The Impact of Differentiation Methods (Content, Process, Product) of Differentiated Instruction on the Achievement and Perception of Students in Higher Education: A Meta-Analysis of Literature in Recent Ten Years (2015-2024)

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Abstract
Objective: A meta-analysis of implement different differentiation methods (content, process, product) of differentiated instruction in universities affects students' achievement and perception in the past decade further. **Methods**: In the databases of Eric, Web of Science, and Science Direct, relevant researches on differentiated instruction for university students were collected from January 1, 2015, to March 17, 2024. After screening, there were 21 articles recorded. Applying Review Manager 5.4 software and Stata 17.0 statistical software to research deviation risk testing and quality assessment of included articles. **Results**:Comparison of students' achievement and students' perception after the implementation of differentiated instruction and traditional teaching methods, differentiated instruction could significantly improve students' achievement and students' perception, and it had significant statistically difference(P< 0.001). In addition, product differentiation methods improved the students' achievement at the highest, and it had significant statistically difference(P< 0.001). Process differentiation methods improved students' achievement moderately, with statistical significance (P< 0.001). While content differentiation methods showed the lowest improvement on students' achievement, and the

difference emerged statistical significance(P< 0.001). **Conclusion**: Differentiated instruction can improve students' achievement and perception. Differentiated instruction method of product differentiation is better than content differentiation and process differentiation. Through meta-analysis, this study systematically measures the specific impact of differentiated instruction in different differentiation methods, aiming to accumulate relevant practice materials and provide systematic basis for the existing teaching reform.
Keywords: Differentiated Instruction, University, Meta Analysis, Achievement, Perception

Introduction

Every student in a class does not all have the same interests, abilities, and learning styles. Even in a classroom, students have different thinking processes, the perception of what is delivered, and the types of content is delivered. The traditional classroom teaching method usually adopts a one-size-fits-all teaching method, unified teaching materials, teaching syllabus and led by teachers, which makes the traditional teaching dissatisfaction satisfy the differences between students, leading to the unfairness of education. Therefore, differentiated instruction can be used as a way for teachers to provide guidance and track the progress of each student's teaching level to meet the differences of these students (Taylor, 2015).

Differentiated instruction lies in taking the difference between learners as a key factor in teaching teaching, According to the individual differences of learners, teachers should start from the differences in learning ability, learning interest, and learning habits among learners, By building diversity, to design different kinds of teaching objectives, Design of different forms of teaching content and teaching activities, And also the evaluation strategy, Using a flexible classroom grouping strategy, Create a harmonious and equal teaching environment, Comprehensive teaching that enables learners to independently select challenging learning objectives, contents, activity methods and achievement display forms under the guidance and help of teachers (Zelalem, 2022). Differentiation is a term used to describe how teachers respond to the needs of students through practical, active actions and combining differentiated instruction methods. Differentiation can provide fair learning opportunities for all students, including those defined as priority learners, as well as those with higher grades. The application of differential teaching in university classroom teaching mainly discusses the contribution of differential teaching in higher education guidance. Compared with traditional teaching, differentiated instruction can significantly improve students' achievement (Salameh, 2022). However, Need for further study to survey the impact on this this educational approach on students' academic success.

For the past several years, numerous studies have examined the impact of using tiered instruction at universities on students' self-efficacy. However, findings from these studies had both proactive and negative implications and were inconclusive.According to Li's study, the use of tiered instruction did not have an important impact on students' self-efficacy; however, according to Masoud's study, tiered instruction significantly increased students' self-efficacy, and the results of the two studies were inconsistent and even contradictory. (Li, 2022; Masoud, 2021). Therefore, for the systematic analysis about the impact of differentiated teaching on students is an urgent problem, this study is prepared to show that different ways of differentiation of differentiated teaching have different effects on students. This study fills the research gap in this field by classifying and summarizing the specific ways of

differentiating differentiated teaching and the resulting effects, looking for patterns, providing data support for the better application of differentiated teaching in higher education, maximizing students' performance and perception, helping to improve teaching practice, promoting the development of the educational field, promoting students' personal development, and forming a more equitable teaching environment.

In order to fully as well as logically understand the impact of different ways of differentiating differentiated instruction on students, this study used a systematic review as well as a meta-analysis research methodology related to the issue. A systematic review is a collection of past studies around a topic and these studies are analyzed for summary of results, bias testing, strength and consistency (Linnenluecke et al., 2020). A systematic review and meta-analysis of the impact of tiered teaching on students and synthesizes evidence from previous studies on related topics to provide a clearer, deeper, and more logical understanding of differentiated instruction.

There are few meta-analysis of differentiated instruction. Muh et al. (Muh, 2023), Sayed (Sayed, 2022) conducted a meta-analysis of differentiated instruction. They only studied the attitude and achievement of students implementing differentiated instruction in universities, which has some limitations. No mention has been made of the effects of different ways of differentiating differentiated instruction on student achievement and cognition.Therefore, this study uses bibliometric methods to examine the literature related to decades of differentiated instruction in universities, which will help researchers and educational practitioners to understand the current situation of differentiated instruction research from the perspective of different differentiation methods and guide their future work. By systematically understanding how differentiated instruction in different ways affects student achievement and perceptions, this study provides new perspectives and valuable insights for educators, researchers, and policymakers, with the potential to reshape differentiated instruction strategies to provide instructional strategies that are more capable of enhancing student achievement, which, in turn, can maximize student achievement and perceptions and promote equity in education.

