2021) and Popham (2017) further argue that effective formative assessment requires teachers to continuously interpret pupils' performance and adjust instruction. Recent empirical studies in inclusive education emphasise that formative assessment should move beyond written or oral responses to incorporate multimodal evidence of learning (Florian & Spratt, 2013). For example, Klenowski (2018) found that visual artefacts, portfolios, and task demonstrations can provide valid and reliable data on pupils' learning processes.

Technological tools have expanded the possibilities of multisensory formative assessment. Digital platforms and assistive technologies enable teachers to provide immediate, differentiated feedback through audio, visuals, and tactile cues (Al-Azawei et al., 2016; Poon et al., 2020). Empirical work by Chen, Lee, and Lin (2021) showed that using interactive multimedia feedback increased engagement and self-efficacy among learners with special educational needs. Similarly, Wong and Chik (2022) demonstrated that multisensory digital tools improved writing fluency and confidence among pupils with dyslexia. These findings reinforce the principle that technology can bridge sensory modalities and feedback processes, aligning with the inclusive intent of *MFAF*.

Collectively, the reviewed studies establish that multisensory approaches, when embedded within formative assessment, create learning environments that are more engaging, equitable, and responsive. However, the literature also reveals gaps. Many studies examine multisensory learning or formative assessment in isolation rather than integrating both systematically. Few models explicitly link sensory engagement, assistive technology, and reflective teacher practice into a single inclusive framework. The *MFAF*, thus, addresses this gap by offering a cohesive model that synthesises theory and empirical evidence into practical guidance for inclusive assessment design.

In order to consolidate these findings, Table 1 summarises key empirical studies that have examined multisensory learning, formative assessment, and inclusive classroom practices. The table highlights each study's focus, main outcomes, and specific contributions that inform the development of the *Multisensory Formative Assessment Framework (MFAF)*.

TABLE 1. Summary of Key Empirical Studies on Multisensory Learning and Formative Assessment

Author(s)	Focus of Study	Main Findings	Contribution to MFAF
Shams & Seitz (2008)	Cognitive effects of multisensory learning	Multisensory input improves retention and conceptual understanding	Supports sensory-based engagement
Kraemer et al. (2023)	Neural mechanisms of multisensory learning	Parallel sensory pathways enhance cognition and motivation	Validates multisensory design
Hwang & Hughes (2021)	Sensory strategies in ASD learners	Sensory-based feedback improves engagement and task performance	Informs inclusive classroom application
Poon et al. (2020)	Technology and formative assessment	Interactive tools increase motivation and participation	Integrates assistive technology
Florian & Spratt (2013)	Inclusive pedagogy and assessment	Emphasises multiple modes of representation and response	Frames equity principle
Chen et al. (2021)	Multimedia feedback for SEN learners	Audio-visual feedback enhances learning outcomes	Links feedback to sensory modalities
Wong & Chik (2022)	Multisensory writing tools	Improved writing fluency and confidence in dyslexic pupils	Demonstrates practical innovation

CONCEPTUAL FRAMEWORK: THE MULTISENSORY FORMATIVE ASSESSMENT FRAMEWORK (MFAF)

The *Multisensory Formative Assessment Framework (MFAF)* was developed to address the limitations of conventional assessment practices that often rely on linguistic or written responses. Building on the theoretical and empirical foundations outlined in the preceding sections, this framework integrates sensory engagement, formative feedback, assistive technology, authentic learning tasks, and reflective teacher practice into a single cyclical model. The aim is to enable teachers to observe, interpret, and respond to pupils’ learning through diverse sensory modalities while fostering inclusion, agency, and equity. The MFAF promotes the principle that assessment is not merely an end-point measurement but a continuous process of interaction and empowerment (Black & Wiliam, 2018; Heritage, 2021).

The MFAF is grounded in the belief that every learner can demonstrate understanding if provided with appropriate sensory pathways and feedback mechanisms. This philosophy aligns with the constructivist idea that learning occurs through active engagement with one’s environment (Bruner, 1986) and the sociocultural view that knowledge is co-constructed through social interaction (Vygotsky, 1978). By combining these perspectives with Universal Design for Learning (UDL) principles (Meyer, Rose, & Gordon, 2014) and sensory integration theory (Ayres, 1972), the framework conceptualises assessment as a dynamic cycle where learners construct meaning, receive guidance, and refine their performance through sensory-rich experiences. The MFAF consists of components as follow:

