

Article

Assessment and Intervention for Tool-Use in Learning Powered Mobility Intervention: A Focus on Tyro Learners

Lisbeth Nilsson ^{1,*}  and Lisa Kenyon ²¹ Department of Health Sciences, Lund University, Box 157, 221 00 Lund, Sweden² Department of Physical Therapy and Athletic Training, Grand Valley State University, 301 Michigan Street NE, Grand Rapids, MI 49503, USA; kenyonli@gvsu.edu

* Correspondence: lisbeth.nilsson@med.lu.se or lisbethsweden@gmail.com

Abstract: Young infants, children, and persons of any age who have cognitive limitations can be thought of as tyro learners, who are beginners in learning. For tyro learners, the self-produced mobility afforded by a powered mobility device offers opportunities, to explore tool-use learning and interact with the surrounding environment, thereby potentially enhancing development and learning, providing a foundation for future goal-directed, tool-use activities. The Assessment of Learning Powered mobility use tool, version 2.0 (ALP), developed with tyro learners, is a process-based implementation package, focused on assessing and progressing an individual's understanding of how to use a powered mobility device. Although the ALP tool can be used with any powered mobility learner, research suggests that this process-based approach may be, especially, beneficial for tyro learners, who are in the early phases of learning how to operate a powered mobility device. This article aims to (1) explain tool-use learning in powered mobility intervention; (2) distinguish between the characteristics of process-based and task-based implementation packages; (3) provide an in-depth description of using the ALP tool in providing powered mobility intervention; and (4) highlight the benefits of using the ALP tool, with a focus on tyro learners.

Keywords: powered wheelchair; intellectual disabilities; occupational performance; novice; early intervention; education; rehabilitation



Citation: Nilsson, L.; Kenyon, L. Assessment and Intervention for Tool-Use in Learning Powered Mobility Intervention: A Focus on Tyro Learners. *Disabilities* **2022**, *2*, 304–316. <https://doi.org/10.3390/disabilities2020022>

Academic Editors: Angelo Rega, Alessandro Frolli and Reinie Cordier

Received: 4 March 2022

Accepted: 27 May 2022

Published: 31 May 2022

Publisher's Note: MDPI stays neutral with regard to jurisdictional claims in published maps and institutional affiliations.



Copyright: © 2022 by the authors. Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

1. Introduction

Human activity involves many forms of tool use and related tool-use learning [1,2]. The term “tool” can be used in a broad sense to encompass a wide variety of both concrete (hand, switch, joystick, etc.) and abstract (methods for assessment and intervention, etc.) tools [3–6]. Those who are beginners in tool-use learning, young infants, children, and persons of any age who have cognitive limitations, can be thought of as tyro learners (tyro as defined in the Merriam-Webster Dictionary and Cambridge Dictionary). Tyro learners grow consciousness of new activities, starting from the very beginning of the learning continuum [7,8]. For children and adults who are tyro learners, exploring how to use a powered mobility device, such as a powered wheelchair [9–13], modified ride-on toy car [14,15], and other powered devices [16–20], is often less about learning to drive [21,22], and more about Driving to Learn [8,23–25]. The self-produced mobility afforded by a powered mobility device offers opportunities to explore tool-use learning and interact with the surrounding environment [26,27], thereby potentially enhancing development and learning, providing a foundation for future goal-directed, tool-use activities [6–8]. The potential for these benefits supports powered mobility device use in tyro learners, as an effective and appropriate intervention, even though they may never become independent, competent powered wheelchair users [8,28–34].

All individuals, who are learning to use a powered mobility device, pass through a floating continuum, represented by exploratory, operational, and functional powered

mobility learner groups [35]. Tyro learners, often, remain in the exploratory- or operational-learner groups, for prolonged periods of time. As compared to functional-learner groups, exploratory- and operational-learner groups are more dependent on others, to set up and provide powered mobility learning opportunities, and, often, require additional encouragement and motivation, when exploring and learning how to use a powered mobility device [6–8,33–37].

Developed through work with tyro learners [8,25,28,29], the Assessment of Learning Powered mobility use tool, version 2.0 (ALP), is a powered mobility implementation package focused on assessing and progressing an individual’s understanding of how to use a powered mobility device [6,7,37]. The ALP tool is comprised of the ALP instrument for assessment and the ALP facilitating strategies for intervention. The ALP instrument defines eight phases in the process of learning (from *Phase 1—Novice* to *Phase 8—Expert*), encompassed within three stages of learning (*Explore Functions*, *Explore Sequencing*, *Explore Performance*). The ALP instrument is used in tandem with the ALP facilitating strategies, such that a learner’s actual stage and phase of learning, as identified through the ALP instrument, are used to guide and select the specific ALP-facilitating strategies that will best support the learner. In this manner, the ALP tool provides each learner with the precise level of challenge needed to progress their understanding across the continuum of learning to use a powered mobility device [6,7]. The ALP instrument has been shown to have excellent inter-rater reliability (linear-weighted kappa of 0.85) [38].

As outlined in Table 1, research suggests that the process-based approach [8,28,29], reflected in the ALP tool [7], may be beneficial in supporting powered mobility device use learning in tyro learners, who belongs in exploratory and operational powered mobility learner groups [6,7,35,37]. Task-based approaches [39–46], those involving production of specific powered mobility tasks, may be beneficial for integrative learners focused on integrating both patterns of operation and powered mobility device use into their everyday lives, who are functional powered mobility learners/users [35].

Table 1. Comparison of tyro and integrative learners of powered mobility use.

Powered Mobility Learner Group [35]	Tyro Learners ¹		Integrative Learners ²
	Exploratory	Operational	Functional
Assessment of Learning Powered mobility use-(ALP) Stage [7]	ALP Stage 1: Explore Functions	ALP Stage 2: Explore Sequencing	ALP Stage 3: Explore Performance
Recommended Type of Powered Mobility Implementation [35]	Process-based packages focused on learning and developing a conscious understanding and awareness of how a powered mobility device works		Task-based packages focused on the production of specific powered mobility tasks, often as listed in a specific protocol

¹ Young infants and children or persons who have cognitive limitations. ² Those focused on integrating patterns of operation and powered mobility device use, into everyday life.

This feature article aims to (1) explain tool-use learning in powered mobility intervention; (2) distinguish between the characteristics of process-based and task-based powered mobility implementation packages; (3) provide an in-depth description of using the ALP tool, in providing powered mobility intervention; and (4) highlight the benefits of using the ALP tool with tyro learners.

