

MOTOR COORDINATION AND RELATED FACTORS IN CHILDREN, EFFECTS OF A TEACHING INTERVENTION

COORDINAZIONE MOTORIA E FATTORI CORRELATI NEI BAMBINI, EFFETTI DI UN INTERVENTO DIDATTICO



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ABSTRACT

The teaching of motor competencies requires attention to the psycho-pedagogical and didactic models adopted, in relation to the contexts and needs of the students. The study evaluates the effects of teaching styles on motor development, self-efficacy and satisfaction in primary school children. The results show significant post-intervention improvements. Production styles promote the integration of motor, cognitive, emotional and social aspects.

L'insegnamento delle competenze motorie richiede attenzione ai modelli psicopedagogici e didattici adottati, in relazione a contesti e bisogni degli allievi. Lo studio valuta gli effetti degli stili d'insegnamento su sviluppo motorio, autoefficacia e gradimento in bambini della primaria. I risultati mostrano miglioramenti significativi post-intervento. Gli stili di produzione favoriscono l'integrazione tra aspetti motori, cognitivi, emotivi e sociali.

KEYWORDS

Motor competence; teaching styles; variability of practice
Competenza motoria; stili di insegnamento; variabilità della pratica

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Introduction

School-based physical education is widely recognized as a privileged context for the promotion of physical activity and for the integral development of the child. It contributes not only to the acquisition of motor competencies, but also to the formation of knowledge, skills and attitudes functional to a conscious, autonomous and lasting participation in physical activity throughout life (Bailey et al., 2009; Kirk, 2005; UNESCO, 2015). Through intentionally structured motor proposals, well supported methodologically and organizational methods appropriate to the developmental age, physical education supports learning in a disciplinary, interdisciplinary and transversal key, contributing to the broader educational project of the school.

In terms of the impact on daily physical activity, recent evidence shows that the school context represents a significant opportunity. According to the systematic review conducted by Grao-Cruces et al. (2020), children spend an average of between 14 and 61 minutes per day in moderate-vigorous intensity physical activity (MVPA) during school hours, confirming that school can contribute substantially to the achievement of international guidelines on physical activity in developmental age. In particular, physical education classes are one of the most effective times to promote movement, with studies showing significantly higher levels of physical activity on days when physical education classes are scheduled than on days when physical education is absent (Fairclough & Stratton, 2006).

Participation in physical activity and the development of motor competence in childhood are strongly associated with physical, psychological and behavioral benefits (Robinson et al., 2015). According to the model of Stodden et al. (2008), motor competence, physical activity, fitness, perceived self-efficacy and weight status influence each other. High levels of motor competence promote greater participation in PA and positive health trajectories (Robinson et al., 2015). Motor competence, understood as the interconnection of different and complementary factors, skills (knowing how to do), knowledge (knowing) and behaviors/attitudes (knowing how to be), requires educational practices based on flexible pedagogical relationships that can be adapted to the learning context. These practices must take into account the variability of groups, the characteristics of spaces and available material resources, so as to promote the effectiveness of the teaching-learning process (Colella, 2018), since motor development is modulated by individual and environmental factors and by the teaching methods adopted (Newell, 1986; Wulf

& Lewthwaite, 2016). In this perspective, contemporary pedagogical approaches to the teaching of physical education, based on theories of motor learning that enhance task-environment-teacher relationships – such as non-linear pedagogy – are potentially effective tools to influence the development of motor competence and promote children's engagement with physical activity (Chow et al., 2016; Davids et al., 2008; Rudd et al., 2021).

An effective didactic-educational process in the field of physical education requires careful design and analysis of the motor task, as well as strategic planning of equipment and space organization. Particularly relevant is the attention paid to the configuration of the relationships between teacher, students and environment, as these interactions constitute a key element in facilitating motor learning processes (Pisot, 2012; Colella, 2018). The proposal of motor tasks mediated by different teaching styles and strategies makes it possible to make explicit the mediation functions exercised by the teacher in promoting not only the development of motor competence, but also the adoption of healthy and active lifestyles (HEPA Europe, 2013; Lubans et al., 2008; Robinson et al., 2015; Stodden et al., 2008).

In this framework, the Teaching Styles Spectrum model proposed by Mosston and Ashworth (2008) represents a consolidated theoretical reference for understanding the different ways in which the teacher can distribute decision-making power during teaching activity. The Spectrum describes a progression that goes from predominantly directive styles - in which the teacher assumes total responsibility in the selection of motor tasks and equipment, in their organization and conduct - to non-directive styles in which open motor responses are required that generate inclusiveness, in which decision-making power and responsibility for motor action are gradually transferred to the student or group-class.

