

Differentiation instruction publications in physical education: bibliometric analysis of the last ten years

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ABSTRACT

Research and publications on differentiation instruction in various subjects have developed rapidly in the world. Unfortunately, this trend is not directly proportional to the subject of physical education, even though differentiation instruction is the latest learning trend that is based on student learning needs. This research aims to analyze the metrics and visualization of differentiation instruction publications over the last ten years (2013-2023) using the literature review method. Google Scholar inspection using the Publish or Perish application only found nine articles (out of 16 articles) that met the VOSviewer visualization analysis criteria. As a result, the highest publication metrics were only three articles in 2014 and 53 citations as the highest top citations in 2019 for two articles. Network term differentiation is limited to three terms: analysis, lesson, and education. The VOSviewer visualization confirms that differentiation instruction has great potential to be developed in physical education to contribute to fulfilling students' learning experiences by their learning potential preferences. Future research can consider aspects of differentiation instruction that are not limited to teachers evaluating student learning outcomes based on differentiation instruction, and using differentiation instruction to improve various skills that help students survive in real life.

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1. INTRODUCTION

Along with the transformation of students' different and complex learning needs, experts have developed alternative pedagogical approaches that can bridge differences in student characteristics, known as differentiated instruction (from now on referred to as differentiated instruction (DI)). DI is an educational concept highly valued and promoted by teachers worldwide [1] because it seeks to promote a pedagogical-didactical philosophy that focuses on the nature of individual learning [2]. DI meets the diverse learning needs of students [3] by providing opportunities for students to do their best rather than forcing all students to reach the same level [4]. DI offers an inclusive teaching method so that teachers provide a variety of learning opportunities based on students' backgrounds, readiness, interests, and profiles [5] to support social, emotional, and academic success for all students in heterogeneous classroom contexts [6], [7]. In a differentiated classroom, different students have different needs. Therefore, teachers proactively plan ways for students to express their learning [8] rather than ignoring student differences in readiness, interests, and

learning profiles [4]. In simple terms, DI is a way of teaching based on the talents and learning styles of different students [9], [10], different from traditional learning, which holds the view that students have the same abilities and must obtain learning outcomes to the same standard.

Effective teachers in contemporary classrooms must learn to recognize differences when developing students' learning experiences [4]. Student heterogeneity is evident in almost every classroom, even throughout the world (gender, age, developmental stage, interests, motivation, intellectual abilities, learning preferences, learning speed, socioeconomic status, background, and family situation). Although biological and psychological processes may appear similar among students, various contextual factors make learning a unique experience for each student [1]. As student diversity increases, DI's function becomes increasingly significant in meeting students' learning needs [11]. Teachers can maximize their learning improvement by meeting the needs of each student (individually and in small groups) through various ways of expression and offering adequate learning opportunities with various approaches to content and learning skills [12]. Teachers continuously shift their focus to students as individuals by making effective and efficient learning approaches, methods, and strategies with their expertise, personality, and social relationships to explore students' potential to the fullest in response to diverse student needs rather than focusing on a series of practices that individualize or adapting learning tasks [13]-[15].

The national education system law of the Republic of Indonesia [16] has mandated that the curriculum at all levels and types of education be developed with the principle of diversification by educational units, regional potential, and student needs. The development of a diversified curriculum is intended to enable the adjustment of educational programs in educational units (schools or universities) to the conditions and unique potential in the region to accommodate the various existing diversity, including students [17]. Responding to the mandate of the law above, in 2022, the Indonesian government will begin to promote the independent curriculum (including DI) to accommodate students learning based on their needs. It has worked well based on the evidence of a series of published reports explaining the contribution of DI to teachers, students, and schools. First, implementing DI is far below the benchmark for learning completeness (80%). However, teachers feel capable of dealing with student diversity and have basic ideas about implementing DI [18]. Second, students responded positively to implementing DI to become more motivated in learning [19]. Third, positive perceptions of teachers in practicing DI through content, remedial assignments, and products were based on student interests through formative and summative assessments [20]. Fourth, teachers understand and are fully aware of the heterogeneous conditions in their classes and have carried out DI to deal with students' different abilities so that they have succeeded in increasing students' grades [21]. Fifth, the DI conceptual model is proven to provide opportunities for students to walk their path and ensure learning that prioritizes students' physical and spiritual well-being [22].

