

Review

# Exploring Multiple Intelligence Theory Prospects as a Vehicle for Discovering the Relationship of Neuroeducation with Imaginative/Waldorf Pedagogy: A Systematic Literature Review

Manos Mavrelou<sup>1,\*</sup>  and Thanasis Daradoumis<sup>1,2</sup> 

<sup>1</sup> Department of Cultural Technology and Communication, University of Aegean, University Hill, 81100 Mytilini, Greece; adaradoumis@uoc.edu

<sup>2</sup> Department of Computer Science, Multimedia and Telecommunications, Open University of Catalonia, Rambla Poblenou, 156, 08018 Barcelona, Spain

\* Correspondence: mmavrelou@aegean.gr

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**Abstract:** Waldorf Education follows a holistic approach of children’s development, where the fundamental characteristics are creative/artistic activities, integrating imagination-based teaching methods to support and enhance the development of children’s and adolescents’ physical, social, emotional, and cognitive skills. Neuroeducation provides the most relevant level of analysis for resolving today’s core problems in education. Multiple Intelligence (MI) theory investigates ways of using the theory as a framework in school for improving work quality, collaborations, opportunities for choice, and a role for the arts. To that end, we provide a systematic literature review that critiques and synthesizes representative literature on these three topics in order to reveal new perspectives towards a novel transformative educational paradigm in a digitized society. A comprehensive analysis of theoretical and empirical articles between 2000 and 2019 is provided. The search included five main academic databases (ERIC, Web of Science, ScienceDirect, SpringerLink, and Scopus) using predefined selection criteria. In total, 321 different articles were screened, from which 43 articles met the predefined inclusion criteria. The results indicate a correlation between pedagogical practices of Waldorf schools and MI theory compatible teaching practices and between Waldorf schools and neuroeducation. Further empirical research examining different facets of this relationship is still needed to establish live and effective schools as Learning Organizations.

**Keywords:** early childhood education; teaching methods; cognitive development; curriculum development; alternative education

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## 1. Introduction

Recent reports from international organizations [1,2] stressed the need for improved quality in the educational setting. One issue is the inadequacy of the testing systems established, urging the adoption of a unified testing system and appropriate “measurement of learning” especially in poorer countries. In the educational establishment, though, the interpretation is quite the opposite. The educational culture is one of constant testing and stress, of over confidence to technology, and of rising number of learning problems according to several authors [3–5]. Among other problems reported, students are treated primarily as future units of economic production, following a fragmented curriculum that lacks a sense of higher meaning or purpose, whereas the arts and humanities are regarded as frivolous in comparison to other subjects [6]. Various solutions have been proposed, such as: (1) the blending

of traditional with holistic education [7], (2) diversifying and tailoring instruction to the individual student [8], and (3) taking into account the way the human brain works [9].

### 1.1. Mind, Brain, and Education

The development of brain imaging technics like Positron Emission Tomography (PET), functional Magnetic Resonance Imaging (fMRI), Near Infrared Spectroscopy (NIRS), and Event Related Potential (ERP) made it possible to visualize the brain during the cognitive process [10]. Inside this emerging field of neuroeducation, neuroscientists, educators, and psychologists tried from different sides to explore how the human mind learns and adjusts the learning process [11]. Mind, Brain, and Education Science (MBE) has been a newly emerging discipline that incorporates developmental psychology, cognitive neuroscience, and educational psychology to answer the question: “How do we learn best?” [12]. In addition, it is presented as a holistic approach to a new, brain-based way of teaching and learning [13]. As such, MBE is presented as an alternative educational approach that can provide many interesting aspects to conventional education as well [14,15]. Some of these aspects are the understanding of the link between emotion and cognition, the creation of a positive emotional environment, and the establishment of strong relations [15], aspects which are similar to some Waldorf schools’ characteristics.

### 1.2. Waldorf Schools

Waldorf Schools (or alternatively Steiner Schools) follow the holistic educational theory of Rudolf Steiner. These alternative schools, which cover all types of school levels from kindergarten to high school, have some characteristics that makes them distinct, such as:

- The pedagogy follows Steiner’s theory about the development of the child. There are three stages, from 0-7, 7-14, and 14-21, and every stage is related with a different aspect of the child’s being [16].
- The class teacher usually stays with the same class for eight years. The class teacher teaches the “main” lesson, the two-hour main subject of the day, using Steiner’s oral, artistic, and imaginative way of teaching [17].
- Art plays a central role in the pedagogy. The role of art is to strengthen students’ spiritual sense, feelings, and imaginative power [18].
- Interacting with screens and computers or similar technological devices is not encouraged, especially in the first stages. The reason for that is because Waldorf educators believe that these instruments limit the children’s imagination, which is considered vital for their healthy growth in these early stages of development [19].
- Play is also crucial, because it encourages children’s health and spiritual well-being. Toys are also natural and handmade; plastic is avoided [20].
- There is a special lesson called Eurythmy (Greek: eurythmy = “harmonious rhythm”), which combines movement and speech [21].

This approach and the equal importance given to a broad range of subjects remind the importance given to all aspects of intelligence by Howard Gardner in his Multiple Intelligences Theory (MI theory). In MI theory, Gardner, guided by his investigation on the fields of brain-study, genetics, anthropology, and psychology, proposed the existence of not one, but many intelligences or “computational systems” [22]. The way the main lesson is taught is similar to MI theory by approaching the topic from many entry points [23].

### 1.3. Multiple Intelligences

Gardner [23] described MI theory as the idea that

*“ ... all human beings possess not just a single intelligence (often called by psychologists ‘g’ for general intelligence). Rather, as a species, we human beings are better described as having a set of relatively autonomous intelligences ... ”*

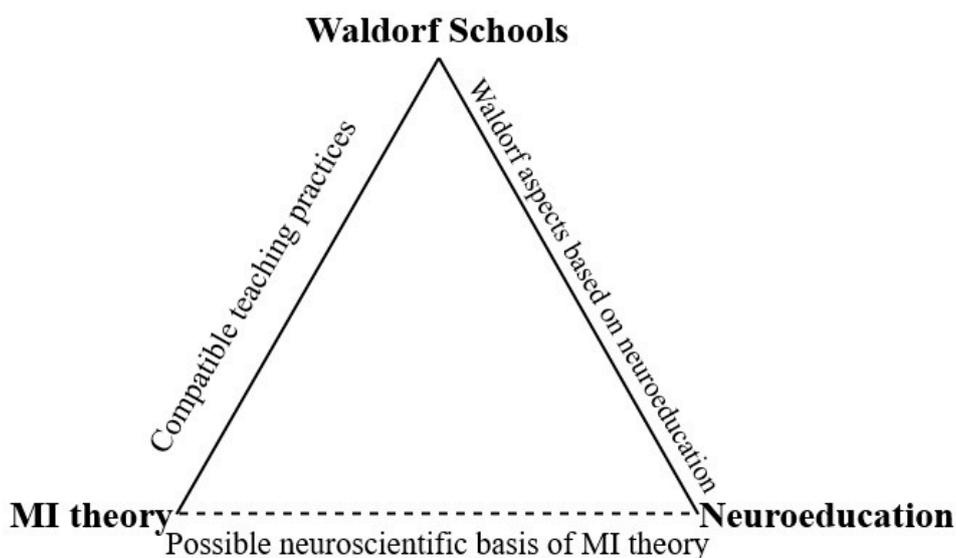
His use of the term intelligence, where he could equally have used another term, and his belief that the notion of *g-factor* was giving too much worth to some and not to all aspects of human intelligence, led him into direct confrontation with his psychologist colleagues and others [24]. MI theory has been accused of being a neuromyth [25] and of lacking validating evidence. Authors warned that it should not be applied to education [26] and that it is similar to the idea of learning styles [23]. Visser et al. [27] tested the theory and resulted in the confirmation of the prominence of the *g-factor*. Gardner replied to some of his critics that his theory is based on his experience and research on psychology and neuroscience, that it is has nothing to do with learning styles, that the tests used for testing his theory are based on linguistic and mathematic skills, and that the educational aspect of his theory is popular to educators all around the world [24,28,29]. This last assertion is what most agree on: the fact that MI theory became very popular to educators [25,26]. This possibly stems from the variance of success of students across subjects, an observation evident to teachers. There is a similarity of the teaching practices proposed by some MI theory proponents [8,30,31] and the holistic way of Waldorf schools.