In conclusion, The aim of this study was to direct a comprehensive and system review of effectiveness of tiered teaching and learning on student accomplishments and perception. It explores how different ways of differentiated differentiated instruction affect students differently and which ways of differentiating maximize impact on student learning outcomes. The specific questions of the study were as follows.
RQ:
1. How does the implementation of differentiated instructional strategies with different modes of differentiation (content, process, product) at colleges affect student academics? Are there differences in impacts across different differentiation approaches?
2. What is the impact of implementing differentiated instructional strategies with different differentiation styles (content, process, and product) at colleges on student perception?

Methodology
Literature Search Strategy
A meta-analytic approach was used in this study as it allows for the re-analysis and combination of data from a specific variety of studies, focusing on the collection and analysis

of numerical data to differentiate it from other research methods. （Kanadlı，2020）。The process and steps of the meta-analysis of student-differentiated pedagogy were as follows: topic selection, literature search, literature screening, topic identification, identification of research questions, data coding, data analysis, effect size calculations, heterogeneity testing, model selection, overall effect calculations, and interventions.

To include all relevant studies, the Eric, web of science, science direct database was used to collect the impact of differentiated instruction and other teaching at the university, from 1 January 2015 to 17 March 2024. References of the included articles were manually searched to supplement access to relevant articles. Retrieval words include: : differentiat* , "differentiat* instruct*" , "adapt* instruct*" , "individuali* instruct*" , "differentiat* learning" , "differentiat* practices", "adapt* education"。Below is the search formula of web of science:

TS=""differentiated instruction") OR TS=(differentiation) OR TS=("adaptive instruction") OR TS=("individual instruction ")OR TS=("adaptive education") OR TS=("differentiated learning") OR TS=("differentiated practices")
And
(((TI=(university)) OR TI=(college)) OR TI=(higher education))
As a result of the extensive literature in the Erich and science direct databases, both documents were screened for nearly a decade by explicit keywords.
Differentiation , "differentiation instruction" , "adaptive instruction" , "individual instruction" , "differentiation learning" , "differentiation practices" , "adaptive education"The combination of these keywords is that:university，college，higher education

Inclusion and Exclusion Criteria for The Literature
The initial search yielded 5676 articles. Documents were first included in accordance with the preliminary screening standard, yielding 787 articles. After evaluating the availability of abstracts and data according to the screening criteria in the second step, 21 articles were eventually selected. Table 2 shows the literature screening process.
The literature inclusion criteria are as follows:

Preliminary Screening
0. The article is not from January 1,2015 to March 16,2024
1 Screening is not for research on higher education
2. Screening studies were not conducted about students, excluding studies about teachers, administrators, etc.
3. Screout no quantitative studies, or not mentioned.
4.written not in English
5. Whether to repeat
6. The study is not about differentiated instruction
7. The research is not theoretical course experiments, but reviews, books, and extracurricular tutoring

Screening Inclusion criteria
0.The study explored the impact of differences on the accomplishment of college students in class (i. e., student achievement was not studied).

1.The intervention occurred in the classroom (i. e., not on the normal school day).
2.Each treatment group consisted of at least 15 students.
3.This study compared students who used the intervention in class to students who used another intervention or standard teaching practice ("Everything as usual") in the control class. Or this study conducts secondary data analysis of existing large-scale survey study data to enable group comparison of classes. Studies that had no control group were excluded.
4.The study provided pre-test data unless the study used a random assignment of at least 30 units (student, classroom, or school) and there was no indication of initial inequality.
5.Related measures include the achievement of quantitative measures, such as standardized reading measures. If it was a holistic measure of fairness in comparison group, the measures developed by the experimenter were accepted. Enough statistics are available to calculate the effect size.: n (sample size), sd (standard deviation), mean (mean)
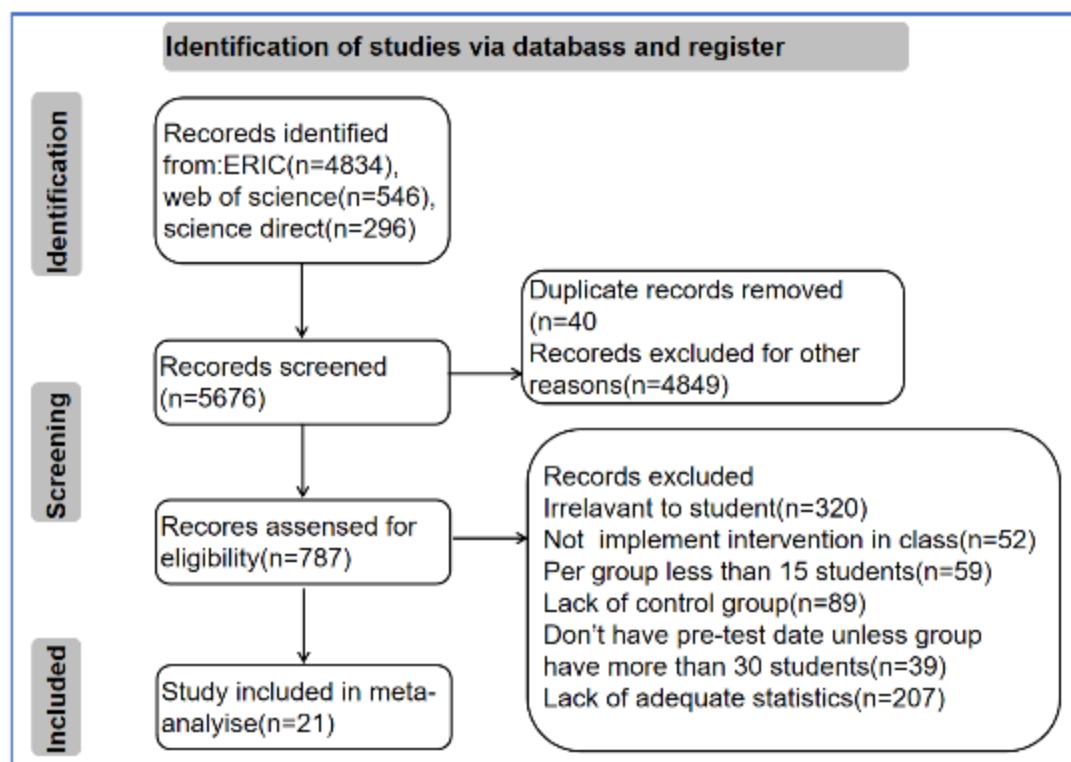