At the international level, Am *et al.* [10] will release a bibliometric study on DI research trends. Sadly, there are only 34 documents from Indonesian authors that have been successfully published in reputable international journals (Scopus), making Indonesia the last of 10 productive countries to report DI publications in these reputable journals (the USA ranks first with 718 documents). So, what about trends in DI research in physical education (PE)? If the reader examines it, the development of DI research in PE has not made significant progress. This statement is confirmed by published data on DI in PE only reported by [23]-[25]. In response to the limitations of DI research, it is essential to carry out a comprehensive bibliometric study to help PE teachers' literacy in recognizing the application of modern pedagogic-didactical approaches to address the heterogeneous learning needs of students when using their learning modalities. Moreover, PE is a learning subject that uses physical activity to achieve educational goals [26] so that student's academic performance is assessed directly through their movement skills. Suppose teachers do not conduct careful diagnostic assessments of students' uniqueness (diversification) in learning. In that case, students have the potential to face various challenges in equalizing skill performance, which, of course, can harm their learning rights to develop according to personal potential.

Seeing the limited research on DI in PE above, exploring DI in future research is very open. However, comprehensive bibliographic metrics are needed to ensure "keywords" that are worth exploring in DI in PE. This research proposes using bibliometric studies to solve the DI bibliographic tracking problem in PE. Bibliometric studies are useful as a decision support tool in setting research priorities and tracking the evolution of science and technology in a particular field as well as highlighting emerging areas in that field [27], [28], such as examining publication patterns such as subject, author, citation, title, and other factors [29]-[31]. Thus, bibliometric mapping findings will provide useful and meaningful contributions for future researchers and find opportunities and updates to contribute more [32], [33]. The results contribution of this research is to provide the latest metric literature on the development of DI in PE in the world through tracking network visualization, display, and density, as well as contributing to future researchers, teachers, and policymakers regarding the challenges and opportunities for developing DI in PE in supporting the implementation of effective learning independence, and quality for students.

2. METHOD

This research uses a quantitative approach with a literature review method. Literature reviews increase researchers' understanding of previous work in a particular field. It enables them to more easily identify gaps in innovative ways (empirical, knowledge, theoretical, methodological, application, and population) in the body of literature and potential projections for future research [34], [35]. Specifically, this research uses bibliometrics studies to measure, track, and analyze social and structural relationships between various components of literature [27], [36]. Apart from that, researchers use bibliometric studies because they can analyze large amounts of data, the process is fast and accurate, and the interpretation of keyword metrics is practical. This study uses the type of analysis (co-authorship; co-occurrence), the unit of analysis (authors; keywords), the counting method (full counting), the minimum number of documents and a minimum number of authors (1), the minimum number of occurrences of a keyword (1), and fields from which terms were extracted (title and abstract fields), the minimum number of occurrences of a term (3).

The research was done on September 14, 2023. The first stage is to collect scientific bibliographic data from data sources from Google Scholar using the help of the Publish or Perish (PoP) application with the title words "Differentiated instruction in physical education," "Differentiated learning in physical education," and "Differentiated learning in physical education" from 2013-2023 (maximum number of results=200). This research uses English language criteria (at least title and abstract) for published bibliographies from national and international indexing institutions. Apart from that, articles that are worthy of analysis are journal articles and conference proceedings. Partially, from the three title words above, 16 articles were captured: nine articles each for the first title words, two for the second title words, and five articles for the third title words as shown in Table 1. All articles resulting from inspection (each title word) were stored in research information systems (RIS) format in the document folder to track publication trends and citation trends.

Table 1. Citation metrics from PoP

| Citation metrics | Differentiated instruction in physical education | Differentiation learning in physical education | Differentiated learning in physical education |
|-------------------|--|--|---|
| Publication years | 2013-2023 | 2013-2023 | 2013-2023 |
| Citation years | 10 (2013-2023) | 8 (2015-2023) | 5 (2019-2023) |
| Papers | 9 | 2 | 5 |
| Citations | 84 | 4 | 50 |
| Cites/years | 8.4 | 0.50 | 12.50 |
| Cites/paper | 9.33 | 2.00 | 10.00 |
| Author/paper | 2.78 | 3.00 | 2.20 |
| h-index | 4 | 1 | 1 |
| g-index | 9 | 2 | 5 |
| hl, norm | 3 | 1 | 1 |
| hl, annual | 0.30 | 0.13 | 0.25 |
| hA-index | 1 | 1 | 1 |

The second stage is to import the previous RIS format article library from the document folder into the Mendeley Reference Manager application to verify the author, title, publication (for example, journal name, volume, issue, and page), and type (journal article and conference proceedings), as well as editing and completing article abstracts. The aim is that the data to be analyzed using the VOSviewer application is credible. If the data is not carefully verified, the metrics displayed also can be biased (including duplication of articles and so on). The verification results produced nine articles eligible for the VOSviewer analysis stage. Respectively, six articles from the first title words, one article from the second title words, and two articles from the third title words. The nine articles were exported back to RIS format using the Mendeley application and saved in the documents folder.