2. Powered Mobility: A Tool-Use Learning Experience

The perception–action experiences provided through engagement in exploration of self-produced mobility are powerful drivers of cognitive developmental change and learning about the world [2,3,13,33,34,47,48]. Numerous researchers have studied powered mobility, as a means for independent mobility [49–54]. For tyro learners, learning by driving a powered mobility device, also, provides the opportunity to explore tool-use learning [6,8,37]. A tool can be thought of as something used to carry out a particular action

or function. Depending on how they are used, a part of our body, an object, and a device can all be tools. Tools range in complexity from simple, one-part tools, such as a spoon, to complex, multi-part tools, such as a smartphone [6,8]. Regardless of what tool is being used, the phases and stages in the process of learning to use a tool are similar in nature [6,7] and involve a growing consciousness, or understanding, of how to use and relate to the tool, when integrating it in everyday activities [7,8].

A powered mobility device is a complex, multi-part tool, involving coordination of three distinct tools: a part of the body (a hand, foot, eye, etc.), an access method (switch/es, joystick, eye-tracking technology, etc.), and the powered mobility device itself [55]. Development of conscious awareness, in how to integrate the use of these three tools together, is a process encompassing learning, as described in the ALP instrument [7]. Controlled execution of actions, with a part of the body (tool 1), and an understanding of the function/s of the access method (tool 2) and the device (tool 3), are necessary to move and control the operation of the powered mobility device (ALP stage 1, explore function). Accurate action on the access method is required to develop a pattern for how to move and control the operation of the powered mobility device in space and time (ALP stage 2, explore sequencing). Functional navigation and integrated use of the powered device in the physical and social environments requires understanding of situations and judgement (ALP stage 3, exploring performance). The path that each learner follows through this tool-use learning process may differ in terms of individual abilities, pace, oscillation across ALP phases, trajectory over time, and motives for development and learning [7,8].

Tyro learners, who are provided with repeated opportunities to explore powered mobility use, may develop their abilities and grow their understanding of tool use [7,8,25,37]. Many tyro learners are motivated to explore, by the experience of independently changing their own position in space [8]. This self-produced change of position provides a new perspective of the situation and changes the tyro learner's relationships to others and objects in their surrounding environment [6,8]. These repeated powerful experiences develop the tyro learner's sense of agency and control, and provide opportunities for acquiring comprehensive knowledge about the world [8,56]. The achievements gained through tool-use learning in a powered mobility device may transfer to other tool-use situations, expanding the tyro learner's opportunities to explore and use other assistive technologies for goal-directed tool-use activity and communication [8,37].

3. Distinguishing between Process-Based and Task-Based Powered Mobility Implementation Packages

There are two main types of powered mobility implementation packages: task-based and process-based [7,35]. Both often marry the assessment and intervention procedures, such that assessment directly guides intervention. However, understanding the characteristics of each type of implementation package may assist clinicians/educators in matching the type of package with a specific learners' needs, abilities, and level of tool-use understanding. Table 2 provides an overview of the distinguishing characteristics of the process-based and task-based implementation packages.

3.1. Task-Based Powered Mobility Implementation Packages

Tasked-based packages, such as the Wheelchair Skills Program (WSP) [45,46], are focused on an individual's production of specific powered mobility tasks (moving the powered mobility device forward, turning the powered mobility device, maneuvering the powered mobility device through a doorway, etc.). In the WSP, the Wheelchair Skills Test for Powered Wheelchairs Operated by Their Users, a standardized assessment instrument, is used to identify specific powered mobility tasks that could be improved with intervention. The accompanying WSP intervention curriculum, known as the Wheelchair Skills Training Program, is used to help learners work towards safe and proficient performance of the identified powered mobility tasks in need of improvement. This task-based approach has been found to be highly successful in adult populations [45,46]. Given its emphasis

on the production of specific tasks, the WSP presumes a foundational understanding of how a powered mobility device operates. As such, integrative learners, who are focused on integrating both patterns of operation and powered mobility device use into their everyday lives, are most likely to benefit from task-based packages [35]. The most prominent characteristics of task-based assessment and intervention are outlined in Table 3.

Table 2. Distinguishing process-based and task-based implementation packages.

	Process-Based Packages	Task-Based Packages
Population	Any learner group, including tyro learners	Operational or functional learner groups
Learner prerequisites	Awake and consent to involvement (in whatever way they are able to express their agreement)	Aware of how to use access method
Procedure of assessment	Protocol free Observation, functional analysis, and interpretation of tool-use performance within descriptive categories	Protocol-like Observation of task performance is compared to a description of the task in a protocol
Documentation	Actual stage and phase of learning Need of facilitating strategies	Pass, fail, or needs improvement Task/s to practice
Intervention goal	To explore tool-use functions, sequencing or performance	To improve performance of specified tool-use tasks
Intervention setting	Relevant for the learner's phase of understanding, age, and motives	Relevant for performing the specified tasks
Integration of assessment and intervention	Concurrent integration Simultaneous assessment and intervention Emphasizes recognition of individual needs and motivation for engagement in the tool-use activity	Linear integration Assessment proceeds intervention Emphasizes tasks specific for the tool being used
Expectations of outcome	Growing consciousness/understanding of tool use	Safe and controlled tool use

Table 3. Characteristics of task-based implementation packages.

	Task-Based Assessment	Task-Based Intervention
Approach	Assesses tasks using a protocol-like list of specific tasks to be assessed	Guided execution of tasks
Purpose	To identify tasks in need of improvement	To develop or refine execution of relevant tasks through practice
Focus of learner's tool-use performance	Performing tasks specific for skilled tool-use	Practicing to master tasks listed in the protocol
Clinician/educator performance	Direct observation of execution of task	Instruction Demonstration Repetition of tasks
Focus and relevant knowledge for implementation of package (clinician/educator performance)	Assessing WHAT (task) Following the protocol Descriptive Comparative Concrete, observable actions Pass, fail, or needs improvement	Cognition to contrast performance based on a protocol Complex intellectual processing Reflection ON action Giving notice of the obvious Serially adjusting assessment and intervention

3.2. Process-Based Powered Mobility Implementation Packages

Process-based packages, such as the ALP tool, focus on assessing and progressing a person's growing consciousness and understanding of how to coordinate and use the combination of three tools (part of body, access method, and device) involved in using a powered mobility device [6,7,55]. In this manner, the ALP tool allows clinicians/educators to apply their knowledge of the learning process, to guide and promote each learner's tool-use understanding, along the broad continuum of learning, to use a powered mobility device, from novice to expert. Although the ALP tool can be used with any powered mobility learner, research suggests that this process-based approach may be, especially, beneficial for tyro learners, who are in the early phases of learning how to operate a powered mobility device [35].

