Stages of motor learning and the teaching-learning process in swimming

Fases da aprendizagem motora e o processo de ensino-aprendizagem na natação

Etapas del aprendizaje motor y el proceso de enseñanza-aprendizaje en natación

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Abstract
A formal swimming learning occurs through a direct interaction between teacher and learner. The aim of this study is to present models for classification of learning in stages and discuss their implications for the teaching-learning process of swimming. This narrative review was carried out through bibliographic research. We used qualitative and exploratory approaches. Models proposed by Adams (1971), Fitts and Posner, (1967), and Gentile (1972) categorize learning into several stages, accounting for the characteristics of the learners and the environment. To enhance the teaching-learning process of swimming skills, the teacher must recognize the stages in which the learner finds himself, and to establish efficient teaching strategies. The learning stage identification affects the manipulation of variables that interfere in learning, such as setting goals, selecting content, choosing appropriate strategies and assessing learning, regardless of the swimming stroke. Even though some points will differ between swimming styles, such as the specificity, the specificity of errors, the informational demand, and the amount of practice, it is the teacher's role to establish the relationship between the student and the contents to be taught in the teaching-learning process. Overall, the quality of the teaching-learning process will depend on the teacher's ability to propose contents that are appropriate to the characteristics, needs and expectations of the learners, being sufficiently challenging to arouse motivation and to promote skills learning.
Keywords: Swimming; Motor learning; Teaching; Stages of learning.

Resumo
A aprendizagem formal da natação ocorre por meio da interação direta entre professor e aprendiz. O objetivo deste estudo foi apresentar modelos de classificação da aprendizagem em etapas e discutir suas implicações para o processo de ensino-aprendizagem da natação. Esta revisão narrativa foi realizada por meio de pesquisa bibliográfica. Para tanto, utilizaram-se abordagens qualitativas e exploratórias. Os modelos propostos por Adams (1971), Fitts & Posner,

(1967) e Gentile (1972) categorizam a aprendizagem em vários estágios, considerando as características dos aprendizes e do ambiente. A fim de potencializar o processo de ensino-aprendizagem na natação, o professor deve reconhecer as etapas em que o aprendiz se encontra e estabelecer estratégias de ensino eficientes. A identificação do estágio de aprendizagem afeta a manipulação de variáveis que influenciam na aprendizagem, como o estabelecimento de metas, a seleção dos conteúdos, a escolha das estratégias adequadas e a avaliação da aprendizagem, independentemente estilo do nado. Ainda que hajam diferenças entre os nados, como a especificidade, a especificidade dos erros, a demanda informacional e a quantidade de prática, é papel do professor estabelecer a relação entre o aluno e os conteúdos a serem ensinados no processo de ensino-aprendizagem. De forma geral, a qualidade do processo de ensino-aprendizagem dependerá da capacidade do professor para propor conteúdos adequados às características, necessidades e expectativas dos aprendizes, conteúdos suficientemente desafiadores para motivá-los e promover aprendizagem.

Palavras-chave: Natação; Aprendizagem motora; Ensino; Fases de aprendizagem.

Resumen

El aprendizaje formal de la natación ocurre mediante una interacción directa entre maestro y alumno. El objetivo de este estudio fue presentar modelos de clasificación del aprendizaje en etapas y discutir sus implicaciones para el proceso de enseñanza-aprendizaje de la natación. Esta revisión narrativa se realizó a través de una investigación bibliográfica. Se utilizaron enfoques cualitativos y exploratorios. Los modelos propuestos por Adams (1971), Fitts y Posner, (1967) y Gentile (1972) clasifican el aprendizaje en varias etapas, teniendo en cuenta las características de los alumnos y del entorno. Para potencializar el proceso de enseñanza-aprendizaje de las habilidades de natación, el docente debe reconocer las etapas en las que se encuentra el aprendiz y establecer estrategias de enseñanza eficientes. La identificación de la etapa de aprendizaje afecta la manipulación de variables que interfieren en el aprendizaje, como el establecimiento de metas, la selección de contenidos, la elección de estrategias adecuadas y la evaluación del aprendizaje, independientemente del estilo de natación. Aunque algunos puntos diferirán entre los estilos de natación, como la especificidad y cantidad de información, la especificidad de los errores, la demanda de información y la cantidad de práctica, es el papel del profesor establecer la relación entre el estudiante y los contenidos a enseñarse en el proceso de enseñanza-aprendizaje. En general, la calidad del proceso de enseñanza-aprendizaje dependerá de la capacidad del profesor proponer contenidos adecuados a las características, necesidades y expectativas de los educandos, siendo lo suficientemente desafiantes para despertar la motivación y promover el aprendizaje de competencias.