There were three articles that the researchers eliminated because they did not meet the criteria and two documents because they were duplicated. First, an article written by [37] entitled "The effect of using differentiated instruction on learning breaststroke in female college students of physical education and sports sciences". Second, the article entitled "Universal design for learning and differentiated instruction in physical education" by [24]. Both bibliographic documents were removed because they were duplicated. Meanwhile, one other article that was deleted was of the dissertation type, written by [38] with the title "A qualitative study of teachers' experiences with differentiated instruction in elementary physical education".

The final stage is analyzing the visualization of RIS format articles using the VOSviewer application. VOSviewer pays special attention to the graphical representation of bibliometric maps. The VOSviewer functionality is very useful for displaying large bibliometric maps in an easy-to-interpret manner [39].

There are three ways of interpreting when using VOSviewer-first, network visualization, where items are represented by their labels (default or circles). The size of the label and circle of an item is determined by the weight of the item. Additionally, the distance between two items in the visualization roughly indicates the relatedness of the items. The closer the two items are located, the stronger their association. Second, overlay visualization: if an item has a score, the item color is determined by the item's score, and by default, the color ranges from blue (lowest score) to green to yellow (highest score). Third, density visualization: each point in the density visualization item has a color that shows the item's density at that particular point. By default, colors range from blue-green to yellow. The more items there are around a point and the higher the weight of the items around it, the closer the point's color is to yellow. Conversely, the smaller the number of items around a point and the lower the weight of the items around it, the closer the point's color is to blue [40].

3. RESULTS AND DISCUSSION

3.1. Publication trends

The metrics explain that the trend of publishing physical education scientific articles with the title words DI is still very limited. In the last ten years, only eight articles ($M+SD=0.7+0.8$) were successfully inspected (journal articles), while there was only 1 article of the conference proceedings type as shown in Figure 1. Most articles were published in 2014 (3 documents; 33.3%), followed by 2019 (2 documents; 22.2%), and in 2013, 2016, 2018, and 2023 only managed to produce 1 article (11.1%). It means that during 2013-2023, only 50% of the years were filled with published articles, comparable to years without publications (2015, 2017, 2020, 2021, 2022). After further investigation, three articles (the most) published in 2014 turned out to be connected to collaborative authors from Romania, namely Gheorghe Marinescu, Virgil Tudor, Ana-Maria Mujea, Cristina Georgiana Vărzaru, and Carmen Băisan. Of the five authors, only Carmen Băisan has her name recorded in 1 publication.

In 2013, Adkins *et al.* [41] tried to promote the DI in the PE article, which was successfully published in a Scopus-indexed journal with the title "The mystery behind the code: differentiated instruction with quick response codes in secondary physical education." Furthermore, one year later, it had increased to three publications. Unfortunately, this positive trend did not increase in subsequent years. On the contrary, it declined until 2023 (1 document) with the title "Organization and methods of conduct of physical education lessons in the complete classroom of the experimental school with an individual and differentiated approach to learning" written by [42].

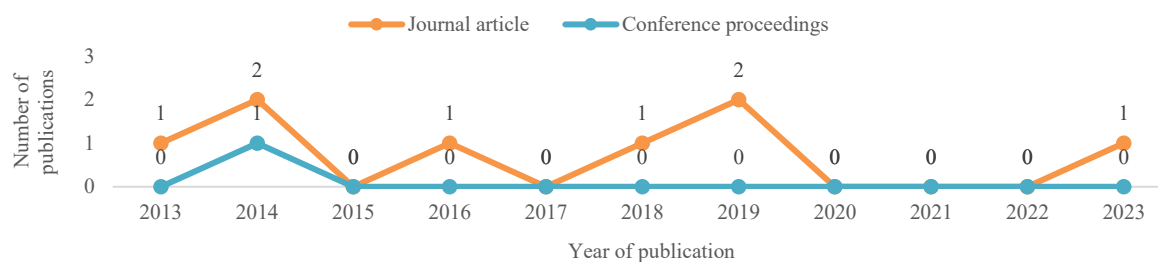


Figure 1. Publication trends by article type

Twenty-two authors contributed to publishing nine DI articles in PE, but only four succeeded in publishing two articles. They were Ana-Maria Mujea and Virgil Tudor, each with three articles (13.6%) as shown in Figure 2. Meanwhile, Marinescu Gheorghe and Christina Georgiana Vărzaru had two articles (9.1%). Thus, 18 other authors (81.8%) only contributed to one published article. Apart from that, of the 22 authors, only one author (4.5%) was involved as the sole author, namely Ifikhar Ahmed, with the title of the article "The effect of using differentiated instruction on learning breaststroke in female students college of physical education and sport sciences." This means that the other 21 authors (95.5%) were involved in the article publication as collaborative writers.