One of the unique characteristics of process-based implementation packages is the emphasis on allowing, through actively supporting, each learner's own initiative within the learning process [7,8,28,29]. Clinicians/educators, thus, must provide the learner with the freedom to explore each of the three tools encompassed within the powered mobility device (part of the body, access method, and device), in whatever ways they desire [6–8,32,55]. Allowing each learner to explore and learn in their own way, and at their own pace, independent of any outside influence or control, provides the learner with the opportunity to figure out for themselves how each of the three tools work, both as separate entities and as a coordinated unit [55]. This, also, enables the learner to experiment with a variety of action patterns and sequences (e.g., using their mouth to activate the joystick, moving the joystick in different directions, experiencing the resulting movement of the device relative to the physical and social environment), and develop their own strategies, while, simultaneously, learning from their own mistakes. Learners are, also, encouraged to develop and act upon their own desires and goals, as they move from exploring the functions of the three tools encompassed within a powered mobility device, to exploring sequencing of these tools and the environment as well as to exploring performance and use of the device to interact with others [7,8,36–38]. This emphasis, on allowing and encouraging the learner to explore and discover in their own way, may help to contribute to a tyro learner's developing sense of self and agency as well as growing autonomy. The most prominent characteristics of process-based assessment and intervention are outlined in Table 4.

Table 4. Characteristics of process-based implementation packages.

	Process-Based Assessment	Process-Based Intervention
Approach	Assesses process of learning and provides indicators, for each stage and phase along the continuum of the tool-use learning process	Tool-use learning is guided by facilitating strategies, for each phase in the tool-use learning process
Purpose	To identify, in the moment, the learner's actual stage and phase of understanding of how to use the tool	To support the learner's needs and desires based on knowledge of their tool-use understanding, in the specific moment
Focus of learner's tool-use performance	Allowing learners to explore tool-use in their own way	Practicing at the learner's level of tool-use understanding
Clinician/educator performance	Continuous functional analysis of learner performance of tool-use	Continuous adjustment, in the moment, of the degree of challenge, to match the learner's actual phase in the learning process
Focus and relevant knowledge for implementation of package (clinician/educator performance)	<i>Assessing HOW</i> (process) Understanding the process Analytic Reflective, relative to described indicators of performance Abstract Continuous assessment during a session	Metacognition to infer learner's tool-use understanding, based on observable actions Higher level of complexity in intellectual processing <i>Reflection IN action</i> Discerning the obscure Concurrently aligning the facilitating strategies to actual understanding

4. An In-Depth Description of the ALP Tool

The development of the ALP tool was published by the open-access Journal of Rehabilitation Research and Development (JRRD), and the complete ALP tool is provided as an online resource to Nilsson and Durkin on their webpage [7]. The ALP instrument is found in the JRRD online Appendix 1, and the ALP facilitating strategies are found in the JRRD online Appendix 2 [7]. A brief overview of the prominent elements, of the ALP instrument and ALP facilitating strategies, for each of the three ALP stages, are outlined in Table 5 (ALP stage 1), Table 6 (ALP stage 2), and Table 7 (ALP stage 3).

Table 5. ALP tool: prominent elements of stage 1: explore functions—phases 1–3 *.

ALP Instrument, Stage 1: Explore Functions: Body and Tool(s)					
ALP Phase	Attention	Activity and Movement	Understanding of Tool-Use	Expressions and Emotions	Interaction and Communication
1 Novice	Extreme distractibility	Excited, Non-Act, Rejection	No idea or vague idea of tool use	Open, Neutral, Anxiety	No response, Avoidance
2	Single channeled At times more alert, at times, passive	Pre-act	The idea of basic use is born	Contented, Curious, Anxious, Angry	Responds to interactions
3	Single channeled attention but able to shift attention	Acts directed	Basic use of the tool	Serious, Contented, Smiles	Initiates interactions
ALP Facilitating Strategies, Stage 1—Introvert Level					
<i>Use a gentle approach to establish a safe and secure relationship</i>					
<i>Focus attention to tool function and close vicinity</i>					
Oriented at tool use functions and tool interaction					
– Persistence with interactive approaches and physical demands, such as touch and manual guidance – Build awareness of body use for tool use; encourage exploration of tool parts and tool function – Offer manual guidance, adjusting according to learner’s needs – Constantly shift between withdrawing and re-entering the learner’s space					
Frustration					
– Accept the learner’s rejection, anxiety, or passivity and acknowledge there may be signs of basic frustration at this stage					
Oriented at social interaction					
– One-to-one interaction – Structured variation of physical and social interaction					
Language					
– Imperative and deliberate, but gentle, slowly paced language – Labeling of body parts, tool parts, acts, and effects – Attaching words to the acts being performed – Precise and condensed language					
Encourage own initiatives to act					
– Inspire own initiatives by using manual guidance – Allow the learner to do trials their own way – Allow repetitions of exploratory acts to the learner’s level of satisfaction					

* Full ALP tool, version 2.0, see Nilsson and Durkin [7], online Appendix 1 and 2, at JRRD’s homepage.

Foundational concepts within the ALP tool relate to promoting an atmosphere of mutual respect and collaboration with the goal of empowering the learner [7,8,36–38]. The clinician/educator sets up as well as prepares the environmental and social circumstances for powered mobility assessment and intervention, to meet the specific needs of the learner and invites the learner to engage in an allowing co-constructive partnership [6].

As noted in Tables 5–7, the ALP instrument for assessment defines eight phases of learning, from Phase 1 (Novice) to Phase 8 (Expert). Categories of observation with each ALP phase include Attention, Activity and Movement, Understanding of Tool Use, Expressions and Emotions, and Interaction and Communication. These five categories, with their indicators, structure the clinician’s/educator’s observations of the learner’s occupational performance (behaviors, acts, actions, emotional expressions, interactions, communication).

