SOCIAL SCIENCE REVIEW ARCHIVES
ISSN Online: 3006-4708
ISSN Print: 3006-4694
https://policyjournalofms.com

A Comparative Analysis of the Steam-Based National Curriculum (2022–23) and the 2006 Curriculum for College-Level Physics in Pakistan

Dr. Muhammad khan[1], Dr. Farkhanda Rasheed Choudhary[2]

[1] FG Degree College Attock, Pakistan, Email: hashirdanial@yahoo.com

[2] Allama Iqbal Open University, Islamabad, Pakistan, Email: farkhunda.rasheed@aiou.edu.pk

DOI: https://doi.org/10.70670/sra.v3i1.609

Abstract

The concept of Science, Technology, Engineering, the Arts, and Mathematics (STEAM) provides a framework for structuring science education by integrating core disciplinary knowledge with interdisciplinary themes. In Pakistan, the National Curriculum 2022–23, designed using the STEAM framework, has replaced the 2006 curriculum. This study compares the National Curriculum (2022–23) with the 2006 Curriculum for college-level physics, focusing on dimensions such as content organization, relevance to current and future needs, hands-on activities, student engagement, flexibility, and resource requirements. It is a mixed method approach where both qualitative and quantitative data were collected. A survey involving 50 college-level physics teachers used a 5-point Likert scale questionnaire to gather feedback. Semi structured interviews were conducted for in-depth analysis of the various dimensions of curriculum. Results indicated that the National curriculum (2022–23) outperformed the 2006 Curriculum in flexibility, student engagement, and relevance, while the 2006 curriculum was rated higher in content organization. It is recommended to revise the content and organization of the 2022–23 National curriculum to address this gap and include foundational knowledge at college level.

Key words: STEAM, Curriculum, Content Organization, Hands-on Activities, Resource Requirement

Introduction

Science is the study of daily life experiences. It is the way of knowing and is the use of evidences to construct testable explanations of natural phenomena. Teaching science develop logical reasoning, curiosity, critical sense, thinking skills, and the ability to acquire new knowledge with the help of science and technology. Learning science enables students to address science and technology related issues concerning social, economic, environmental and ethical aspects and prepare students for science related occupations (khan, 2021). Teaching science at school level aims at developing cognitive, affective and psychomotor skills in students necessary for studying science subjects at higher level and practical life ahead. After 8th grade different braches of science are taught as a separate subject. Mainly, these include Physics, Chemistry, Biology. Curriculum of these subjects used to be changed in past with claim that the new curriculum would address the requirement of the new era. The New and Old Curricula: The old curriculum refers to the curriculum 2006 which was adopted from academic year 2010-11(Jamil, 2009). The Old curriculum was significantly different to its predecessor, promising greater accessibility and engagement. The aims of old curriculum 2006 were to develop the habit of scientific thinking, an attitude to search symmetry and order in diverse natural phenomena, strengthen the already learned concept, an effective problem solver, productive citizens and a lifelong learner, in a technological world, understand the problems associated with the over exploitation of the environmental resources and disturbance because of the human activities in the ecological balance and , thus taking care of the environment (khan, 2021). To develop skills of reasoning, applications, analysis, synthesis and evaluation topics related to ‘science, technology and society connections were also included. The new curriculum 2022-23 was based on the Next Generation Science Standards (NGSS). The primary focus of the new curriculum is on performance, foundation and coherence. Coherence. Efforts have been made to provide the connection of the performance expectations to other ideas within the disciplines of science, engineering, technology and with standards in Arts, mathematics and language. STEAM (science, technology, engineering, arts and Mathematics) education helps developing problem solving and creative skills. The framework of the new curriculum2022-23 was adapted from the framework of the Next Generation Science Standards (NGSS). This framework consists of three dimensions namely (i) a science or engineering practice (ii) a core disciplinary idea, and (iii) a crosscutting concept. The present study aims to compare the old and new curriculum on various dimensions. The study was delimited to the comparison of old curriculum 2006 and new curriculum 2022-23 for grades XI-XII Physics

Literature Review

Although teaching of science was introduced at higher secondary level in Pakistan even before 1950s, more determined curriculum reforms were initiated in the 1970s when practical work was first introduced at school and college level (Halai, 2008). In 1972 the new education policy emphasized scientific education at school and college levels. But the quality of science teaching could not be improved due to certain factors like shortage of science teachers. The first National Curriculum was developed in 1975-76. In 1979 governmental education policy highlighted the importance of science teachers and the Institute for the Promotion of Science Education and Training (IPSET) was established for on-job training of science teachers. The curriculum was reviewed in 1984-85 and then in 1994-95. The next review took place in the years 2000. In 2002, Higher Education Commission was established but the focus was only higher education and science at schools and higher secondary schools were totally ignored. The need for a new curriculum was felt and in 2006, national curriculum was formed and practically implemented (Dilshad et al., 2023).