Gardner based his theory on his academic experience with biological, behavioral sciences, and neuroscience. The scarcity of supporting empirical studies did not help the legitimation of the theory. On the other hand, there has been some effort to provide empirical evidence in support of the theory. Castejon et al. [32] compared four different theoretical models of the structure of intelligence based on the analysis of data obtained in a series of measured abilities corresponding to the intelligence assessment activities. Model 1 represented a “strong” version of MI theory with fully autonomous intelligences. Model 2 represented the *g-factor*, a single general second-order factor. Model 3, with two correlated second-order general factors, the “cognitive” and “non-cognitive” factors, represented what Visser et al. [27] found. Model 4 represented a model with six first-order correlated factors, corresponding to a “weak” version of the theory of multiple intelligences [28]. This last model was the one that fitted better to the empirical data. Another effort to provide empirical support for the theory of MI is a published systematic literature review [33]. The main question the review tried to answer is whether every intelligence is distinct from one another. To prove that, they tried to map specific brain areas and their neural connections to every intelligence. The reviewers argue that every intelligence has its distinct areas of the brain associated to and so they claim that they proved that MI theory is correct.

The effort to make education and neuroscience work has been likened to bridging a river too wide for crossing [34]. The effort to bridge this gap needs cooperation and effort from both sides, the neuroscience laboratory, and the classroom [11,35]. This effort and the similarities previously stated provide the basis to study the possible relations of Waldorf education, an alternative holistic pedagogical movement to the teaching applications of MI theory and to the MBE field.

## 2. Research Problem

The three main concepts can be represented as the vertices of the triangle that is shown in Figure 1. The goal is for the possible connections between the top vertex and the other two to be revealed, and thus to be able to configure the real shape of the triangle, depicting a dynamic model of relationships and interactions between pedagogy, intelligence, and neuroscience of learning. The establishment of a link between MI theory and neuroeducation is not a goal of this paper, only the pedagogical use of it. For that reason and because the debate on this relationship is ongoing, the connection is represented by a dotted line.



**Figure 1.** A starting point of a three-concept relationship. MI theory, Multiple Intelligences theory.

From the examination of the literature about Waldorf education, MI theory, and MBE, a question was formed:

- “Is there empirical evidence that the theory of multiple intelligences supports the relationship established between Waldorf education and neuroeducation?”

The first step to answering the question is to systematically examine two specific research questions:

1. How are Waldorf-Steiner educational practices related to MI theory (RQ1)?
2. Which aspects of neuroeducation are shown to be related with Waldorf-Steiner educational practices (RQ2)?

### 3. Methodology

For a theory to contribute to scientific knowledge, Patterson [36] proposed eight criteria. As stated earlier in the introduction, the blending of traditional and holistic education was proposed as an answer to today’s educational problems. The research question of this review blends a holistic educational paradigm such as Waldorf schools with aspects of MI theory and neuroeducation. Such a suggestion has relevance to actual life since it may explain why Waldorf students have certain attributes. It has a practical value as well, since it could lead to a new curriculum proposal, blending traditional and alternative school’s curricula. The choice of conducting a systematic literature review was made because the systematic aspect of the review could act as a foundation to a future empirical research. The results of this systematic review can be the basis of an empirical study that will test the proposed relationship.

This literature review follows the guidelines described in the PRISMA statement [37], as well as those proposed by Petticrew & Roberts [38]. A list of inclusion criteria was made in order to collect the necessary articles. The intention was to find the greatest number of empirical studies about Waldorf education and, from there on, to distinguish which studies could be linked to MI theory and which to neuroscience in order to answer RQ1 and RQ2. The eligibility criteria are shown in Table 1. Appendix A contains more information about the methodology. The search included five main academic databases (ERIC, Web of Science, ScienceDirect, SpringerLink, and Scopus) websites and journals related to Waldorf education (Research on Steiner Education (Rose), The Online Waldorf Library, see Appendix A Table A2 for more). Additionally, the publications reference lists added several articles. The search terms used were chosen to return a broad selection of articles about Waldorf education (“(Rudolf AND Steiner) OR (Steiner AND Education) OR Waldorf”).

Table 1. Article inclusion criteria.

Article Inclusion Criteria	
Types of Studies	Quantitative and Qualitive Empirical Research
Length	More than five pages
Language	English
Theme	Waldorf schools and their students
Date	After 2000
Publication	All publications based on original research

The PRISMA diagram, shown in Figure 2, displays the number of publications on each stage. During the screening stage, the title and abstract were screened in order to exclude irrelevant articles. During the eligibility stage, the inclusion criteria were applied to the full text. The screening and eligibility phases were conducted by a single researcher while the second researcher participated by examining a sample of them.

This procedure led to the creation of a database of 43 scientific papers to be reviewed fulfilling the criteria set and corresponding to RQ1 as well as of 10 papers corresponding to RQ2. There were six papers that were relevant to both RQ1 and RQ2.

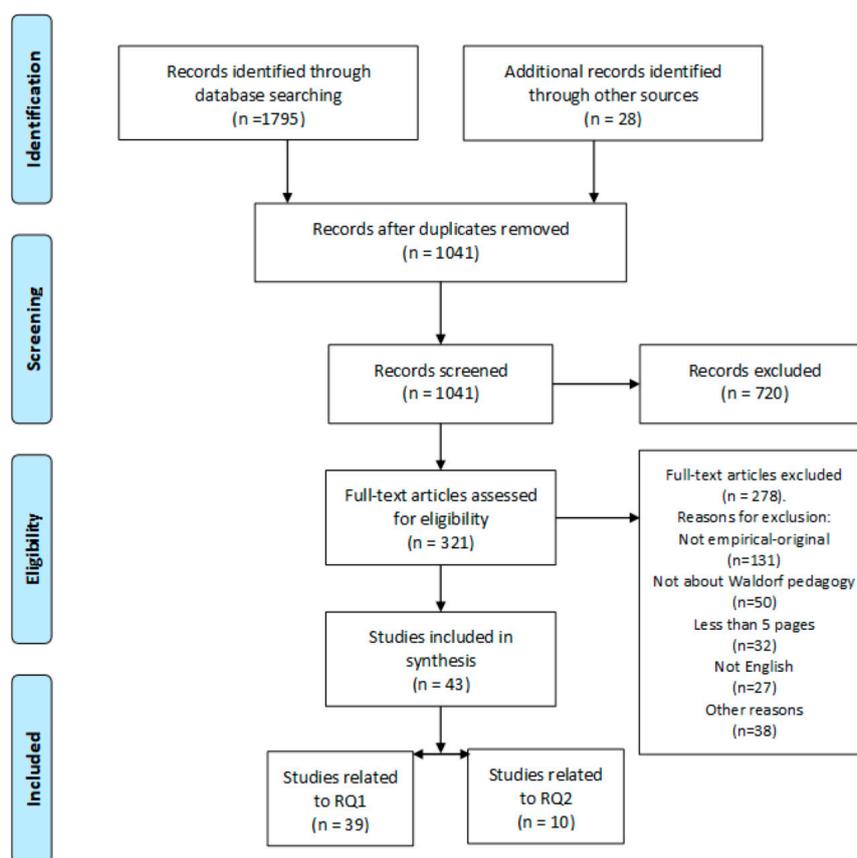


Figure 2. PRISMA flow diagram.