- a. Sensory Engagement – forms the foundation of the framework. Sensory engagement recognises that pupils learn and express understanding through multiple sensory channels such as visual, auditory, tactile, and kinaesthetic experiences (Shams & Seitz, 2008; Kraemer et al., 2023). By activating these channels, teachers can capture a more accurate picture of pupils’ learning processes. For example, a pupil might demonstrate comprehension of a story through a tactile sequencing task or through gestures rather than verbal explanation. This approach validates alternative expressions of learning and reduces barriers for pupils with special educational needs (SEN), including those with communication or sensory processing differences.
- b. Formative Feedback – acts as the connecting mechanism between learning and progress. It provides pupils with specific, timely information about their performance and guides them on how to improve (Hattie & Timperley, 2007). Within the MFAF, feedback is not limited to verbal commentary; it may take visual, auditory, or sensory forms, such as using pictorial symbols, vibration cues, or gesture-based prompts. This multimodal feedback supports the continuous flow of communication between teacher and pupil, promoting self-awareness and sustained motivation.
- c. Assistive Technology Integration – the use of assistive and digital technologies enables the implementation of multisensory formative assessment across diverse settings. Devices such as touch screens, text-to-speech tools, interactive software, and sensory-responsive learning materials extend pupils’ ability to engage, respond, and reflect

(Al-Azawei, Serenelli, & Lundqvist, 2016). Assistive technology not only enhances accessibility but also enables data-driven insights for teachers, allowing them to monitor progress across different sensory modes. When used ethically and inclusively, these tools can transform assessment into an adaptive process responsive to individual learning profiles (Chen, Lee, & Lin, 2021).

- d. Authentic Learning Tasks – connect assessment to meaningful, real-world experiences. They encourage pupils to apply knowledge and skills in contexts that mirror daily life, promoting deeper understanding and transfer of learning (Herrington & Oliver, 2000). In the MFAF, authenticity is achieved through tasks that stimulate multiple senses such as role play, experimentation, or collaborative creation—enabling learners to demonstrate competence through action rather than written tests. This dimension reinforces the constructivist notion of learning as an active, situated process and aligns with inclusive education principles by valuing diverse learner contributions.
- e. Reflective Teacher Practice – reflection by the teacher is the driving force that sustains the framework’s cyclical nature. Through reflection, teachers evaluate the effectiveness of multisensory strategies, interpret the outcomes of formative feedback, and adjust instructional approaches accordingly (Schön, 1983). Reflective practice ensures that assessment is continuously refined in response to pupil needs, classroom context, and emerging evidence. It also empowers teachers to adopt a mindset of flexibility and responsiveness—qualities central to inclusive pedagogy (Florian & Spratt, 2013).

The MFAF draws its conceptual strength from the intersection of multiple theoretical paradigms. Constructivist theory contributes the understanding that knowledge construction is an active and iterative process shaped by experience and interaction (Bruner, 1986). Sociocultural theory adds a dialogic dimension, emphasising collaboration and mediation (Vygotsky, 1978). Universal Design for Learning provides the structural blueprint for offering multiple means of representation, engagement, and expression (Meyer et al., 2014). Meanwhile, sensory integration theory explains how the brain organises sensory input to enable adaptive responses (Ayres, 1972). Together, these perspectives validate the MFAF’s emphasis on flexible, sensory-based, and feedback-driven assessment cycles.

The MFAF operates as a continuous cycle that begins with sensory engagement and flows through feedback, technology-supported interpretation, authentic task performance, and reflective practice. Each component interacts dynamically with the others. For example, feedback may lead to adjustments in sensory engagement activities, or reflective insights may prompt redesign of authentic tasks. This iterative cycle enables teachers to respond in real time to pupils’ evolving needs, transforming assessment into a living process of adaptation and inclusion.

The framework also recognises the role of learners as active participants rather than passive recipients. By engaging in sensory-rich formative tasks and receiving multimodal feedback, pupils develop self-awareness, independence, and confidence in their learning journey. This aligns with the core goal of inclusive education—empowering learners to participate fully and meaningfully in the classroom community (UNESCO, 2023).