In the field of physical education, the variation of teaching styles plays a strategic role, as it allows to diversify learning methods and to personalize the teaching intervention according to the individual characteristics of the pupils (Goldenberg et al., 2012; Mosston & Ashworth, 2008). The intentional choice of different communication styles and methods not only affects the quality of educational interaction, but also promotes the activation of motor, cognitive and psycho-affective competencies, contributing to the construction of a meaningful and multidimensional learning experience. Within each lesson, the organization of motor tasks and activities can be designed through the structured alternation of teaching styles, generating effects that involve both the motor and coordinative dimensions, as well as the motivational ones, linked to aspects such as the

perception of competence and the perceived pleasure (enjoyment). In particular, the use of the production styles proposed by Mosston and Ashworth (2008) is relevant, which favor the autonomous and creative expression of the executive variants, of the methods of use of the tools, by the student, promoting active and conscious learning. The didactic intervention described in this study is divided into three complementary dimensions: a) the structuring of motor tasks through executive variants that stimulate the functional adaptation of the motor gesture; b) the selection and alternation of teaching styles, with particular attention to those oriented towards the autonomous production of motor responses; c) the analysis of the multidimensional effects deriving from the variation of styles, with reference not only to motor development, but also to cognitive and affective development (e.g. self-perception, intrinsic motivation). The study was conducted at a primary school in the province of Lecce as part of a didactic experimentation promoted by the Laboratory of Didactics of Motor Activities, aimed at the observation and analysis of teaching-learning processes in design and experimental contexts.

1. Self-perception ed Enjoyment

Within the school context, self-perception and enjoyment represent two central psycho-pedagogical variables in promoting the active, conscious and continuous participation of children in motor and sports activities. Self-perception in the motor field is configured as the individual awareness of one's own bodily competencies, resulting from the interaction between concrete experiences and meaningful learning environments (Babic et al., 2014; Bardid et al., 2016). It is built through the student's ability to mobilize cognitive, motor and social resources in a wide repertoire of actions adaptable to the different contexts of daily life (Cairney et al., 2019; Castoldi, 2011; Robinson et al., 2015).

Motor experiences lived with success and fun, in particular when proposed through teaching styles oriented towards the autonomous and creative production of variants of the motor task, promote the development of the perception of competence, promoting meaningful, motivating and lasting learning (Colella, 2018; Mosston & Ashworth, 2008). Self-perception also assumes a mediation function between real and perceived motor skills, conditioning the level of motor engagement and the persistence of practice in different educational contexts and over time (Barnett, 2016; Stodden et al., 2008). In particular, higher levels of self-

perception are associated with greater motivation and frequency of physical practice, as well as a more accurate perception of one's own competence, which tends to consolidate with age (Babic et al., 2014; Utesch et al., 2018). This perception, rather than reflecting objectively possessed abilities, reflects what students believe they can and can do through their motor repertoire (Bong & Skaalvik, 2003).

Numerous studies have shown that self-perception significantly influences motor engagement, both in school and informal contexts, resulting in a relevant predictor of physical activity and an indicator of psychophysical well-being in children and adolescents (De Meester et al., 2016; Estevan & Barnett, 2018; Khodaverdi et al., 2015). In this sense, the quality of the teaching proposals, understood in terms of variability, adaptability and significance, is a determining factor for the consolidation of self-perception and for the promotion of favorable attitudes towards motor practice (Dapp et al., 2019; Kantzas & Venetsanou, 2020).

Alongside self-perception, perceived enjoyment represents a motivational lever of primary importance to promote the continuity of physical activity in children. Fun is among the main predictors of voluntary participation and spontaneous adherence to physical and sporting activities, while its absence is frequently associated with a decline in motivation and abandonment of practice (Garn & Cothran, 2006; Hills et al., 2014). Enjoyment is closely connected to intrinsic motivation and develops especially in educational contexts that privilege autonomy, variety and perceived success (Gråstén & Watt, 2017; Yli-Piipari et al., 2012). Positive and pleasant motor experiences contribute to strengthening self-perception and increasing engagement in physical activities over time, generating a positive circular process (Lubans et al., 2008; Robinson et al., 2015).

Children who have acquired a wide repertoire of motor skills tend to have more fun, participate enthusiastically in structured and unstructured activities and are more likely to continue practicing sports, compared to peers with lower motor competencies (Faigenbaum et al., 2018). In this perspective, physical literacy represents a multi-year process, based on the interconnection of motor skills, knowledge, emotions and attitudes that support regular physical activity in different life contexts.

In primary school, this process should be supported through a varied teaching program, oriented towards the quality of the proposals, the diversification of motor responses and the promotion of the active involvement of all pupils (Ceciliani, 2016; Pesce et al., 2018). Targeted interventions that integrate rewarding bodily

experiences and stimulating educational environments can be a powerful tool to foster motivation, enjoyment and positive motor self-construction.