For the collection of the data, a form was used that was pilot-tested on the first included articles from the ERIC database. Both researchers participated independently in the data extraction process and in the case of different views, a consensus was needed.

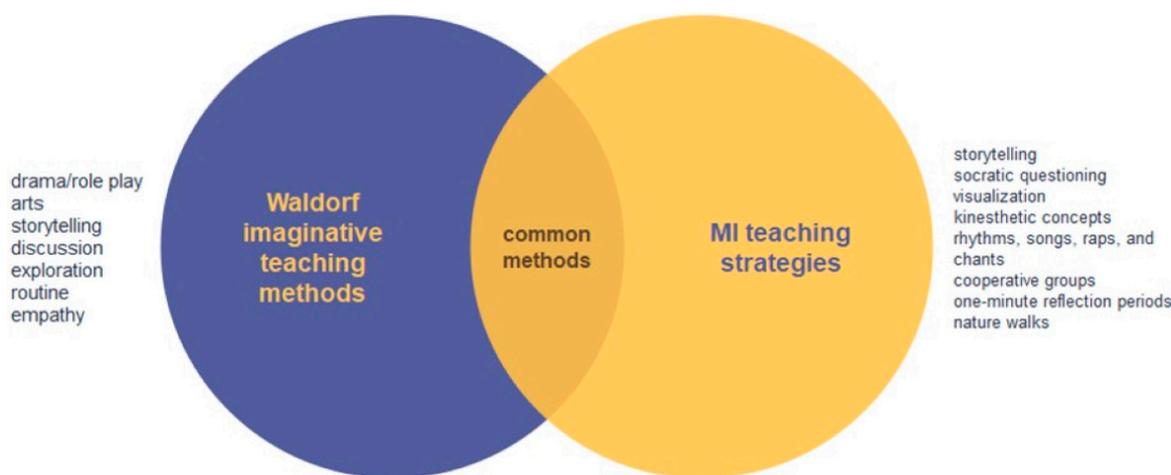
A coding system was created to associate, in a qualitative manner, each publication to the research questions. The articles were searched for methods that connected the way children are taught in

Waldorf schools and the way children could be taught according to the MI theory [23,39]. Armstrong [8] describes ways and methods to integrate MI theory with teaching (Table 2).

**Table 2.** Intelligence-specific teaching methods [8].

Intelligence	Teaching That is Well-Suited to Develop an Intelligence Could Include the Following Teaching Methods
R3.1: Linguistic	Lectures, reading to the class, discussions, word games, storytelling
R3.2: Logical-Mathematical	Brainteasers, problem solving, science experiments, mental calculation, number games, critical thinking
R3.3: Spatial:	Visual presentations, art activities, imagination games, mind-mapping, metaphor, visualization
R3.4: Bodily Kinesthetic	Hands-on learning, drama, dance, sports that teach, tactile activities, relaxation exercises
R3.5: Musical	Rhythmic learning, using songs that teach
R3.6: Interpersonal	Cooperative learning, peer tutoring, community involvement
R3.7: Intrapersonal	Individualized instruction, independent study, private time, self-esteem building
R3.8: Naturalist	Nature study, ecological awareness, care of animals

To this end, a two-way method was followed. Firstly, an examination of the publications from the MI theory end to the Waldorf end was made. A list with teaching strategies that are well-suited to MI theory was created and the articles were searched for evidence that these strategies are used in Waldorf schools (Figure 3).



**Figure 3.** Relating Waldorf and MI teaching methods.

For each teaching strategy that taps into a specific intelligence, a code was associated. A similar approach was taken with the focus or concept of each study. Each study had a different focus, which was depended on the goal of the study. All the relevant articles were associated with one concept. The concepts were the MI theory eight “intelligences” and the neuroeducation concept. For example, in Rose, Jolley, and Charman [40], the goal was to examine the Expressive and Representational Drawings in different school settings. The study focus “drawing development” can be related to the MI’s *spatial* intelligence. As such it was identified as “spatial” and was tagged with the *spatial* concept (Table 3.). After reading the study and specifically its results, it was associated with three codes, spatial, bodily-kinesthetic and “other.” That meant that the study succeeded in proving its aim and also reported two other results. According to Webster and Watson [41], the use of such a table, which relates the articles with the key concepts of a topic, is crucial to the transition to a concept-centric review. The table, in this case, lists all the relevant articles, their focus-concepts, the intelligence and



Table 4. Cont.

Studies	Intelligence and Neuroeducation Codes									
	R3.1	R3.2	R3.3	R3.4	R3.5	R3.6	R3.7	R3.8	Other	Ned
Dorfman and Fortus [56]						+	+			
Friedlaender, Beckham, Zheng, and Darling-Hammond [57]	+	+								
Gerdes, Tegeler, and Lee [58]										+
Gidley [59]									+	
Ionova, Luparenko, Partola, and Gres [60]	+	+						+		
Jelinek and Sun [61]		+								
Kamalova and Vasilyeva [62]				+		+				
Kanitz, et al. [21]										
Kikas [63]		-								
Kirkham and Kidd [64]			+						+	
Larrison and Dalya [65]	+	+								+
Larrison, et al. [4]	+	+								
Liebenwein, Barz, and Randall [66]							+		+	+
Mather [67]										+
Nicholson [68]	+		+	+	+	+				
Oberman [69]	+	+								
Randoll and Peters [70]	+						+		+	
Rios and Menezes [71]								+		
Rose and Jolley [72]			+							
Rose and Jolley [73]			+				+			
Rose, et al. [40]			+	+					+	
Shankland, Genolini, Franca, Guelfi, and Ionescu [74]										+
Steenbergen [75]	+					+	+			
Suggate, et al. [42]	+									
Suggate, Schaughency, and Reese [76]	+									
Wagemann, et al. [77]										+
Waite and Rees [78]			+			+			+	+
Wendt, et al. [79]										+
Woods, et al. [80]	+	+	+	+	+	+	+	+	+	+
Zhang [81]			+		+	+	+	+		

Nearly half of the studies were comparative studies comparing Waldorf schools to other school types, mostly mainstream. This is a known feature with studies about Waldorf schools, as the most of them are comparative studies [52]. In these comparative studies, the assessment of Waldorf students in a specific area was usually compared to the assessment of students of mainstream schools. Regarding the field of the study, most of them were about primary-secondary education and about psychology. Table 5 describes the types of the studies.

Table 5. Studies types and subjects.

Study Characteristic	Description	Number of Studies
Study Type	Comparative Study	18
	Mixed	6
	Survey	5
	Observation-Interviews	3
	Case Study	2
	Scoping Review	2
	Control Study	1
	Exploratory Study	1
	First Person Study	1
	Prospective Open Cohort Study	1
	Interviews	1
	Intervention	1
	Longitudinal Study	1
	Total	43

Table 5. Cont.

