

# Development of an Evaluation Scale for a Manual Wheelchair with Bidirectional Propulsion

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## INTRODUCTION

- Usability evaluation of assistive devices plays a critical role in product development and improvement.
- However, most existing assessment tools have been developed for general assistive technologies and often fail to reflect the unique features of devices with specialized functions.
- In particular, in Korea, translated tools developed abroad are commonly used, which do not adequately incorporate the needs and physical characteristics of local users.

## OBJECTIVE

- This study aims to develop a customized usability evaluation scale that reflects the unique characteristics of a manual wheelchair with bidirectional propulsion, enabling more accurate analysis of its functionality and facilitating user-centered improvement.



**Figure 1.** Manual Wheelchair with Bidirectional Propulsion

## METHODS

- Key principles of assistive device usability evaluation were analyzed through a literature review, leading to the development of core evaluation criteria.
- Each criterion was further specified into subcategories and detailed items, which were used to construct the evaluation scale.
- To ensure the validity and objectivity of the developed scale, iterative revisions were made through expert panel consultations and internal research team discussions.



**Figure 2.** Development Process of the Usability Evaluation Scale

**Table 1.** Usability Evaluation Principles Proposed by Researchers

Researcher	Usability Evaluation Principles
Gould & Lewis (1985)	Satisfaction, Memorability, Learnability
Nielsen (1994)	Learnability, Efficiency, Memorability, Errors, Satisfaction
Seffah et al (2006)	Efficiency, Effectiveness, Productivity, Satisfaction, Learnability, Safety, Trustfulness, Accessibility, Universality, Usefulness
ISO 9241-11 (2018)	Effectiveness, Efficiency, Satisfaction

## RESULTS

- The evaluation scale consists of seven domains and includes a total of 45 items, developed using a five-point Likert scale for quantitative analysis.
- It was designed to accurately assess the characteristics and functionality of a manual wheelchair equipped with bidirectional propulsion.
- The structure of the scale enables the identification of specific areas for improvement based on user feedback.

**Table 2.** Evaluation Domains and Focus Areas

Domain	Evaluation Focus
Ease of learning	Assesses whether the operation method is intuitive and easy to understand
Safety	Assesses whether there are risks such as getting caught or falling
Effectiveness	Assesses whether the user can use the device accurately as intended
Efficiency	Assesses whether operation and movement are performed quickly and easily
User Satisfaction	Assesses the level of comfort and satisfaction experienced during use
Aesthetics	Assesses satisfaction with the appearance of the wheelchair
Universality	Assesses whether the device is accessible to a wide range of users

## CONCLUSION

- The usability evaluation scale developed in this study addresses the limitations of existing assistive device assessment tools and can serve as a customized tool tailored to devices with specific functionalities.
- It is expected to provide foundational data for future research on the development and evaluation of similar assistive technologies and contribute to user-centered design and improvement of assistive devices.

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