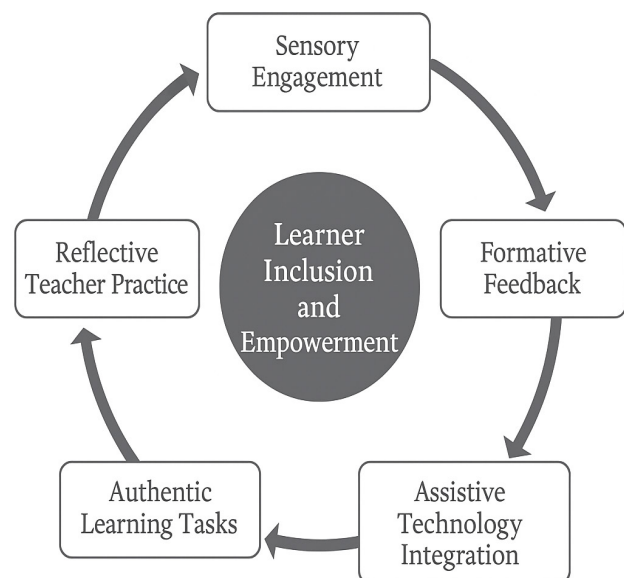


FIGURE 1. The Multisensory Formative Assessment Framework (MFAF)

Figure 1 illustrates the Multisensory Formative Assessment Framework as a circular flow model. Five interrelated components—Sensory Engagement, Formative Feedback, Assistive Technology Integration, Authentic Learning Tasks, and Reflective Teacher Practice are arranged around a continuous loop. Arrows indicate the cyclical flow, symbolising the ongoing nature of assessment and reflection. At the centre lies the core labelled Learner Inclusion and Empowerment, representing the ultimate goal of the framework. The circular form reinforces that inclusive assessment is not a linear sequence but a continuous process of observation, interaction, and adaptation that evolves with learners’ growth.

## CONCEPTUAL SYNTHESIS AND FRAMEWORK RATIONALE

The MFAF integrates theoretical and practical insights from inclusive pedagogy and formative assessment. Constructivism, UDL, and sociocultural theory collectively highlight that learning is an active and socially mediated process (Vygotsky, 1978; Meyer et al., 2014). These theories advocate for varied modes of engagement and expression that value pupils' diverse abilities. However, assessment practices often lag behind instructional reforms, continuing to privilege verbal and written forms over sensory or nonverbal expression (Black & Wiliam, 2018; Hwang & Hughes, 2021).

The MFAF was designed to close this gap by reframing assessment as a multisensory and inclusive process. It views sensory channels – visual, auditory, tactile, and kinaesthetic – as valid means of communication and understanding. This approach extends UDL's principle of multiple means of expression (Meyer et al., 2014), ensuring that each pupil's preferred sensory mode is acknowledged. For instance, a pupil who cannot articulate responses verbally may demonstrate comprehension through object manipulation or gesture, both recognised as legitimate evidence of learning.

Formative assessment naturally aligns with this multisensory perspective because it depends on observing, interpreting, and responding to learners' cues in real time (Heritage, 2021). The MFAF expands this interaction by including sensory cues such as movement, gaze, or touch as meaningful indicators of understanding. Teachers continuously interpret these signals and provide feedback that encourages participation and progress. This continuous feedback loop positions assessment as a shared process of discovery rather than a one-sided evaluation.

The inclusion of Assistive Technology strengthens the framework's inclusivity. Tools such as touchscreens, communication devices, and interactive software allow pupils to engage through sensory channels that suit their abilities (Florian & Black-Hawkins, 2011). Technology also helps teachers collect and interpret multimodal data, providing more equitable insight into learning progress.

Reflective Teacher Practice forms the final component of the MFAF. Teachers act as reflective practitioners who adapt assessment strategies based on pupils' responses and learning profiles (Schön, 1983). Through reflection, they refine interpretations of performance and design tasks that accommodate sensory diversity.

Together, the five components – Sensory Engagement, Formative Feedback, Assistive Technology Integration, Authentic Learning Tasks, and Reflective Teacher Practice – form a continuous, circular process of observation and adaptation. At its centre lies Learner Inclusion and

Empowerment, representing the core purpose of assessment: to ensure that every pupil is seen, heard, and valued in their learning journey. In summary, the MFAF redefines formative assessment as a multisensory, interactive, and reflective process. It bridges theoretical understanding with classroom practice, advancing inclusive assessment that promotes participation and equity for all pupils.

## METHODOLOGY

This study adopts a conceptual research design aimed at developing, synthesising, and validating the MFAF. A conceptual design is appropriate when the purpose is to construct or refine theoretical understanding rather than to collect empirical data (Jaakkola, 2020). The process combines systematic literature synthesis with expert validation to ensure the framework is both theoretically coherent and practically relevant for inclusive formative assessment.