Study Characteristic	Description	Number of Studies
Study Subject	Primary and Secondary	10
	Psychology	7
	General Education	6
	Preschool- Early	5
	Art Education	4
	Alternative Education	3
	Environmental	2
	Medical	2
	Higher Education	2
	Linguistics	1
	Science Education	1
	Total	43

Figure 4 shows the number of studies associated with an intelligence code as well as the number of studies about Steiner pedagogy associated with neuroeducation. Studies that were associated with an intelligence not included in Gardner’s list of eight, such as spiritual, were linked to the code “other.”

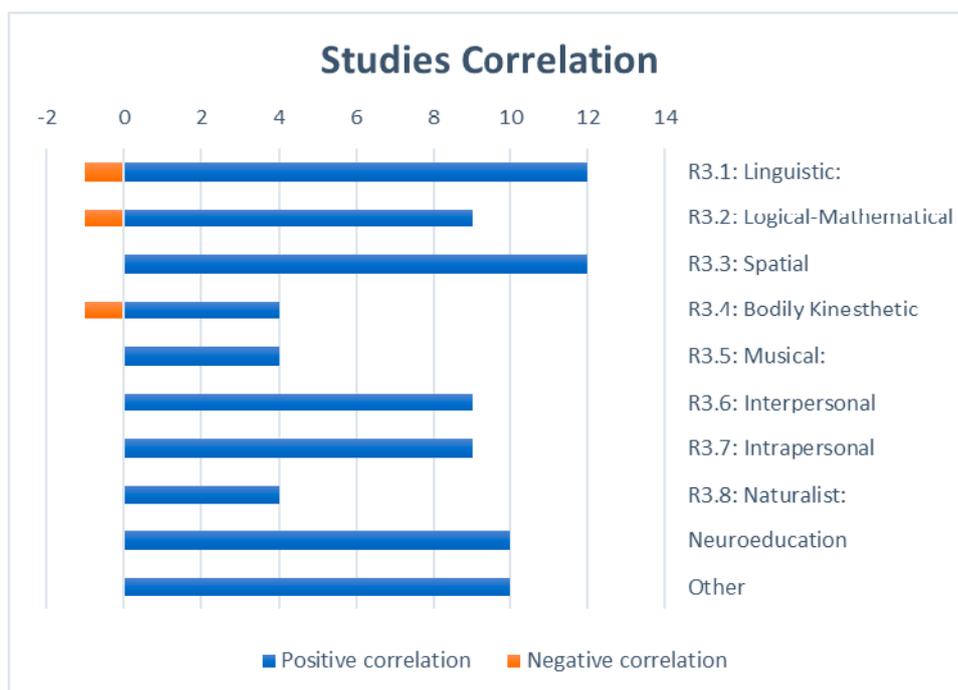


Figure 4. Correlation of each intelligence code to studies.

Each study was given an MI theory intelligence code either by matching similar teaching practices or by examining the results of the study, such as superior performance of Waldorf students to other in an area, e.g., mathematics.

A qualitative analysis follows, where the majority of the studies are discussed as well as their relationship to each intelligence.

#### 4.1. RQ1. How Are Waldorf-Steiner Educational Practices Related to MI theory?

##### 4.1.1. Linguistic

Teaching Methods: Lectures, Discussions, Word Games, Storytelling, Choral Reading, Journal Writing

Cunningham and Carroll [49] wrote about the way children are taught phonics in Steiner schools. This is described as an analytic approach, including games and the position of letters in familiar words. It was concluded that Steiner students exhibit superior reading-related skills and greater maturity. Nicholson [68] writes that discussion and a sort of “Socratic” dialogue is a part of the oral tradition of Steiner schools. He also adds storytelling and reciting to that list. Students usually write their own textbooks based on the oral and written feedback given by teachers [82]. Ashley [17] states that Waldorf teachers are effective storytellers who operate with a much stronger tradition than teachers in mainstream schools, with recitation and choral speaking being regular features in the curriculum. A known criticism of Steiner schools is the delay in starting to read and write until the age of seven. Suggate [83] states that students in Steiner schools catch up very quickly with their mainstream counterparts, with no need of intensive instruction. This is attributed to the strong oral language activities in Steiner schools.

##### 4.1.2. Logical-Mathematical

Teaching Methods: Brainteasers, Problem Solving, Science Experiments, Mental Calculation, Number Games, Critical Thinking

Oberman [69] and Larrison and Dalya [65] describe studies that show that Waldorf students have equivalent test results in Math tests with students of traditional schools, albeit not in early grades. Randoll and Peters [70] report a PISA study result that suggests a better understanding of physics among Austrian Waldorf students. Jelinek and Sun [61], in a study about science education and Waldorf students, describe their deductive ability as on par, if not better, with public schools’ students. In the same study, Waldorf students’ reasoning-skills are labeled as high and their logical reasoning as sophisticated. Waldorf schools are also reported to encourage the use of experiments, the development of problem-solving skills and scientific reasoning. On the other hand, the authors conclude that some pseudoscientific notions, which derive from Steiner’s philosophy, are in contrast with modern mainstream scientific thinking.

##### 4.1.3. Spatial

Teaching Methods: Visual presentations, art activities, imagination games, mind-mapping, metaphor, visualizations

Visual presentations and visualizations are embedded in the Waldorf curriculum and they are used in many lessons, like history maps in history [68]. Wright [84] writes about Waldorf students constructing pictorial maps of their neighborhood in geography lessons. The drawing ability of Waldorf students is rated very highly in many studies [40,48,72]. Artistic work starts in an early age with making toys, painting, and modeling. In later years students will also draw, role play, and paint based on history themes, like Ancient Greece or Medieval Europe [85].

##### 4.1.4. Bodily-Kinesthetic

Teaching Methods: Hands-On Learning, Drama, Dance, Sports That Teach, Tactile Activities, Relaxation Exercises

Kanitz et al. [21] reported on the benefits of Eurythmy in stress and fatigue coping, although in adults. As with other aspects of Waldorf pedagogy, the kinesthetic approach is an integral part of the curriculum, like children forming the number eight in an eurythmy lesson, weaving to calm and gain

a sense of balance [17], or role-playing the trial of Galileo [85]. Drama plays at the end of the year is considered a method of expression and forming bonds as are dancing and sport events [80].

#### 4.1.5. Musical

Teaching Methods: Rhythmic Learnings, Using Songs That Teach

Music lessons, singing, and playing instruments are part of the Waldorf special classes and activities [57,80]. Singing and reciting is also part of the “main” lesson block with students singing songs related to the lesson or songs with a moral dimension. Of special interest to the changing of the learning rhythm is the singing and reciting breaks that occur between lessons [68]. Rhythm and musicality are aspects that are carried in language. Steiner associated them with writing using a correct orthography. Because of that, Waldorf teachers must be very articulate in speaking [82].

#### 4.1.6. Interpersonal

Teaching Methods: Cooperative Learning, Peer Tutoring, Community Involvement, Social Gatherings, Simulation

Role plays in order to understand each other [78,81], a non-competitive atmosphere, festivals in which students are engaged in group-effort, and peers involved in the academic function [80] are some characteristics that show an increased value attributed to interpersonal relations in Waldorf schools. Of special importance is the bond between the teacher and the students, and among the students themselves, which is formed because of the eight years the teacher stays with the same class and the participation of the parent community in the life of a typical Waldorf school [57]. Waldorf schools value drama, role play, simulations, and physical enactments in any content area [86].