Salient features of old Curriculum 2006

Curriculum 2006 was introduced after realizing that revised curriculum 2000 failed to help students achieve to their maximum abilities (Governamnet of Paksitan, 2006). Old curriculum 2006 was drafted after examining field study reports and critical review of existing curriculum. Likewise, comparative studies were carried out with international curricula. Specially, Physics curriculum of GCE “A” Level University of Cambridge, South Australia Certificate of Education Physics Curriculum, Physics Curriculum Secondary Level, Hong Kong, Physics, California State Board of Education, U.S.A., Physics Curriculum Guidelines of Ontario, Canada, 2006 and New South Wales Australia Physics Curriculum 2002. Ten well-reputed international curricula were downloaded for careful consultation. In order to stress the significance of higher order skills students learning outcomes (SLOs) have been used throughout. Laboratory process skills under the subhead “skills” were expected to be developed through related investigations, practical work and activities. Similarly, “science, technology and society connections” were also provided to provide connection of bookish knowledge with students’ daily life experiences. It means the Old Curriculum 2006 was crafted very carefully, keeping the existing international standards in mind.

Standards, Benchmarks, and Learning Outcomes constituted the old curriculum 2006 to monitor the students learning. Standards were based on the Higher Order Thinking (HOT), Deep Knowledge (DK), Substantive Conversation (SC) and connections to the World Beyond the Classroom.

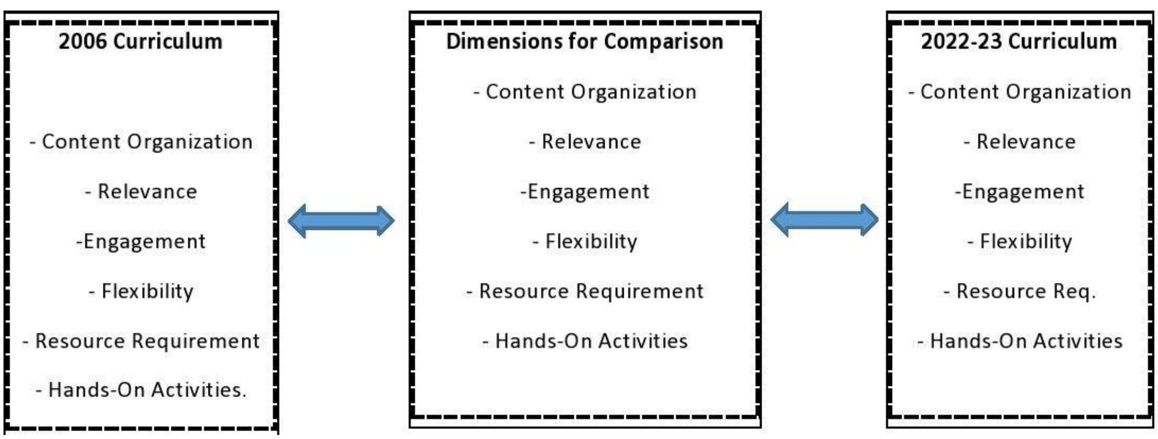
Table 1: Compares the two syllabuses along a number of dimensions.