Palabras clave: Natación; Aprendizaje motor; Enseñanza; Fases de aprendizaje.

1. Introduction

Swimming is a physical activity that brings several health benefits to practitioners (Chase et al., 2008; Stanković et al., 2017), in addition to being a life-saving skill (Pharr et al., 2018). Even though the liquid environment is present in human life since the intrauterine phase, the act of swimming demands the acquisition of specific aquatic motor skills (Stallman, 2017). The acquisition of these skills occurs in a system in which the teacher, the learner and the content interact aiming to promote the change of learner's behaviors, abilities and skills (Tani et al., 2012). The knowledge and identification of the moment or stage in which the learner finds himself during the learning process is crucial to optimize the teaching-learning process of swimming skills (Lepore et al., 2015). When identifying the stage the apprentice finds himself in, and knowing its characteristics, the teacher will be able to suit the contents of his classes to the competences and demands of the learners (Coker, 2017). Accordingly, it will be possible to adjust the practice factors that influence the learning of the skills, achieving efficiency in the swimming teaching-learning process (Monteiro et al., 2021). Thus, the aim of this study is to present three models of classification of learning in stages and discuss their implications for the teaching-learning process of swimming.

2. Methodology

The present study is characterized as a narrative review. Narrative reviews are based on critical analysis of multiple literature, with the purpose of describing and discussing the state of these scientific findings based on a theoretical and contextual point of view (Rother, 2007). This narrative review was carried out through bibliographic research, which is developed based on already published material, consisting mainly of books and scientific articles. The methodology chosen for the bibliographic research was qualitative, with an exploratory approach.

The models of classification of learning in stages proposed by Fitts and Posner (1967), Adams (1971) and Gentile (1972) along with other motor learning literature served as a basis for the discussion of the learning stages in the teaching-learning process of swimming and the possibilities of practical intervention for coaches and teachers.

The research sources consulted for data collection were publications available in the Academic Google, Pubmed (Public/Publisher MEDLINE), ResearchGate and Scielo (Scientific Electronic Library Online) databases. The search included books and scientific articles written in English or Portuguese, using as descriptors "motor learning stages" and "swimming", and the boolean operator "and". For a more specific search on the topic, a manual search based on references from other articles was also performed. In both cases, we did not set a specific period for the searches. According to Casarin et al. (2020) and Rother (2007), in narrative reviews, authors do not need to inform in detail the procedures or criteria used to select and evaluate the references included in the analysis, as the form of selection is variable and arbitrary.

Once we defined the models for classification of motor learning in stages and their implications for the teaching-learning process in swimming as the theme of this investigation, which is the first stage of the bibliographic research, the preliminary bibliographic survey began. According to Gil (2002), this preliminary survey can be understood as an exploratory study, which seeks to provide the researcher familiarity with the study area of interest. After the exploratory reading, which consists of the material selection phase, the analytical reading begins. At this stage, a more in-depth study of the selected literature is carried out, aiming to order and summarize the information that subsidize obtaining possible answers to the research problem (Gil, 2002).

3. Results and Discussion

3.1 Models of classification of learning in stages

Learning how to locomote requires that learners develop the ability to select appropriate responses for specific situations, since the environment is changeable and the same goal can be achieved by different means. The development of the capacity to respond to the growing challenges imposed by the environment is produced through motor skills acquisition. This implies internally produced changes, on a relatively permanent basis, depending on practice (Magill, 2000; Schmidt, 1988). These internal changes generate observable behavioral consequences, in form of increasingly efficient and complex motor responses.

In order to explain this process, in which the learner initially does not have the mastery of a given skill and then starts to master it later, the classification systems of the stages of motor learning are proposed. Among the many classification systems for these stages, three stand out. The first, proposed by Fitts and Posner (1967), has three stages, namely: cognitive, associative, and autonomous. The second, proposed by Adams (1971), presents a classification divided in two stages, namely: verbal-motor and motor. The third classification system, proposed by Gentile (1972), divides the learning process into two stages, namely: acquisition of the idea of movement and fixation / diversification of the motor pattern.