Figure1. Diagram of the literature inclusion process in meta-analysis

Data Extraction
Data for the features and included results of each literature were extracted and coded. The code of literature characteristics includes: author, sample size, country of the experiment, test volume, type of students, course name, specific implementation method, cycle, experiment or quasi-experiment. See table 1 for the specific code. The test volume is divided into two categories, namely 1. Students 'achievement includes composition achievement, GPA achievement, etc., 2. Students' perception includes self-efficacy, metacognition, emotion, etc.

Data Analysis
A meta-study is a statistical research method that enables a quantitative and comprehensive aggregation of data as well as a statistical synthesis of findings on the same issue.Meta-

studies get the effect size of the study by collecting the mean and the standard deviation of the studies. To analyze implication sizes, Cohen's d coefficient was used for the purpose of interpret the effect sizes, where the 0 to 0.20 interval was a weak effect, the 0.21 to 0.50 interval was a small effect, and between 0.51 and 1.00 or greater than 1.00 was a powerful effect (Cohen et al., 2007, p. 521).

Once influence sizes were calculated, the transdisciplinary analysis was initiated to reckon the total effect size through two models: fixed-effects and random-effects models.This examination used random-effects model (REM) in the meta-analysis because the heterogeneity analysis I-squared was greater than 50%, and takes into account the fact that research effects vary from one study to another. So the observed effect size was determined by the random effects model(Pigott, 2020) In addition, in the meta-analysis of these selected studies, a corrected measure of the standardized mean difference Hedge's g, known as Cohen's d, was used as the effect size of the differentiated instructional intervention.Hedge's g was calculated by entering the sample size and standard deviation of the posttest (or tracking measurement).

The heterogeneity test used the I^2 test when there was no heterogeneity of the results ($I^2 <$ 50%).If the results were heterogeneity (I 2> 50%,) or the total study sample size was small, the random effects model was addopted. The publication bias test plots were plotted from review manager5.4. Forest, funnel, sensitive plots were drawn, and all analyses were performed the use of integrated meta-analyses stata17 software.

Conclusion
Quality Analysis of the Literature Screening Process and the Included Literature
A total of 5676 articles were retrieved from three databases, respectively Eric, Web of Science, and Science Direct. Sum up to 787 literary works were obtained after the initial screening, and 21 English-language publications of randomized controlled trials met the criteria after the second screening (5,14-33).

Table 1
Studies Included in the Literature and their Key Elements

No	Study	n	Effect size	Country	Measure	Student	Subject	Process	During	Experimental type
1	Katherine 2022	58	0.44	United States	Academic achievement	Undergraduate	Language Science	Content differentiation. [illegible]	16 weeks	experimental design
2	Chen 2018	30	0.72	China Taiwan	Academic achievement	Undergraduate	Calculus	Content differentiation. [illegible]	16 weeks	quasi-experimental design
3	Christos 2020	50	0.75	Greece	Test score	Undergraduate	programming language course	Content differentiation. [illegible]	1 semester	experimental design
4	Maria 2016	200	0.28	German	Exam performance	Undergraduate	psychology	Content differentiation. [illegible]	16 weeks	quasi-experimental design
5	Li 2022	54	0.88	China	Test of Reading Comprehension	Undergraduate	L2 reading course	Process differentiation. [illegible]	16 weeks	quasi-experimental design
6	Masoud 2021	35	0.91	Iran	writing performance	Undergraduate	writing course	Process differentiation. [illegible]	1 semester	experimental design
7	Guilan 2023	57	1.21	Turkey	Learning Outcome	graduate students	Architectural and interior architecture education	Process differentiation. [illegible]	16 weeks	experimental design
8	Hanan 2020	24	0.44	Egypt	Grammatical knowledge test	apprehensive students	Writing IV	Process differentiation. [illegible]	12 weeks	experimental design
9	Moore 2018	35	0.44	United States	Test score	Undergraduate	Statics course	Process differentiation. [illegible]	a semester	experimental design
10	Deng 2020	52	0.58	China	Students translation competence	Undergraduate	Business English Translation Course	Process differentiation. [illegible]	16 weeks	experimental design
11	Maria 2019	37	0.33	Spain	Achievement	Undergraduate	unnamem	Process differentiation. [illegible]	16 weeks	experimental design
12	Seda 2021	46	0.25	unnamem	test score	Undergraduate	calculus course	Process differentiation. [illegible]	a semester	experimental design
13	Ana 2018	46	0.78	United States	test score	Undergraduate	biology course	Process differentiation. [illegible]	45 class hours/four weeks accelerated format	quasi-experimental design
14	Ana 2018	46	0.72	United States	test score	Undergraduate	biology course	Process differentiation. [illegible]	45 class hours/four weeks accelerated format	quasi-experimental design
15	Jeffrey 2021	125	0.65	United States	test score	Undergraduate	STEM courses	Process differentiation. [illegible]	16 weeks	experimental design