2. Linear vs Non-Linear Pedagogy and Teaching Styles

The distinction between linear pedagogy and non-linear pedagogy reflects two divergent theoretical approaches to motor learning and instructional design in education. Linear pedagogy is based on Information Processing Theory (Gentile, 2000), according to which the acquisition of motor skills occurs through an ordered sequence of cognitive stages (cognitive, associative, autonomous), guided by explicit and structured teaching (Fitts & Posner, 1967). In this perspective, the teacher assumes a central role in the transmission of "optimal" motor models, to be learned through analytical and progressively more complex exercises. Within this paradigm, movement variability is considered as a disturbing factor, to be contained or eliminated in order to facilitate the learning of standardized and reproducible patterns (Rudd et al., 2021).

On the contrary, nonlinear pedagogy develops from the principles of ecological-dynamic theory (Newell, 1986; Davids et al., 2008) and proposes an emergent and self-organized learning model, which is realized through the continuous interaction between individual, task and environment. The teacher, in this case, assumes the role of facilitator and mediator of learning, structuring representative learning environments and modifying specific constraints (e.g. spatial, temporal, material) to promote the exploration of adaptive and functional motor solutions. In this approach, variability is recognized as an intrinsic and necessary element of the learning process, as it reflects the flexibility of the motor system in responding to different contextual conditions (Chow et al., 2016; Renshaw et al., 2010). In addition, an external attentional focus is encouraged from the initial stages, useful for supporting the autonomous organization of the action.

Therefore, while linear pedagogy tends to privilege predefined and sequential motor tasks in terms of difficulty and intensity, executive uniformity and movement control through reduction of variability, non-linear pedagogy promotes the variability of motor practice, adaptability and diversification of motor responses, considered central to the development of motor competence and motivation to physical activity. especially in developmental age (Rudd et al., 2021).

Below, the characteristics of the two pedagogical principles have been summarized and schematized, highlighting their differences (table 1).

Aspect	<i>Linear Pedagogy</i>	<i>Nonlinear pedagogy</i>
Approach	Board, structured	Exploratory, adaptive
Centrality	Teacher	Child
Role of variability	To be reduced	To be encouraged
Attentional focus	Indoor → Outdoor	External
Objective	Optimal technique, competence	Personal solutions, motivation

Table 1. Comparison between Linear and Nonlinear pedagogy

The theories of linear and non-linear pedagogy find a natural place within the Spectrum of teaching styles developed by Mosston and Ashworth (2008), a theoretical model that describes the progressive distribution of decision-making responsibility between teacher and student along a continuum. Linear pedagogy, which is based on a hierarchical and sequential view of motor learning (Fitts & Posner, 1967; Gentile, 2000), is typically placed in the initial part of the spectrum, corresponding to direct teaching styles. In these styles, such as command (Style A) or practice (Style B), the teacher assumes a central role and controls the fundamental variables of the teaching process — from the selection of content to the organization of spaces and times — with the aim of guiding the student towards the reproduction of standardized motor models with no or poor variability.

On the other hand, non-linear pedagogy, inspired by the principles of ecological dynamics (Newell, 1986; Davids et al., 2008), is positioned towards the opposite end of the spectrum, where more open and participatory styles prevail, such as guided discovery (Style F) or autonomous invention (Style H). In these contexts, the teacher assumes the role of facilitator, setting up representative environments and modifying individual, environmental and task constraints to encourage students to generate functional and personal motor solutions independently. The variability of movement, an element considered an obstacle in the linear approach, is here valued as an essential component of learning.

In summary, the Mosston and Ashworth Spectrum of Styles offers a useful framework for understanding the pedagogical continuity between directive and autonomous approaches, clarifying how the choice of teaching style reflects precise theoretical conceptions of motor learning. The linear and non-linear approaches do

not simply represent two opposing teaching strategies, but are configured as paradigms that orient — in a distinct way — the management of teaching interactions, the role of variability, and the degree of decision-making autonomy recognized to the student in the learning process.

3. Objectives

The aim of the present study is to analyze and compare the effects deriving from the variation of teaching styles on the evolution of motor coordination, self-perception and perceived enjoyment in primary school classes.

4. Sample

The sample consists of 74 children attending four primary school class groups (Males = n: 38; Females = n:36), divided only according to gender differences and into a single experimental group (table 2).

<i>Gender</i>	<i>N</i>	<i>Age</i>	<i>Height</i>	<i>Weight</i>	<i>BMI</i>
<i>Male</i>	38	8,97±0,82	1,36±0,08	35,08±8,87	18,80±3,19
<i>Female</i>	36	9,03±0,77	1,36±0,08	34,99±9,71	18,69±3,88
<i>TOT</i>	74				

Table 2. Sample Description

5. Materials and methods

The following tests were administered for the evaluation of motor skills, validated in the literature (Falk et al., 2001; Morrow et al., 2000; Ruiz et al., 2011): standing long jump, 4x10 meter shuttle, seated front throw and 20 meter slalom. In addition, in order to detect psychological aspects related to motor experience, two self-report tools were used: the PSP_C questionnaire for the evaluation of self-perception (Colella et al., 2008) and the PACES scale for the detection of Enjoyment (Carraro et al., 2008).