In this manner, the clinician/educator is able to infer the learner’s actual phase of tool-use understanding [6,7,38,57]. The “Attention” category reflects the learner’s ability to regulate and shift their attention. “Activity and Movement” focuses on the learner’s performance of activity and motor control. “Understanding of tool use” pertains to the learner’s level of consciousness/understanding, regarding the operation of the powered mobility tool/s and is the primary, observable cognitive component, within each ALP phase. “Expression and Emotions” provides insights into the learner’s motivation, whilst “Interaction and Communication” addresses the expression of interpersonal relationships and social interplay amongst the powered mobility device, the environment, and available social partners. Indicators for each of these observational categories are described in detail, for each of the eight ALP phases, in JRRD online Appendix 1 [7].

Table 6. ALP tool: prominent elements of stage 2: explore sequencing—phases 4–5 *.

ALP Instrument Stage 2: Explore Sequencing: Body, Tool(s), Environment					
ALP Phase	Attention	Activity and Movement	Understanding of Tool-Use	Expressions and Emotions	Interaction and Communication
4	Single-channeled attention but able to shift spontaneously	Chains of acts	Exploration of extended tool use	Serious, Smile, Sometimes laughs	Mutual interactions
5	Two-channeled attention	Sequences of chains of acts	Idea of competent tool-use is born	Eager, Smiles, Serious, Frustration	Reciprocated interactions, Triadic Interaction
ALP Facilitating Strategies, Stage 2—Difficult Transition					
<i>Focus attention to tool function and external tool use goals</i>					
Oriented at tool use interaction					
– Encourage exploration and experimentation with pattern building – Non-interference intertwined with manual guidance and verbal prompts or instructions – Introduce speed variation and the concept of using gentle, slow, graded body movements with the operating tool—joystick, switch or other access method – Confirm success, difficulties, and failure of patterning details – Provide external motivators, to convey the idea of a goal for tool use					
Frustration					
– Accept the learner’s expressions of frustration – Calm and reassure the learner, to reduce their level of frustration					
Oriented at social interaction					
– Extend interplay distance – Introduce simple playful one-to-one interactive activities and, then, gradually increase the complexity					
Language use					
– Dialogue using simple verbal language, body language, and guiding – Labeling and explaining tool function and tool-use outcome					
Encourage own initiatives and trials—find out how it works, give it another try, try another way!					
– Allow the learner to explore use of the tool, in their own way – Allow the learner to make their own mistakes – Allow the learner to develop their own strategies					

* Full ALP tool, version 2.0, see Nilsson and Durkin [7], online Appendix 1 and 2, at JRRD’s homepage.

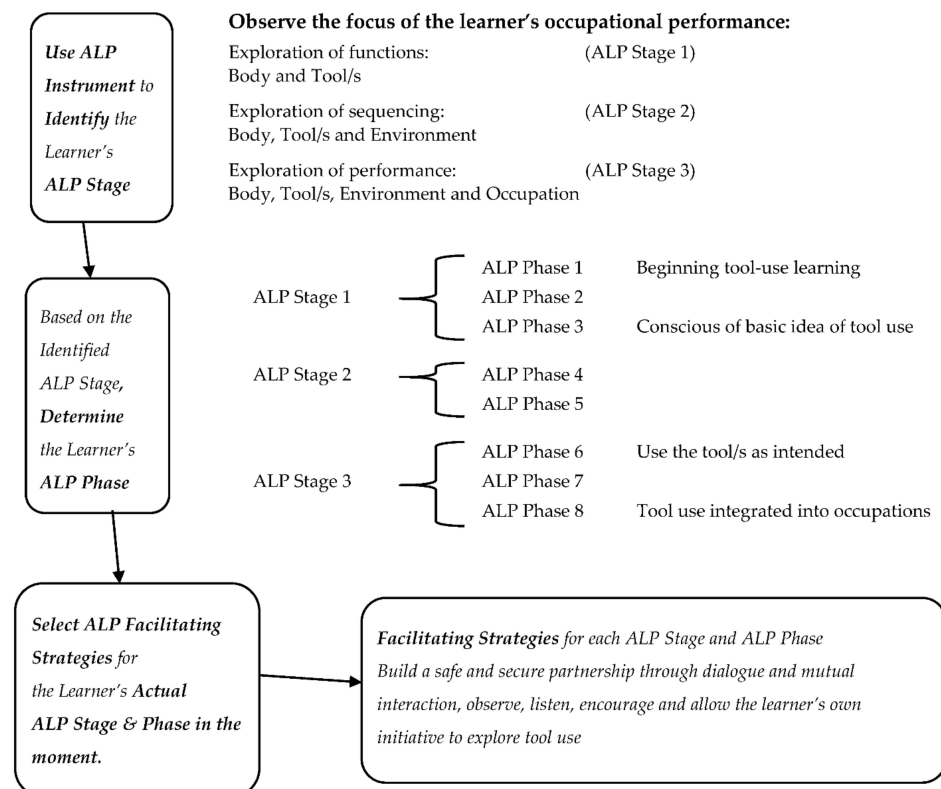
As illustrated in Tables 5–7, the ALP phases are encompassed within three stages of learning: stage 1: explore functions (ALP Phases 1–3); stage 2: explore sequencing (ALP Phases 4–5); and stage 3: explore performance (ALP Phases 6–8). Learners in ALP Stage 1 (Table 5) are in an introverted stage of learning and may appear shy and withdrawn. As such, they need time and understanding, to be able to explore the functions of their body in relation to the access method and the powered mobility device as well as to learn concepts related to cause and effect. Learners in ALP Stage 2 (Table 6) are in the difficult transitional stage, of exploring the sequencing of the inter-related functions of their body, the powered mobility tools, and the environment. They may appear eager, but will often exhibit frustration because their understanding of what they can do with the powered mobility device outpaces their ability to achieve what they desire to accomplish.

Learners in ALP Stage 3 (Table 7) are in the extrovert stage of learning and exploring performance, so are learning to integrate powered mobility use into their daily activities. These learners are developing and demonstrating higher cognitive functions, within goal-directed powered mobility activities, specific to the learner’s actual ALP phase, within this stage. A flowchart outlining use of the ALP tool is provided in Figure 1, below.

Table 7. ALP tool: prominent elements of stage 3: explore performance—phases 6–8 *.