#### 4.1.7. Intrapersonal

Teaching Methods: Individualized Instruction, Independent Study, Private Time, Self-Esteem Building

Friedlaender et al. [57] and Zhang [81] report about the individualized instruction given to Waldorf students based on a holistic approach. Sobo [20] discusses the building of “will” in Waldorf kindergartens, which corresponds partly with the results in [75] that show higher academic self-image. The individualized approach is partially based on the Steiner adherence to the classical though outmoded (for some researchers) idea of “temperaments.” Dahlin [82] ascertains, though, that this idea should not be scorned since it is implicit in the EAS theory of temperament [87].

#### 4.1.8. Naturalist

Teaching Methods: Nature Study, Ecological Awareness, Care of Animals

Wright [84], talking about the geography curriculum in Waldorf schools, states that it moves away from determinism to different cultures and their relationship to nature. Woods et al. [80], in their study about Steiner school in England, report the well-known fact of using props and resources (like toys, pencil cases, craft material) that are natural. Plastic is excluded from the Waldorf school.

“Gardening ... environmental studies and ecology ... woodland work, landscape, building paths etc., propagation techniques, caring for bushes/trees, and grafting” form a distinct curriculum area, as the same study informs. Student field trips to farms where the students participate and help care for farm animals are also reported [57]. Dahlin [82] writes of a domination of an ecological holistic perspective that explores how everything is connected to the world around it. Rawson and Richter [88] argue that the Waldorf curriculum, with its connection to nature, preceded today’s interest and concerns about ecology and sustainable development.

#### 4.1.9. Imaginative- Spiritual

One of the prominent features of Waldorf education is its unique imaginative and spiritual character. On the special imaginative quality of Waldorf students, Gidley [59] reports that they produce rich and positive imaginative visions of the world. This quality is cultivated by the teaching methods of drama, exploration, storytelling, routine, arts, discussion, and empathy [89]. Furthermore, the imagination playing and the lack of outside influences like plastic toys, cartoons, etc. force the children to use their imagination [78].

The existential-spiritual intelligence was eventually not included in Gardner’s list of intelligences, but Waldorf schools have a distinct relation with spiritual education. Pearce [90] studied the spiritual education in Steiner schools and concluded that they are “weakly” confessional schools. They intentionally prepare pupils for spirituality without enforcing a dogma, but they tend to tip the scaled against agnosticism or atheism.

#### 4.2. RQ2. Which Aspects Of Neuroeducation Are Shown To Be Related With Waldorf-Steiner Educational Practices?

Table 6 lists the ten (10) studies associated with the neuroeducation code. Two of these studies [58,77] were not specifically about education but associated certain aspects of Steiner pedagogy to neuroeducation. Six studies were also relevant to RQ1. The number of articles related to RQ2 is small. Only five articles had a neuroeducation focus.

**Table 6.** Studies associated with neuroeducation.

Studies
Gerdes, Tegeler, and Lee [58]
Liebenwein, Barz, and Randoll [66]
Mather [67]
Waite and Rees [78]
DeLuca and Hughes [54]
Shankland, Genolini, Franca, Guelfi, and Ionescu [74]
Woods et al. [80]
Larrison and Dalya [65]
Wendt et al. [79]
Wagemann et al. [77]

The 10 studies describe Waldorf school practices that were quantitatively associated to characteristics crucial to cognitive development. Neuroeducation focuses on some educational topics: the linguistic and mathematical skills and problems, the social and emotional “intelligence,” and the attention levels of students. A critical factor is also the cognitive development of the children related to age, something that is central to Steiner’s pedagogy, with his age stages. Educational aspects that associate to these topics and were present to the articles were given the neuroeducation code.

A discussion of these associations follows.

#### 4.2.1. Late Entry

Waldorf students start primary schooling at the age of seven, following Steiner’s development stages. Under this tradition, children start learning to read and write in a later age that it is usually practiced in mainstream schools. Puhani and Weber [91], in their study in the German school system, report positive effects for entering school at a higher age. It is supported [3,82] that when stimulation is presented at an inauspicious time, this may harm the ideal growth of neural connections and that any effort spent on formal teaching in early age may harm creativity and the students’ cognitive development. According to Suggate [83], there is a list of skills that are crucial to have in order to start formal schooling, namely, neural maturation, language, attention, social skills, memory, and general

knowledge. Suggate [83] also calls for further research about potential psychological or developmental costs to early literacy instruction.

#### 4.2.2. ADHD

Halperin and Healey [92] reported that physical exercise and play impact the development of the human high-order executive functions. In the same review, it is supported that directed play, physical exercise, and the engagement of children in sports and nature could benefit children with ADHD in a more persistent manner than drugs and behavioral intervention. A study by Payne et al. [93], albeit in a preliminary stage, reported that students in Waldorf schools have reduced rates and severity of ADHD. Larrison and Dalya [65] justifies that, because Waldorf schools employ somatosensorimotor activities related to basal ganglia, which is a brain area related to ADHD. It is also reported that societal reasons that may contribute to ADHD, like early age, poor education, and increased academic expectations [94], are absent from the Waldorf setting.

#### 4.2.3. Physical Activity-Play

Sibley and Etnier [95], in an influential meta-analysis of studies pertaining to physical activity and cognition in children, concluded that a significant positive relationship exists between them. The eurythmy class, a unique characteristic of Waldorf education, is reported to provide benefits in coping with stress and fatigue [21]. Eurythmy also attempts to help students express concepts through movement and sound connecting the mind and body [86].

In a literature review about the impact of play in children [96], a number of benefits are reported concerning the cognitive growth of children: developing vocabulary, understanding of different concepts, increased ability to solve problems, increased self-confidence and motivation, and an awareness of the needs of others. In the same review, it is reported that play involving arts develops the fine motor skills of hand and finger control, whereas fantasy play has a therapeutic value. Finally, play that involves contact with nature appears to have a positive effect on recovery from stress and attention fatigue and on mood, concentration, self-discipline, and physiological stress.

Sobo [20] states that outdoor play is highly valued by Waldorf teachers because of the sensory and motor stimulation it allows. In the same study it is argued that outdoor play contributes to the handling of the changing rhythm and pace by Waldorf teachers, by alternating the quieter classroom activities with the boisterous play action. The outdoor play constitutes an activity that is more and more disappearing from the modern city with great cost to the health, well-being, and achievement of children [97].

#### 4.2.4. Rhythm

The attention to rhythm, the way students alternate between tasks demanding concentration and more relaxed activities, is vital to Waldorf schools and to neuroeducation principles [58]. This alternation is likened to “breathing” in and out by the Waldorf teachers. This control of students’ attention, by teachers and schedule, is intentional and it is aimed in they having more concentration during the more structured parts of the day [78]. The two-hour “main lesson” is a system which incorporates many good principles of “rhythm” or pace and timing [17]. The teacher is responsible for the pacing of the lesson and, through this management of the rhythm, pupils’ attention spans and capacities for protracted periods of work can be considerably lengthened [80].

#### 4.2.5. Sleep

Sleep plays an important role in Waldorf education. Every topic presented during the main lesson lasts more than a day; new ideas are usually presented over a three-day period [80] and are integrated into the main lesson block that lasts 2–4 weeks [68]. As it is argued by Maquet [98], sleeping is important for brain plasticity and for learning and memory. Furthermore, procedural memory tasks do not improve performance until hours later and sleep is vital to memory consolidation. The practice

of Waldorf teachers of requesting recall of the previous day in oral and written form is related to this theory of connecting sleep to memory and cognition.

