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Analyzing the Patterns of Enrollment, Self-Assessment of Skills, and Academic Achievement for University Science Students

Vhutshilo Nekhubvi [1] & Ronel Ronella Randela [1]
[1] Faculty of Science, Engineering and Agriculture, University of Venda, South Africa.

ABSTRACT
The study investigated the enrollment patterns, self-reported high school physics and chemistry proficiency, and actual Physics performance across various degree programs at a University in South Africa. The academic performance in physics and chemistry within South African high schools is aggregated under physical science. The aggregation complicates university curriculum facilitators' ability to assess and enhance student outcomes. The absence of clear differentiation in physics and chemistry scores hinders targeted interventions to improve student understanding and performance. The data was collected from 275 first-year University entering students from across South African high schools. The study used a quantitative approach to contrast self-assessed ability and actual academic performance. The study examines how physics confidence relates to enrolment in Extended Curriculum Programmes and how self-assessed ability affects university performance. Advanced data analysis using Python and its analytical libraries was employed for statistical analysis, trend identification, and performance reporting. The research indicates that self-assessed knowledge in physics and chemistry during high school significantly influences success in higher education. Students confident in these sciences tend to excel in university courses. The study recommends aligning students' self-assessments with actual performance early to create tailored educational strategies and support that enhance ECP outcomes. These strategies should cater to various learning needs, elevate academic performance, and improve retention rates. The study proposes the splitting of physics and chemistry categories from the physical sciences to boost learners' confidence when preparing for university.

Keywords: Python, Physics and Chemistry, Physics, Chemistry, Extended Curriculum Programmes, Self-Assessed Knowledge.

Correspondence
Vhutshilo Nekhubvi
Email: Vhutshilo.Nekhubvi@univen.ac.za

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INTRODUCTION
In the pursuit of equitable access to quality education, nations, including South Africa, strive to ensure all citizens can access educational opportunities. The demand for STEM fields is increasing because of their growth and expansion. This is because solutions to research problems require bridging several disciplines, such as chemistry, biology, mathematics, and computer science.[1] Academic institutions attract students from diverse backgrounds to ensure that STEM education continues to fuel the economy.

[1] Daniel L. Silverio et al., "We Have More in Common than We Think: A Comparison of Scientific Skills and Disciplinary Practices in the Guiding Documents for Biology, Chemistry, and Mathematics," *Journal of College Science Teaching* 53, no. 5 (September 2, 2024): 472–79, https://doi.org/10.1080/0047231X.2024.2373027.

Recent studies have indicated a decline in student enrollment in STEM programs at higher education institutions.[2] A significant number of STEM students transition to non-STEM fields, encounter difficulties in achieving comparable performance to their classmates in other disciplines or ultimately exit from university entirely.[3] It is crucial to understand the significance of factors such as self-confidence and individual decision-making with the goal of improving motivation and achieving success in the study of STEM disciplines. These characteristics are also considered significant by professionals in fields other than STEM.[4] Understanding how students assess their abilities and evaluate their skills ("What is your proficiency level?") is crucial. Self-confidence in one's capabilities frequently determines an individual's success in academic pursuits and the motivation to participate in educational activities. Studies have revealed that students' self-assurance in their scientific aptitude can indicate their academic achievement in science-related subjects.[5] As indicated by Britner, the confidence level is a significant predictor of achievement in science courses for every student, regardless of gender.[6] It is imperative to engage students in learning activities and integrate the physics materials with their existing knowledge to teach them effectively.[7] There is a concerning trend in numerous South African institutions whereby a declining number of students are interested in and registering for the discipline of physics. Higher education institutions stand to gain immensely from insights that shape students' choices regarding the study of physics. Such data empowers these institutions to refine academic offerings and tailor communications to resonate with the preferences and requirements of prospective students. By understanding this information, decision-makers gain a comprehensive insight into the factors that affect students' choices when selecting their programs of study.

LITERATURE REVIEW

The expectancy value, which links self-efficacy and motivation, is the theoretical framework employed in this study to explain how perceived task value and expected success interact to shape achievement-oriented decisions. The framework underlines the insightful impact of beliefs on one's engagement with tasks, revealing that a robust confidence in both success and the intrinsic value of the task significantly raises motivational levels. The value component is further divided into four dimensions: intrinsic, utility, attainment, and cost, each playing a critical role in the motivational landscape. Through this lens, we gain insight into the different ways in which these beliefs can guide students toward greater involvement and achievement in their education.[8]

The intrinsic value of a task is the expected satisfaction that an individual anticipates from participating in the task. Education guided by curiosity or interest is seen as having intrinsic value; for instance, Fielding-Wells, O'Brien, and Makar proposed that students motivated by the intrinsic value of their learning tasks are highly engaged, even asking them to stay in the classroom during breaks and after school to continue working.[9] It is hypothesized that students are deeply engaged in a task when intrinsically motivated.[10]

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2 Katherine Kricorian et al., "Factors Influencing Participation of Underrepresented Students in STEM Fields: Matched Mentors and Mindsets," *International Journal of STEM Education* 7, no. 1 (December 21, 2020): 16, https://doi.org/10.1186/s40594-020-00219-2.

3 Alec Sithole et al., "Student Attraction, Persistence and Retention in STEM Programs: Successes and Continuing Challenges," *Higher Education Studies* 7, no. 1 (January 16, 2017): 46, https://doi.org/10.5539/hes.v7n1p46.

4 Allan Wigfield and Jacquelynne S. Eccles, "Expectancy–Value Theory of Achievement Motivation," *Contemporary Educational Psychology* 25, no. 1 (January 2000): 68–81, https://doi.org/10.1006/ceps.1999.1015.

5 Toni Honicke and Jaclyn Broadbent, "The Influence of Academic Self-Efficacy on Academic Performance: A Systematic Review," *Educational Research Review* 17 (February 2016): 63–84, https://doi.org/10.1016/j.edurev.2015.11.002; Hsiao-Lin Tuan *, Chi-Chin Chin, and Shyang-Horng Shieh, "The Development of a Questionnaire to Measure Students' Motivation towards Science Learning," *International Journal of Science Education* 27, no. 6 (January 17, 2005): 639–54, https://doi.org/10.1080/0950069042000323737.

6 Shari L. Britner, "Motivation in High School Science Students: A Comparison of Gender Differences in Life, Physical, and Earth Science Classes," *Journal of Research in Science Teaching* 45, no. 8 (October 24, 2008): 955–70, https://doi.org/10.1002/tea.20249.