ALP Instrument, Stage 3: Explore Performance: Body, Tool(s), Environment, Occupation					
ALP Phase	Attention	Activity and Movement	Understanding of Tool-Use	Expressions and Emotions	Interaction and Communication
6	Multi-channeled attention but easily disrupted	Goal-directed activity	Competent use of the tool	Serious, Content, Laugh, Exited	Consecutive interactions
7	Multi-channeled attention, generally focused	Occupation, for its own sake	Fluent, precise use of the tool	Happiness, Satisfaction	Concurrent interactions
8 Expert	Attention well established and sustained	Occupation composed of two or more activities	Integrated tool use	Dependent on the doing of “other” activities	Multi-level integrated interactions
ALP Facilitating Strategies, Stage 3—Extrovert level					
<i>Focus attention to competent tool use and physical and social environment</i>					
Oriented at tool use interactions					
– Encourage exploration of tool use, in everyday environment					
Frustration					
– Facilitate the learner’s development of strategies, to release blocking and decrease frustration					
Oriented at social interaction					
– Unstructured variation					
– Group interaction					
Language use					
– Verbal dialogue; labeling, reasoning, instructions for exercises, tasks					
– Mutual agreements, facilitate judgement skills, care of self and others					
Promote the learner’s own initiatives					
– Encourage development of own desires, goals, and initiatives for tool use					
– Allow exploration the learner’s own way with own mistakes					
– Allow unsafe operations, to a certain extent					
– Allow the learner to take the lead					

* Full ALP tool, version 2.0, see Nilsson and Durkin [7], online Appendix 1 and 2, at JRRD’s homepage.

**Figure 1.** Flowchart showing how to use ALP-instrument and ALP-facilitating strategies.

The goal with the first session of powered mobility use is to identify where the learner is in the learning process. During this first session, observations of the learner's performance are interpreted, to recognize and determine the learner's most stable or dominant ALP stage and phase, within the session. When determining a learner's ALP stage and phase, it is recommended that clinicians/educators use a printed copy of the complete three-page ALP instrument [7] (Appendix 1), beginning by identifying the learner's ALP stage.

Then, using a highlighter or other colored pen, the clinician/educator can highlight the observed indicators of performance within, and even across, the specified phase(s). Observations may be scattered across two or more phases, as oscillation in the learner's tool-use learning understanding is, commonly, observed during a single session of powered mobility device use, due to variation in the learner's attention and energy levels. In these instances, the clinician/educator should select the learner's most stable or predominant ALP phase. Once the ALP phase is identified, the clinician/educator consults the ALP-facilitating strategies [7] (Appendix 2), to select specific strategies that will support the learner.

This most stable and dominant ALP stage and phase is used to guide the setup of the intervention situation in the subsequent session [7]. From there on, the learner's actual ALP phase in the precise moment during the intervention session guides how the clinician/educator adjusts the challenges in the situation. It is important for the clinician/educator to stay vigilant to as well as follow the learner's oscillating attention and understanding of the learning situation.

5. Using the ALP Tool with Tyro Learners

Although the ALP tool is recommended, when engaging young children in powered mobility intervention [34,36,58], tyro learners of any age may begin their exploration of powered mobility use at earlier phases in the learning process [7]. They may, also, remain in each phase for prolonged periods of time [8,25,37,38]. Supporting tyro learners in the earlier phases of the learning process may require a more individualized intervention approach, as compared to supporting integrative learners who are in the later phases of tool-use learning [7,31,35]. For example, in the early phases, tyro learners need support to explore what the tool can be used for and how it can be handled in a goal-directed way, whereas, in the later phases, integrative learners need support to explore how the tool can be integrated into everyday activity and participation.

Determining a learner's actual stage and phase of learning, to use a powered mobility device, allows clinicians/educators to optimally support and guide the tyro learner's development of tool-use understanding [7,37,38]. As the ALP tool covers the entire learning process, there are not specific prerequisites or requirements that must be met, before a tyro learner engages in the exploration of learning to use a powered mobility device. To initiate powered mobility device learning, the learner must be awake and agree to engage in the activity, as indicated in whatever way they are able to express their agreement. The powered mobility device is, then, introduced to the learner in a manner and pace that supports the learner's specific needs and preferences for approaching new situations. Ensuring that the learner feels safe and secure, both emotionally and physically, is paramount. Once the learner is ready to be lifted into and placed in the powered mobility device, they should be encouraged to explore the device and the access method, in their own way. The learner may need time to adjust to new situations and overcome any uncertainties or anxiety. Simple verbal explanations of what can be done with the powered mobility device as well as short verbal prompting or gentle manual guidance may be used to encourage the learner to explore the device functions, in a way that fits their abilities and motives. The resulting learner performance within this initial session is assessed, using the ALP instrument, to determine the learner's actual consciousness/understanding of tool use. The identified predominant ALP stage and phase are used to select the ALP facilitating strategies, which will guide the powered mobility intervention for the specific learner, as illustrated in Tables 5–7.

Benefits of the Process-Based ALP Tool

One benefit of using the ALP tool is that within its eight phases, the ALP tool encompasses the entirety of the learning continuum [7,35,37]. The only prerequisites for beginning powered mobility intervention are that the learner must be awake and agree to engage in the activity, as indicated in whatever way they are able to express their agreement. This open, flexible approach not only allows tyro learners, but also integrative learners, to enter the tool-use learning process, at any point along the learning continuum. As such, there are no limitations of when to begin powered mobility intervention.

Within the ALP tool, the focus for assessment of the learner's tool-use performance is to identify the phase of tool-use understanding and use this information to guide the selection of appropriate facilitating strategies for intervention [7,38]. This focus on process allows clinicians/educators the freedom to implement powered mobility intervention sessions, in ways that align with each learner's actual needs, regardless of their age, abilities, diagnosis, or culture. Since each learner is their own individual, the learner's personal abilities, needs, and particular psycho-social and physical environment determine where and how to carry out the intervention as well as which specific challenges will best meet each learner's characteristics and circumstances. In this manner, the clinician/educator tailors the learning challenges, in accordance with the individual's ever-changing abilities, motives, and actual understanding of powered mobility use, with the end goal of growing consciousness/understanding of tool use [8].

By understanding the phases in the process, through which tool-use learning occurs, clinicians/educators can adjust their intervention approaches to any learner's actual phase of tool-use understanding. There are very few assessments that have been developed with or for tyro learners [59,60], and there is a need for valid and reliable assessments, with a sensitivity to identify small changes in tool-use performance, in children with physical and multiple disabilities [5]. Therefore, knowledge of the learning process provided by the ALP tool is essential for achieving optimal outcomes, especially when engaging tyro learners in intervention involving powered mobility use [6–9,25,32,36,61]. In addition, researchers and practitioners performing powered mobility interventions with both tyro and integrative learners have applied the ALP tool in their work [33,62–66].

