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# THE EFFECTIVENESS OF A MAGNETIC PEN IN DEVELOPING WRITING SKILLS AMONG PUPILS IN INCLUSIVE EDUCATION

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**Abstract:** This article examines the pedagogical potential of a magnetic pen as an assistive device for developing writing skills among pupils with special educational needs in inclusive education. Writing is a complex activity requiring the coordinated functioning of fine motor skills, visual–motor integration, spatial orientation, attention, muscle control, and emotional readiness. Pupils with motor, sensory, neurological, or developmental difficulties may experience problems in holding a conventional pen, controlling its movement, maintaining writing pressure, following a line, forming letters, and completing written tasks independently. In this article, a magnetic pen is defined as an adapted writing instrument containing a magnetic component and used together with a compatible magnetic support, wearable hand device, or specially designed writing surface. The magnetic interaction provides gentle stabilization and directional assistance without completely restricting the pupil's voluntary hand movements.

**Keywords:** inclusive education, magnetic pen, writing skills, assistive technology, handwriting, fine motor skills, visual–motor coordination, special educational needs, adapted writing device, pedagogical monitoring.

**Introduction.** Writing is one of the central academic skills acquired during primary education. It enables pupils to communicate ideas, record information, complete educational assignments, and demonstrate their knowledge. The development of writing skills also contributes to language acquisition, memory, attention, organization, and independent learning.

Handwriting is not merely the mechanical reproduction of graphic symbols. It is a coordinated psychophysiological activity involving visual perception, auditory processing, fine motor control, hand–eye coordination, spatial orientation, attention, memory, and language competence. To write successfully, a pupil must hold the pen, regulate pressure, control the direction and amplitude of movement, reproduce letter forms, remain on the writing line, and maintain an appropriate writing rhythm.

For many pupils, these skills develop gradually through modelling, repetition, and systematic practice. However, children with special educational needs may encounter persistent barriers when learning to write. These difficulties may be associated with cerebral palsy, developmental coordination disorder, fine motor delay, visual impairment, intellectual disability, autism spectrum conditions, attention difficulties, speech and language disorders, dysgraphia, or neurological conditions.

In an inclusive classroom, writing difficulties should not be interpreted simply as carelessness, laziness, or a lack of motivation. A pupil may understand the educational task but be unable to demonstrate knowledge because of limited motor control. Conventional writing instruments may not provide sufficient stability for children who have hand tremors, reduced muscle strength, excessive muscle tone, involuntary movements, or difficulty maintaining a functional pen grip.

Assistive technologies can reduce these barriers by adapting the writing instrument, the writing surface, or the method through which hand movement is performed. Ergonomic pen grips, weighted pens, wrist supports, writing slopes, tactile line guides, adapted keyboards, and digital styluses are among the tools used to support written activity.

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A magnetic pen represents another possible assistive solution. Through controlled magnetic interaction, the device may stabilize the writing instrument, support the hand, and gently guide movement along a planned trajectory. Nevertheless, the magnetic pen should not be understood as a device that writes instead of the pupil. Its pedagogical purpose is to provide an appropriate level of assistance while preserving active participation and voluntary movement.

The purpose of this article is to examine the potential effectiveness of a magnetic pen in developing the writing skills of pupils in inclusive education, determine the conditions for its pedagogically appropriate use, and propose criteria for evaluating its influence on handwriting performance.

**Theoretical Foundations of Writing Skill Development**

Writing skill is formed through the interaction of several interrelated components. These components should be considered when determining the pupil's need for an adapted writing device.

**Motor Component**

The motor component includes finger mobility, wrist stability, muscle strength, movement coordination, and the ability to control the writing instrument. Insufficient motor control may cause irregular letters, interrupted lines, excessive pressure, weak pressure, and rapid fatigue.

**Visual–Motor Component**

Visual–motor integration refers to the ability to transform visually perceived information into coordinated hand movements. A pupil must recognize the structure of a letter and reproduce its elements in the correct sequence and direction.

**Spatial Component**

Writing requires an understanding of direction, proportion, distance, and position. Pupils must distinguish left and right, identify the starting point of a letter, maintain orientation on the line, and control spacing between letters and words.

**Cognitive Component**

The cognitive component includes attention, working memory, planning, self-monitoring, and the ability to follow a sequence of actions. A pupil must remember the letter form while simultaneously controlling hand movement.

**Linguistic Component**

The learner must understand the relationship between sounds, letters, syllables, words, and sentences. Motor support alone cannot correct writing difficulties originating mainly from phonological or linguistic barriers.

**Emotional and Motivational Component**

Repeated failure may cause anxiety, avoidance, reduced self-confidence, and unwillingness to participate in written activities. Therefore, an assistive device should support not only physical performance but also the pupil's sense of competence and independence.