The classification system proposed by Fitts and Posner (1967) proposes the analysis of five performance parameters: amount of errors; magnitude of errors; ability to detect and correct errors; consistency of performance and automation of movements. In the first stage, called cognitive stage, the apprentice is acquiring the idea of what should be done, which makes his acts fully conscious. Therefore, the apprentice requires a great amount of attention in the execution of the skill. At this stage, the movements do not have any automation and the performer needs to think about all the component of the skill. A large amount of gross errors (e.g. which are visible to observers) are also expected in this phase. Furthermore, correcting these errors is an arduous task that requires external sources of information on performance, since the apprentice has not developed the ability to detect and correct the errors by themselves yet. Another peculiarity of this stage is the difficulty to maintain performance consistency, due to the absence of a well-established movement pattern.

In the second stage of motor learning, the associative stage, the learner approaches better performance, leaving the characteristics of the cognitive stage behind. During this stage, some parts of the movement begin to become automatic, resulting in a decrease in the demand for attention to perform the skill. Among the observable characteristics present at this stage, the reduction of errors and the increase in the consistency of performance between trials stands out. Additionally, the learner improves his ability to perceive and correct errors during practice. These changes lead to greater independence of the learner, since external feedback is no longer essential.

The autonomous phase comprises the most advanced phase of learning. An automatic motor skills performance, with a minimum allocation of attentional resources defines this phase. At this stage, the capacity for error detection is fully developed, since the learner is able to detect and correct even small magnitude errors during practice. Due to the high capacity for error detection and correction, performance in the autonomous stage is accurate and consistent.

Analogously to Fitts and Posner (1967), the model proposed by Adams (1971) proposes a shifting use of cognitive resources throughout the learning process. In the verbal-motor stage, the learner provides instructions to himself during the practice, through verbal behavior, which implies a high participation of cognitive processes. The beginning of the motor learning process is marked by uncertainty about what must be done to achieve the goal of the skill being learned. The distinctive self-instructions of the verbal-motor stage allow the learner to guide his movement towards the goal. The apprentice's performance at this stage is still poor and mistakes are frequent.

As learning progresses and the uncertainty regarding the execution of the movement decreases, results in a cognitive load decrease. This is an indication that the apprentice reached the motor stage. At this stage, the learner has a better comprehension of what must be done to achieve the goal of the task, thus, self-instruction is no longer necessary. The performance becomes more fluid and the amount and magnitude of errors decrease. The decrease in conversation with oneself and the improvement in performance characterize a motor performance that relies more on motor functions (e.g. the coordination between muscles and joints) than on cognitive functions (e.g. the reasoning about what should be done).

Unlike the models proposed by Fitts and Posner (1967), Adams (1971), and Gentile's (1972) propositions assess learning considering not only the internal characteristics of the learners, but also the characteristics of the environment in which the task is performed. In this perspective, the environment varies between two extremes according to its stability. In one extreme, we find the closed environment, in which external agents have minimal effects on practice. Conversely, at the other end of the extreme several external factors contribute to the constant change in the environment, directly interfering in practice, which denotes an open environment. In regard to the classification of the environment, two premises were raised: (1) the same skill can be performed both in a closed and open environment; and (2) the environments must be analyzed within a continuum delimited by environments of minimum and maximum stability, with most of them located at an intermediate position (Gentile, 1972).

Based on the two premises to classify learning, Gentile (1972) defines the first learning stage as the "acquisition of the idea of movement". In this stage, learners have a high demand for cognitive resources, analogously to the cognitive (Fitts & Posner, 1967) and the verbal-motor (Adams, 1971) stages. At this point, the learner is still a beginner, seeking to understand the movement and to learn the general motor pattern that will be useful to achieve the task goal. Hence, there is still a great demand for understanding and using the information available in the environment. This causes fluctuations in the motor performance, since different attempts to reach the goal are required. As the learner builds up practice, the idea of the skill becomes clearer, the overall motor pattern is learned and performance becomes more consistent.

In the second stage, the apprentice is able to reach a higher level of performance in the practiced skill. At this point, the overall motor pattern acquired in the first stage can be refined, maintained or even adapted as a function of the stability of the environment. For this reason, this stage was called "fixation/diversification stage". When considering motor skills

performed in closed environments, in which environmental regulatory conditions remain constant, there is a tendency for fixating the motor pattern similar to the pattern acquired in the first stage. On the other hand, in motor skills practiced in an open environment, where conditions are unstable, there is a diversification of the original pattern due to the unpredictability of the environment. According to Gentile (1972), adaptation to an open environment context is essential for the learner to achieve the goal of the skill.