Figure 3 explains the distribution of affiliate metrics based on the number of authors (22 people) so that one affiliate can have more than one author. Of the 22 authors, in detail, five authors (22.7%) are affiliated with the University of the West Indies, Jamaica, and affiliated with the National University of Physical Education and Sport in Bucharest, Romania. Meanwhile, two authors (9.1%) are affiliated with the University of Nebraska-Kearney, United States, University of West Georgia in Carrollton, United States, and

Ternopil National Medical University, Ukraine. Others, one author (4.5%) each affiliated with Virginia Commonwealth University, United States; University of Baghdad, Iraq; Federal University of São Carlos, Brazil; State University of New York, United States; University of New Hampshire, United States, and West Ukrainian National University, Ukraine. Referring to author affiliations, it is recorded that the 22 authors above come from five countries; Jamaica, Brazil, Iraq, Romania, Ukraine, and the United States. Furthermore, if measured by country, the United States contributes the most authors in the publication of DI articles in PE, namely 31.8%, followed by Jamaica (22.7%), Romania (22.7%), Ukraine (13.6%), Brazil (4.5%), and Iraq (4.5%).

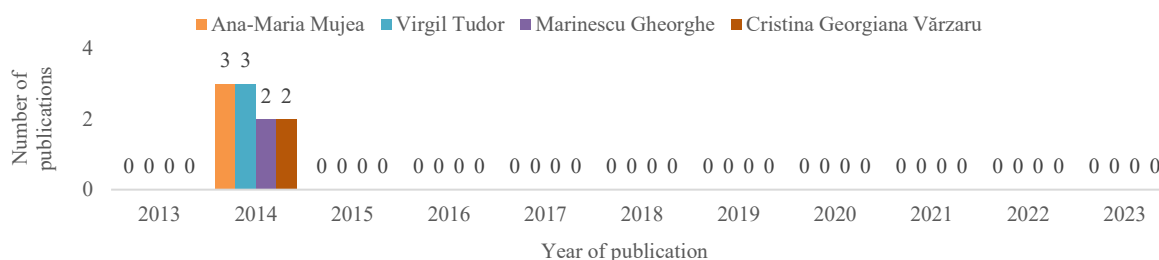


Figure 2. Publication trends based on authorship (minimum two publications)

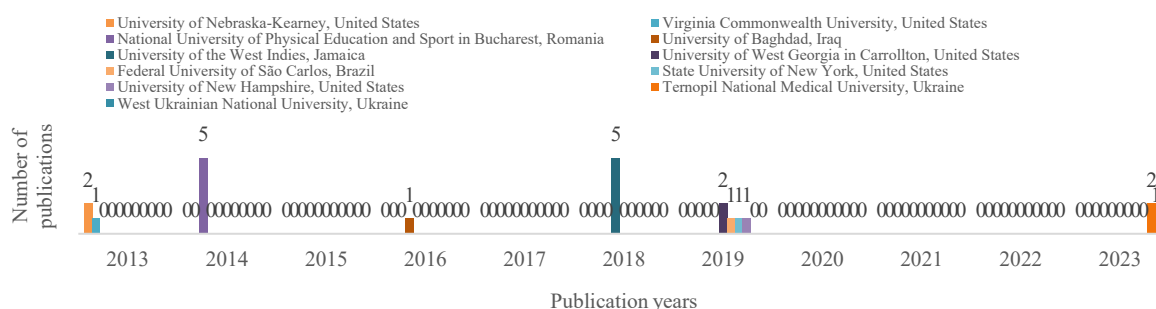


Figure 3. Author publication trends by affiliation

If looking at affiliation trends by year, in 2013, there were only two affiliates who contributed, namely the University of Nebraska-Kearney (two documents) and Virginia Commonwealth University (one document). In 2014, five documents were published by affiliates of the National University of Physical Education and Sport in Bucharest. Meanwhile, in 2016, there was only one affiliation that contributed to one document, namely the University of Baghdad. Continuing in 2018, like in 2014, there were five documents published only from one affiliation, namely the University of the West Indies. In 2019, four affiliations contributed to the publication of five DI documents in PE, two documents each from the University of West Georgia in Carrollton, and other affiliations only contributed one document, including the Federal University of São Carlos, State University of New York, and the University of New Hampshire. Finally, in 2023, there were only two contributing affiliations: Ternopil National Medical University (two documents) and West Ukrainian National University (one document).

Successfully published articles have also been indexed in international databases. At least 33.3% of articles have been successfully published in international journals indexed by Scopus. The journal “Strategies: A Journal for Physical and Sport Educators” published two articles, the first in 2013 entitled “The mystery behind the code: differentiated instruction with quick response codes in secondary physical education” and the second in 2019 entitled “Differentiation for student learning in physical education.” One article was published in the journal “Adapted physical activity quarterly” in 2019 entitled “Universal design for learning and differentiated instruction in physical education.” These two journals can be a reference for future researchers to replicate DI-based PE articles. As additional information, in 2014, there was one article published by Procedia-Social and Behavioral Sciences (Elsevier), but after confirming the author’s Scopus ID, the article was not indexed, so it was categorized in the non-Scopus indexer.