All motor tests and self-assessment questionnaires were administered to participants at two distinct times: pre-intervention (t0) and post-intervention (t1),

in order to measure the changes attributable to a 15-week educational path, during which a total of 24 hours of physical education lessons were carried out.

The teacher's didactic behavior was defined a priori by means of a structured observation grid, containing descriptors corresponding to the teaching styles mainly used in the conduct of lessons and in the management of educational communication and motor tasks (Colella et al., 2020; cf. Tables 3 and 4).

Teaching style of reproduction	Teacher behavior descriptors
Practice	a) Presents the motor task and communicates the learning objective; b) Prepares the organizational methods and operational spaces (individual tasks, in pairs, routes, relays, circuits, in which the use of small tools is also foreseen; group and team games; etc.); the executive variants are predefined and few in number; c) Prepares the organization of sub-groups; d) Indicates the methods of execution, the number of sets, repetitions, the intensity of the task and the difficulty of execution on which to practice; communicates the criteria for the success of the task; e) It corrects the error directly and <i>indirectly</i>.
Inclusion	a) Presents the motor task and states the learning objective; b) It presents the executive and organizational methods, according to different levels of difficulty/intensity, increasing or reducing the number of executive variants and the use of tools; c) Adapts the motor task through executive variations, according to the needs of the students; d) Communicates the relationships between motor skills performed/required and related motor abilities; e) It corrects the error directly and <i>indirectly</i>.

Table 3. Playback styles, teacher behavior descriptors used

Production Teaching Style	Teacher Behavior Descriptors
Guided discovery	a) Sets out the objective, presents the motor task and recalls the motor skills already acquired (in formal and non-formal contexts); b) Proposes a motor task and asks questions on possible spatial-temporal-qualitative-qualitative executive variants / how to use a tool / management of spaces and environments; c) It proposes a motor task and stimulates the discovery of similarities and differences with other tasks/tools/activities through questions and stimulus-situations (in how many ways? How can you ?.....); d) It requires the repetition of the motor task without repeating the same task but independently discovering the executive variants; e) Communicate questioning/descriptive feedback to the learner.
Problem solving	a) Communicates the objective, presents the motor task and recalls the motor skills already acquired; b) It proposes the execution of a motor task and solicits open, divergent motor responses (Who can ...? How many other ways is it possible... if I am in this position?) c) Asks questions and solicits open-ended motor responses, in which each student is autonomous in the use of any skill/choice of position, etc.); d) Asks questions and solicits motor responses through combinations of executive variations; e) Proposes motor tasks within space-time constraints; f) Communicate questioning/descriptive feedback to the learner.

Table 4. Production styles, teacher behavior descriptors used

6. Procedure

For the purposes of the experimental intervention, four class groups were selected, whose pupils regularly participated in physical education lessons conducted by a teacher with a master's degree in Science and Techniques of Preventive and Adapted Motor Activities. Due to the limited number of participants, it was not possible to identify a control group, which is why the survey took on a pre-post configuration with a single group.

The learning units developed for the intervention (cf. Table 5) covered the following thematic areas:

- a) Motor skills and use of small tools, with emphasis on spatio-temporal executive variants;
- b) Group games oriented to the development of spatial-temporal orientation and cooperative dynamics;
- c) Motor coordination, with a focus on the organization of global and segmental movement.

The learning units were preliminarily designed by the authors of the study and subsequently shared with two primary school physical education teachers, in order to ensure their consistency with the educational context and with the training objectives.

The motor activities were carried out in the period February-May, with a frequency of two hours per week for each group and a unit duration of 45 minutes for each lesson. The didactic intervention was characterized by a prevalent use ($\geq 50\%$ of the lesson time) of the production styles described in the Spectrum of Mosston and Ashworth (2008), in particular the guided discovery and divergent problem solving, aimed at stimulating active participation, reflection and autonomous generation of motor responses by the students.

Reproduction styles — in particular practice and inclusion — have been integrated in a modulated manner within each lesson, with the function of supporting and consolidating basic technical execution and promoting equal access to the proposed tasks.

The activities were presented according to diversified operating methods, including individual, pair and small group motor tasks, with the use of small tools and the intentional variation of spaces, materials and execution methods. The teacher has adopted a stimulating and open educational communication, constantly

stimulating reflection and motor creativity through questions, suggestions and explicit requests, in line with the principles of non-linear pedagogy.