#	Author, Year	N	ES	Country	Outcome	Education level	Course	Description	Duration	Design
16	Andrew, 2017	54	2.43	United States	Academic Achievement	Undergraduate	Human Rights and Community-Organizing Course	Product differentiation.Assessment differentiation.An Adaptive Equity-Oriented Pedagogy.The instructors also incorporated an assessment-driven pedagogy to collect ungraded formative student-assessment data (i.e., weekly pre-tests and post-tests), survey data on student interests, and weekly anonymous course-feedback items.The key difference is that the instructors in the treatment used the student data and feed back to adjust instruction, whereas the same group of instructors in the control did not use data and feedback to improve instruction	a semester	experimental design
17	Ahmet, 2023	60	1.71	Turkey	writing test	Undergraduate	German IV course	Product differentiation.Collaborative writing instruction should be combined with metacognitive guidance in different learning contexts.Experimental Group-1 (on-CWI+MG) received collaborative writing instruction combined with metacognitive guidance synchronously via the BigBlueButton web conferencing system on the information management system designed for distance education programs of the university. Experimental Group-2 (f2f-CWI+MG) received the same curriculum face-to-face in a traditional classroom setting.In contrast, the students in the control group (i-WRITE) participated in in-class individual writing activities but did not receive metacognitive guidance;	16weeks	quasi-experimental design
18	Pava, 2017	35	0.86	Portugal	performance	Undergraduate	Course of Marketing	Product differentiation.Implementation and evaluation of a tutoring system (TS).TS consists on small self-spaced modularized units of educational contents, including tutorial videos, notes and formative t-assessment with personalized feedback. The TS ensures that the student is only allowed to proceed to the next unit after he or she achieves the required mastery criterion of the current unit.Product differentiation.In this study, the approach of designing and developing adaptive presentation techniques was made according to the ADDIE (Analysis, Design, Development, Implementation, Evaluation) model. In the analysis phase, the characteristics of the target students, knowledge and skills needed, general objectives, and the course content were analyzed and identified.	a semester	experimental design
19	Ahmed, 2020	35	1.79	Egypt	achievement	Undergraduate	Educational technology course	Product differentiation.Predict-observe-explain (POE) procedure as an effective strategy for eliciting and promoting discussions of students' science conceptions. This strategy involves students in predicting the results of an experiment demonstration, explaining their prediction, observing the demonstration, and finally explaining any discrepancies between their prediction and their observation.	a semester	quasi-experimental
20	Sevilay, 2015	20	1.52	unmention	MCT score	Undergraduate	Chemistry course	Product differentiation.Predict-observe-explain (POE) procedure as an effective strategy for eliciting and promoting discussions of students' science conceptions. This strategy involves students in predicting the results of an experiment demonstration, explaining their prediction, observing the demonstration, and finally explaining any discrepancies between their prediction and their observation.	3weeks	quasi-experimental design
21	Sevilay, 2015	20	1.61	unmention	OET score	Undergraduate	Chemistry course	Product differentiation.An approach that was unfamiliar to participants and thus potentially challenging.The instructional materials differed in format and source of content, that is, discrete pedagogical grammar rules for TI versus explanations and dia grams derived from cognitive linguistics for CBI.	3weeks	quasi-experimental design
22	Karen, 2021	21	1.88	The United Kingdom	test score	Undergraduate	Spanish courses	Product differentiation.Adaptive learning (ADDIE) Instructional Design Model: analysis, design, develop, implement, and evaluate. Te adaptive learning environment offers an interactive decentralized media environment that takes into account individual differences among students	unmention	quasi-experimental design
23	Hassan, 2021	60	1.02	Saudi Arabia	students'engagement(skills, participation,performance,emotional)	Undergraduate	English learning skills course	Process differentiation.A CALLA model.teacher-scaffolding was to develop the students' ability to use reading strategies independently.No explicit reading strategy instruction was provided to the students in the control group	a semester	quasi-experimental design
24	Li, 2022	54	2.65	China	Motivation	Undergraduate	L2 reading courses	Process differentiation.Wiki-mediated collaborative writing.the EFL students received wiki-mediated collaborative writing instruction, while in the control group the EFL students experienced face-to-face (non-wiki) collaborative writing instruction.	16weeks	quasi-experimental design
25	Masoud, 2021	35	1.88	Iran	writing self-regulation	Undergraduate	Writing course	Process differentiation.Wiki-mediated collaborative writing.the EFL students received wiki-mediated collaborative writing instruction, while in the control group the EFL students experienced face-to-face (non-wiki) collaborative writing instruction.	1 semester	experimental design
26	Masoud, 2021	35	1.01	Iran	Writing self-efficacy	Undergraduate	Writing course	Process differentiation.Wiki-mediated collaborative writing.the EFL students received wiki-mediated collaborative writing instruction, while in the control group the EFL students experienced face-to-face (non-wiki) collaborative writing instruction.	1 semester	experimental design
27	Hanan, 2021	22	1.36	Egypt	Apprehensive	apprehensive students	Writing IV	Process differentiation.Automated writing evaluation (hereafter AWE) As participants in the experimental group received focused training on the use of AWE in class. The control group had an instructor evaluate their essays	12weeks	experimental design