6. Conclusions

This feature article has highlighted the benefits of engaging tyro learners in exploration of tool-use learning in powered mobility intervention. It distinguishes the characteristics of process-based and task-based powered mobility implementation packages and provides an in-depth description of the process-based ALP tool, to assist clinician/educator in choosing the assessment and intervention approach that best meets the needs of a specific tyro or integrative learner. Research exploring and expanding the application of the ALP tool version 2.0 for powered mobility use, as well as the transferability, relevance, and usefulness of the new generic Assessment of the Learning Process, ALP tool version 3.0 for general tool-use learning (Nilsson unpublished data, [67]) are needed to determine the relevance of these assessment and intervention tools in different learner groups and within various tool-use-learning situations.

Author Contributions: L.N. received the invitation and enrolled L.K. in the co-construction of the manuscript. The two authors, in collaboration, developed the structure and organization of the content, elaborated on the presentation of the aims and message, revised and edited the manuscript with tables and figure, and provided final approval of the version to be submitted. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Conflicts of Interest: The authors declare no conflict of interest.

References

1. Mangalam, M.; Frigaszy, D.M.; Wagman, J.B.; Day, B.M.; Kelty-Stephen, D.G.; Bongers, R.M.; Stout, D.W.; Osiurak, F. On the psychological origins of tool use. *Neurosci. Biobehav. Rev.* **2022**, *134*, 104521. [CrossRef] [PubMed]
2. Lockman, J.L. A perception—Action perspective on tool use development. *Child. Dev.* **2000**, *71*, 137–144. [CrossRef] [PubMed]
3. Kahrs, B.A.; Lockman, J.J. Building tool use from object manipulation: A perception–action perspective. *Ecol. Psychol.* **2014**, *26*, 88–97. [CrossRef] [PubMed]
4. McCarty, M.E.; Clifton, R.K.; Collard, R.R. The Beginnings of Tool Use by Infants and Toddlers. *Infancy* **2001**, *2*, 233–256. [CrossRef]
5. Hoppenbrouwers, G.; Stewart, H.; Kernot, J. Assistive technology assessment tools for assessing switch use of children: A systematic review and descriptive analysis. *Technol. Disabil.* **2014**, *26*, 171–185. [CrossRef]
6. Nilsson, L.; Durkin, J. Powered mobility intervention: Understanding the position of tool use learning as part of implementing the ALP tool. *Disabil. Rehabil. Assist. Technol.* **2017**, *12*, 730–739. [CrossRef]
7. Nilsson, L.; Durkin, J. Assessment of learning powered mobility use—Applying grounded theory to occupational performance. *J. Rehabil. Res. Dev.* **2014**, *51*, 963–974. [CrossRef]
8. Nilsson, L.; Eklund, M.; Nyberg, P.; Thulesius, H. Driving to learn in a powered wheelchair: The process of learning joystick use in people with profound cognitive disabilities. *Am. J. Occup. Ther.* **2011**, *65*, 652–660. [CrossRef]
9. Butler, C.; Okamoto, G.; McKay, T. Powered mobility for very young disabled children. *Dev. Med. Child. Neurol.* **1983**, *25*, 472–474. [CrossRef]
10. Jones, M.A.; McEwen, I.R.; Hansen, L. Use of power mobility for a young child with spinal muscular atrophy. *Phys. Ther.* **2003**, *83*, 253–262. [CrossRef]
11. Lynch, A.; Ryu, J.-C.; Agrawal, S.; Galloway, J.C. Power Mobility Training for a 7-Month-Old Infant with Spina Bifida. *Pediatr. Phys. Ther.* **2009**, *21*, 362–368. [CrossRef] [PubMed]
12. Ragonesi, C.B.; Galloway, J.C. Short-term, early intensive power mobility training: Case report of an infant at risk for cerebral palsy. *Pediatr. Phys. Ther.* **2012**, *24*, 141–148. [CrossRef] [PubMed]
13. Plummer, T.; Logan, S.W.; Morress, C. Explorer Mini: Infants’ Initial Experience with a Novel Pediatric Powered Mobility Device. *Phys. Occup. Ther. Pediatr.* **2020**, *41*, 192–208. [CrossRef] [PubMed]
14. Logan, S.W.; Huang, H.H.; Stahlin, K.; Galloway, J.C. Modified ride-on car for mobility and socialization: Single-case study of an infant with Down syndrome. *Pediatr. Phys. Ther.* **2014**, *26*, 418–426. [CrossRef]
15. Logan, S.W.; Feldner, H.A.; Galloway, J.C.; Huang, H.H. Modified ride-on car use by children with complex medical needs. *Pediatr. Phys. Ther.* **2016**, *28*, 100–107. [CrossRef] [PubMed]
16. Odor, J.; Watson, M. *Learning Through Smart Wheelchairs: A Formative Evaluation of the Effective Use of the CALL Centre’s Smart Wheelchairs as Part of Children’s Emerging Mobility, Communication, Education, and Personal Development. Final Report*; University of Edinburgh: Edinburgh, UK, 1994.
17. McGarry, S.; Moir, L.; Girdler, S. The Smart Wheelchair: Is it an appropriate mobility training tool for children with physical disabilities. *Disabil. Rehabil. Assist. Technol.* **2012**, *7*, 372–380. [CrossRef]
18. Galloway, J.C.; Ryu, J.C.; Agrawal, S.K. Babies driving robots: Self-generated mobility in very young infants. *Intell. Serv. Robot.* **2008**, *1*, 123–134. [CrossRef]
19. Jonasson, M. The AKKA-board—Performing mobility, disability and innovation. *Disabil. Soc.* **2014**, *29*, 477–490. [CrossRef]
20. Marchal-Crespo, L.; Furumasa, J.; Reinkensmeyer, D.J. A robotic wheelchair trainer: Design overview and a feasibility study. *J. Neuroeng. Rehabil.* **2010**, *7*, 40–51. [CrossRef]
21. Field, D. Powered mobility: A literature review illustrating the importance of a multifaceted approach. *Assist. Technol.* **1999**, *11*, 20–33. [CrossRef]
22. Hardy, P. Powered wheelchair mobility: An occupational performance evaluation perspective. *Aust. Occup. Ther. J.* **2004**, *51*, 34–42. [CrossRef]
23. Livingstone, R. A critical review of powered mobility assessment and training for children. *Disabil. Rehabil. Assist. Technol.* **2010**, *5*, 392–400. [CrossRef]
24. Bray, N.; Kolehmainen, N.; McAnuff, J.; Tanner, L.; Tuersley, L.; Beyer, F.; Grayston, A.; Wilson, D.; Edwards, R.T.; Noyes, J.; et al. Powered mobility interventions for very young children with mobility limitations to aid participation and positive development: The EMPoWER evidence synthesis. *Health Tech. Assess.* **2020**, *24*, 226. [CrossRef] [PubMed]
25. Nilsson, L.; Eklund, M. Driving to learn: Powered wheelchair training for those with cognitive disabilities. *Int. J. Ther. Rehabil.* **2006**, *13*, 517–527. [CrossRef]
26. von Hofsten, C. Afterword: Infants’ explorative actions. An important aspect of early cognitive development. *Enfance* **2012**, *1*, 115–121. [CrossRef]
27. Bertenthal, B.; Campos, J.; Barrett, K. Self-produced locomotion. An organizer of perceptual, cognitive and emotional development in infancy. In *Continuities and Discontinuities in Development*; Emde, R., Harmon, R., Eds.; Plenum Press: New York, NY, USA, 1984; pp. 175–210.
28. Durkin, J. Developing powered mobility with children who have multiple and complex disabilities: Moving forward. Ph.D. Thesis, University of Brighton, Brighton, UK, 2006. Available online: <https://ethos.bl.uk/OrderDetails.do?uin=uk.bl.ethos.426977> (accessed on 3 March 2022).