Learning units	Objectives	Contents	Modality Organizational	Teaching styles
Motor skills and small tools: the spatio-temporal executive variants	• Perform basic motor skills and executive variants with the use of small tools; • Discover and distinguish the specific use of tools; • Distinguish the rules referring to the activities practiced.	Motor tasks with small tools: hoop and ball, mainly considering relationships: a) body stationary and tool in motion; b) body and tool in motion.	Individuals and couples	• Practice Style • Guided discovery style
Motor coordination	• Combine motor skills according to spatial and temporal variations; • Perform motor skills by adapting the strength and speed of execution • Analyze and Evaluate (verbalize) the motor experiences performed.	Motor combination tasks and spatial-temporal differentiation also with the use of small tools; Paths with specific interactions of basic motor skills and executive variants.	In pairs	• Practice Style • Guided discovery style • Problem-solving style
Group games and spatial-temporal orientation	• Anticipate the progress and result of an action.; • Perform and vary motor skills in minimal time; • Organize a group game; • Compare and apply different rules.	Ball games preparatory to team games.	Class group and small groups	• Practice Style • Style of inclusion • Problem-solving style • Guided discovery style

Table 5. Educational proposals

7. Results

In addition to the descriptive statistics ($M \pm SD$), the Student's T-Test was carried out, in order to highlight significant differences within the group. The significance index has been set to $p < .05$.

Statistical analysis (T0 vs T1) showed significant differences in both groups (males and females) both in motor tests (tables 6a-6b) and in self-reports (tables 7a-7b).

Gender	SLJ t0	SLJ t1	p	4x10m t0	4x10m t1	p
<i>Male</i>	1,17±0,22	1,29±0,23	.015	14,41±1,59	13,20±1,29	.000
<i>Female</i>	1,03±0,17	1,14±0,16	.011	14,90±1,03	13,71±0,98	.000

Table 6a

Gender	SMBT t0	SMBT t1	p	20m slalom t0	20m slalom t1	p
<i>Male</i>	4,02±0,80	4,42±0,92	.047	10,77±3,29	9,04±2,65	.014
<i>Female</i>	3,76±0,52	4,11±0,52	.006	13,31±3,63	10,93±2,60	.002

Table 6b

Gender	SE t0	SE t1	p
<i>Male</i>	19,53±2,49	20,76±2,36	.029
<i>Female</i>	18,00±2,72	19,25±2,47	.044

Table 7a

Gender	PACES-P t0	PACES-P t1	p	PACES-N t0	PACES-N t1	p
<i>Male</i>	38,05±4,43	40,97±3,54	.002	12,00±4,26	8,92±2,73	.000
<i>Female</i>	37,97±5,47	40,67±3,90	.018	9,47±2,72	7,97±1,65	.006

Table 7b

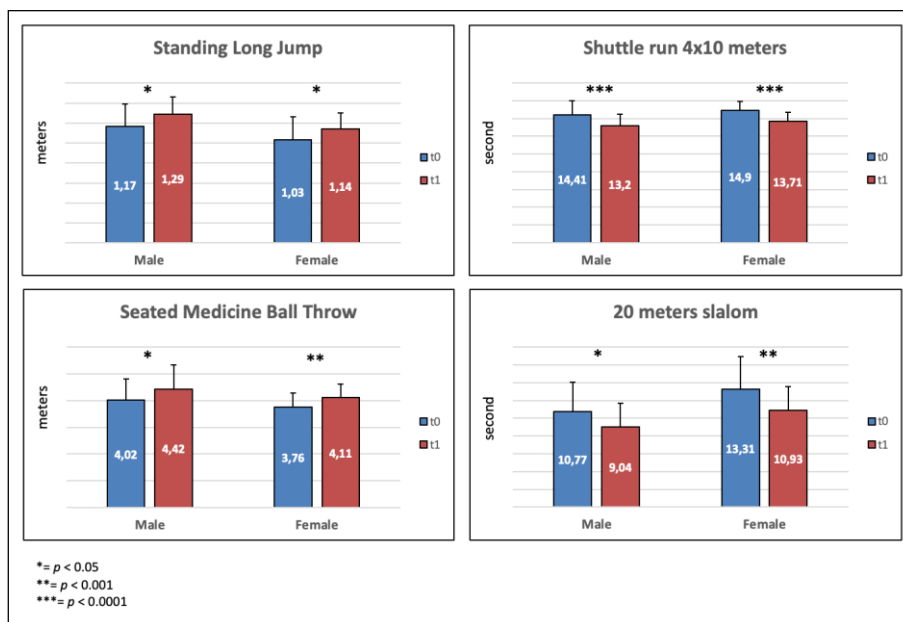


Figure 1. Graphs of motor tests, mean, standard deviation and student's t-test between pre (t0) and post intervention (t1)