The other six articles (66.7%) were published in international publications not indexed by Scopus. The details are three articles in 2014 (including an article published in Marathon with the title “Experimental

study for improving the speed using the differentiated instruction in 5th grade in the physical education classes”). One article in 2016 entitled “Effect of using differentiated instruction on learning breaststroke in female college students of physical education and sports sciences” was published in the Journal of Physical Education. One article in 2018 was entitled “Same or different? A qualitative investigation of in-service science and physical education teachers’ perceptions of differentiated instruction,” published in the Journal of Education and Development in the Caribbean. Finally, one article in 2023 entitled “Organization and methods of conducting of physical education lessons in the complete classroom of the experimental school with an individual and differentiated approach to learning” was published in the Scientific Journal National Pedagogical Dragomanov University as shown in Figure 4.

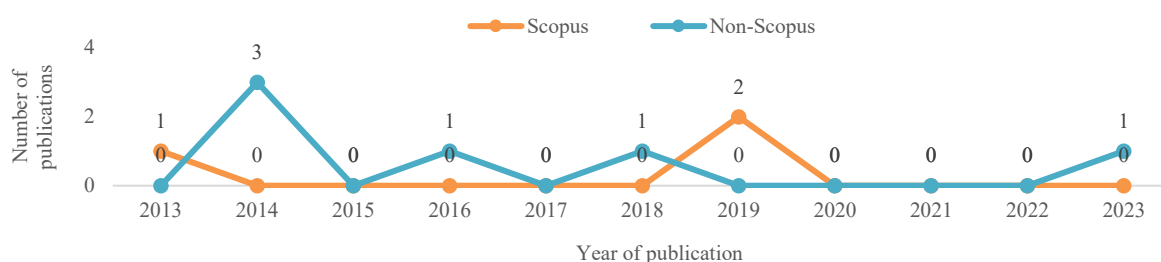


Figure 4. Publication trends by indexing agency

3.2. Citation trends

A total of 80 citations for the 10-year journey of publication of DI articles in PE is an alarming number as shown in Figure 5. The average number of article citations each year is only 7.3. Of the articles that were successfully published, 2019 received the highest number of citations (for two articles), followed by 2013, with 14 citations (for one article), 2014, with 11 citations (for three articles), and finally, 2018, with two citations. (for one article). Even though in 2014 there were three articles successfully published, unfortunately, the citation trend was still lower than the other two publication years (2013 and 2019).



Figure 5. Citation trends based on article publication year

The highest top citation (50 citations) is in the article entitled “Universal design for learning and differentiated instruction in physical education” by [24]. Meanwhile, the article with the lowest top citations (three citations) is entitled “Experimental study for improving the speed using the differentiated instruction in 5th grade in the physical education classes [43]. Additional information from content analysis also proves that journals from reputable international publishers published the four top citations. For example, Human Kinetics (Adapted Physical Activity Quarterly), Taylor and Francis (Strategies: A Journal for Physical and Sport Educators), and Elsevier (Procedia-Social and Behavioral Sciences). Meanwhile, the last top citation was published by a university publisher (Academy of Economic Studies) as shown in Table 2. Accessibility could be one of the potential things that makes it easier for readers to access information about articles that discuss DI in PE (apart from the limitations of studies about DI in PE itself).

The top citation (50 citations) in the article entitled “Universal design for learning and differentiated instruction in physical education” was motivated by a team of authors who succeeded in promoting and discussing two approaches simultaneously for students with disabilities in PE (differentiated teaching and universal design for learning (UDL)). Considering that the needs for educational and learning services must differ among students with disabilities in PE classes, implementing DI is very important so that all student’s

needs can be considered appropriately and proportionally so that they do not feel isolated during learning because of certain limitations. Implementing DI requires modifications in the program and pedagogical accommodations by considering learning principles using Universal design for learning (a teaching approach that works to accommodate the needs and abilities of all learners and eliminates unnecessary hurdles in the learning process).

Table 2. Five top-cited articles

| No | Citation | Title | Journal name | Author | Affiliation | Year |
|----|----------|--|--|--|---|------|
| 1 | 50 | Universal design for learning and differentiated instruction in physical education | Adapted Physical Activity Quarterly | Mey A. van Munster, Laureen J. Lieberman, and Michelle A. Grenier | Federal University of São Carlos, State University of New York, and University of New Hampshire | 2019 |
| 2 | 14 | The mystery behind the code: Differentiated instruction with quick response codes in secondary physical education | Strategies: A Journal for Physical and Sport Educators | Megan Adkins, Misti R. Wajciechowski, and Ed Scantling | University of Nebraska-Kearney Virginia and Commonwealth University | 2013 |
| 3 | 8 | The improvement of strength in mentally disabled pupils through the use of differentiated instruction in the physical education lesson | Procedia-Social and Behavioral Sciences | Gheorghe Marinescu, Virgil Tudor, Ana-Maria Mujea, and Carmen Băisan | The National University of Physical Education and Sports and Special Secondary School | 2014 |
| 4 | 3 | Differentiation for student learning in physical education | Strategies: A Journal for Physical and Sport Educators | Brent Heidorn and Brian Mosier | University of West Georgia in Carrollton | 2019 |
| 5 | 3 | Experimental study for improving the speed using the differentiated instruction in 5 th grade in the physical education classes | Marathon | Virgil Tudor, Ana-Maria Mujea, and Cristina Georgiana Vărzaru | The National University of Physical Education and Sports | 2014 |