29. Durkin, J. Discovering powered mobility skills with children: ‘responsive partners’ in learning. *Int. J. Ther. Rehabil.* **2009**, *16*, 331–341. [[CrossRef](#)]
30. Livingstone, R.; Field, D. Systematic review of power mobility outcomes for infants, children and adolescents with mobility limitations. *Clin. Rehabil.* **2014**, *28*, 954–964. [[CrossRef](#)]
31. Livingstone, R.; Paleg, G. Practice considerations for the introduction and use of power mobility for children. *Dev. Med. Child. Neurol.* **2014**, *56*, 210–221. [[CrossRef](#)]
32. Kenyon, L.K.; Gallagher, C.; Hammond, L.; Webster, L.M.; Farris, J.P.; Aldrich, N.J. Power Mobility Training for Young Children with Multiple, Severe Impairments: A Case Series. *Phys. Occup. Ther. Pediatr.* **2017**, *37*, 19–34. [[CrossRef](#)]
33. Kenyon, L.K.; Farris, J.P.; Aldrich, N.J.; Usoro, J.; Rhodes, S. Changes in Electroencephalography Activity in Response to Power Mobility Training: A Pilot Project. *Physiother. Can.* **2020**, *72*, 260–270. [[CrossRef](#)]
34. Rosen, L.; Plummer, T.; Sabet, A.; Lange, M.L.; Livingstone, R. RESNA position on the application of power mobility devices for pediatric users. *Assist. Technol.* **2017**, 1–9. [[CrossRef](#)] [[PubMed](#)]
35. Field, D.A.; Livingstone, R.W. Power mobility skill progression for children and adolescents: A systematic review of measures and their clinical application. *Dev. Med. Child. Neurol.* **2018**, *60*, 997–1011. [[CrossRef](#)]
36. Feldner, H.; Plummer, T.; Hendry, A. A Guideline for Introducing Powered Mobility to Infants and Toddlers. Available online: <https://www.permobil.com/en-us/research-innovation/a-guideline-for-introducing-powered-mobility-to-infants-and-toddlers> (accessed on 4 March 2022).
37. Nilsson, L. Powered mobility for people with profound cognitive disabilities leads to developing occupational performance. *Br. J. Occup. Ther.* **2019**, *82*, 655–657. [[CrossRef](#)]
38. Svensson, E.; Nilsson, L. Inter-rater reliability of the assessment of learning powered mobility use, version 2.0, when applied with children and adults engaged in Driving to Learn in a powered wheelchair. *Aust. Occup. Ther. J.* **2021**, *68*, 115–123. [[CrossRef](#)] [[PubMed](#)]
39. Furumasu, J.; Guerette, P.; Tefft, D. The development of a powered wheelchair mobility program for young children. *Technol. Disabil.* **1996**, *5*, 41–48. [[CrossRef](#)]
40. Rushton, P.W.; Kirby, R.L.; Routhier, F.; Smith, C. Measurement properties of the Wheelchair Skills Test—Questionnaire for powered wheelchair users. *Disabil. Rehabil. Assist. Technol.* **2016**, *11*, 400–406. [[CrossRef](#)] [[PubMed](#)]
41. Gefen, N.; Rigbi, A.; Archambault, P.S.; Weiss, P.L. Comparing children’s driving abilities in physical and virtual environments. *Disabil. Rehabil. Assist. Technol.* **2021**, *16*, 653–660. [[CrossRef](#)]
42. Townsend, K.; Unsworth, C.A. The inter-rater reliability of the Powered Mobility Device Assessment Training Tool. *Aust. Occup. Ther. J.* **2019**. [[CrossRef](#)]
43. Mortenson, W.B.; Miller, W.C.; Auger, C. Issues for the selection of wheelchair-specific activity and participation outcome measures: A review. *Arch. Phys. Med. Rehabil.* **2008**, *89*, 1177–1186. [[CrossRef](#)]
44. Kamaraj, D.C.; Dicianno, B.E.; Cooper, R.A. A participatory approach to develop the power mobility screening tool and the power mobility clinical driving assessment tool. *Biomed Res. Int.* **2014**, *2014*, 15. [[CrossRef](#)]
45. Keeler, L.; Kirby, R.L.; Parker, K.; McLean, K.D.; Hayden, J.A. Effectiveness of the Wheelchair Skills Training Program: A systematic review and meta-analysis. *Disabil. Rehabil. Assist. Technol.* **2019**, *14*, 391–409. [[CrossRef](#)]
46. Kirby, R.L.; Miller, W.C.; Routhier, F.; Demers, L.; Mihailidis, A.; Polgar, J.M.; Rushton, P.W.; Titus, L.; Smith, C.; McAllister, M.; et al. Effectiveness of a Wheelchair Skills Training Program for Powered Wheelchair Users: A Randomized Controlled Trial. *Arch. Phys. Med. Rehabil.* **2015**, *96*, 2017–2026.e2013. [[CrossRef](#)] [[PubMed](#)]
47. Anderson, D.I.; Campos, J.J.; Anderson, D.E.; Thomas, T.D.; Witherington, D.C.; Uchiyama, I.; Barbu-Roth, M.A. The flip side of perception-action coupling: Locomotor experience and the ontogeny of visual-postural coupling. *Hum. Mov. Sci.* **2001**, *20*, 461–487. [[CrossRef](#)]
48. Uchiyama, I.; Anderson, D.I.; Campos, J.J.; Witherington, D.; Frankel, C.B.; Lejeune, L.; Barbu-Roth, M. Locomotor experience affects self and emotion. *Dev. Psychol.* **2008**, *44*, 1225–1231. [[CrossRef](#)] [[PubMed](#)]
49. Jones, M.A.; McEwen, I.R.; Neas, B.R. Effects of power wheelchairs on the development and function of young children with severe motor impairments. *Pediatr. Phys. Ther.* **2012**, *24*, 131–140. [[CrossRef](#)] [[PubMed](#)]
50. Butler, C. Effects of powered mobility on self-initiated behaviors of very young children with locomotor disability. *Dev. Med. Child. Neurol.* **1986**, *28*, 325–332. [[CrossRef](#)] [[PubMed](#)]
51. Dunaway, S.; Montes, J.; O’Hagen, J.; Sproule, D.M.; Vivo, D.C.; Kaufmann, P. Independent mobility after early introduction of a power wheelchair in spinal muscular atrophy. *J. Child. Neurol.* **2013**, *28*, 576–582. [[CrossRef](#)] [[PubMed](#)]
52. Guerette, P.; Furumasu, J.; Tefft, D. The positive effects of early powered mobility on children’s psychosocial and play skills. *Assist. Technol.* **2013**, *25*, 39–50. [[CrossRef](#)]
53. Sondag, A.; Gretsches, P. Empowered to play: A case study describing the impact of powered mobility on the exploratory play of disabled children. *Occup. Ther. Int.* **2016**, *23*, 11–18. [[CrossRef](#)]
54. Casey, J.; Paleg, G.; Livingstone, R. Facilitating child participation through power mobility. *Br. J. Occup. Ther.* **2013**, *76*, 158–160. [[CrossRef](#)]
55. Reindl, E.; Tennie, C.; Apperly, I.A.; Lugosi, Z.; Beck, S.R. Young children spontaneously invent three different types of associative tool use behaviour. *Evol. Hum. Sci.* **2022**, *4*, e5. [[CrossRef](#)]