A conceptual research approach was selected because it allows for the systematic integration of theories and ideas into a structured model that advances educational understanding (Snyder, 2019). Conceptual papers rely on critical reasoning and evidence synthesis to connect existing knowledge in innovative ways, rather than testing hypotheses through experiments. Following this approach, the development of the MFAF progressed through three iterative phases:

- a. conceptual analysis
- b. framework development
- c. expert validation

These phases established a rigorous and transparent pathway, ensuring theoretical integrity and practical applicability.

The first phase involved a targeted review and synthesis of literature on multisensory learning, formative assessment, inclusive education, and assistive technology. Sources were obtained from databases such as Scopus, ERIC, and Google Scholar, focusing on studies published between 2000 and 2024. Search terms included multisensory learning, inclusive assessment, formative feedback, and assistive technology in education. A total of 120 articles were identified, and 68 were selected based on relevance and methodological soundness. The literature was thematically categorised into five areas that informed the framework's core dimensions: sensory engagement, formative feedback, assistive technology integration, authentic learning tasks, and reflective teacher practice. The synthesis process followed Snyder's (2019) guidelines for conceptual reviews, emphasising theoretical clarity, analytical rigour, and scholarly contribution.

Drawing from the conceptual synthesis, the MFAF was designed as an integrative model connecting the five identified dimensions. Each represents a principle of inclusive assessment:

- a. Sensory Engagement – acknowledging diverse sensory channels as valid expressions of learning
- b. Formative Feedback – supporting continuous, two-way communication between teacher and pupil
- c. Assistive Technology Integration – enhancing accessibility and participation
- d. Authentic Learning Tasks – linking assessment to meaningful, real-life contexts
- e. Reflective Teacher Practice – promoting adaptability and professional growth.

The components were organised into a circular configuration to reflect the continuous, dynamic nature of inclusive assessment. Figure 1 illustrates this iterative structure, representing assessment as an evolving process of observation, interpretation, and reflection.

To ensure the framework's credibility and contextual relevance, validation was conducted through consultation with five experts in inclusive education, educational psychology, and assessment design. Experts were purposively selected from Malaysian and international universities for their specialised expertise and practical experience. A two-round Delphi-inspired validation process was employed. In the first round, experts evaluated conceptual clarity, theoretical alignment, and classroom feasibility. Their qualitative feedback was analysed thematically and used to refine terminology and logical sequencing. The second round confirmed consensus on the framework's conceptual soundness and applicability across diverse educational settings.

Although the study did not involve direct pupil participation, ethical standards were upheld throughout. Expert reviewers' identities and feedback were treated with strict confidentiality, and all intellectual contributions were properly acknowledged. Ethical clearance for the expert validation process was granted by the Faculty of Education, Universiti Malaya. Methodological rigour was ensured through triangulation across three sources: theoretical literature, conceptual synthesis, and expert validation. Transparency was maintained by documenting each developmental stage. Following Jaakkola (2020), this iterative approach reinforced theoretical consistency and practical relevance, ensuring that the MFAF contributes meaningfully to inclusive assessment scholarship.

## FINDINGS AND DISCUSSION

The development of the Multisensory Formative Assessment Framework (MFAF) represents a conceptual advancement in inclusive education by integrating sensory engagement, formative feedback, assistive technology, authentic learning, and reflective practice into a single cyclical process. This section discusses how these components interact to enhance equitable participation and meaningful learning for pupils with special educational needs (SEN).

### SENSORY ENGAGEMENT AS THE FOUNDATION OF INCLUSION

Multisensory learning affirms that learners process and retain information more effectively when several sensory modalities are activated simultaneously. Empirical studies confirm that multisensory instruction supports comprehension, particularly among children with learning difficulties or autism spectrum conditions (Shams & Seitz, 2008; Kraemer et al., 2023). In formative assessment, sensory engagement allows teachers to observe pupils' understanding through tactile manipulation, visual cues, gestures, or movement rather than relying solely on verbal or written output. By diversifying input and output channels, teachers move from deficit-based evaluation to recognising pupils' individual strengths (Mayer, 2021). The MFAF positions sensory engagement as the first and continuing stage of assessment, ensuring that learning evidence is gathered from multiple, authentic expressions of understanding.

### FORMATIVE FEEDBACK AS A PROCESS OF EMPOWERMENT

Formative feedback is central to responsive teaching. Black and Wiliam (2018) emphasise that feedback must be timely, specific, and actionable to close the gap between current and desired performance. Within the MFAF, feedback is not limited to teacher-to-pupil transmission; it involves reciprocal communication that values pupils' interpretations of their own learning. Inclusive classrooms demand differentiated modes of feedback—visual symbols, tactile prompts, simplified language, or digital reinforcement (Heritage, 2021). Such multimodal feedback enables pupils with communication challenges to understand progress and feel validated. Feedback thereby becomes an instrument of empowerment, encouraging self-regulation and metacognitive growth (Hattie & Clarke, 2019).