7 Zheng Zhu, "Learning Content, Physics Self-Efficacy, and Female Students' Physics Course Taking," *International Education Journal* 8 (November 1, 2007): 204–12.

8 Jessie Durk et al., "Using Expectancy-Value Theory to Understand the Teaching Motivations of Women Physics Lecturers," *Physical Review Physics Education Research* 20, no. 1 (June 28, 2024): 010157, https://doi.org/10.1103/PhysRevPhysEducRes.20.010157.

9 Jill Fielding-Wells, Mia O'Brien, and Katie Makar, "Using Expectancy-Value Theory to Explore Aspects of Motivation and Engagement in Inquiry-Based Learning in Primary Mathematics," *Mathematics Education Research Journal* 29, no. 2 (June 17, 2017): 237–54, https://doi.org/10.1007/s13394-017-0201-y.

10 Sumeyye Aslan et al., "People's Naïve Belief about Curiosity and Interest: A Qualitative Study," *PLOS ONE* 16, no. 9 (September 30, 2021): e0256632, https://doi.org/10.1371/journal.pone.0256632.

Utility value pertains to the practicality of a task in upcoming situations. This may resemble an extrinsic incentive when a task is executed to achieve a particular goal. Student-driven utility value would strive for concrete outcomes in the immediate future. For instance, high school students participating in physical education to satisfy their obligations may opt out of extra courses if they do not perceive them as beneficial.[11]

The cost is a student's sacrifice to complete a school-related activity. When students believe that the cost of the task outweighs its potential benefits, they are more likely to avoid it. The effort cost refers to the energy a student has to dedicate to completing a task, whereas the opportunity cost is associated with selecting alternative decisions. Emotional costs, on the other hand, originate from psychological or emotional states that can influence a student's actions. As a result, students may be less inclined to fully engage in tasks that provoke anxiety and avoid potential emotional costs.[12]

Rieder et.al., defined self-efficacy as the belief and perceptions of one's capability to perform certain activities.[13] Sağlam and Ayşenur believed that there exists a link between academic performance, learning motivation, and self-efficacy in physics.[14] According to Panergayo, the students' self-confidence in physics can positively impact how they view knowledge, which in turn could eventually lead to outstanding academic outcomes.[15] The link between self-confidence and beliefs about knowledge suggests a possible connection with motivation. Those with stronger beliefs in their understanding and abilities may be more inclined to learn. This study proves the connection between self-confidence and academic performance in physics, supporting previous research findings. Meral, Colak, and Zereyak mentioned in the results that there is a strong relationship between self-confidence and performance.[16]

Looking at the principles of the Expectancy-Value Theory, how do students' self-confidence, secondary school academic experiences, and choice of program influence their enrolment, persistence, and academic performance in tertiary Physics courses? To answer this research question, the following hypotheses have been formulated:

(1) Students with greater confidence in their physics abilities are more inclined to enrol in and persist in ECP Physics programs;
(2) The second hypothesis predicts a positive association between students' self-reported proficiency in high school physics and chemistry and their actual academic performance in university-level physics courses,
(3) Students with higher confidence in physics will attain superior academic results in physics courses compared to those with greater confidence in chemistry,
(4) The fourth hypothesis postulates that students enrolled in programs with a substantial focus on physics will achieve better results in advanced physics courses, and
(5) Students' own assessments of their proficiency will be more accurate in popular ECP programs. These hypotheses are linked to the components of the Expectancy-Value Theory and are essential for comprehending student conduct and achievements in ECPs.

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[11] Allan Wigfield and Jacquelynne S. Eccles, "35 Years of Research on Students' Subjective Task Values and Motivation: A Look Back and a Look Forward," in *Advances in Motivation Science*, ed. Andrew J. Elliot, vol. 7, 2020, 161–98, https://doi.org/10.1016/bs.adms.2019.05.002.

[12] Jacquelynne S. Eccles and Allan Wigfield, "The Development, Testing, and Refinement of Eccles, Wigfield, and Colleagues' Situated Expectancy-Value Model of Achievement Performance and Choice," *Educational Psychology Review* 36, no. 2 (June 17, 2024): 51, https://doi.org/10.1007/s10648-024-09888-9.

[13] Annamina Rieder et al., "Why Users Comply with Wearables: The Role of Contextual Self-Efficacy in Behavioral Change," *International Journal of Human–Computer Interaction* 37, no. 3 (February 7, 2021): 281–94, https://doi.org/10.1080/10447318.2020.1819669.

[14] Havva Sağlam and Ayşenur Yontar Toğrol, "High School Students' Physics Achievement in Terms of Their Achievement Goal Orientations, Self-Efficacy Beliefs and Learning Conceptions of Physics," *Bogazici University Journal of Education* 35, no. 1 (2018): 31–50.

[15] Albert Andry E. Panergayo, "Self-Efficacy, Epistemological Beliefs, and Academic Performance in Physics: A Mediation Analysis," *Philippine Social Science Journal* 6, no. 2 (October 13, 2023): 46–52, https://doi.org/10.52006/main.v6i2.749.

[16] Mustafa Meral, Esma Colak, and Ertan Zereyak, "The Relationship between Self-Efficacy and Academic Performance," *Procedia - Social and Behavioral Sciences* 46 (2012): 1143–46, https://doi.org/10.1016/j.sbspro.2012.05.264.

This research aims to assess the effectiveness of ECP, particularly within the Faculty of Science, Engineering, and Agriculture. Key focuses include the relationship between self-reported high school physics and chemistry proficiency and academic performance in university-level physics courses.

METHODOLOGY

The following method presents a plan that guided this research process. It covers approaches and designs, data collection, and analysis in quantitative research.

Research Design

Quantitative methods as a research approach are research methods that have the objective of testing hypotheses or answering research problems in which the variables are measured in the form of numbers.[17] In this study, a quantitative research design method is applied.

Data Collection

Survey questionnaires were used to collect quantitative data from populations of 275 students. The surveys were designed to obtain respondents' data on beliefs in closed-ended options. This survey asks a question with a range of two answers to collect data on belief, and respondents select one option from a list. This limits respondents' answers but allows for statistical data and responses to be analysed and compared. The study also collected data on student enrollment and Academic performance.