**The Concept and Structure of a Magnetic Pen**

In the context of this article, a magnetic pen is an adapted writing instrument equipped with a magnetic element and used together with a compatible magnetic component. The supporting component may be incorporated into:

- a glove or hand strap;
- a wrist support;
- a movable guide;
- a writing board;
- a surface positioned beneath the paper;
- a modular hand-stabilization device.

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The magnetic force is intended to provide gentle resistance, stabilization, or directional guidance. The exact structure may differ depending on the learner's functional needs.

A magnetic pen system may consist of the following elements:

1. an ergonomic pen body;
2. a replaceable writing tip;
3. an internal or external magnetic element;
4. a compatible magnetic support;
5. an adjustable grip or hand strap;
6. a protective casing;
7. a writing surface or movement guide;
8. a mechanism for adjusting the level of magnetic interaction.

The strength of magnetic interaction must be carefully controlled. Excessive magnetic force may restrict voluntary movement, increase muscle tension, or cause frustration. Insufficient force may fail to provide meaningful stabilization.

The magnetic pen should therefore be designed as an adjustable assistive device rather than a universal tool with identical settings for every pupil.

**Writing Difficulties That May Be Addressed by a Magnetic Pen**

The device may be considered for pupils who experience one or more of the following difficulties:

- unstable pen grip;
- involuntary deviation from the writing trajectory;
- hand tremor;
- difficulty maintaining contact with the writing surface;
- weak wrist stability;
- excessive lateral hand movement;
- irregular writing pressure;
- inability to remain within graphic boundaries;
- difficulty tracing lines and shapes;
- low endurance during writing;
- dependence on direct adult hand guidance;
- fear or avoidance of written tasks.

The device is not appropriate for every type of writing difficulty. For example, pupils whose main difficulties are phonological, grammatical, or orthographic may require language-based instruction rather than magnetic motor support.

A multidisciplinary assessment is necessary before the device is introduced. The classroom teacher, special education specialist, psychologist, occupational or rehabilitation specialist, parent, and pupil should participate in the decision-making process.

**Research Methodology**

The study employs a theoretical and practice-oriented research design. The following methods were used:

- analysis of scientific literature on handwriting and assistive technology;
- comparative analysis of conventional and adapted writing instruments;
- systems analysis of the components involved in written activity;
- pedagogical modelling;
- development of observation and assessment criteria;
- design of a proposed experimental framework;

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- analysis of the conditions required for safe classroom implementation.

The article does not claim that the magnetic pen is universally effective. Instead, it develops a theoretical and methodological basis for evaluating its effectiveness under controlled educational conditions.

**Proposed Experimental Design**

The effectiveness of the magnetic pen can be examined through a pedagogical experiment involving primary school pupils with identified motor-based writing difficulties.

Participants should be selected according to transparent criteria. They may include pupils who:

- attend inclusive primary classes;
- experience persistent handwriting difficulties;
- have sufficient understanding of basic writing instructions;
- demonstrate motor instability when using a conventional pen;
- can participate safely in adapted writing activities;
- have parental or legal guardian consent.

Pupils may be divided into an experimental group and a comparison group. Both groups should receive systematic handwriting instruction. The experimental group uses the magnetic pen as part of the intervention, while the comparison group uses conventional or non-magnetic adapted writing instruments.

**Independent Variable**

The independent variable is the structured use of the magnetic pen during handwriting exercises.

**Dependent Variables**

The dependent variables may include:

- accuracy of letter formation;
- stability of lines;
- number of deviations from the writing line;
- uniformity of letter size;
- spacing between letters and words;
- writing pressure;
- task completion time;
- number of independently written symbols;
- frequency of adult assistance;
- physical fatigue;
- motivation and willingness to write.

**Assessment Stages**

Assessment may be conducted in three stages:

1. **Pre-intervention assessment** – determining the initial level of writing performance;
2. **Formative assessment** – monitoring progress during the intervention;
3. **Post-intervention assessment** – comparing final performance with the initial results.

A delayed assessment may also be conducted to determine whether the acquired skills are maintained after the intensity of support is reduced.

**Methodology for Using the Magnetic Pen**

The magnetic pen should be introduced gradually. Immediate use during complex writing assignments may cause confusion or dependence.

**Stage 1. Initial Diagnostic Assessment**

The teacher and relevant specialists examine:

- hand dominance;

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- pen grip;
- finger mobility;
- wrist stability;
- muscle tone;
- movement range;
- visual–motor coordination;
- writing pressure;
- sitting posture;
- endurance;
- emotional response to writing.

Samples of the pupil's handwriting should be collected before the device is introduced.

**Stage 2. Familiarization with the Device**

The pupil is allowed to observe, hold, and explore the magnetic pen. The teacher explains its function using simple language.