In short, the three models of classification of learning introduced so far have several similarities. The early stages propose high cognitive demands, inconsistent performance and many errors. On the other hand, the final stages propose less cognitive demand, more efficient and flexible performance, and fewer errors. In addition, the transition between stages does not happen abruptly. As the learner practices the motor skill, performance gradually improves until reaching the next stage of learning. Recognizing the characteristics of the stages is important information for the teacher to plan his classes and adapt the teaching strategies to the learners, as it will be seen in the next topic.

3.2 Learning stages in the teaching-learning process of swimming

In order to provide efficient teaching-learning situations, teachers must masters the contents and processes involved in teaching-learning of swimming (Monteiro et al., 2021), as well as take control over some aspects of the practice setting, such as setting goals, selecting content, choosing appropriate strategies and assessing learning (Tani, 1987). Accordingly, the teacher must be able to observe the relevant aspects of the movement and extract useful information for teaching (Spittle, 2021). The identification of learning stages works as a guide for the management of the teaching-learning process, in addition to produce valuable information that helps teacher to establish attainable goals and select appropriate contents and strategies for learning. In short, the learning process generates different information, and its careful observation by teachers provides relevant indications for the manipulation of teaching variables (Teixeira, 1990).

Before we examine the implications of identifying the stages of learning in the teaching-learning process of swimming more extensively, it is important to classify the swimming skills in terms of predictability of the environment. The traditional teaching of swimming in a pool is located at the extreme of the most closed skills, in a hypothetical continuum between open and closed skills. Another aspect to be considered is that, in most situations, the teacher will choose the following sequence to teach the strokes: starting from the freestyle stroke, going to the backstroke, advancing to the breaststroke and finally the butterfly stroke.

Learning an aquatic skill is by its very nature a great novelty, since the natural habitat of the human being is not the liquid environment. In addition, there is a great deal of uncertainty regarding what to do and how it must be done to achieve the goal of the skill. To illustrate, the learner in the initial stage of the freestyle learning may have difficulty understanding the movement as a whole, coordinating movements of upper and lower limbs and breathing in addition to the inability to detect and correct errors. At this point, performance is inconsistent, with a high frequency of gross errors (e.g. totally submerged swimming kick, inconsistent swimming kick, deep hips, dog paddle stroke, and keeping the head completely out of the water). A frequent mistake occurs when beginners breathe during the freestyle performance. Since the movement is not automated yet, the apprentice interrupts the swimming kicks and decreases the stroke rate to prolong the breathing time. This demonstrates the learner's need for external information about his performance to assist in the learning process.

The way external information should be transmitted depends, among other aspects, on the learners' level of experience. The clarity of the task goals, teachers can manipulate variables such as the specificity of information, the relationship between new aspects of the skill and what has already been learned, and the amount and speed of presentation of this information. In this respect, teachers should be concerned with adjusting these variables according to the apprentices' learning stage, in order to enhance the acquisition of skills (Diewert & Stelmach, 1978).

Considering the characteristics of the initial stage of learning, the certainty of what to achieve through a given skill takes greater importance. This is essential because the student is in the phase of acquiring the idea of the movement, which implies that the intended goal must be very clear. As an illustration, if the content taught is the displacement in the prone position, it may be important for the teacher to clearly instruct where the learner should look so that his body maintains proper alignment during the movement performance. Inaccurate information could raise doubts and hinder the apprentice's performance.

As for the information transmitted, teachers should consider that learners have a large amount of novelty to process in the initial stage of learning. Therefore, a small amount of information must be transmitted within each instruction, not to mention that this information must be related to the immediate needs of the learner. Returning to the previous example of teaching the displacement in prone position, the instruction on where to look at during displacement constitutes critical information for the execution of the movement, since the positioning of the head is crucial to maintain alignment in prone position. The teacher could have focused on many other aspects of the movement, such as the movement of ankles, knees and hips during the displacement. However, providing all instructions at once could result in an information overload for the learner, compromising performance.

Regarding the specificity of the information, instructions for beginners should contain information about the overall structure of the movement (Hoth, 1975). During the learning of the stroke, for example, the movement of the arms must be taught without many details, such as elbow and wrist angulation. General information such as the need to alternately take the arms out of the water is more important at this point than technical details. As for the speed teachers present information to learners, instructions for apprentices in the initial stage should be provided more slowly than for apprentices in later stages. Speaking or demonstrating a slower movement produces valuable extra time for the effective processing of information (Teixeira, 1990).