Data Analysis

In this study, a statistical analysis using quantitative approaches was employed to improve the quality of the research report. Descriptive statistical analysis is a data analysis technique that can be employed by researchers, both on a trial basis and for production data analysis. The results of statistical analysis will provide comprehensive data information, so that decisions can be made with a high level of confidence or accuracy. There are several software packages available to assist in data analysis, but each of these can be used in a wide variety of ways. In this study, Python programming packages were used to facilitate descriptive analysis.

PRESENTATION OF FINDINGS AND DISCUSSION

Enrolment patterns

Figures 1 and Table 1 show different enrollment figures in individual qualification programs. Some degree codes, such as Biochemistry and Microbiology (MNEBSA) with 31 students, Computer Sciences (MNEBSP) with 22 students, and Botany and Zoology (MNEBSO) with 19 students, had relatively higher enrolment than others. Degree codes for Physics and Mathematics had 10 students enrolled, and Physics and Chemistry had 11 students. High enrollment in Biochemistry and Microbiology (MNEBSA) could be because students recognize biochemistry's importance in clinical problem-solving, increasing its appeal for future medical careers. However, undergraduate biology students show gaps in microbiology education, with the curriculum not aligning with industry needs. This disconnect between career aspirations and understanding microbiological concepts highlights the need for curriculum reforms. A strong microbiology curriculum that links theory with practical applications is essential for effectively preparing students. Studies reveal that student attitudes, curriculum design, and educational frameworks affect enrollment trends in biochemistry and microbiology programs, making positive perceptions and curriculum reform crucial for university students.[18]

The key statistical indicators that determine the distribution of students across the various degree programmes are shown in Table 1. The data analysis shows a right-skewed distribution with a positive skewness of 1.87. The value for the kurtosis of 3.38 means that the distribution has a tail that is somewhat more pronounced than a normal distribution. The variation coefficient, which is 45.44 %, reflects a considerable degree of variability in student numbers compared to the mean in the various degree

[17] Erica Scharrer and Srividya Ramasubramanian, *Quantitative Research Methods in Communication* (New York : Routledge, 2021. | Series: Routledge social justice communication activism series: Routledge, 2021), https://doi.org/10.4324/9781003091653.
[18] Denisa Kostovicova and Eleanor Knott, "Harm, Change and Unpredictability: The Ethics of Interviews in Conflict Research," *Qualitative Research* 22, no. 1 (February 8, 2022): 56–73, https://doi.org/10.1177/1468794120975657.

programmes. The provided bar chart can be categorized as a component of exploratory data analysis (EDA) as it aids in the identification of patterns, outliers, or anomalies in the distribution of students among degree codes. Higher enrolment in certain programs indicates greater popularity or demand for these programs among students. This could reflect perceived career opportunities, academic reputations, or specific institutional strengths. Institutions may need to consider resource allocation based on enrolment patterns.[19]

Degree programs with higher enrollment may require additional support services to maintain quality and accommodate growth. A broad distribution across multiple degree codes indicates a wide range of academic offerings that meet students' diverse interests and educational needs within a faculty. Analysis of this data assists in strategic planning for curriculum development, program expansion, or adjustments in response to changing educational or market demands. Understanding enrolment patterns helps institutions adjust their offerings, allocate resources effectively, and respond proactively to educational trends and student preferences.

Monitoring and analyzing such data are essential for maintaining relevance, promoting academic excellence, and meeting the changing needs of students and society.[20] This information is critical in developing a case study to determine how many of these students are good at physics.

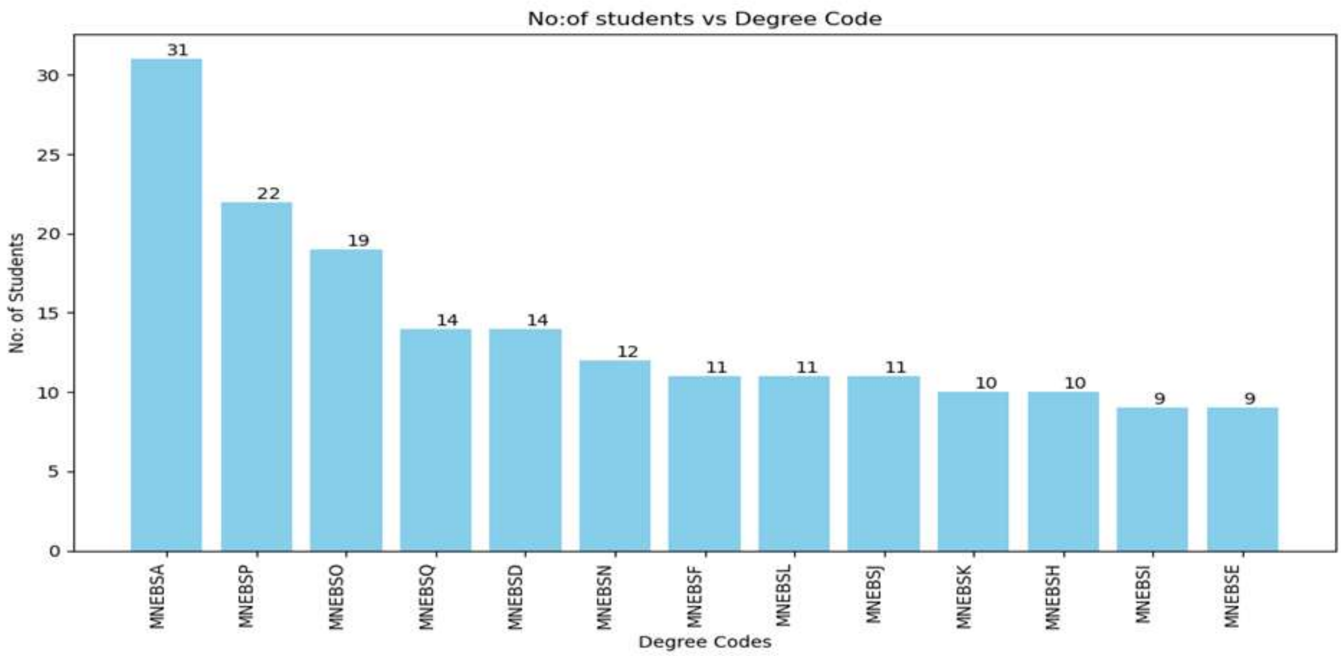

Figure 1: Count of total students who participated in the research per degree code enrolled

Table 1: Statistical parameters

Statistic	Value
Total number of students	183
Mean number of students per program	14.08
Median number of students	11
Mode of students	11
Range of students	22
Variance of students	40.91
Standard deviation of students	6.4
1st Quartile (Q1)	10
2nd Quartile (Q2 / Median)	11

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[19] Tore Dag Bøe, "Ethical Realism before Social Constructionism," *Theory & Psychology* 31, no. 2 (April 14, 2021): 220–36, https://doi.org/10.1177/09593543211004756.