The first activities should not involve formal letter writing. The pupil may:

- move the pen freely across the surface;
- draw dots;
- produce straight lines;
- draw circles;
- trace wide paths;
- connect large visual targets.

The purpose is to develop comfort and reduce anxiety.

**Stage 3. Adjustment of Magnetic Support**

The level of magnetic assistance is adjusted according to the pupil's needs. The force should be strong enough to provide stability but weak enough to preserve active movement.

The teacher should observe whether the pupil:

- moves the hand freely;
- experiences discomfort;
- increases muscle tension;
- becomes dependent on the magnetic direction;
- can stop and restart movement independently.

**Stage 4. Graphic Preparatory Exercises**

The pupil practises basic graphic elements:

- vertical lines;
- horizontal lines;
- diagonal lines;
- semicircles;
- circles;
- ovals;
- waves;
- loops;
- spirals;
- zigzag patterns.

These exercises should progress from large shapes to smaller and more precise forms.

**Stage 5. Tracing Letters**

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The learner traces large letters with clearly marked starting points and directional arrows. Magnetic support may help maintain the trajectory.

At this stage, the teacher should provide short verbal instructions, such as:

- "Start at the top";
- "Move down slowly";
- "Turn to the right";
- "Return to the line";
- "Finish at the marked point."

**Stage 6. Guided Letter Formation**

The pupil writes letters using dotted models, highlighted boundaries, or partially completed elements. The visual support is gradually reduced as control improves.

**Stage 7. Independent Writing**

The learner writes letters, syllables, words, and short sentences without direct tracing. The magnetic pen continues to provide stabilization, but the pupil independently plans and performs the movement.

**Stage 8. Gradual Reduction of Assistance**

An important objective is to avoid unnecessary dependence on the device. When appropriate, magnetic assistance should be reduced gradually.

The learner may progress through the following sequence:

1. strong but comfortable stabilization;
2. moderate stabilization;
3. minimal stabilization;
4. ergonomic pen without magnetic assistance;
5. conventional writing tool where functionally possible.

Not every pupil will progress to fully unsupported writing. For some learners, continued use of assistive technology may remain appropriate.

**Possible Pedagogical Effects of the Magnetic Pen**

**Improved Grip Stability**

The magnetic system may help maintain the writing instrument in a more stable position. This can reduce unintended movement and allow the pupil to focus on letter formation.

**Better Movement Trajectory**

Directional support may help pupils follow straight, curved, and circular paths. This is particularly relevant when learning the basic graphic elements of letters.

**More Accurate Letter Formation**

When the pen is easier to control, the pupil may reproduce letter elements more consistently and complete them in the correct direction.

**Regulation of Writing Pressure**

A stable writing instrument may reduce the need to grip the pen excessively. This may help some pupils regulate pressure and decrease hand fatigue.

**Increased Writing Endurance**

When less physical effort is required to stabilize the pen, the learner may be able to participate in writing activities for longer periods.

**Greater Independence**

The device may reduce the need for the teacher or parent to hold and guide the pupil's hand directly. This can support independence and personal control.

**Improved Motivation**

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A pupil who observes visible improvement may become more willing to participate in writing tasks. The innovative nature of the device may also increase initial interest.

**Development of Self-Confidence**

Successful completion of previously difficult tasks can strengthen the pupil's confidence and reduce fear of making mistakes.

These effects should be treated as possible outcomes requiring individual evaluation rather than guaranteed results.

**Criteria for Evaluating Effectiveness**

The effectiveness of the magnetic pen should be evaluated through a combination of quantitative and qualitative indicators.

Assessment should compare the pupil primarily with their own previous performance. Comparison only with class averages may fail to reflect meaningful individual progress.

**Comparison of Conventional and Magnetic Pens**

A conventional pen requires the pupil to control its position, angle, pressure, and direction independently. This is appropriate for pupils with sufficiently developed motor coordination.

A magnetic pen provides additional stabilization and may reduce the number of uncontrolled movements. However, its educational value depends on whether the support encourages active motor learning.

The magnetic pen should not automatically replace conventional writing tools. It should be selected when assessment indicates that it removes a specific functional barrier.

**Role of Interdisciplinary Collaboration**

The implementation of a magnetic pen requires cooperation among several participants.

**Primary School Teacher**

The teacher identifies educational difficulties, organizes writing exercises, adapts assignments, and monitors classroom performance.

**Special Education Specialist**

The specialist analyses developmental barriers and recommends differentiated or corrective teaching methods.

**Occupational or Rehabilitation Specialist**

This specialist evaluates hand function, muscle tone, posture, range of movement, and the suitability of magnetic resistance.

**Psychologist**

The psychologist assesses motivation, anxiety, attention, confidence, and the pupil's emotional acceptance of the device.

**Engineer and Designer**

The engineer and designer ensure mechanical reliability, ergonomic suitability, adjustable magnetic force, durability, and safety.