3.3. Co-authorship

In the co-authorship analysis, the entire counting method was used with the number of co-authorship authors determined to have published at least one article (bearing in mind that the articles analyzed were very limited=9), so that 22 met the threshold of 22 authors appeared in the VOSviewer Choose threshold. The analysis results (select no on unconnected items) verify that there are 22 authors spread into seven clusters, forming 29 links and 35 total link strengths. Cluster 1 (five authors), includes Dorian Barrow, Susan Herbert, Rowena Kalloo, Kenny Kitsingh, and Patsy-Ann Rudder. Cluster 2 (five authors), including Carmen Băisan, Gheorghe Marinescu, Ana-Maria Mujea, Virgil Tudor, and Cristina Georgiana Vărzaru. Cluster 3 (three authors), including Megan Adkins, Ed Scantling, and Misti R. Wajciechowski. Cluster 4 (3 authors), including N. Bezpalova, N. Davybida, and V. Matsenko. Cluster 5 (three authors), including Michelle A. Grenier, Laureen J. Lieberman, and Mey A. van Munster. Cluster 6 (two authors), namely Brent Heidorn and Brian Mosier. The last cluster (one author), namely Iftikhar Ahmed.

Overlay visualization in Figure 6 confirms that Ana-Maria Mujea and Virgil Tudor are the authors who appear the most because they have duplicated three articles (please confirm in Figure 2); unfortunately, the article they wrote was published nine years ago (2014). Meanwhile, Davybida *et al.* [42] only published 1 article entitled “Organization and methods of conduct of physical education lessons in the complete classroom of the experimental school with an individual and differentiated approach to learning.” However, this is the latest article (2023) discussing DI in PE.

3.4. Co-occurrence

Co-occurrence analysis is helpful in frequencying closely structured keywords in a corpus of data to visualize future research opportunities based on the occurrence (semantic closeness) of keywords. This analysis uses the complete counting method with the number of co-occurrence keywords set at a minimum of one so that all meet the threshold representing four keywords will appear in the VOSviewer networking map. The analysis results (select yes on unconnected items) verify that four keywords only form one cluster and six links. The cluster includes differentiated instruction, i25, operational modules according to classification:

i20, and speed as shown in Figure 7. The results of the overlay visualization of four keywords explain that each keyword forms three total link strengths. The DI keyword has a very limited network, so the future development of DI research in PE is open widely.