[20] P Padmanabhan, R, R. Karle, and S. N. Jangle, "Assessment of Attitude and Approach Adopted for Studying Biochemistry amongst First-Year MBBS Students." *International Journal of Clinical and Biomedical Research*, 2015, 38–45.

3rd Quartile (Q3)	14
Interquartile Range (IQR)	4
Skewness	1.87
Kurtosis	3.38
Coefficient of Variation	45.44%

Source: Prepared by researchers

Self-reported competency in high school physics and chemistry

Figure 2 shows data that students are categorised based on their self-assessed knowledge since physics and chemistry were merged into the physical sciences at the high school level. In the figure, 92 students claimed to be good at physics, and 83 students claimed to be good at chemistry. At least one student claimed to be good at physics and chemistry, and six students claimed to be good at both physics and chemistry. Finally, one student claimed to be neither good at physics nor chemistry. The significant difference between students claiming proficiency in physics (92) and chemistry (83) raises questions regarding the possible reasons for this discrepancy.

Possible factors include teaching quality, student interests, curriculum structure, and motivation. This aligns very well with the study of Breetzke and Carla, who emphasized the significance of fostering students' confidence in their capacity to excel in physics courses.[21] Analysing why more students feel confident in physics than chemistry could involve examining high school teaching methods or curriculum design. Additionally, Educators play a vital role in creating a supportive learning environment that builds students' confidence in tackling challenging chemistry concepts.[22]

As Vishnumolakala et.al. argued, traditional lecture-based methods may suffocate critical thinking and engagement, particularly in chemistry, which is often perceived as more abstract than physics.[23] Physics instruction may be more engaging or effective at the school level. The data presented provide a starting point for a more in-depth analysis of educational strategies and student perceptions in physics and chemistry. Understanding these dynamics can enable targeted interventions to improve all students' learning experiences and outcomes. It is critical to assess whether self-reported competence matches the actual performance.

[21] Jonas Breetzke and Carla Bohndick, "Expectancy-Value Interactions and Dropout Intentions in Higher Education: Can Study Values Compensate for Low Expectancies?," *Motivation and Emotion* 48, no. 5 (October 20, 2024): 700–713, https://doi.org/10.1007/s11031-024-10088-9.

[22] Pawinee Narueponjirakoon and Suwattana Eamoraphan, "A Comparative Study on Self-Efficacy For Performing Learning Inquiry Tasks and Attitudes Toward Learning Chemistry Through Inquiry-Based Laboratories In Grades 9-12 Students at Concordian International School, Thailand," *Scholar* 10, no. 1 (2018): 77.

[23] Venkat Rao Vishnumolakala et al., "Students' Attitudes, Self-Efficacy and Experiences in a Modified Process-Oriented Guided Inquiry Learning Undergraduate Chemistry Classroom," *Chemistry Education Research and Practice* 18, no. 2 (2017): 340–52, https://doi.org/10.1039/C6RP00233A.