#### 4.2.6. Screens and Computers

Today, public worries are targeted towards smartphone use by children and adolescents. There is evidence, hitherto small, that associates smartphone use with negative effects on memory, cognition, attention, and stress [99]. In this setting, Steiner education with discouraging students from using computers and screens in the early age seems prophetic. The disagreement with the early use of technology, even for educational reasons, comes from the belief that students must learn to perform tasks by themselves first. For example, pupils must learn to draw a map from memory first since the early use of geography software may harm their spatial awareness [80] (or intelligence as Gardner may point out).

#### 4.2.7. Architecture and Space

Steiner was, among other things, an architect with very distinctive ideas about shapes and colors (goethean style-organic shape-relation of colors to developmental stages). Waldorf schools try to follow these ideas in different levels of involvement. Bjørnholt [100], in her article about the Oslo Waldorf school, writes that

“The rooms are shaped so as to support concentration and immersion in the subject at hand over time, and at the same time, the aesthetic-spatial arrangements mirror and support the growing and developing child.”

There is also an effort to have green spaces, gardens, etc. in the environment of Waldorf schools, wherever this is possible. There are Waldorf schools situated near forest or semi-urban areas [71], or schools that are in urban areas attempt to reshape the site into a more natural setting [57]. This effort, as Karjalainen et al. [101] state, presents benefits that assume that natural settings is related to reducing stress and facilitating recovery from concentration-demanding tasks.

#### 4.2.8. Imitation

Waldorf teachers are expected to be a role model for students, especially in preschool. This has its origins in the developmental theory of Rudolf Steiner, which argues that the child before the age of seven has a strong need and instinct for imitation (an idea also developed by Piaget at a later age). Teaching during these years should be formational but not, as someone may understand it at first sight, that the child must be formed into something else, but rather that teachers should be forming themselves as role-models for the child [82,102]. They do that by taking actions, whenever they are observed by children, like sweeping the path and gardening when outdoors [20]. This need of imitation is related by Waite and Rees [78] to the emergence of “mirror neuron theory” in neuroscience, which associates imitation to cognition, an association that also has its opponents [103].

#### 4.2.9. Stress, Emotion, and Cognition

The connection between emotion and cognition is something that it is easily accepted by teachers but not fully researched yet. Teachers recognize that the success of a student in a class depends on his/her emotional state. The relationship between teacher and student is also critical for the students to succeed [104]. Immordino-Yang and Damasio [105] explored how cognition is subject to emotion and how they interact with each other. In Immordino-Yang [106], it is also described how students of disadvantaged areas found a new meaning in learning science when they felt that the lesson was relevant to their emotional experiences (diversity and ethnic identities). Likewise, Ashley [17] describes students in Waldorf schools situated in deprived districts as achieving better grade results than their mainstream peers because of the stable teacher-students relationship. The eight years this relationship

lasts allows for deep trust and appreciation and a feeling of belonging [82]. Early life stress was indicated by Pechtel and Pizzagalli [107] to have a major impact on the cognitive and affective function. Waldorf schools are described as schools that attempt to reduce stressful activities [80,86].

### 5. Discussion

The results showed that most of the studies were associated with the linguistic intelligence and with the spatial intelligence. This is not surprising because of the strong oral tradition of Waldorf schools and the importance of drawing and art in these schools [17].

Most of the studies were about preschool education as well as primary-secondary. These school levels cover the developmental stages significant to Steiner, i.e., from the time when the child is between 3 and 7 years old (preschool), to the second developmental stage between 7 and 14 years old (primary and early secondary), until students finally pass to the adolescent phase of their life.

Figure 5 shows the correlation of Waldorf schools with intelligences after considering the level of school.

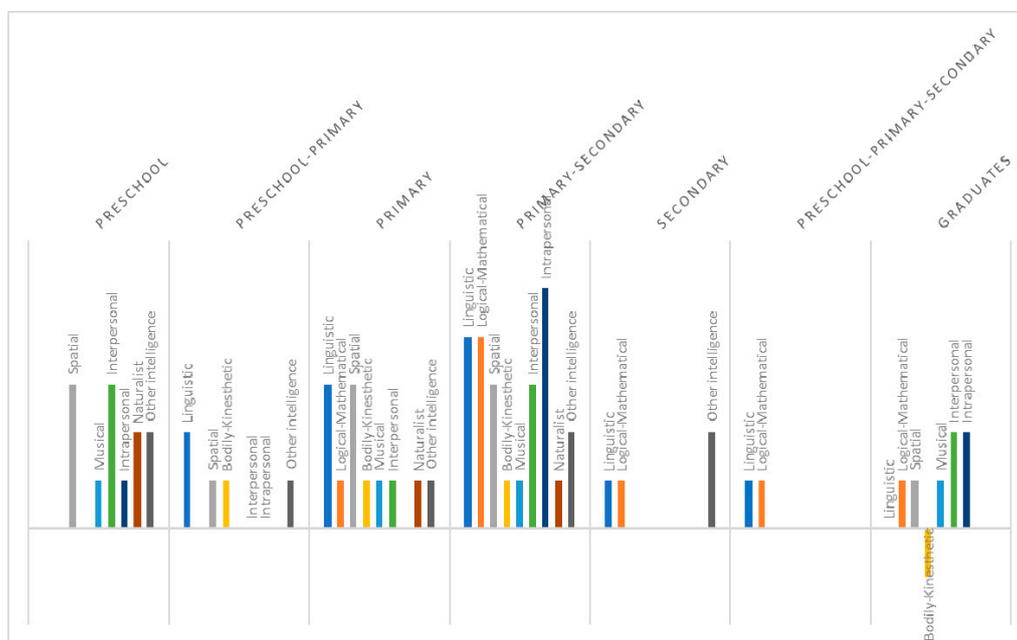


Figure 5. Correlation of each school level to intelligence codes.

Figure 5 illustrates that, in the preschool setting, most of the studies related Waldorf with spatial, interpersonal, naturalist, and spiritual-existential (other) intelligence as well as with linguistic and bodily-kinesthetic (preschool-primary). Indeed, the Steiner-Waldorf early childhood approach considers the interdependence of physical, social, emotional, spiritual, and cognitive development [82]. Children are highly involved with painting and drawing, which helps them acquire balance and symmetry skills (spatial and bodily-kinesthetic intelligence) as well as with playing activities [68]. During play, children participate in physical exercise or carry out craft activities, which develop fine motor skills (bodily-kinesthetic) [40]. Play also allows them to communicate with other children; in addition, imitation is fostered, which is one of the most effective and natural means of developing social skills and awareness of others at this age (interpersonal) [78]. Oral narrative is also central to Waldorf education. Through the rich language of fairy tales, children are building their vocabularies. Moreover, children can tell a story by “reading” the pictures in a book, which develops verbal skills and encourages them to use their own words [68]. Many children are also participating in puppet shows, thus developing dramatic skills through working with narrative and dialogue in an artistic way (linguistic). In addition, traditional fairy tales and nature stories fill children with a world of

feelings, while they gradually evoke a fine moral sense for knowing right from wrong (intrapersonal). In Waldorf setting, children are also encouraged to appreciate the natural world, since the beauty of nature, animals, insects, and plants are brought to them with a feeling of respect and wonder. Besides this, the use of natural materials (wool, wood, felt, cotton) in play and craft fosters a connection with the natural world. All these help children value the gifts of nature (naturalist) [20]. The Waldorf kindergarten day has different “moods.” There are moments of reverence each day when the children associate the mood with stillness, awe, and wonder (spiritual). Music and movement are introduced by letting children experience the musicality of language and its social aspects through playing ring games and eurythmy. Ring games let children enjoy and participate in traditional songs and rhymes, accompanied by rhythmical and routinely performed gestures by imitation of the teacher. Next, children try to recreate these songs, rhymes, and stories as part of their creative play or in puppet shows or theatre. Eurythmy is a form of movement that works with language and music. Moreover, the celebration of festivals provides experiences of different cultures, so children learn songs and rhymes in many languages as part of regular activity (musical).