**Parent or Caregiver**

Parents provide information about daily hand use and support appropriate practice outside school.

**Pupil**

The pupil should express whether the device is comfortable, useful, attractive, or difficult to use. The learner's opinion is essential in evaluating practical effectiveness.

**Safety and Ergonomic Requirements**

The magnetic pen must meet clear safety requirements. The device should:

- use securely enclosed magnetic components;

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- contain no sharp or detachable hazardous elements;
- have an ergonomically appropriate diameter;
- be made from non-toxic materials;
- allow easy cleaning;
- avoid excessive magnetic force;
- be appropriate for the pupil's age;
- be used under adult supervision during initial sessions;
- be inspected regularly for damage;
- be stored safely.

Additional caution is required when a learner uses an implanted medical device or other equipment that may be affected by magnetic fields. In such cases, specialist medical or technical guidance is necessary before the magnetic device is used.

**Limitations of the Magnetic Pen**

Although the magnetic pen may provide useful support, several limitations should be recognized.

First, writing difficulties have different causes. A magnetic device cannot resolve phonological, grammatical, spelling, or language comprehension problems.

Second, excessive assistance may reduce active motor participation. The device should support movement rather than perform it for the pupil.

Third, individual responses may differ. A level of magnetic resistance that is helpful for one pupil may be uncomfortable for another.

Fourth, novelty may temporarily increase motivation. Long-term monitoring is required to determine whether engagement is sustained.

Fifth, improvements achieved with the magnetic pen may not automatically transfer to conventional writing. Transfer exercises should therefore be included.

Sixth, the device requires ergonomic design, technical maintenance, and specialist adjustment. An incorrectly designed magnetic pen may be ineffective or counterproductive.

**Discussion**

The theoretical analysis indicates that the magnetic pen may serve as a supplementary assistive tool for pupils whose handwriting difficulties are associated primarily with motor instability. Its potential effectiveness is connected with the ability to provide gentle stabilization, reduce unintended movement, and support the reproduction of graphic trajectories.

However, technical stabilization alone does not guarantee the development of writing skills. Handwriting improvement requires systematic pedagogical instruction, fine motor exercises, visual–motor activities, language development, motivation, and repeated meaningful practice.

The magnetic pen should therefore be integrated into a broader corrective and developmental programme. It can be used during graphic preparation, letter tracing, independent writing, and skill-transfer activities. Its use should be based on individual assessment rather than diagnosis alone.

The most important pedagogical principle is graduated assistance. The device should provide only the amount of support necessary for successful task performance. As the learner's control improves, assistance should be reduced where possible.

The effectiveness of the device should not be evaluated only through the visual neatness of handwriting. Increased independence, reduced fatigue, greater classroom participation, improved confidence, and willingness to complete written tasks are equally significant outcomes.

**Practical Recommendations**

For the effective use of a magnetic pen in inclusive education, the following recommendations are proposed:

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1. conduct an individual assessment before introducing the device;
2. determine whether the main writing difficulty is motor-based;
3. involve the learner in selecting and adjusting the device;
4. begin with simple graphic movements rather than complex letters;
5. adjust magnetic support to the minimum effective level;
6. combine the device with fine motor and visual–motor exercises;
7. avoid excessively long writing sessions;
8. monitor fatigue, discomfort, frustration, and muscle tension;
9. use positive and specific feedback;
10. document changes in writing accuracy, speed, and independence;
11. include exercises with reduced magnetic support;
12. cooperate with teachers, specialists, engineers, and parents;
13. evaluate whether acquired skills transfer to other writing tools;
14. revise or discontinue the device when it does not provide meaningful benefit.

**Conclusion**

The magnetic pen is a promising assistive device for supporting the development of writing skills among pupils with special educational needs. Its main pedagogical function is to provide adjustable stabilization and directional assistance while preserving the learner's active hand movement.

The device may contribute to improved grip stability, movement control, letter formation, writing pressure, endurance, independence, motivation, and self-confidence. Nevertheless, these outcomes depend on the pupil's individual characteristics, the design of the device, the level of magnetic support, the quality of pedagogical instruction, and systematic monitoring.

The magnetic pen should not be treated as a universal solution or a substitute for handwriting instruction. It should be used as one component of an individualized educational programme that includes diagnostic assessment, fine motor development, multisensory exercises, differentiated tasks, formative assessment, and interdisciplinary collaboration.

Its effectiveness must be determined through structured experimental research comparing pupils' performance before, during, and after intervention. Assessment should include both technical handwriting indicators and broader educational outcomes, such as independence, participation, comfort, and motivation.

Thus, the pedagogically justified use of a magnetic pen can help reduce motor barriers to written activity and expand the participation of pupils with special educational needs in inclusive education.

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