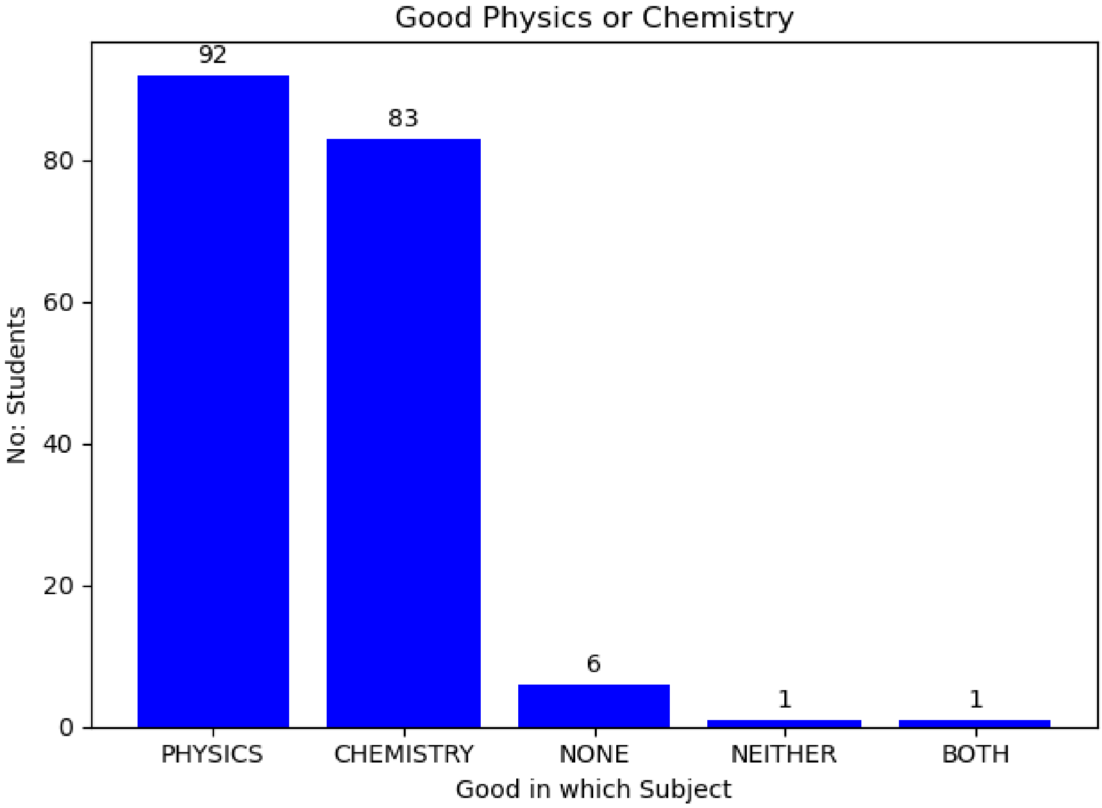


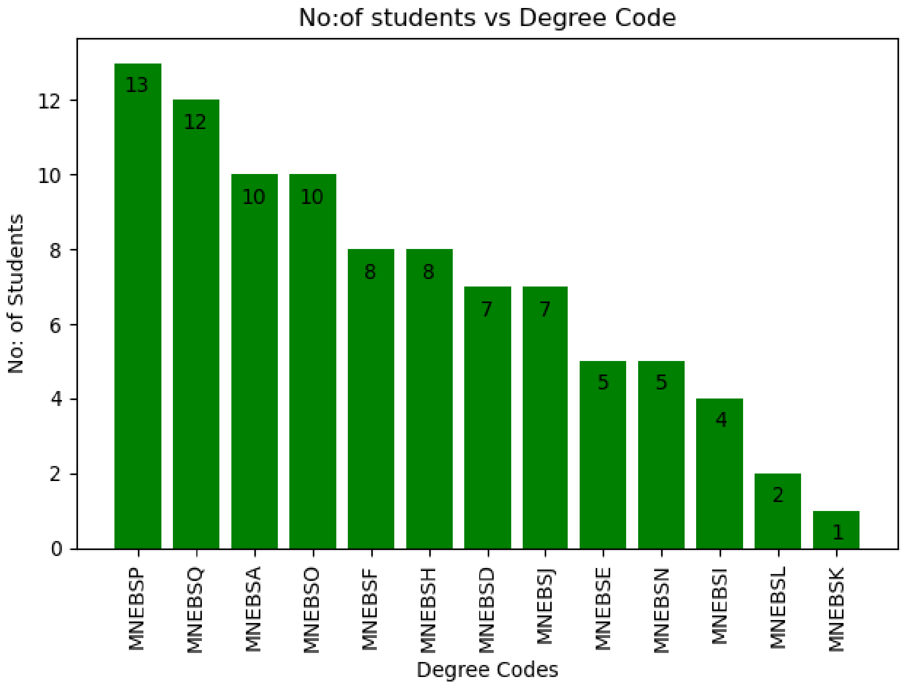
Figure 2: Count of total students who were good in Physics or Chemistry at the matric level

Analysis of student enrolment and performance by degree code

Figure 3a and Figure 3b show an analysis of the total number of students per degree code. The total number of students for each degree code ranges from 1 to 13 for those good at physics and 1 to 19 for those good at chemistry. Some degree codes have similar values in the physics and chemistry datasets. Degree codes with higher counts could indicate greater student interest, higher enrolment in related degree programs, or better performance in these subjects. Degree codes with lower values could indicate less interest or poorer performance, which could be further investigated regarding educational strategies or curriculum development. It is arguably that qualifications with low interest are regarded as less valuable in the current job market.[24] To deepen the analysis, comparing these results with broader datasets or across multiple years would be beneficial to identify trends and patterns in student interest and performance in physics and chemistry. The categorical breakdown of students can tell a lot about the status of exam results. This information helps to categorize student performance (good in physics or chemistry) by degree.

[24] Mike Vuolo, Jeylan T. Mortimer, and Jeremy Staff, "The Value of Educational Degrees in Turbulent Economic Times: Evidence from the Youth Development Study," *Social Science Research* 57 (May 2016): 233–52, https://doi.org/10.1016/j.ssresearch.2015.12.014.

(a)



(b)

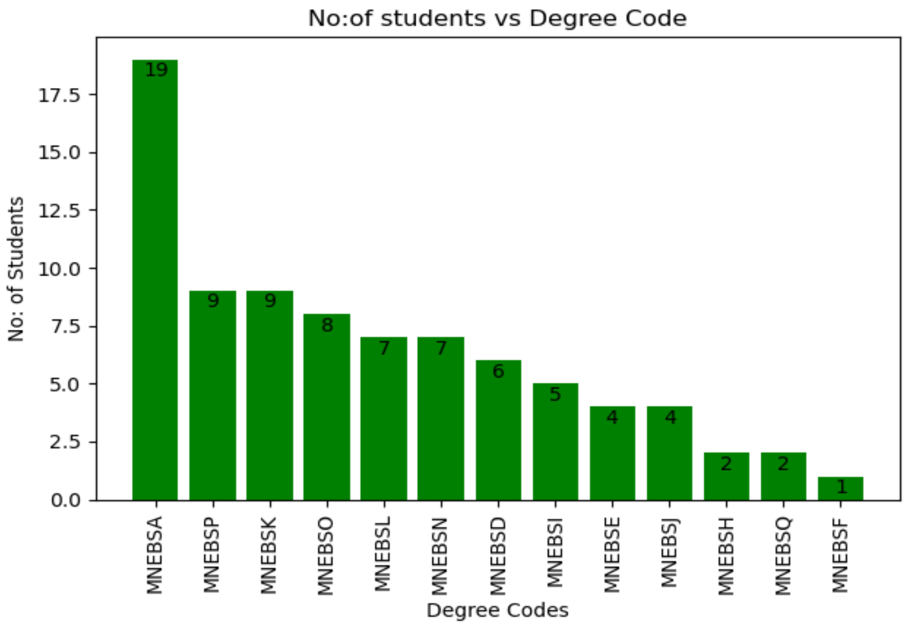


Figure 3: Count of total students who were filtered per degree code for those who are (a) good in Physics, (b) good in Chemistry)

Comparative Analysis of Student Performance in Different Degree Programs

Figure 4 (a) and (b) show an analysis of the results distribution of performance categories, with both data sets showing a range of performance categories from "FAIL SUPPLEMENTARY ALLOWED" to "PASS DISTINCTION". In Figure 4(a), one sees cases where students failed or needed supplementary exams, while in Figure 4(b), similar patterns are observed, but with different numbers. When comparing the pass rates in Figure 4(a) and Figure 4(b), "PASS" (including "PASS CONDONE" and "PASS DISTINCTION") tends to be the most common category. As shown in Figure 4(a), many degree codes have a significant number of students who passed with either distinction or a regular pass, such as MNEBSA, MNEBSH, MNEBSJ, MNEBSO, MNEBSP, and MNEBSQ. In Figure 4(b), degree codes such as MNEBSA, MNEBSB, and MNEBSN also show significant pass rates, particularly in the "PASS DISTINCTION" category. Within the individual data sets, there are clear differences in performance between the different degree programs. For example, in Figure 4(a), MNEBSE has more students failing or requiring additional examinations than other programs, such as MNEBSA or MNEBSO. In Figure 4(b), programs such as MNEBSA show strong performance in the "PASS DISTINCTION" category, whereas others, such as MNEBSH or MNEBSQ, have lower overall pass rates. When analyzing both datasets, we can see that students who rate themselves as good at physics perform differently from those who rate themselves as good at chemistry. Programs such as MNEBSP in Figure 4(a) and MNEBSN in Figure 4(b) have a strikingly high number of students who require additional examinations or do not meet the minimum requirements to pass, indicating potential areas for improvement in pedagogical support and curriculum adjustment.