Overview of Primary Studies
Screening based on the inclusion criteria yielded 21 pieces of literature, and the researchers obtained 27 independent samples from the primary studies in the 21 pieces of literature. Table 1 summarizes key information from this literature, comprising the author and year of publication of the paper, number of experimental samples, effect size (g), country, sample size, measured variable, type of student, name of the program, implementation process, period. As can be seen from the data in Table 1 the effect sizes of the effects of different differentiated instructional differentiation methods on students' achievement and perceptions varied, all of which indicate differences in the results of the various studies. Analysis of these 27 data shows that most of the studies focused on achievement checks, including various types of exams (81.48%), while the least number of studies examined students' perceived categories, including self-efficacy, feelings, etc(18.52%). In addition, when considering the distribution of subject-based studies, the proportion of language subjects including English, Spanish and German was the highest (44.44%), that of science and engineering subjects including computing and C language was the highest (37.04%), while that of humanities and social sciences was the lowest (14.81%).

Main Analysis Results
Heterogeneity Analysis of the Included Studies
Random effects model was used to analyze 22 studies on the effect of implementing differentiated instruction with different differentiation methods on student achievement, as shown in Figure 2, and it was found that the mean effect size of the 22 out of 27 studies on student achievement was 0.98 (p < . 001). And the 95% confidence intervals interval of 0.73-1.23. These results indicate that the implementation of differentiated instruction has a significant impact on students' academic achievement compared to traditional teacher-centered teaching methods. Effect sizes large than 0.8 are in the large effect size class, as defined by Cohen (1998). Consequently, the positive influence of implementing differentiated instruction in university on stuedents achievement and in contrast with other instructional strategys in the high effect size class for this impact effect. The research also showed that there was heterogeneity in effect sizes among the 22 studies and the difference was statistically significant I^2 = 86.2%, p < 0. 001. I^2 was greater than 50%, and therefore a subgroup analysis was performed for achievement-related studies. Subgroup analysis was conducted according to the differentiated instruction differentiation method (content, process, product).There was a heterogeneity in the effect size of the content differentiation of the differentiated instruction part of the study: I^2 =45.6%, p <. 001, where I^2 is less than 50% heterogeneity was acceptable.There was a heterogeneity in the effect size of the process differentiation of the differentiated instruction part of the study: I^2 =37.1%, p <. 001, where I^2 is less than 50% heterogeneity was acceptable. The difference in the product of the study I^2 =43.9%, p <. 001, where I^2 with less than 50% heterogeneity is acceptable. These results indicate that the 22 studies on achievement, and that heterogeneity are acceptable after subgroup analysis, which emphasize the need for subgroup analysis.

Subgroup analysis meta-regression results and regression bubble plots are shown in Table 2, p <. 001 shows a significant difference in the effect size between these three subgroups. Results of the highest improvement after product differentiation methods effect size=0.982,95%CI 0.734 to 1,231, z= 12.07, P <0.001. Process differentiation improved students' academic achievement moderately effect size=0.679,95%CI ranged from 0.516 to

0.842, z=8.16, P <0.001. The lowest improvement of students' academic achievement was effect size=0.485,95%CI was 0.238 to 0.732, z= 3.84, P <0.001.

For the five studies analyzed by random effect model in Figure 3. Forest plot of student perception.Of the 27 study types, five of these studies were on the effects of implementing differentiated instruction in university on student perceptions. And these five studies had a mean effect size of 1.58 (p< 0. 001) and 95% confidence intervals scope includes 0.93-2.23. I^2 =87.5%,p<. 001. I^2 was greater than 50%, using a random effects model. It shows that the amount of statistics is statistically significant, that is, the students' perception after implementing differentiated instruction is significantly different compared with other teaching.

Assessing Publication Bias
These 27 items on the impact of differentiated instruction on student achievement and perceptions and perceptions of publication bias were assessed based on funnel plot results and the study's fail-safe N-value.

The results of the funnel diagram appear that all effect size plots are essentially symmetric,as shown in Figure 4.Most of the studies were distributed in the middle of the funnel map and concentrated in the middle, indicating that the possibility of publication bias was small, but some literature had potential bias, and the potential bias may be due to the lack of strictly qualified treatment measures of the control group adopted in the included literature.The data used in this study showed no publication bias. When the fail-safe N(Nfs) is greater than to 5K + 10 , K is the number of individual studies, It dose not have publication bias at this point in this meta-analysis.And larger Nfs indicate that the results of the Meta-analysis are more stable and the conclusions are less likely to be overturned (Ahn, 2018). In this study, z = 8.69 and K equals 27, which is calculated as 5* (27) + 10 = 145. The Nfs value of this study is 2405. Especially when the N value is significantly greater than "5k + 10", it indicates that the reliability of Meta-analysis results is good, the possibility of being overturned is small, and the conclusion is not affected by publication bias.