Dimension	2006 Curriculum (Old Syllabus)	New Syllabus 2022- 23 (new Syllabus)
Organization and Topics	The Module includes 20 chapters. In Physics Textbook XI, Chapters related to vectors, mechanics, fluid dynamics, waves and circular motion, sound, Physical optics, heat and thermodynamics were included whereas in Physics Textbook XII, chapters include electrostatics, current electricity, electromagnetism, electromagnetic induction, AC current, physics of solids, electronics, modern physics, atomic physics and nuclear physics.	The module consists of 08 domains namely measurement, mechanics, heat & thermodynamics, waves, electricity & magnetism, modern physics, nature of science experimental skills. Both 1st year and 2nd year include chapters related to these themes.
Point of difference	Focus on the content knowledge and its understanding	Focus on students' performance
STEAM Approach	Limited information was given separately in small boxes with heading 'For your information'. This information is related to practical applications of the concept being taught. 'Science, Technology and Society Connection' was provided.	The study of Physics has been based on the concept of STEAM and divided into disciplinary knowledge and cross-cutting themes (STEAM). Cross-cutting themes have been incorporated in different units of textbook developed by national Book Foundation, Pakistan.
Assessment	Externally administered assessment which contains a mixture of MCQs, short questions answers and longer response questions.	Externally administered assessment which contains a mixture of MCQs, short questions answers and longer response questions. Both formative and summative assessments are involved. SLOs related to Formative assessments will be taught in the class, assessed by the class teacher. Formative assessment has no weight in the final grading and evaluation of the students. Some SLOs are not compulsory for students because they are out of scope of the grade. The content related to these SLOS is optional.

Salient Features of the New Curriculum 2022-23

The National Curriculum 2022-23, commonly referred to as the New Curriculum 2022-23, is designed to align with global standards and benchmarks while addressing the social, religious, and economic needs of students. Its primary aim is to promote concept-based learning, with a strong emphasis on student performance. In this curriculum, the study of physics is divided into two key components: core disciplinary knowledge and cross-cutting themes. Core disciplinary knowledge encompasses the essential subject-specific content required for students to achieve academic success. Cross-cutting themes, on the other hand, provide interdisciplinary connections and intellectual tools that link diverse areas of subject matter, enhancing the understanding of core ideas (Roemmele & Criswell, 2023). These themes are aligned with educational standards and have been thoughtfully integrated into the textbooks. The New Curriculum 2022-23 is rooted in the STEAM (Science, Technology, Engineering, Arts, and Mathematics) framework and is adapted from the Next Generation Science Standards (NGSS). The NGSS are articulated as "Performance Expectations," which define the abilities learners are expected to demonstrate in science (Krajcik et al., 2014). Unlike the 2006 curriculum, the 2022-23 curriculum assumes that learners already possess the foundational knowledge required for specific concepts at their grade level and can apply this knowledge effectively. As a result, content and related Student Learning Outcomes (SLOs) from previous grades are not repeated. Textbook publishers have been granted the flexibility to organize content in a manner they deem appropriate, provided they cover the required learning outcomes outlined in the cross-cutting themes and curriculum progression grid. For instance, Cantab Publisher, Lahore, structured the Physics-11 textbook into 13 chapters, placing "Fluid Mechanics" as Chapter 7. In contrast, the National Book Foundation organized the same content into 14 chapters, positioning "Fluid Mechanics" as Chapter 6. Additionally, the Nature of Science (NOS) learning outcomes have been incorporated for students in grades 9, 10, and 12. These NOS SLOs often begin with the phrase "explain with examples." The assessment of NOS in standardized board exams will focus on objective knowledge, evaluated through multiple-choice questions (MCQs) or short-answer questions requiring 2-3 line responses (National Curriculum of Pakistan for Physics, 2024).

Conceptual Framework of the study



Hypotheses:

H_0: There is no significant difference in respondents' perceptions of the content organization between the 2006 curriculum and the 2022-23 curriculum. H_0: There is no significant difference in respondents' perceptions of the relevance to practical life between the 2006 curriculum and the 2022-23 curriculum.

H_0: There is no significant difference in respondents' perceptions of student engagement between the 2006 curriculum and the 2022-23 curriculum.

H_0: There is no significant difference in respondents' perceptions of flexibility between the 2006 curriculum and the 2022-23 curriculum.

H_0: There is no significant difference in respondents' perceptions of resource requirements between the 2006 curriculum and the 2022-23 curriculum.

H_0: There is no significant difference in respondents' perceptions of hands-on activities between the 2006 curriculum and the 2022-23 curriculum.