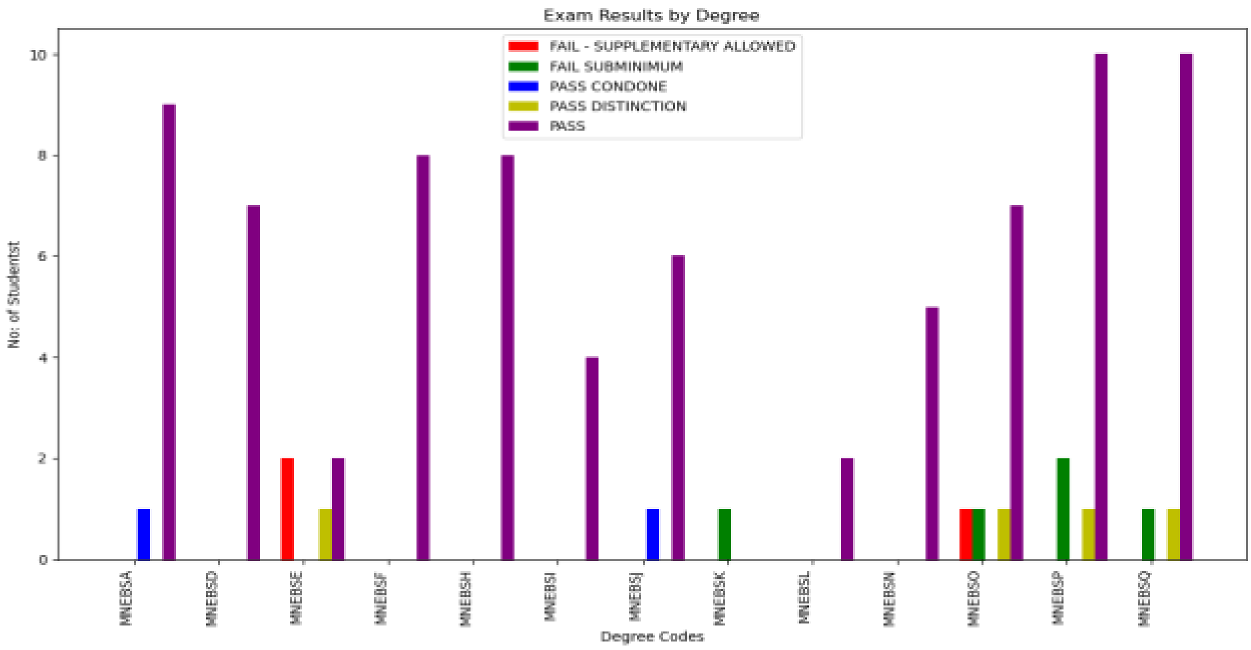


Figure 4a: Count of student exam results by degree code for those who are good in Physics

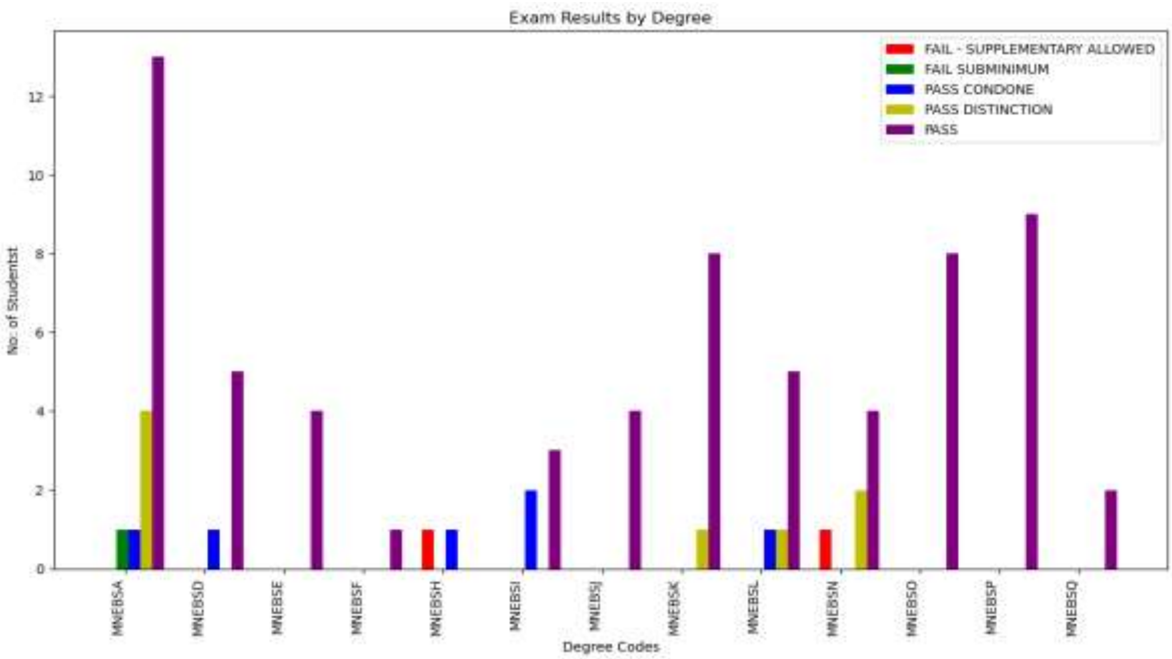


Figure 4b: Count of student exam results by degree code for those good in Chemistry.

Table 2 shows that the distribution of students proficient in Physics exhibits a more uniform allocation across various degree codes. In contrast, those who claim excellence in Chemistry are concentrated in specific codes, notably MNEBSA, which comprises 18 students, and MNEBSK, with 9 students. Marked discrepancies in pass rates are evident among different degree codes; MNEBSF and MNEBSH report a 100% pass rate for Physics students, whereas only 50% of Chemistry students achieve a passing mark. Furthermore, MNEBSK shows a 0% pass rate for Physics students, based on the performance of just one individual, in stark contrast to the 100% pass rate for Chemistry students in that code, represented by 9 students. MNEBSE records a 60% pass rate for Physics students, while Chemistry students achieve a perfect score of 100%. A consistent level of performance is noted in MNEBSI, which documents 100% pass rates for students who claim to excel in both subjects. MNEBSA continues to show high success rates for both groups, with 90% for Physics and 94.44% for Chemistry. The largest cohorts of Physics students are located in MNEBSP (13 students) and MNEBSQ (11 students), whereas the largest groups for Chemistry are found in MNEBSA (18 students) and MNEBSK (9 students). Conversely, the smallest cohorts for Physics are in MNEBSK (1 student) and MNEBSL (2 students), while for Chemistry, the smallest groups are in MNEBSF, MNEBSH, and MNEBSQ, each comprising 2 students.