Table 2

Results of Subgroup Analysis Meta-Regression Analysis and Bubble Plots for 22 Items of Data on Student Achievement

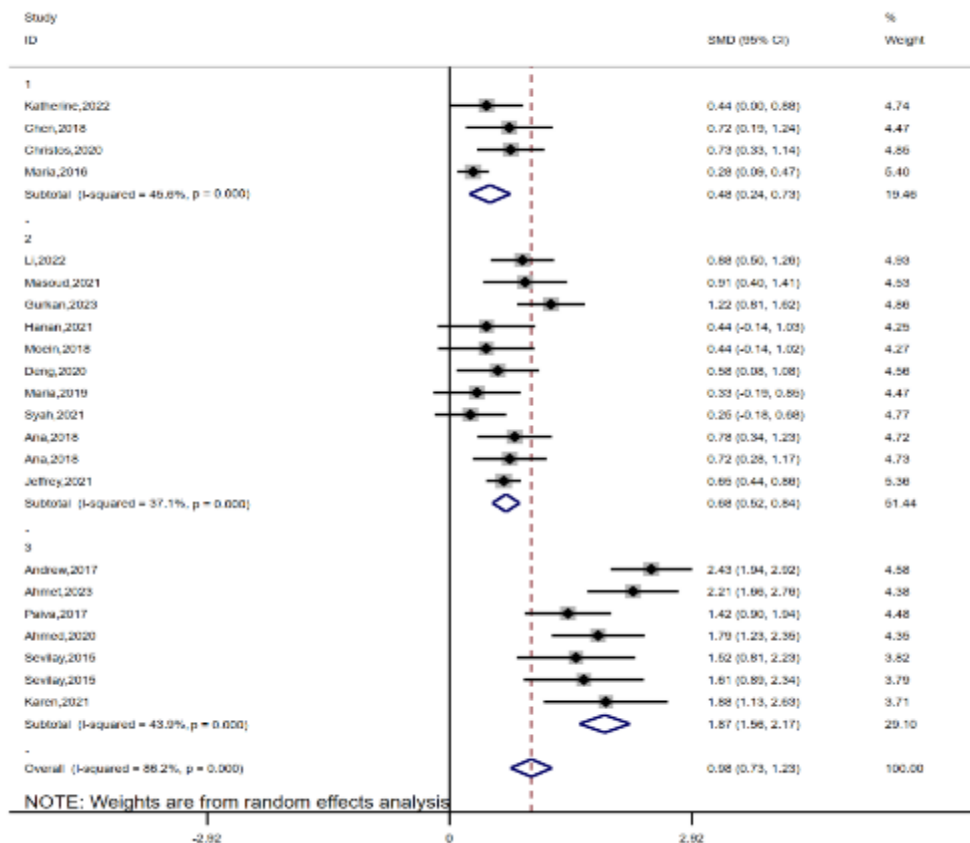| _ES	Coefficient	Std. err.	t	P>|t|	[95% conf. interval]	
group	.701899	.1258612	5.58	0.000	.4393572	.9644408
_cons	-.4897912	.2725041	-1.80	0.087	-1.058225	.0786423
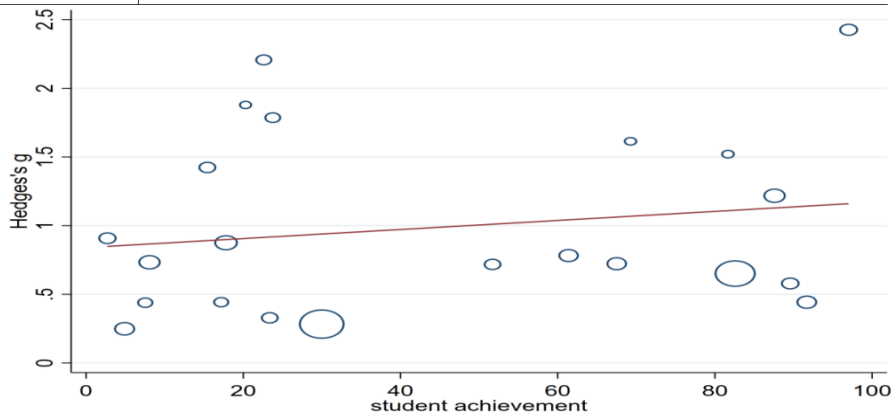
Figure 2. Forest plot of 22 studies related to students' achievement.
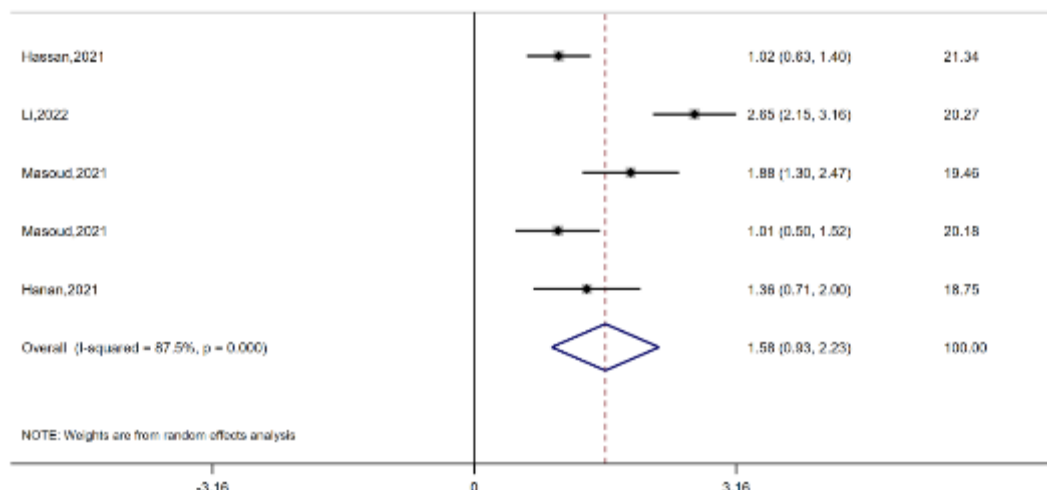
Figure 3. Forest plot of 5 studies related tostudents' perception.
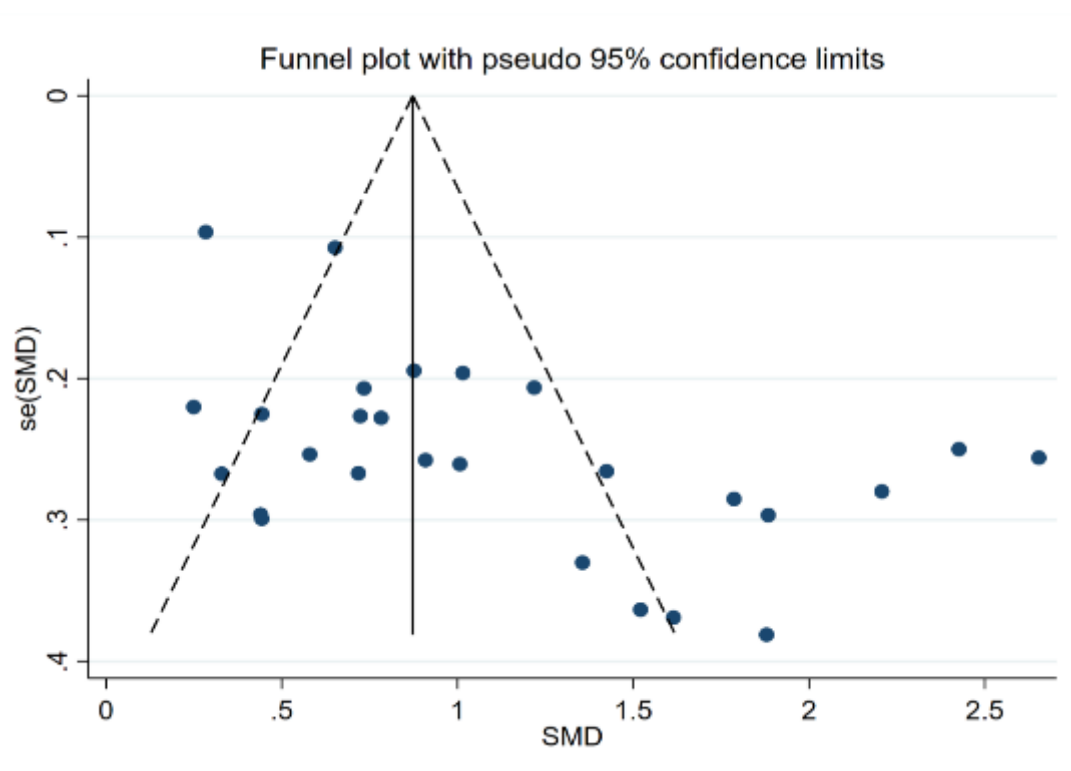
Figure 4. Funnel plot