Methodology

This study employed a mixed-method approach, combining both quantitative and qualitative data collection techniques. Data was gathered through a 5-point Likert scale survey and in-depth interviews. The survey questionnaire was carefully developed, validated, and disseminated to respondents via Google Forms. It comprised six key dimensions: (1) quality of content and its organization, (2) relevance of the content to students' practical lives, (3) student engagement, (4) flexibility, (5) resource requirements, and (6) provision of hands-on activities. The study targeted physics teachers from colleges affiliated with the Federal Board of Intermediate and Secondary Education (FBISE), Pakistan. A total of 50 physics teachers participated in the survey, including 35 female professors and 15 male professors. The ratio of private to public sector teachers was 55:45. Most respondents had over 6 years of teaching experience, and all had experience teaching both the current (2022–23) and previous (2006) syllabi at the college level. The textbooks analyzed for comparison were those published by the National Book Foundation, Pakistan, and the Khyber Pakhtunkhwa Textbook Board (KPTBB). Additionally, five senior professors were interviewed to gain deeper insights into the curriculum's effectiveness

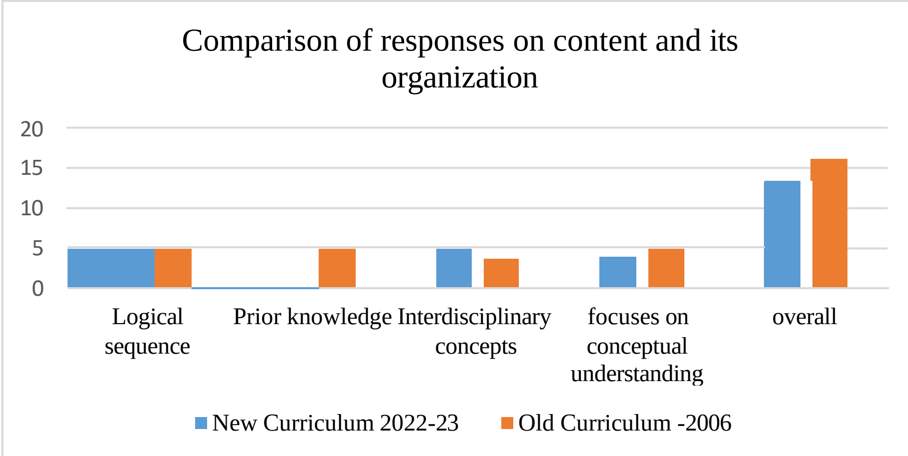
Results

Content and its organization

Table 2: *Comparison of responses on the content and its organization*

Dimension	t-test for Equality of Means						
	t(50)	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference Lower	Upper
Content and its organization	9.110	98	.000	1.820	.19978	2.216	-1.424

As indicated in table 2, there was statistically significant difference between the means of the respondents t(98)= 9.110, *p*= .000 regarding the content and its organization of the 2006 curriculum and curriculum 2022-23. It means the 2006 curriculum was better in content and its organization.



According to most respondents, the new curriculum demonstrates a stronger interdisciplinary approach. However, the old curriculum excels in maintaining a logical sequence and effectively addressing prior knowledge. Overall, the 2006 curriculum was considered superior in both content and organization

Table 3: *Comparison of responses on the Relevance of curriculum to practical life*

	t-test for Equality of Means						
						95% Confidence Interval of the Difference	
Dimension	t(98)	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Relevancy	9.110	98	.000	1.820	.199	2.216	1.424

As indicated in table 3, there was statistically significant difference between the means of the respondents t(98)= 9.110, p= .000 regarding the relevance of 2006 curriculum and curriculum 2022-23. It means the new curriculum 2022-23 was better in relevance.