Throughout practice, the learner understands the global idea of the movement, and becomes able to coordinate movements of arms, legs, and breathing. Based on increasing the consistency and coordination of movements from one training session to another one, the movement or parts of the movement become less conscious. The learner becomes able to perceive the decrease in the stroke and kick rates when he starts breathing; he can identify when the elbow is going lower than the hand in the water, among other characteristics. During the final stage of learning, it is possible to observe a consistent performance of the movement as a whole. A technical swim unfolds, in which the learner has the ability to identify details to be polished in the teaching process, such as the need for increasing the propulsion at the swim start or improving the exit angle. During this stage, the attentional demand is lower, that is, the movement is more automated and the learner is less dependent on external information.

In addition, the clarity of information provided in the final stage of learning can be reduced because the learner is expected to comprehend the goal to be achieved and the means to achieve this goal. Information such as "your hip is low" is as clear in this phase as "adjust the position of your head to adjust the height of your hip". Furthermore, as the learning progresses, instructions can be more specific in order to refine the movement. Specific information such as specific joint angulation and timing between components in freestyle no longer impairs the performance of the skill.

The amount of information that learners are able to process in the final stage of learning is comparatively greater than in the initial stage. This occurs because the degree of uncertainty is smaller, allowing the development of cognitive strategies to deal with a greater number of information. Hence, the teacher has more freedom to provide more complex and complete instructions to the learners, in order to adjust and refine the movement. To illustrate this notion let us consider instructing how the swimming kick should go along with the torso twist in order to maintain the alignment of the body when coordinating the stroke and breathing actions. In addition to transmitting a greater amount of information, time for effective information

processing is reduced in comparison to the previous stage. The amount of uncertainty is so small in this stage that the learner is able to process the information more efficiently.

As the teaching-learning process of swimming progresses and the learning of new swimming styles takes place, the learner may face new uncertainties and difficulties, and the teacher must once again be aware of the quantity, quality and specificity of the information transmitted, as well as the need for more processing time by learners. However, previously learned skills can be used as a valuable resource to make the teaching-learning process even more efficient. Learning related to the liquid environment itself and the way the body behaves in this environment can be the basis for new learning. In addition, transfer between similar skills are likely to occur. As an example we could consider the similarity between some movement patterns of the backstroke and freestyle, such as the swimming kicks and the alternating stroke, that favor the transfer of learning from one swimming style to another. This, in turn, can contribute to the recovery of long-term memory, facilitating the acquisition of new skills.

4. Final Considerations

It is important that the learning stages are seen as parts of a continuum over time, which can be identified regardless of the swimming style practiced. Some points will differ between swimming styles, such as the specificity and amount of information, the specificity of errors, the informational demand, and the amount of practice. However, it is the teacher's role to establish the relationship between the student and the contents to be taught in the teaching-learning process, regardless of the methods employed (Lepore et al., 2015). In other words, teachers must select and propose content that are suitable to the learners' characteristics, needs, expectations, and interests (Larson et al., 2019). These contents must be dosed in order to present itself a little beyond the skills and competences already acquired by learners, being sufficiently challenging to arouse motivation and enthusiasm (Nosko et al., 2019). As we have seen, the identification of the moment or stage in which the learner finds himself during the learning process based on the theoretical systems of classification of the stages of learning is crucial to enhance the teaching-learning process.

The literature on the theme is scarce, and few studies make associations between theories, concepts and applications in the area of knowledge of Learning and Motor Control with sports practice, especially in swimming. To provide support to the teacher/coach regarding the teaching-learning process in swimming, further studies should be conducted trying to extrapolate the theory, thus expanding the practical application of the valuable knowledge about motor learning. Furthermore, future studies can advance the understanding of the factors that can be manipulated by the teacher in order to optimize the learning of aquatic skills such as the organization of practice, type of practice, demonstration and verbal instruction."

References

Adams, J. A. (1971). A Closed-Loop Theory of Motor Learning. *Journal of Motor Behavior*, *3*(2), 111–150. https://doi.org/10.1080/00222895.1971.10734898

Casarin, S. T., Porto, A. R., Gabatz, R. I. B., Bonow, C. A., Ribeiro, J. P., & Mota, M. S. (2020). Tipos de revisão de literatura: considerações das editoras do Journal of Nursing and Health/Types of literature review: considerations of the editors of the Journal of Nursing and Health. *Journal of Nursing and Health*, *10*(5).