## ASSISTIVE TECHNOLOGY INTEGRATION

Technology plays a crucial role in bridging access gaps for diverse learners. Assistive tools—ranging from augmentative and alternative communication (AAC) devices to interactive applications—extend the reach of formative assessment (Al-Azawei et al., 2020). The MFAF integrates assistive technology as a mediating layer connecting sensory engagement and feedback. For example, digital portfolios, tactile response pads, or adaptive software can capture pupils' nonverbal evidence of learning. When teachers analyse these multimodal artefacts, they obtain a richer understanding of each pupil's conceptual grasp. However, effective use of assistive technology requires teachers' digital literacy and institutional support (Florian & Beaton, 2018). The framework therefore promotes a continuous cycle of professional reflection on technology use to prevent dependency or tokenistic implementation.

## AUTHENTIC LEARNING TASKS AND REAL-WORLD RELEVANCE

Authentic assessment links classroom learning to real-life contexts. Pupils are more motivated and capable of demonstrating competence when tasks reflect meaningful situations (Herrington & Reeves, 2019). In the MFAF, authentic tasks replace abstract testing with experiential performance—such as sorting everyday objects, following practical sequences, or role-playing communication scenarios. Such tasks generate observable evidence of skill transfer across contexts. For pupils with SEN, authenticity ensures that assessment outcomes correspond to functional and social participation rather than rote accuracy. This aligns with UNESCO's (2023) vision of inclusive quality education that prepares learners for independent living and community involvement.

## REFLECTIVE TEACHER PRACTICE

Reflection sustains the cycle of multisensory assessment. When teachers critically analyse patterns in pupils' multimodal responses, they refine instructional decisions and design differentiated pathways for progress (Schön, 2016). Reflection also extends to ethical awareness—questioning whether assessment methods privilege certain abilities or inadvertently exclude others. The MFAF conceptualises teacher reflection as both individual and collaborative, encouraging dialogue within professional learning communities (Florian & Spratt, 2013). Through ongoing reflection, teachers evolve as adaptive practitioners who recognise that inclusion is a dynamic, context-responsive commitment rather than a static goal.

## INTERCONNECTEDNESS OF THE FRAMEWORK

Figure 1 visually represents the MFAF as a continuous loop in which each component informs and renews the others. Sensory engagement stimulates evidence collection; feedback interprets that evidence; assistive technology mediates communication; authentic tasks contextualise learning; and reflection re-designs the next cycle. The central focus – learner inclusion and empowerment – symbolises the outcome of this interdependence. By conceptualising assessment as cyclical rather than linear, the MFAF reflects socio-constructivist and ecological perspectives of learning, wherein knowledge emerges through interaction, environment, and reflection (Bronfenbrenner, 1992; Vygotsky, 1978). This synthesis demonstrates how inclusive assessment can transcend compliance with policy to become a transformative pedagogy.

## IMPLICATIONS FOR INCLUSIVE PRACTICE

The MFAF suggests three main implications. First, teacher education programmes should embed multisensory and technological competencies as essential professional standards. Second, school leaders must ensure structural support – time, resources, and collaboration – for teachers to apply formative cycles effectively. Third, policy frameworks should legitimise multisensory evidence of learning as valid for reporting and progression. Collectively, these measures operationalise the ethos of '*education for all*' by translating inclusive philosophy into everyday assessment practice.

## CONCLUSION

The Multisensory Formative Assessment Framework (MFAF) underscores that inclusion in education depends not only on access but on meaningful participation. By integrating sensory engagement, formative feedback, assistive technology, authentic learning, and reflective teacher practice into a continuous cycle, the framework transforms assessment from a measure of ability into a process of empowerment. The findings highlight that pupils with special educational needs can demonstrate understanding through diverse sensory and communicative pathways when teachers adopt flexible, reflective practices supported by technology. The MFAF therefore provides both a conceptual and practical guide for educators seeking to align daily assessment with the broader vision of equitable, quality education for all. Future research could empirically test the framework's classroom implementation and examine its impact on learner motivation, teacher competence, and policy development toward truly inclusive systems.

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- Received: 29 November 2025  
Reviewed: 26 February 2026  
Accepted: 1 May 2026  
Published: 30 May 2026