Table 2: **Comparison analysis of university Physics Exam performance per degree code between students who are good at Physics and Chemistry.**

Degree Code	Self-Proficiency in Physics Count	Self-Proficiency in Physics Pass Rate	Self-Proficiency Chemistry Count	Self-Proficiency Chemistry Pass Rate
MNEBSA	10	90%	18	94.44%
MNEBSD	7	100%	6	83.33%
MNEBSE	5	60%	4	100%
MNEBSF	8	100%	2	50%
MNEBSH	8	100%	2	50%
MNEBSI	4	100%	5	100%
MNEBSJ	7	85.71%	4	100%
MNEBSK	1	0%	9	100%
MNEBSL	2	100%	6	83.33%
MNEBSN	5	100%	7	85.71%
MNEBSO	9	88.89%	8	100%
MNEBSP	13	84.62%	9	100%
MNEBSQ	11	100%	2	100%

Source: Prepared by a researcher

Comparative analysis of student performance in physical sciences and mathematics, from secondary school to university physics.

Figures 5(a) and 5(b) show the distribution of the two groups across the grade levels in Physical Science. The numbers are close to each other in each category, indicating comparable performance or interest in the subject between the two groups. Similar to physical science, the distributions in mathematics are similar for both groups. This suggests that students who excel in physics or chemistry also have similar competencies in mathematics at the high school level.[25] There are notable differences in physics distributions at the university level. For students who claim proficiency in physics, the top score was level 5, followed by levels 4 and 6, with lower numbers in levels 3 and 7. For students who claim proficiency in chemistry, the top score was Level 5, followed by Level 4 and 6, with lower numbers in

[25] Tong Tong et al., "Exploring the Effect of Mathematics Skills on Student Performance in Physics Problem-Solving: A Structural Equation Modeling Analysis," *Research in Science Education* 55, no. 3 (June 7, 2025): 489–509, https://doi.org/10.1007/s11165-024-10201-5.

Level 7 and 3. Students claiming proficiency in physics show a higher concentration in the middle Level (4, 5, 6), possibly indicating a stronger or greater interest in physics courses at university than those performing well in chemistry.

While both groups showed similar performance in math and science at the secondary school level, students who were good in physics were significantly more represented in mid-level university physics courses than those who were good in chemistry. This indicates a potential alignment between perceived strength in high school physics and continued success or interest at the university level.

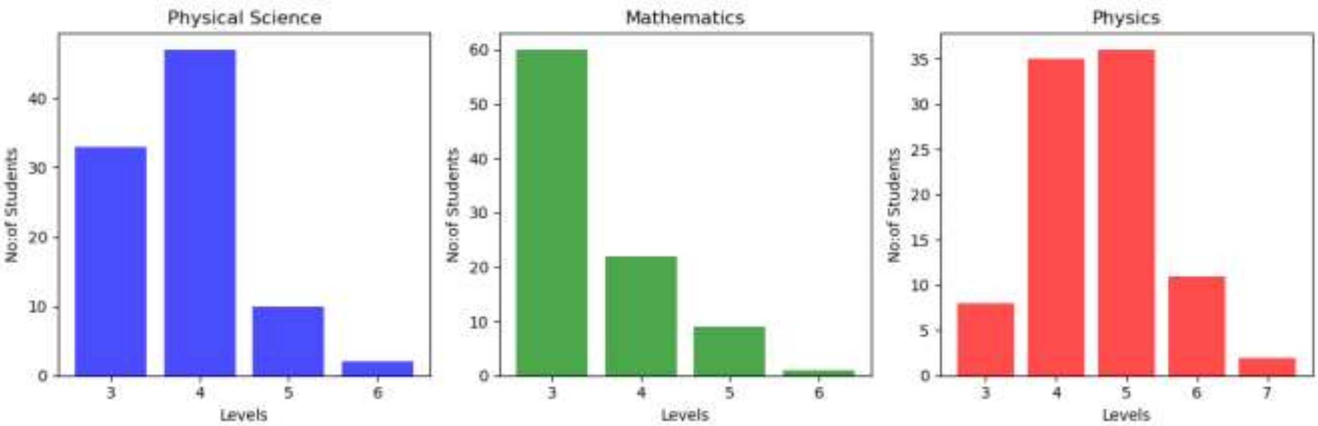


Figure 5a: Count of students for each grade level in Physical science (High school), Mathematics (High school) and Physics (university) for those who are good at Physics.

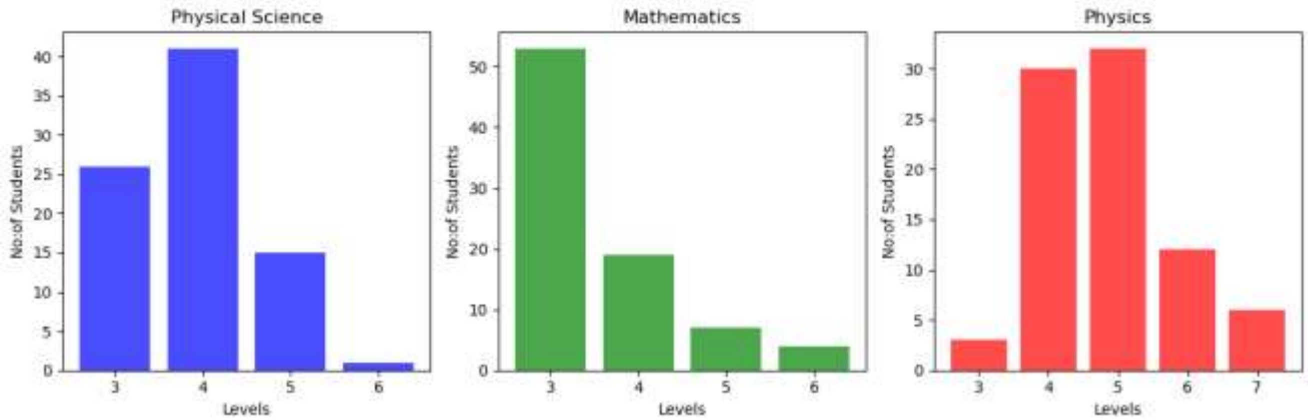


Figure 5b: Count of students for each grade level in Physical Science (High school), Mathematics (High school), and Physics (university) for those who are good in Chemistry.