As regards the second developmental stage between 7 and 14 years old (primary and early secondary), Figure 5 shows that several studies associated Waldorf with all intelligences. Some of them are given special attention, such as linguistic and spatial (primary) as well as logical-mathematical, interpersonal, and intrapersonal (primary-secondary). Indeed, as the child moves from preschool education to primary education setting, there is a shift to the development of their linguistic intelligence [42]. This is attributed to the start of learning how to read and write after the age of seven. Spatial intelligence also plays an important role until the conclusion of the primary education stage, since the artistic immersion continues.

One goal of Waldorf education is linking any knowledge gained to life experiences. For instance, science education starts with stories about the living world. This helps children use their imagination, which, according to Steiner, is an area that must be cultivated during the second developmental stage. The use of children’s imagination is vital because they form a personal experience with the subject taught and this makes the knowledge “live” for a longer time [85]. Another aspect of science teaching is the importance bestowed to observation, a feature influenced by Goethe [108]. Students, during early primary grades, observe and describe the living world. Zoology, botany, and human studies are introduced as subjects in a later stage. Only at later grades are chemistry, physics, and other more abstract subjects integrated to the curriculum. A similar approach is followed with mathematics. Students start with numbers and drawing and then proceed to measurement and geometry. There is also an effort to engage many senses when teaching a subject: counting backwards, in second grade for example, is done while students walk backwards in a circle and multiplying is done with a singing and clapping game [57].

Consequently, there is activation of imagination and of different intelligences during this kind of teaching that include logical-mathematical, interpersonal, and intrapersonal ones. Only after these essential and easy-to-relate subjects are conquered, are algebra and the more abstract notions of mathematics introduced.

Indeed, the child during the first grades of this stage longs to appear adequate and skilled. The student wants to gain the approval of the teacher and of his or her peers. The lack of testing and the more relaxed environment of Waldorf schools enforce that feeling (intrapersonal). The practice of experiencing the lesson in an artistic way, through painting, singing, or role playing, is another factor that helps children explore their inner selves. The increased value of art in Waldorf education has its basis on Steiner and his belief that it makes students establish a personal connection to the subject and that it creates social bonds between students. This is more important during the middle grades, when the child wants to build friendships and to be included as part of a group. The choirs and theatrical plays, which are a common feature of Waldorf schools, help towards this socialization (interpersonal). Students do not just memorize facts; there is an effort to empathize with the subject, as in role playing biographies of historic persons.

Regarding RQ1, there was a considerable number of articles that showed that Waldorf schools are MI “compatible.” There is an overlap of the teaching practices proposed by MI enthusiasts. The subjects are covered by many ways and art plays a role in every subject from mathematics to physical education as Gardner has proposed [109]. It is true that the empirical evidence that support MI theory is scarce; only two studies were mentioned in this article. The support for the educational implications of MI theory, on the other hand, by educators is strong [25].

Regarding RQ2, the number of articles that this review unveiled was considerably smaller. In order to explore this relation, more empirical evidence is needed about Waldorf students and anxiety, stress, concentration, and conditions like dyslexia or dyscalculia. The articles that were examined in this review reported that Waldorf students have reduced rates of ADHD, thus better concentration, a subject of neuroeducation. Children in Waldorf schools start reading and writing later in their lives, a practice that is based on Steiner’s theory. This happens because Steiner believed that play and imagination is more critical to the child than reading or writing. Stress, which is related to the cognitive function, is reported to be low in Waldorf schools.

## 6. Limitations

This systematic literature review carries some limitations. The databases searched are multidisciplinary (except ERIC) general databases—something that led to extensive duplication of the results. Even though the databases contain a significant part of the existing literature, they do not represent the whole. The methodology of the study, an exhaustive analysis but primarily descriptive, could be accompanied with subsequent meta-analytical analyses. The systematic literature review was limited by establishing the inclusion criteria of the length of the article (more than five pages) and the inclusion criterion that focused searching only on English-language articles. This represents a risk of language bias. Waldorf-Steiner schools are popular in German-speaking countries [110] so the exclusion of articles published in German inserts the risk of omitting valuable data. There has been an effort though to include German studies through the bilingual (German-English) RoSE – Research on Steiner Education academic journal, and studies about German Steiner schools have been included [66]. The majority of the articles, though, concern English-speaking Waldorf schools, as shown in Appendix A.

## 7. Conclusions and Future Research Directions

*Can the Pedagogical Applications of Multiple Intelligence Theory be Used as a Vehicle for Discovering the Relationship of Neuroeducation with Imaginative/Waldorf Pedagogy and How?*

This analysis of the published empirical studies between 2000 and 2019 about Waldorf education confirms what was expected when one examines their theoretical pedagogical background: that they are holistic schools that devote the same time and importance to all subjects. Waldorf schools use many teaching methods to approach each subject: imagination, music, movement, drawing, reciting in order to help students learn mathematics, writing, science, and history. This demonstrates that there is an overlap between Waldorf teaching strategies and MI-compatible teaching methods. This systematic review indicated that Waldorf schools do employ MI-consistent teaching strategies (RQ1). Yet, Waldorf schools are not MI schools per se, since there is not an official and absolute MI school established.

Steiner formulated his theories based on three aspects of the development of the child: the senses, the emotion, and the brain. Concerning RQ2, this review unveiled some Waldorf educational practices where their success may be attributed to the way the cognitive development is understood in these schools.

MI recognizes many human aspects to the brain: the eight intelligences. There are many factors that affect the way humans, and especially children, learn. For instance, stress and anxiety are two factors that can impede learning [107]. The same is true for physical activity and play, as they may help the cognitive and psychological development [95,96]. The learning environment may also support learning, lower stress and improve concentration [101].

This review reported a few articles that showed that some aspects of neuroeducation existed in Waldorf schools. It reported even more articles that showed a relation to the MI “intelligences.” Waldorf schools are considered by some as art schools or that their graduates are destined to become artists. This notion may have its roots in the way art is integrated to the curriculum and because it is used to explore other subjects. Revealing their possible connection to MI and neuroeducation makes it easier to understand their value and success. It also may provide with a new curriculum proposal that is more holistic, humanistic, and fuses traditional and alternative pedagogy.

To further establish the link between Waldorf pedagogy and neuroeducation, there is a need to explore how Waldorf schools affect these aspects and the way students learn. An empirical investigation is needed on how imaginative/Waldorf teaching methods affect students’ multiple intelligences and if there is a correlation between these methods and students’ concentration and emotional state, also, which factors that influence the development of the cognitive functions, according to neuroeducation, are present in the Waldorf environment. Finally, after combining these findings, it is important to propose certain changes to both mainstream and alternative curricula in order to unify the proven teaching practices of Steiner education with the novel neuroscientific discoveries.

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## Appendix A

### Information Sources

We collected the articles by using online resources. We used a data collection form that we tested, along the inclusion criteria, on the first articles we studied. In addition to the online databases, which we detail in Table A1, we studied several articles that we had collected by other means, such as article reference lists, private collection of articles, and hand searching of books and websites.