Discuss

This meta-analysis examined relevant studies on the impact of differentiated instruction implementation in universities during the approximate decade from 2015 to 2024. Research has shown that differentiated instruction leads to more active engagement in learning and improves the quality of learning, academic performance, self-efficacy, motivation, metacognition, and self-confidence.

Of the 27 studies that examined the effects of implementing differentiated pedagogies on academic achievement and cognition at the university level. 48% utilized an experimental

design and 52% utilized a quasi-experimental design. Participants in only one study were graduate students; the rest were undergraduates.22% of study conducted in the Americas, 22% in Asia, 19% in Europe, 22% in Africa, 15% in countries, and many to account for student needs, preferences, and interests and their level of understanding that may help to improve their academic achievement (Hayder, 2022). Through a meta-analysis of the effect sizes of these studies on student academic achievement and perception of 27 studies, 6 effects were small, 9 moderate and 12 strong, and the mean effect size favored the experimental group.

Common findings from 22 of all 27 studies on student achievement suggest that implementing differentiated instruction enhances student academic achievement compared to other instructional methods.This result is using differentiated instruction in the instructional tackle of teaching and learning by the teachers, which can build on student learning and meet the needs of different students, thereby achieving enhancement. Differentiated instruction emphasizes the identification and discovery of student differences and the development of appropriate instructional practices based on the individual differences of different students, thereby increasing student engagement and motivation and achieving gains in their knowledge. Relevant studies have shown that differentiation of instruction improves student participate in class, locomotive, comprehension, study skills, and finally raises learning achievement (Moein, 2018; Paiva, 2017).

Common findings from five of all 27 studies illustrate that implementing differentiated instruction makes a positive impact on perception as compared to other teaching modalities. Student perceptions in this study included self-efficacy, self-regulation, emotion, motivation, metacognition, sense of participation, etc. These factors are considered to contribute to student achievement improvement (Su, 2019; Su 2018). A key factor to consider in teaching is the knowledge of student behaviors and beliefs, such as student self-regulation and self-efficacy. Affect refers to how learners feel about learning during the learning process, such as how eager you are to learn. Engagement refers to the classroom participation behaviors of students during the class, such as answering teacher questions, chatting, discussing, and cooperating with the classroom to complete the lesson. Student engagement is generated through personal attitudes, thoughts, behaviors, and interactions with others about learning.In study, desire, emotion and emotion reach a certain level. Therefore, teachers need to have a certain control over the students' thoughts and attitudes, to grasp the students' attitudes towards learning, attitudes towards the class, attitudes towards teaching methods, attitudes towards the teacher and so on. Masoud uses collaborative writing as an instructional method to improve students' foundational skills in writing, self-regulation skills in writing, and self-efficacy (Masoud, 2021). By designing an adaptive teaching based on an e-learning environment, this pedagogy helps to individual instruction to adress the individual demands of undergraduate, thus enhancing learning. Hassn's findings showed that students in the experimental group were significantly more emotional and interactive than the control group after differentiated instruction (Hassan, 2021).