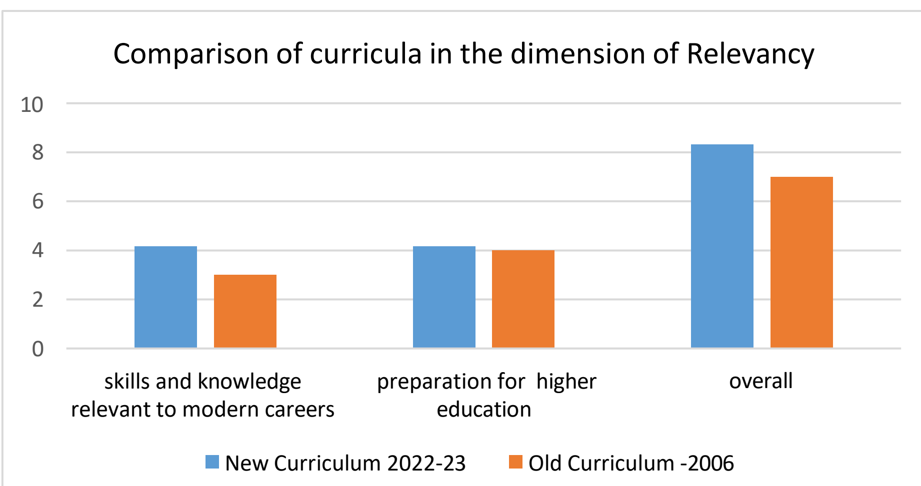


Table 4: *Comparison of responses on the students' engagement*

Dimension	t-test for Equality of Means						
						95% Confidence Interval of the Difference	
	t(98)	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Students Engagement	13.773	98	.000	2.18000	.15828	1.86590	2.49410

As indicated in table 4, there was statistically significant difference between the means of the respondents t(98)= 13.773 *p*= .000 regarding the students engagement. It means the new curriculum 2022-23 engaged students than 2006 curriculum.

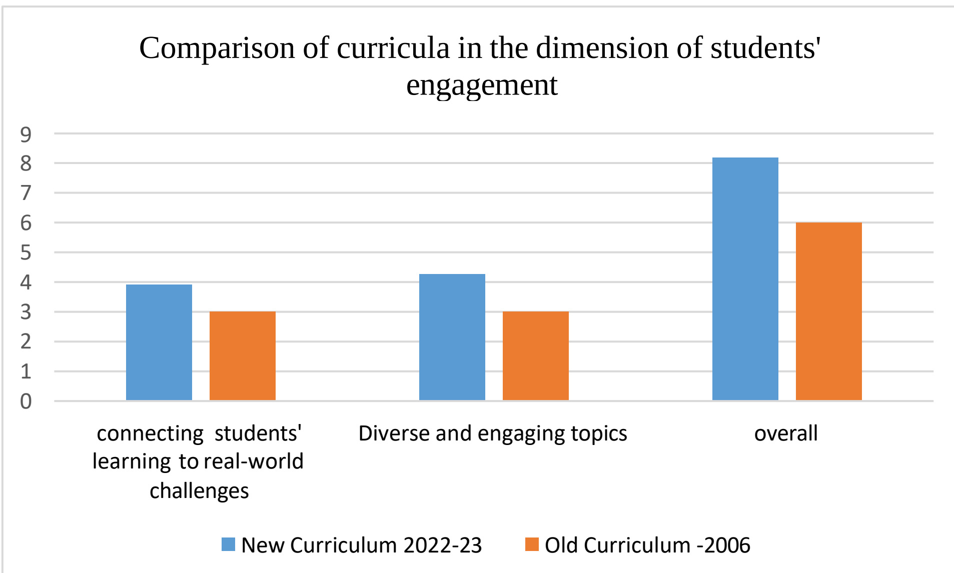
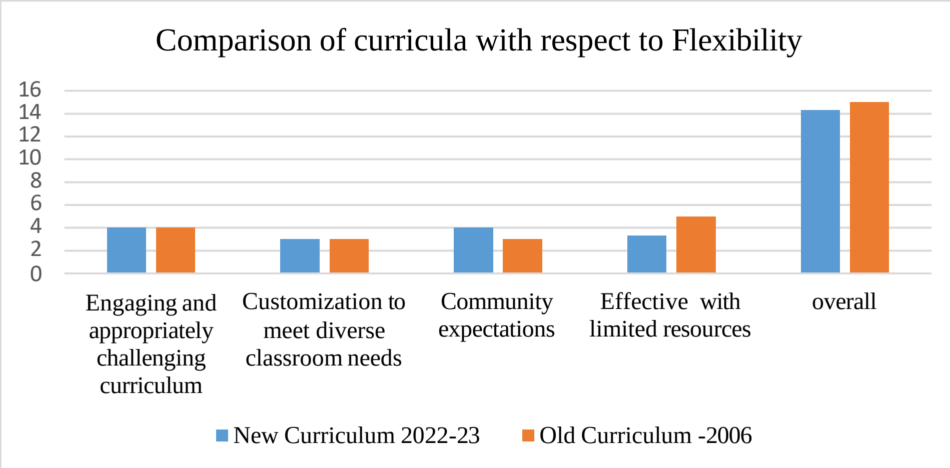


Table 5: *Comparison of responses on the flexibility of the curriculum*

Dimension	t-test for Equality of Means						
						95% Confidence Interval of the Difference	
	t(98)	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Flexibility	7.304	98	.000	.700	.09583	.890	.510

As indicated in table 5, there was statistically significant difference between the means of the respondents t(98)= 7.304 *p*= .000 regarding the students engagement. It means the new curriculum 2022-23 engaged students than 2006 curriculum.