**Table A1.** Main databases used for collecting articles.

Database Name	Provider
ERIC	ProQuest
Web of Science	Clarivate
Scopus	Elsevier
ScienceDirect	Elsevier
SpringerLink	SpringerNature

**Table A2.** Websites used for collecting articles

Websites
Googlescholar
Research on Steiner Education (Rose)
The Online Waldorf Library
Steiner Waldorf Schools Fellowship
The Research Institute for Waldorf Education (RIWE)
Association for Research in Neuroeducation
The Learning & The Brain Foundation
The European Association for Research on Learning And Instruction (EARLI)
The Society for Neuroscience
The American Educational Research Association (AERA)
The Goodwork Project
International Mind Brain and Education Society (IMBES)
MI Oasis

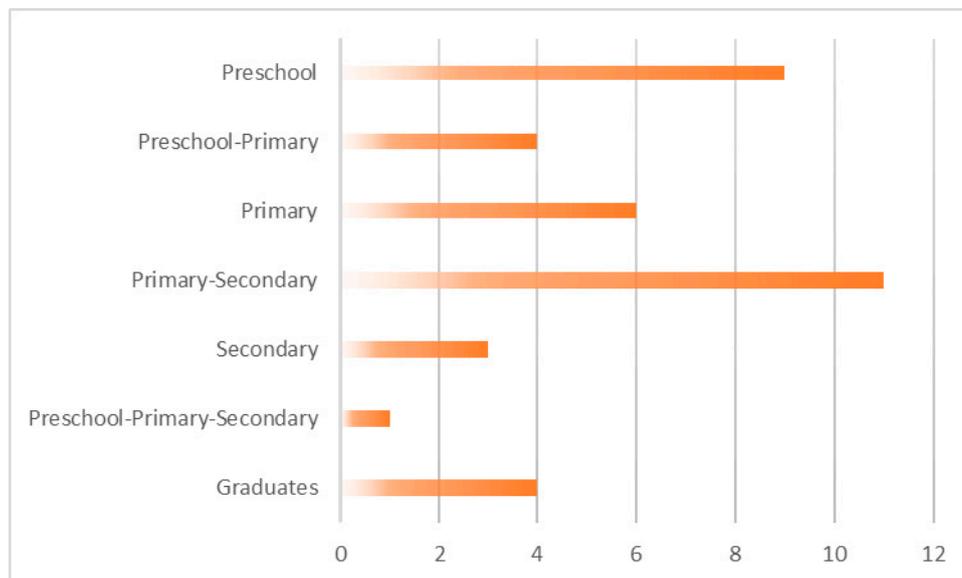
Table A3 displays the electronic search strategy we have followed and the results returned, for each database.

**Table A3.** Electronic search strategy.

Database	Search string	Returned Results	Empirical Articles Saved for Further Analysis
ERIC	Steiner or Waldorf	745	169
Web of Science	(Rudolf AND Steiner) OR (Steiner AND Education) OR Waldorf	307	32
Scopus	(Rudolf AND Steiner) OR (Steiner AND Education) OR Waldorf	495	52
ScienceDirect	(Rudolf Steiner) OR (Steiner Education) OR Waldorf	29	22
SpringerLink	"Waldorf Education" OR "Steiner Education" OR "Waldorf Schools"	169	18
	Other Sources	78	28

**Table A4.** Waldorf compared to what?

<b>Comparative Studies</b>	<b>18</b>
Waldorf-Denominational	1
Waldorf-Mainstream	10
Waldorf-Mainstream-Alternative	7



**Figure A1.** Studies related to school stages.

**Table A5.** Geographical origin of the selected studies.

Country of Origin	No. of Articles
Australia	1
Belgium	1
Canada	2
Estonia	1
France	2
Germany	5
Hong Kong	1
Israel	1
Netherlands	1
New Zealand	3
Portugal	1
Russia	1
Sweden	3
UK	9
Ukraine	1
USA	9
Total	43

Data analysis, concept matrix, or how the study focus was assigned.

For the full concept matrix containing the data and the assigned foci the writers have reserved a dataset which will become available with the publication of this article.

**Table A6.** Evidence level.

Level of Evidence	Description
1	Evidence resulting from meta-analysis of multiple randomized controlled clinical trials
2	Evidence from individual studies with experimental design
3	Evidence from quasi-experimental studies
4	Evidence of descriptive (non-experimental) studies or with a qualitative approach
5	Evidence from case reports or from experience
6	Evidence based on opinions of specialists

**Table A7.** Study Concept.

Authors	Country	Study Type	Focus
Baldwin, Gerwin, Mitchell, Olfman, and Alsop [43]	USA	survey	General
Barz and Randoll [44]	Germany-Switzerland	survey	General
Besancon, Fenouillet, and Shankland [45]	France	Comparative study	Creativity
Bone [46]	New Zealand	case study	Spirituality-Linguistic
Burkitt, Barrett, and Davis [47]	UK	Comparative study	Emotional
Cox and Rowlands [48]	UK	Comparative study	Spatial
Cunningham and Carroll [49]	UK	Comparative study	Linguistic
Dahlin [50]	Sweden	Comparative study	Moral
Dahlin [51]	Sweden	survey	Logical-mathematical
Dahlin [52]	Sweden	survey	General

Table A7. Cont.

Authors	Country	Study Type	Focus
De Bilde, Van Damme, Lamote, and De Fraine [53]	Belgium	Comparative study	School enjoyment
DeLuca and Hughes [54]	USA	Scoping review	Assesment
Deluca, Pyle, Roy, Chalas, and Danniels [55]	Canada	mixed	Assesment
Dorfman and Fortus [56]	Israel	Comparative study	Self-efficacy, Intrapersonal
Friedlaender, Beckham, Zheng, and Darling-Hammond [57]	USA	mixed	General
Gerdes, Tegeler, and Lee [58]	USA	case study	Neuroeducation
Gidley [59]	Australia	interviews	Intrapersonal
Wendt, et al. [79]	Germany	Prospective open cohort study	Neuroeducation, early schooling, ADHD
Jelinek and Sun [61]	USA	mixed	Logical-mathematical
Kamalova and Vasilyeva [62]	Russia	mixed	Interpersonal
Kanitz, et al. [21]	Germany	intervention	Medical-Fatigue
Kikas [63]	Esthonia	Comparative study	Logical-mathematical
Kirkham and Kidd [64]	UK	Comparative study	Spatial
Larrison and Dalya [65]	USA	Comparative study	General comparative Neuroeducation,
Larrison, et al. [4]	USA	Comparative study	Linguistic, Logical-mathematical
Liebenwein, Barz, and Randoll [66]	Germany	survey	General comparative
Mather [67]	Canada	Comparative study	Neuroeducation
Nicholson [68]	USA	observation-interview	Linguistic
Oberman [69]	USA	mixed	Performance
Ionova, Luparenko, Partola, and Gres [60]	Ukraine	experimental study	General
Randoll and Peters [70]	UK	exploratory study	Spatial-Intrapersonal
Rios and Menezes [71]	Germany	literature review	General
Rose and Jolley [72]	Portugal	observation-interview	Naturalistic
Rose and Jolley [73]	UK	Comparative study	Spatial
Rose, et al. [40]	uk	Comparative study	Spatial
Shankland, Genolini, Franca, Guelfi, and Ionescu [74]	France	Comparative study	Coping style
Steenbergen [75]	Netherlands	Comparative study	Linguistic, Logical-mathematical
Suggate, et al. [42]	New Zealand	Comparative study	Linguistic
Suggate, Schaugency, and Reese [76]	New Zealand	longitudinal study	Early literacy
Wagemann, et al. [77]	Germany	first-person study	Neuroeducation
Waite and Rees [78]	UK	observation-interview	Empathy
Woods, et al. [80]	UK	mixed	General
Zhang [81]	Hong Kong	Comparative study	Spiritual

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