56. Kenyon, L.K.; Mortenson, W.B.; Miller, W.C. 'Power in Mobility': Parent and therapist perspectives of the experiences of children learning to use powered mobility. *Dev. Med. Child. Neurol.* **2018**, *60*, 1012–1017. [[CrossRef](#)] [[PubMed](#)]
57. Stigen, L.; Bjørk, E.; Lund, A. The power of observation. Occupational therapists' descriptions of doing observations of people with cognitive impairments in the context of community practice. *Scand J. Occup. Ther.* **2020**, 1–13. [[CrossRef](#)]
58. Cerebral Palsy Alliance, A. Powered Mobility for Young Children/Assessment. Available online: <https://cerebralpalsy.org.au/our-research/about-cerebral-palsy/interventions-and-therapies/powered-mobility-for-children-under-three-years-of-age/#1465351538216-68866623-3242> (accessed on 4 March 2022).
59. Wessels, M.D.; van der Putten, A.A.J.; Paap, M.C.S. Inventory of Assessment Practices in People with Profound Intellectual and Multiple Disabilities in Three European Countries. *J. Appl. Res. Intellect. Disabil.* **2021**, *34*, 1521–1537. [[CrossRef](#)]
60. Maes, B.; Nijs, S.; Vandesande, S.; Van keer, I.; Arthur-Kelly, M.; Dind, J.; Goldbart, J.; Petitpierre, G.; Van der Putten, A. Looking back, looking forward: Methodological challenges and future directions in research on persons with profound intellectual and multiple disabilities. *J. Appl. Res. Intellect. Disabil.* **2020**. [[CrossRef](#)]
61. Kenyon, L.K.; Aldrich, N.J.; Farris, J.P.; Chesser, B.; Walenta, K. Exploring the Effects of Power Mobility Training on Parents of Exploratory Power Mobility Learners: A Multiple-Baseline Single-Subject Research Design Study. *Physiother. Can.* **2021**, *73*, 76–89. [[CrossRef](#)] [[PubMed](#)]
62. Longo, E.; Campos, A.C.D.; Barreto, A.S.; Coutinho, D.L.d.L.N.; Coelho, M.L.G.; Corsi, C.; Monteiro, K.S.; Logan, S.W. Go Zika Go: A Feasibility Protocol of a Modified Ride-on Car Intervention for Children with Congenital Zika Syndrome in Brazil. *Int. J. Environ. Res. Public Health* **2020**, *17*, 6875. [[CrossRef](#)] [[PubMed](#)]
63. Livingstone, R.; Paleg, G. Enhancing Function, Fun and Participation with Assistive Devices, Adaptive Positioning, and Augmented Mobility for Young Children with Infantile-Onset Spinal Muscular Atrophy: A Scoping Review and Illustrative Case Report. *Disabilities* **2021**, *1*, 1. [[CrossRef](#)]
64. Livingstone, R.W.; Field, D.A. Exploring young children's activity and participation change following 6 months' power mobility experience. *Br. J. Occup. Ther.* **2021**, *84*, 713–722. [[CrossRef](#)]
65. Livingstone, R.W.; Bone, J.; Field, D.A. Beginning power mobility: An exploration of factors associated with child use of early power mobility devices and parent device preference. *J. Rehabil. Assist. Technol. Eng.* **2020**, *7*, 2055668320926046. [[CrossRef](#)]
66. Rosenberg, L.; Cohen, R.; Maeir, A.; Gilboa, Y. Effects of a powered mobility summer camp as perceived by school staff: A qualitative study. *Disabil. Rehabil. Assist. Technol.* **2021**, 1–8. [[CrossRef](#)] [[PubMed](#)]
67. Modh, C.; Öhrvall, A.-M.; Nilsson, L. Assessing the learning process in persons with profound intellectual and multiple disabilities (PIMD) who are learning to use an AKKA-mobility platform with line-follower system. *Disabil. Rehabil. Assist. Technol.* **2022**, submitted.