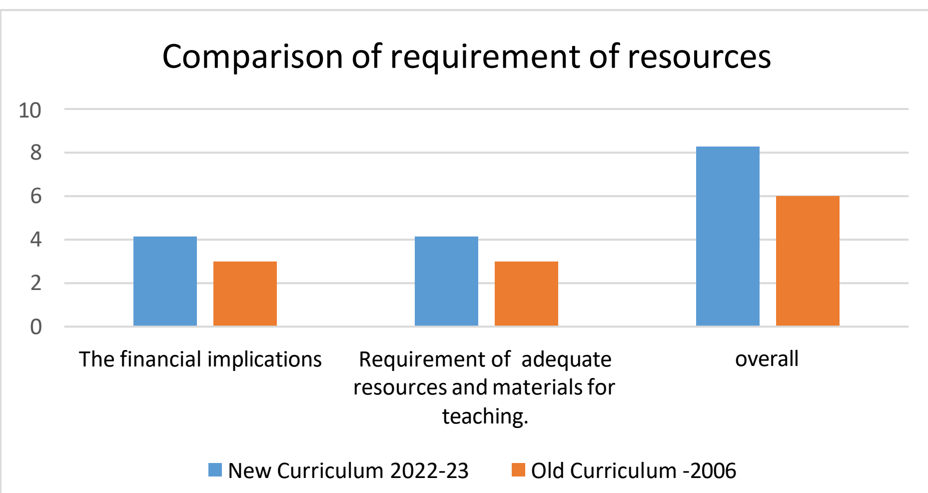


Respondents expressed that the new curriculum (2022–23) better addresses community expectations compared to the old curriculum (2006). Additionally, the new curriculum is more effective in meeting the diverse needs of modern classrooms. However, the old curriculum (2006) was deemed more effective and better suited for environments with limited resources.

Table 6: *Comparison of responses on the resource requirement*

	t-test for Equality of Means						
			Sig.			95% Confidence Interval of the Difference	
Dimension	t (98)	df	(2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Resource requirement	22.346	98	.000	2.260	.101	2.059	2.46

As indicated in table 5, there was a statistically significant difference between the means of the respondents t (98) = 22.346 p= .000 regarding the resource requirement. It means the new curriculum 2022-23 needed more resources than the 2006 curriculum.

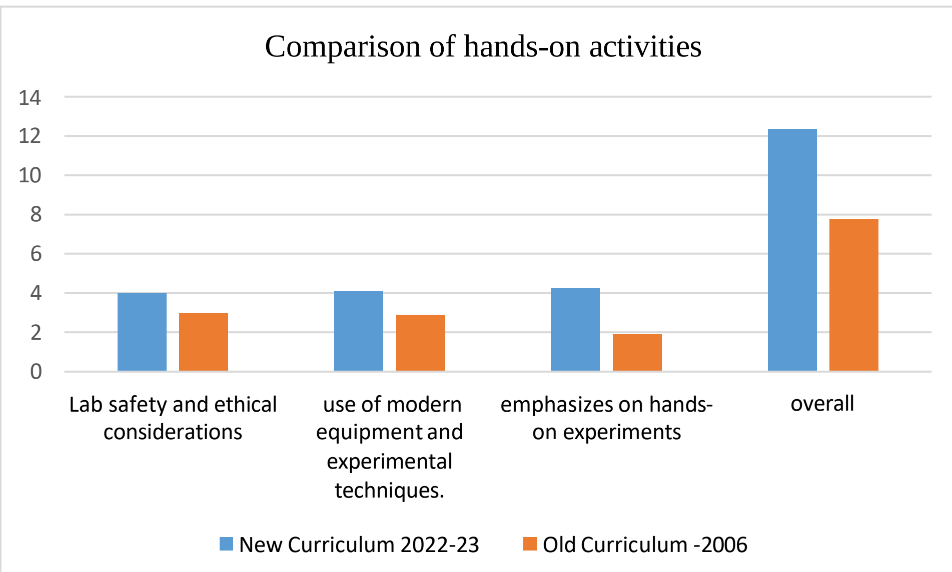


As shown in the graph above, the implementation of the new curriculum (2022–23) requires more financial investment, teaching resources, and materials compared to the old curriculum (2006).