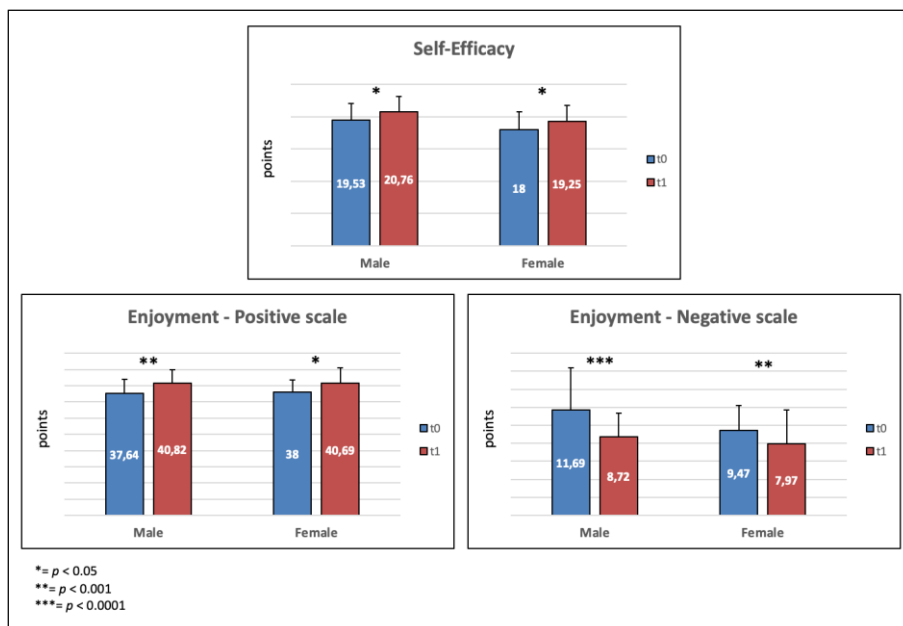


Figure 2. Graphs of scores on Self-efficacy and Enjoyment, mean, standard deviation and student's t-test between pre (t0) and post intervention (t1)

8. Conclusion

The results of the study highlight the effects of intentional variation-modulation of teaching styles, in particular those aimed at enhancing the student's original and creative motor responses and in promoting significant improvements in motor coordination, self-perception and perceived enjoyment by primary school pupils.

The role of facilitator-mediator of learning emerges from the teacher who proposes motor tasks that provide open-ended answers, attributable to the variability of practice and solicits unusual motor responses. The conduct of a didactic process that can be traced back to significant learning environments and diversified motor tasks has made it possible to stimulate the interconnection between cognitive-motor and relational factors. In this perspective, the enhancement of variability and autonomous exploration appears crucial to foster engagement and the development of motor competence in developmental age, in line with non-linear pedagogical approaches and with the teaching styles of the Mosston and Ashworth spectrum.

9. Limitations of the study

The following limitations can be identified: a. absence of a control group, which did not allow a direct comparison with alternative teaching approaches or absence of intervention; b. number of participants; c. conduct of the experiment in a single school context that could limit the generalizability of the results; d. the use of self-reports for the evaluation of psychological variables, although validated, could be influenced by subjective and social factors.

Author contributions

The article is the result of a study designed and shared among the Authors even with the following attributions: Giacomo Pascali is the author of the following §§: Introduction; 1, 3,4, 6,7 Sabrina Annoscia of §§ 6, 7; Dario Colella of § 2,5. Conclusions and limitations of the study are shared among the authors.

References

- Babic, M. J., Morgan, P. J., Plotnikoff, R. C., Lonsdale, C., White, R. L., & Lubans, D. R. (2014). Physical activity and physical self-concept in youth: Systematic review and meta-analysis. *Sports Medicine*, 44(11), 1589–1601. <https://doi.org/10.1007/s40279-014-0229-z>
- Bailey, R., Armour, K., Kirk, D., Jess, M., Pickup, I., Sandford, R., & the BERA Physical Education and Sport Pedagogy Special Interest Group. (2009). The educational benefits claimed for physical education and school sport: An academic review. *Research Papers in Education*, 24(1), 1–27. <https://doi.org/10.1080/02671520701809817>
- Bardid, F., Rudd, J. R., Lenoir, M., Polman, R., & Barnett, L. M. (2016). Cross-cultural comparison of motor competence in children from Australia and Belgium. *Frontiers in Psychology*, 7, 964. <https://doi.org/10.3389/fpsyg.2016.00964>
- Barnett, L. M. (2016). Development of physical literacy and movement competence: Building the foundation for active lifestyles. *Journal of Teaching in Physical Education*, 35(2), 219–225.
- Bong, M., & Skaalvik, E. M. (2003). Academic self-concept and self-efficacy: How different are they really? *Educational Psychology Review*, 15(1), 1–40.
- Cairney, J., Veldhuizen, S., King-Dowling, S., Faught, B. E., Hay, J. A., & Timmons, B. W. (2019). Tracking sport and physical activity in middle childhood: Predicting physical activity in adolescence. *Journal of Physical Activity and Health*, 16(7), 553–558.
- Carraro, A., Young, M. C., & Robazza, C. (2008). A contribution to the validation of the Physical Activity Enjoyment Scale in an Italian sample. *Social Behavior and Personality: An International Journal*, 36(7), 911–918.
- Castoldi, F. (2011). *Corpo, movimento e didattica*. FrancoAngeli.
- Ceciliani, A. (2016). Educazione fisica e sport nella scuola primaria: Quali prospettive? *Italian Journal of Educational Research*, 16, 85–100.
- Chow, J. Y., Davids, K., Hristovski, R., Araújo, D., & Passos, P. (2016). *Nonlinear pedagogy in skill acquisition: An introduction*. Routledge.
- Colella, D., Morano, M., Bortoli, L., & Robazza, C. A. (2008). Physical Self Efficacy Scale for Children. *Social Behavior and Personality: An International Journal*, 36, 841–848. <https://doi.org/10.2224/sbp.2008.36.6.841>