The effect of implement differentiation of instruction strategies on undergraduate performance is significantly different in effect size. This may be because of the different focus of differentiation methods in the development of teaching strategies and the degree of meeting the needs of students. Product differentiation by results have feedback lines that focus on evaluation, feedback and re-adjustment. Short-term evaluation can quickly find out

the problems of teaching strategies and the existing problems and needs of students, and make adjustments, to adreese the diversity demands of undergraduate and improve students' achievement. In Sevilay et al., they explored the effect of using the predictive-observation-interpretation (POE) strategy. The experimental group was treated with POE, statistically significant difference between EG scores and posttest scores. This differentiated instruction of the POE task can help students explore and justify their personal ideas, especially during the prediction and reasoning phases, which can increase student engagement. When in the observation period of the POE task, students have the opportunity to rework their learning understanding and change their early established ideas if their early predictions do not match their early predictions (Sevilay, 2015).The TS system designed by Paiva et al. is a personalized instructional system for a mastery learning pedagogy. Includes class chapter video tutorials, class notes and develop e-assessments with personalized feedback that incorporates individual student characteristics. Students are allowed to study later chapters only after completing tasks in earlier chapters and meeting mastery standards for earlier chapters. Significantly improved student achievement and engagement after being taught through this method (Paiva, 2017).

Differentiated instruction through process differentiation focuses on the implementation of the classroom process. This differentiation method can enhance students 'interest, enhance students' participation in class, and take care of students with different learning levels. Therefore, this learning strategy can improve academic achievement. Maria (Maria, 2016) noted in her study that students with lower academic competence need to further support the application of effective learning strategies. Ana et al. show that in a differentiated instruction classroom, the strategy of process differentiation is that teachers strive to create activities that can improve students' learning ability, create more classroom learning time, and transfer some content to students through the use of short teaching videos. This process of differentiated instruction method, can significantly improve the low level of student achievement.

The differentiated instruction of content differentiation will allocate the corresponding learning content according to the foundation of students, so as to promote students 'participation, so as to achieve the level of equal education, and thus improve students' achievement. Christos et al. designed the system to convert students 'knowledge level to fuzzy weights, and use rule-based decisions to provide sufficient learning activity regarding their type and complexity, improve student-centered learning, improve knowledge acquisition, and significantly improve students' learning effect.

This paper uses a meta-analytic research approach to explore the effect of differentiation of instruction differentiation methods on undergraduate achievement and cognition at the university level, and the findings provide an important theoretical contribution.This study provides conclusive empirical evidence that the carry out of differentiated instruction significantly improves undergraduate academic achievement and student perceptions when compared to traditional or other non-differentiated instructional methods. These findings favor concepts and methodologies about differentiated instruction. In addition, content, process, and outcomes were included through the analysis of different ways of differentiating differentiated instruction. In this study, it was found that all the different differentiation methods had a significant effect on student achievement and that outcome differentiation

had the most significant increase in student achievement, process differentiation had a moderate increase, and content differentiation had a low increase. Through a more systematic and logical understanding of the implementation of differentiated instruction in the university classroom, these findings contribute to the development of differentiated instruction and the development of more effective differentiated instructional strategies. Teachers can refer to the degree of impact of different differentiated instruction on students when designing and implementing differentiated instruction, and develop more inclusive instructional strategies that are more in line with the individual needs of the students, so as to more dramatically Improve student achievement and perceptions, and thus achieve equity in teaching and learning.

Conclusion

With the development of society, the diversity of students increases, so there is a lot of attention on differentiated instruction to meet the needs of different students and achieve more equitable education. In addition, the rapid development of society needs a large number of high-quality talents, and colleges and universities are important places to train high-quality and high-level talents, so improving the teaching quality of colleges and universities is the primary task of college education and teaching reform.However, the systematic summary of differential teaching in universities is still very limited. In recent years, colleges and universities have implemented some differentiated instruction measures to improve students' level and perception, but these studies have different effects on the implementation results. Through meta analysis, this study conducted an in-depth discussion of the research on the implementation of differentiated instruction in universities in the past decade from the three aspects of differentiation of teaching strategies (content, process and result). The results show that different differentiation methods (content, process and result) in differentiated instruction strategies in universities have different effects, and differentiated instruction can significantly improve students' achievement and perception. The result of this study is conducive to improving the teaching effect and the theoretical level of college teachers.

The theoretical contribution of this study is as follows: (1) It plays an important role in enriching the differentiated instruction theory and professional development of university teachers. (2) It plays a positive reference role in broadening the research horizon of contemporary university curriculum and teaching theory. (3) A relatively systematic university differentiated instruction theory system has been initially formed. The contextual contribution of this research is reflected in the following aspects: (1) The research on differentiated instruction in this paper provides university teachers with reasonable differentiated instruction according to the difference of students' learning level, and provides university teachers with implementation examples of differentiated instruction. (2) Implementing differentiated instruction in college teaching based on the effective teaching concept proposed in this paper emphasizes the importance of outcome differentiation, which can provide reference paths for college teachers when designing differentiated instruction strategies.

Limitation

This study conducted a meta-study of papers on the implementation of differentiated instruction at the university between January 1, 2015, to March 17, 2024 to examine the

impact of differentiated pedagogy on students' academic achievement and cognition.Because the included literature has a little impact on perceived aspects, I think this is where the study is limited.

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