Table 7: *Comparison of responses on the hands-on activities*

Dimension	t-test for Equality of Means						
	t (98)	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
						Lower	Upper
Hands-on-Activities	31.382	98	.000	4.600	.147	4.309	4.890

As indicated in table 7, there was a statistically significant difference between the means of the respondents t (98) = 31.382 p = .000 regarding the hands-on activities. It means the new curriculum 2022-23 needed more resource than the 2006 curriculum.



As indicated in the graph above, according to respondents, new curriculum 2022 -23 is better introducing lab safety and ethical considerations, use of modern equipment and experimental techniques and emphasis on hands-on experiments.

Results from Interviews

Semi-structured interviews were conducted with four field experts, each possessing over fifteen years of teaching experience. The open-ended questions were designed to explore key aspects of the 2022-23 curriculum in comparison to the 2006 curriculum. The responses were analyzed to identify recurring themes and categories. Participants indicated that the 2006 curriculum was stronger in terms of content organization. They highlighted a noticeable gap between students' current understanding and the knowledge required for their grade level in the 2022-23 curriculum. One interviewee elaborated:

For example, the 2022-23 curriculum introduces advanced topics, such as vector addition by rectangular component methods, without first establishing foundational concepts related to vectors. This gap is challenging to address at higher levels. In contrast, the 2006 curriculum systematically introduced basic concepts before progressing to advanced topics, making it more effective in building student understanding.

The 2022-23 curriculum was praised for its emphasis on addressing students' practical needs. It incorporates emerging topics and aligns more closely with the demands of future careers and higher education. Participants noted that this curriculum better prepares students for real-world challenges compared to the 2006 curriculum. The 2022-23 curriculum demonstrates a more comprehensive approach to diversity and inclusiveness. It balances global issues (e.g., climate change, migration) with local contexts, ensuring students see themselves reflected in the curriculum while understanding their role in a globalized world. This dual focus was less pronounced in the 2006 curriculum, which tended to prioritize national narratives. Participants acknowledged that the 2022-23 curriculum offers greater flexibility, allowing for adaptation to different learning styles, places, and local contexts. This adaptability was seen as a significant improvement over the more rigid structure of the 2006 curriculum. All participants agreed that the implementation of the 2022-23 curriculum requires significantly more resources compared to the 2006 curriculum. This includes updated teaching materials, training for educators, and infrastructure to support modern pedagogical approaches.

The respondents expressed clear preferences for the new curriculum (2022–23) across most dimensions, except for the quality of content and its organization. Content and its organization are critical elements of any curriculum, as they guide the achievement of educational objectives (Bain, 2023; Prideaux, 2003). The sequencing, which refers to the order in which content is presented to students, is a vital aspect of content organization (Arafeh, 2016; Bain, 2023). Effective sequencing considers students' prior knowledge and prerequisite learning, ensuring that the content is logically structured and not fragmented. A meaningful and coherent sequence enhances students' understanding and retention of subject matter (Friedlander, 2014).

A comparison of the two curricula reveals that the 2006 curriculum outperforms the 2022–23 curriculum in terms of content organization and sequencing. The 2006 curriculum demonstrates superior alignment with students' prior knowledge and a more logical progression of topics. However, the 2022–23 curriculum excels in addressing interdisciplinary concepts, a key focus of the STEAM (Science, Technology, Engineering, Arts, and Mathematics) framework. STEAM education is grounded in learning theories such as the theory of multiple intelligences and constructivist learning theory, which emphasize the effectiveness of interdisciplinary approaches (Li, 2024). Interdisciplinary integration fosters critical and creative thinking skills, making learning more engaging and relevant (Li, 2024).