Colella, D. (2018). *Didattica e pedagogia del movimento*. FrancoAngeli.

Colella, D., Bellantonio, S. Limone, P. (2020). *Descrizione degli stili d'insegnamento in educazione fisica. Quali rapporti con l'apprendimento motorio?* In, Lucisano, P. & Lipoma, M (Eds.). *Le Società per la società: ricerca, scenari, emergenze. Atti del Convegno Internazionale SIRD Roma 26-27 settembre 2019*, pag.30-39. Lecce: Pensamultimedia.

Dapp, L. C., Roebbers, C. M., & Roebbers, C. (2019). The mediating role of self-perceived competence between motor competence and physical activity in middle childhood: A longitudinal approach. *Psychology of Sport and Exercise*, 45, 101544.

Davids, K., Button, C., & Bennett, S. (2008). *Dynamics of skill acquisition: A constraints-led approach*. Human Kinetics.

De Meester, A., Stodden, D. F., Goodway, J. D., True, L. K., Brian, A., Ferkel, R. C., & Haerens, L. (2016). Identifying a motor proficiency threshold for preschoolers to be considered physically active. *Pediatric Exercise Science*, 28(3), 345–354.

Estevan, I., & Barnett, L. M. (2018). Considerations related to the definition, measurement, and development of motor competence. *Journal of Sports Sciences*, 36(10), 1145–1146.

Faigenbaum, A. D., Lloyd, R. S., MacDonald, J., & Myer, G. D. (2018). Citius, Altius, Fortius: beneficial effects of resistance training for young athletes: Narrative review. *British Journal of Sports Medicine*, 50(1), 13–20.

Fairclough, S., & Stratton, G. (2006). Physical education makes you fit and healthy: Physical education's contribution to young people's physical activity levels. *Health Education Research*, 20(1), 14–23. <https://doi.org/10.1093/her/cyg101>

Falk, B., Cohen, Y., Lustig, G., Lander, Y., Yaaron, M., Ayalon, J. (2001). Tracking of physical fitness components in boys and girls from the second to sixth grades. *American Journal Human Biology*, 13, 65-70. [https://doi.org/10.1002/1520-6300\(200101/02\)13:1%3C65::AID-AJHB1008%3E3.0.CO;2-2](https://doi.org/10.1002/1520-6300(200101/02)13:1%3C65::AID-AJHB1008%3E3.0.CO;2-2)

Fitts, P. M., & Posner, M. I. (1967). *Human performance*. Brooks/Cole.

Garn, A. C., & Cothran, D. J. (2006). The fun factor in physical education. *Journal of Teaching in Physical Education*, 25(3), 281–297.

Gentile, A. M. (2000). Skill acquisition: Action, movement, and neuromotor processes. In J. H. Carr & R. B. Shepherd (Eds.), *Movement science: Foundations for physical therapy in rehabilitation* (pp. 111–187). Butterworth-Heinemann.

Goldberger, M., Ashworth, S., & Byra, M. (2012). *Spectrum of teaching styles retrospective* 2012. *Quest*, 64(4), 268–282. <https://doi.org/10.1080/00336297.2012.706883>

Grao-Cruces, A., Velázquez-Romero, M. J., & Rodríguez-Rodríguez, F. (2020). Levels of physical activity during school hours in children and adolescents: A systematic review. *International Journal of Environmental Research and Public Health*, 17(13), 4773. <https://doi.org/10.3390/ijerph17134773>

Gråstén, A., & Watt, A. (2017). A motivational model of physical education: Predicting enjoyment, perceived competence, and physical activity intentions. *Journal of Teaching in Physical Education*, 36(3), 252–264.