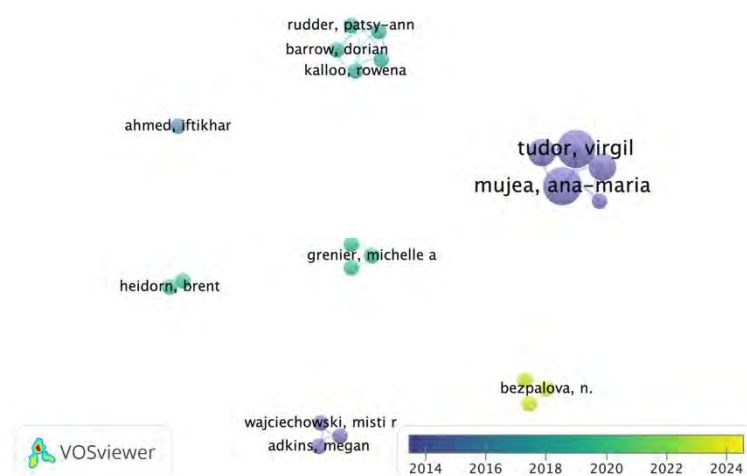


Figure 6. Co-authorship overlay visualization

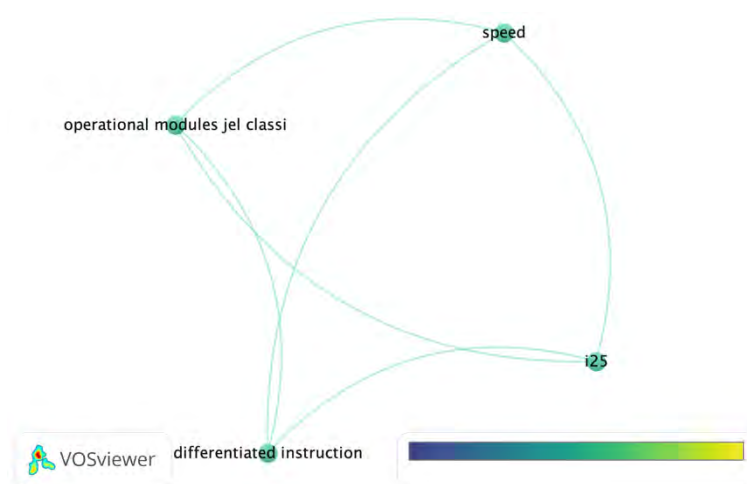


Figure 7. Co-occurrence overlay visualization

3.5. Title and abstract

In the choose threshold display, three minimum numbers of occurrences of a term are used from 289 terms, thus successfully forming 27 meet the threshold. However, in the next stage (verify selected terms), three terms were eliminated because they did not reflect the variable terms, including “control group, experimental group, learner, researcher, today, and use.” The results of the analysis found 10 items, forming three clusters as shown in Table 3, 26 links, and 289 total link strengths.

Table 3. Cluster of 10 item

| Cluster | Color | Item | Total |
|---------|-------|---|-------|
| 1 | Red | Analysis, differentiation, effect, lesson, physical education class | 5 |
| 2 | Green | Education, school, village | 3 |
| 3 | Blue | QR code, technology | 2 |

The term with the highest occurrence is term with the highest occurrence is “education,” which is 19, and the term with the lowest occurrence is “differentiation”, which is three. The network term “differentiation” includes “analysis, lesson, and education”. Figure 8 also explains that the term that has been discussed the longest in DI is “physical education class”, and the most recently discussed term is the term “school and village”, which means that many researchers have not studied the latest research discussing DI in PE. Thus, the VOSviewer visualization confirms that DI still has excellent potential to be developed in PE learning to fulfill students’ learning needs by their potential profile.

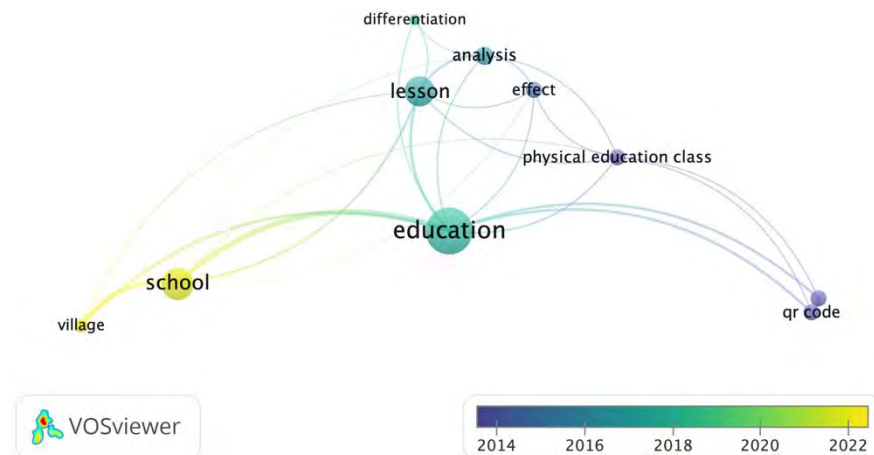


Figure 8. Title and abstract overlay visualization

Based on the results of VOSviewer metrics and visualization, this research problem concludes that there are still very few studies on DI in bibliographic publications (journal articles and seminar proceedings) published in the last ten years in PE. Investigation of DI in PE in the future has great potential to diagnose, organize, and even develop DI to support the creation of meaningful learning for each student’s needs to develop according to his or her profile. Different students have different learning needs, so teachers must proactively plan various ways to accommodate students to express their learning experiences [8]. PE in the DI direction is carried out by classifying student levels and selecting content and exercise forms that suit individual conditions. Thus, students can choose content forms of practice (learning experiences) that suit the characteristics of each individual [25]. With this model (DI), teachers are encouraged to differentiate their lessons for each student and help meet their needs. Often, this includes flexible grouping strategies, focusing on different content or processes, changing the learning environment, and combining different approaches to teaching. Teachers are then allowed to assess students based on their respective levels of ability [44].

Since 2013, the implementation of DI in PE has made significant progress as teachers utilize quick response (QR) in the delivery of instruction to increase interest while accommodating learners with various levels of ability [41]. Developed in 2014, DI began to be applied in experimental research to test its impact on student speed [43] and was followed by testing student motor performance [45], including students with special needs [46]. Carrying learning methods that uphold the characteristics of each student will lead to achieving the specific goals of PE at school; DI can prove a positive impact on students’ motor speed and performance. Ahmed [37] also tested DI research on university students. As a result, using DI resulted in better breaststroke learning for university students, so he recommended updating the teaching style to suit each student’s needs. Another interesting fact that future researchers can also consider for DI investigations can be seen in [47]. Their qualitative investigation results prove that most PE teachers differentiate DI based only on process. It means teachers’ perceptions and experiences of planning and implementing DI in PE can still be explored based on the content, product, and learning environment.