Constructivism posits that new knowledge is constructed based on prior knowledge, which serves as the foundation for learning (Bada & Olusegun, 2015). Prior knowledge significantly influences the acquisition of new knowledge and is a strong predictor of learning outcomes (Rittle-Johnson et al., 2009). Park et al. (2009) found that students with higher prior knowledge achieve better academic performance and learning efficiency, as they experience reduced cognitive load. However, Stuckey et al. (2013) argue that science education at the secondary level is often perceived as irrelevant by students. The present study found that the 2022–23 curriculum addresses this issue more effectively by aligning students' learning with modern career demands and contemporary higher education requirements. The new curriculum also connects students' learning to real-world challenges through diverse and engaging topics, an area where the 2006 curriculum was comparatively weaker. Flexibility is another essential principle of curriculum design. An effective curriculum should be adaptable to accommodate students from diverse backgrounds and with varying abilities (Simanjuntak et al., 2022). While the 2006 curriculum was found to be more flexible, the 2022– 23 curriculum better meets societal expectations in preparing students for future challenges. However, the 2006 curriculum required fewer resources for implementation compared to the 2022–23 curriculum, which may pose challenges in resource-constrained settings.

References

Arafeh, S. (2016). Curriculum mapping in higher education: a case study and proposed content scope and sequence mapping tool. *Journal of Further Higher Education*, *40*(5), 585-611.

Bada, S. O., & Olusegun, S. (2015). Constructivism learning theory: A paradigm for teaching and learning. *Journal of Research Method in Education*, *5*(6), 66-70.

Bain, K. (2023). Exploring the Sequence of Science Contents in the Intended Primary Curriculum of Bangladesh. *Asian Journal of Education Social Studies*, *49*(4), 70-83.

Dilshad, S. A., Shah, R., & Ahmad, N. (2023). Implementation of Single National Curriculum at primary level: Problems and practices in district Khushab. *Journal of Positive School Psychology*, 465-476.

Friedlander, J. (2014). Sequencing contents. *Memphis: Southwest Tennessee Community College*.

Governamnet of Paksitan, M. o. E. (2006). *National Curriculum for Physics XI-XII 2006*. Islamabad: Ministry of Education, Islamabad

Halai, N. (2008). Curriculum reform in science education in Pakistan.

Jamil, B. R. (2009). Curriculum reforms in Pakistan–A glass half full or half empty. Seminar on School Curriculum Policies and Practices in South Asian Countries, NCERT Delhi, India,

khan, M. (2021). *Analysis of quality of teaching Physics in secondary schools of Bahawalpur* (Publication Number 1) [PhD Allama Iqbal Open University, Islamabad]. Islamabad.

Krajcik, J., Codere, S., Dahsah, C., Bayer, R., & Mun, K. (2014). Planning instruction to meet the intent of the Next Generation Science Standards. *Journal of science teacher education*, *25*(2), 157-175.

Li, J. (2024). Effective Strategies for Interdisciplinary Integration in STEAM Curriculum Design. *Transactions on Social Science, Education Humanities Research*, *8*, 99-105.

Nationnal Curriculum of Pakistan for Physics. (2024). Abbottabad: Directorate of Curriculum & Teacher Education Khyber Pakhtunkhwa Retrieved from https://dcte.kpese.gov.pk/wp-content/uploads/Physics-9-12.pdf

Park, S. I., Lee, G., & Kim, M. (2009). Do students benefit equally from interactive computer simulations regardless of prior knowledge levels? *Computers Education*, *52*(3), 649-655.

Prideaux, D. (2003). Curriculum design. *theBmj*, *326*(7383), 268-270.

Rittle-Johnson, B., Star, J. R., & Durkin, K. (2009). The importance of prior knowledge when comparing examples: Influences on conceptual and procedural knowledge of equation solving. *Journal of Educational Psychology*, *101*(4), 836.

Roemmele, C., & Criswell, B. (2023). Utilizing the Cross Cutting Concepts to Design Effective Science Sensemaking Experiences and Scaffolding Scientific Knowledge. Conference Proceedings. New Perspectives in Science Education 2023,

Simanjuntak, M. B., Suseno, M., Setiadi, S., Lustyantie, N., & Barus, I. R. G. R. G. (2022). Integration of curricula (curriculum 2013 and cambridge curriculum for junior high school level in three subjects) in pandemic situation. *Ideas: Jurnal Pendidikan, Sosial, dan Budaya*, *8*(1), 77-86.

Stuckey, M., Hofstein, A., Mamlok-Naaman, R., & Eilks, I. (2013). The meaning of 'relevance'in science education and its implications for the science curriculum. *Studies in Science Education*, *49*(1), 1-34.