Chase, N. L., Sui, X., & Blair, S. N. (2008). Comparison of the health aspects of swimming with other types of physical activity and sedentary lifestyle habits. *International Journal of Aquatic Research and Education*, *2*(2), 7. https://doi.org/10.25035/ijare.02.02.07

Coker, C. A. (2017). *Motor learning and control for practitioners*. (4th ed.). Routledge.

Diewert, G. L., & Stelmach, G. E. (1978). Perceptual Organization in Motor Learning. In *Information Processing in Motor Control and Learning* (pp. 241–265). Academic Press. https://doi.org/10.1016/B978-0-12-665960-3.50017-7

Fitts, P. M., & Posner, M. I. (1967). *Human Performance. Belmont*. Brooke/Cole Publishing Co.

Gentile, A. M. (1972). A Working Model of Skill Acquisition with Application to Teaching. *Quest*, *17*(1), 3–23. https://doi.org/10.1080/00336297.1972.10519717

Gil, A. C. (2002). *Como elaborar Projetos de Pesquisa*. Editora Atlas S.A.

Hoth, S. (1975). The Language of Motor Learning. *Quest*, *23*(1), 68–73. https://doi.org/10.1080/00336297.1975.10519831

Larson, H. K., McHugh, T. L. F., Young, B. W., & Rodgers, W. M. (2019). Pathways from youth to masters swimming: Exploring long-term influences of youth swimming experiences. *Psychology of Sport and Exercise*, *41*, 12-20. https://doi.org/10.1016/j.psychsport.2018.11.007

Lepore, M., Columna, L., & Lizner, L. F. (2015). *Assessments and activities for teaching swimming*. Human Kinetics.

Magill, R. A. (2000). *Aprendizagem motora: conceitos e aplicações*. Edgard Blücher.

Monteiro, G. N., Araújo, N. D., Mazzardo, T., Francisco, P. S., Ribas, S., & Aburachid, L. M. C. (2021). Practice schedule analysis and pedagogical feedback in swimming classes. *Journal of Physical Education and Sport*, *21*(3), 1950–1957. https://doi.org/10.7752/jpes.2021.s3248

Nosko, M., Arkhypov, O., Khudolii, O., Filatova, Z., & Yevtushok, M. (2019). Pedagogical Conditions for Swimming Skills Development in Students of Pedagogical Educational Institutions. *Revista Romaneasca pentru Educatie Multidimensionala*, 11(2), 240-255. https://doi.org/10.18662/rrem/127

Pharr, J., Irwin, C., Layne, T., & Irwin, R. (2018). Predictors of swimming ability among children and adolescents in the United States. *Sports*, *6*(1), 17. https://doi.org/10.3390/sports6010017

Rother, E. T. (2007). Systematic literature review X narrative review. *Acta Paulista de Enfermagem*, 20(2), vii-viii.

Schmidt, R. A. (1988). *Motor control and learning: a behavioral emphasis*. Human Kinetics.

Spittle, M. (2021). *Motor learning and skill acquisition: Applications for physical education and sport*. Bloomsbury Publishing.

Stallman, R. K. (2017). From swimming skill to water competence: a paradigm shift. *International Journal of Aquatic Research and Education*, *10*(2), 2. https://doi.org/10.25035/ijare.10.02.02

Stanković, S., Marković, Ž., Dopsaj, M., Ignjatović, A., & Aleksić, D. (2017). The effects of a swimming program on the functional abilities of female students. *Facta Universitatis, Series: Physical Education and Sport*, 427-434.

Tani, G. (1987). Educação Fisica Na Pre-Escola E Nas Quatro Primeiras Séries Do Ensino De Primeiro Grau: Um Abordagem De Desenvolvimento I. *Kinesis*, *3*(1), 19–41. https://doi.org/10.5902/23165464

Tani, G., Basso, L., & Corrêa, U. C. (2012). O ensino do esporte para crianças e jovens: considerações sobre uma fase do processo de desenvolvimento motor esquecida. *Revista Brasileira de Educação Física e Esporte*, *26*(2), 339–350. https://doi.org/10.1590/S1807-55092012000200015

Teixeira, L. A. (1990). Estágios de aprendizagem motora e o processo de interação professor-aluno. *Kinesis*, *6*(1), 23–42. https://doi.org/10.5902/23165464