Apart from the DI report on students with disabilities studying PE by Munster *et al.* [24], Marinescu *et al.* [46] also conducted a study to describe the DI used by PE teachers to accommodate elementary school students with disabilities in New York. As a result, in addition to Universal Design for Learning, DI can also represent a significant resource for accommodating students with disabilities in physical activities and sports. Apart from the nine previously metricated and visualized articles, two PE studies reviewed DI but were not recorded in the PoP inspection results from Google Scholar. The reason is that the first article uses the title words “Differentiated approach,” and the second article uses the title words “Differential learners,”

“Differentiated-oriented,” and “Differentiation in education” (different from the title words used in this research). Nevertheless, both articles deserve discussion because they contribute to the investigation of DI in PE. First, Sitovskyi *et al.* [23] proved an increase in the level of physical fitness and performance of seventh-grade students using the DI methodology in allocating educational time. Meanwhile, in the second article, Cuong *et al.* [25] proved that students have fundamental differences in awareness, level of favorites, and degrees. Apart from that, students’ assessments of PE also vary, so DI needs to be applied in PE learning.

From the two paragraphs above, readers can figure out the development of DI research in PE in the last ten years and project future DI research in PE from various aspects. Aspects of future DI research that readers can consider include, but are not limited to, teachers’ views on the effectiveness of DI, students’ views on the significance of DI in supporting student learning outcomes, teachers’ skills in implementing DI, teachers’ strategies for integrating the use of technology in DI, teachers’ strategies in evaluating DI-based student learning outcomes, utilizing DI in improving mastery and quality of sports playing techniques. Apart from that, DI research to increase student capacity includes basic motor skills, improving social skills, improving life skills, and increasing higher-order thinking skills (HOTS). It can also carry out investigations into the development of DI-oriented teaching skills, the development of DI-oriented PE learning models, and others. It should be emphasized that DI is a pedagogical-didactical philosophy [2] that focuses on meeting the unique needs of each student to express their learning experiences [43] so that teachers facilitate various learning opportunities based on student profiles [5] to support their success in social, emotional, and academic aspects in heterogeneous classes [6], [7]. Finally, DI helps teachers to provide equal and fair educational services for all students while facilitating students to solve problems according to their respective academic profiles.

In closing, some students may master a subject well, but not so for other students. The fact is that not all students like the same subject matter; material that is a challenge for one student may not be interesting for other students. That is the reason why DI is needed to close the achievement gap between high and low-achieving students and create equality of learning for all students in carrying out their best efforts rather than forcing all students to achieve the same learning level in the same way [4], [8], [48]. Even though teachers accommodate students to learn according to their needs using DI, teachers still have a role in directing students to use their learning needs to focus on achieving national education goals with each student’s learning methods and performance levels (supporting students to survive to their potential).

4. CONCLUSION

Tracing the development of publications over the last ten years proves that research on DI in PE is still minimal. This conclusion is confirmed that only nine articles are available in the 2013-2023 time period. There are only five countries that contribute to the publication of DI articles in PE, namely the United States (31.8%), Jamaica (22.7%), Romania (22.7%), Ukraine (13.6%), Brazil (4.5%), and Iraq (4.5%). Over the last ten years, research articles on DI have only been cited 80, with the highest citation being 50, entitled “Universal design for learning and differentiated instruction in physical education.” The available articles also do not thoroughly and comprehensively discuss the importance of DI in PE, not least from the perspective of DI itself (content, process, product, and learning environment). Apart from that, Indonesian writers have not contributed optimally to DI title words in PE, so national collaboration and global collaboration are needed to provide a more clinical perspective on the success of DI implementation in various countries that have implemented it.

It is recommended that future researchers investigate various other potential DI studies in PE, such as teacher skills in implementing DI, teacher strategies in evaluating student learning outcomes based on DI, increasing student capacity including basic motor skills, increasing social skills, increasing life skills, increasing HOTS and other skills that support students to survive in real life. Finally, DI provides a pedagogical approach that encourages teachers to facilitate various strategies that prepare students to learn according to their needs. Some researchers may use different title words in expressing DI research. Therefore, DI investigations with more comprehensive title words will enrich the results of future investigations. The skill mastery or performance development of one student and another student is very different so that by carefully understanding and analyzing the performance standards that each student has (diagnostic assessment) and followed by the application and development of DI in PE helps teachers to maintain productivity and enthusiasm. Students are to continue to participate in solving the problem with their methods.

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