HEPA Europe. (2013). *Strategies to promote physical activity in children and adolescents*. World Health Organization Regional Office for Europe.

Hills, A. P., Dengel, D. R., & Lubans, D. R. (2014). Supporting public health priorities: Recommendations for physical education and physical activity promotion in schools. *Progress in Cardiovascular Diseases*, 56(4), 368–374.

Kantzas, A., & Venetsanou, F. (2020). The role of self-perception in motor competence development: A review. *Physical Education and Sport Pedagogy*, 25(1), 37–54.

Khodaverdi, Z., Bahram, A., & Stodden, D. (2015). The relationship between actual motor competence and perceived motor competence in children. *Child: Care, Health and Development*, 42(3), 378–385.

Kirk, D. (2005). Physical education, youth sport and lifelong participation: The importance of early learning experiences. *European Physical Education Review*, 11(3), 239–255. <https://doi.org/10.1177/1356336X05056649>

Lubans, D. R., Morgan, P. J., Cliff, D. P., Barnett, L. M., & Okely, A. D. (2008). Fundamental movement skills in children and adolescents: Review of associated health benefits. *Sports Medicine*, 40(12), 1019–1035. <https://doi.org/10.2165/11536850-000000000-00000>

Morrow, J.R., Jackson, A.W., Disch, J.G., Mood, D.P. (2000). *Measurement and Evaluation in Human Performance* (2nd ed.). Champaign, IL: Human Kinetics.

Mosston, M., & Ashworth, S. (2008). *Teaching physical education* (1st online ed.). Spectrum Institute.

Newell, K. M. (1986). Constraints on the development of coordination. In M. G. Wade & H. T. A. Whiting (Eds.), *Motor development in children: Aspects of coordination and control* (pp. 341–360). Martinus Nijhoff.

Pesce, C., Masci, I., Marchetti, R., Vazou, S., Säakslahti, A., & Tomporowski, P. D. (2018). Deliberate play and preparation jointly benefit motor and cognitive development: Mediated and moderated effects. *Frontiers in Psychology*, 9, 2020.

Pisot, R. (2012). Lifelong competency: Model of motor development. *Kinesiology Slovenica*, 18(3), 35–46.

Renshaw, I., Chow, J. Y., Davids, K., & Hammond, J. (2010). A constraints-led perspective to understanding skill acquisition in sport. *Physical Education and Sport Pedagogy*, 15(2), 117–137.

Robinson, L. E., Stodden, D. F., Barnett, L. M., Lopes, V. P., Logan, S. W., Rodrigues, L. P., & D'Hondt, E. (2015). Motor competence and its effect on positive developmental trajectories of health. *Sports Medicine*, 45(9), 1273–1284.

Rudd, J. R., Crotti, M., Fitton Davies, K., O'Callaghan, L., Roberts, S., & Fowweather, L. (2021). Effect of linear and nonlinear pedagogy physical education interventions on children's physical activity: A cluster randomized controlled trial (SAMPLE-PE). *Children*, 8(1), 49. <https://doi.org/10.3390/children8010049>

Ruiz, J. R., Castro-Pinero, J., Espana-Romero, V., Artero, E. G., Ortega, F. B., Cuenca, M. M., ... Castillo, M. J. (2011). Field-based fitness assessment in young people: the ALPHA health-related fitness test battery for children and adolescents. *British Journal of Sports Medicine*, 45(6), 518–524. <https://doi.org/10.1136/bjism.2010.075341>.

Stodden, D. F., Goodway, J. D., Langendorfer, S. J., Roberton, M. A., Rudisill, M. E., Garcia, C., & Garcia, L. E. (2008). A developmental perspective on the role of motor skill competence in physical activity: An emergent relationship. *Quest*, 60(2), 290–306.

UNESCO. (2015). *Quality physical education (QPE): Guidelines for policy-makers*. United Nations Educational, Scientific and Cultural Organization. <https://unesdoc.unesco.org/ark:/48223/pf0000231101>

Utesch, T., Dreiskämper, D., Naul, R., & Geukes, K. (2018). Understanding physical (in-)activity, overweight, and obesity in childhood: The importance of self-perception. *European Journal of Sport Science*, 18(2), 267–276.

Wulf, G., & Lewthwaite, R. (2016). Optimizing performance through intrinsic motivation and attention for learning: The OPTIMAL theory of motor learning. *Psychonomic bulletin & review*, 23(5), 1382–1414.
<https://doi.org/10.3758/s13423-015-0999-9>

Yli-Piipari, S., Watt, A., Jaakkola, T., Liukkonen, J., & Nurmi, J. E. (2012). Relationships between physical education students' motivational profiles, enjoyment, state anxiety, and self-reported physical activity. *Journal of Sports Science and Medicine*, 11(1), 115–123.