Academic Performance of university physics measured by top Students good at high school Physics and Chemistry

Figures 6(a) and 6(b) show the results of Physical Science, Mathematics, and Physics marks for the top 10 students who claim to excel in Physics or Chemistry. The Physical Science and Mathematics performance for the Physics group showed that the top 10 students had scores in Physical Science ranging from 46.0 to 75.0, and in Mathematics, from 42.0 to 62.0. For the Chemistry group, Mathematics scores ranged from 42.0 to 71.0. The top students in both groups generally performed well in Physical Science and Mathematics, with some variations in individual subject strengths. Looking at the Physics scores, the Physics group scores range from 73.0 to 85.0, and for the Chemistry group, the Physics scores range from 72.0 to 88.0. The top students in both groups exhibited strong proficiency in physics, with scores consistently above the average.These findings are in line with the findings of Meli, Pantazatos, and Goulas. Understanding these patterns is valuable for guiding educational strategies for students aspiring to excel in science.[26] Differences in individual strengths, sample variations, and educational environments can explain the slight variations in scores and accomplishments across subjects.

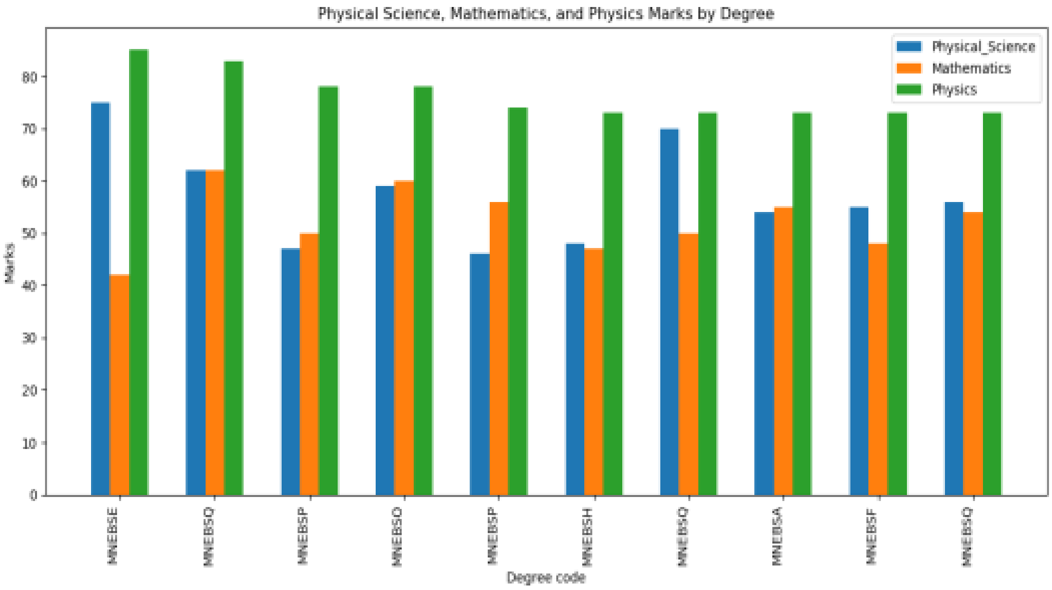


Figure 6a: Physical Science, Mathematics, and Physics Marks for the top 10 students for those who are good in Physics

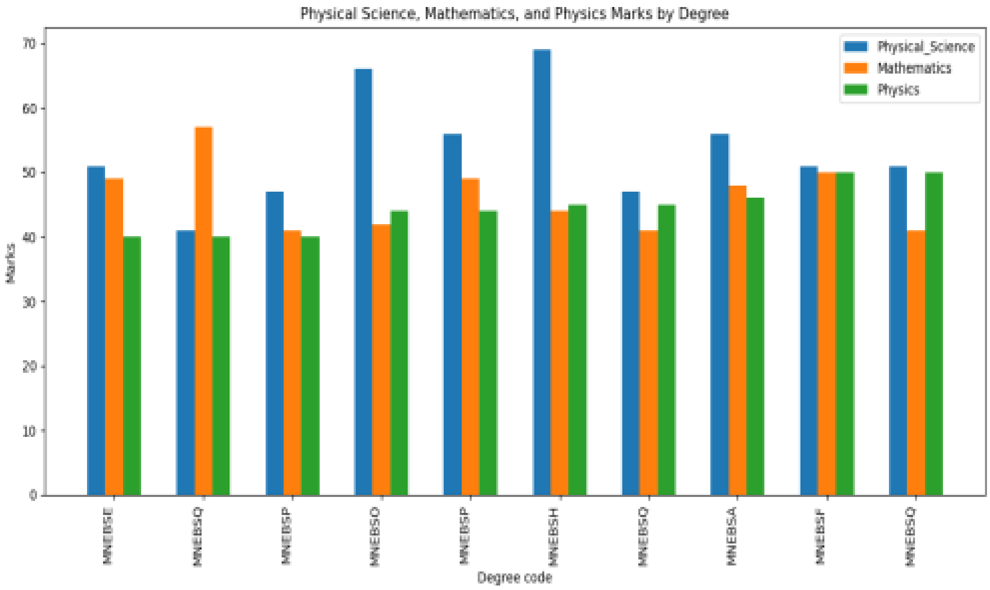


Figure 6b: Physical Science, Mathematics, and Physics Marks for Bottom 10 students for those who are good at Physics

Academic Performance of University Physics measured by the bottom students who are good at high school Physics and Chemistry

In Figures 7(a) and (b), we analyze and discuss the data for the bottom 10 students. The bottom ten students are from two categories: those who claim to be good at physics and those who claim to be good at chemistry. For students who claimed to be good at physics, physical science grades ranged from 41 to 69. The mean was approximately 53.5. Mathematics scores ranged from 41 to 57, with a mean value

[26] Kalliopi Meli, Dimitris Pantazatos, and Sofoklis Goulas, "Achievement in Secondary-School Physics as a Predictor for University Physics Studies Choice and Acceptance," in *Research in Science Education. Pre-Print* (Pre-print on ResearchGate, 2023).

of approximately 47.3. For students who claim to be good at chemistry, their grades in Physical Sciences range from 41 to 69. The mean is approximately 52.3

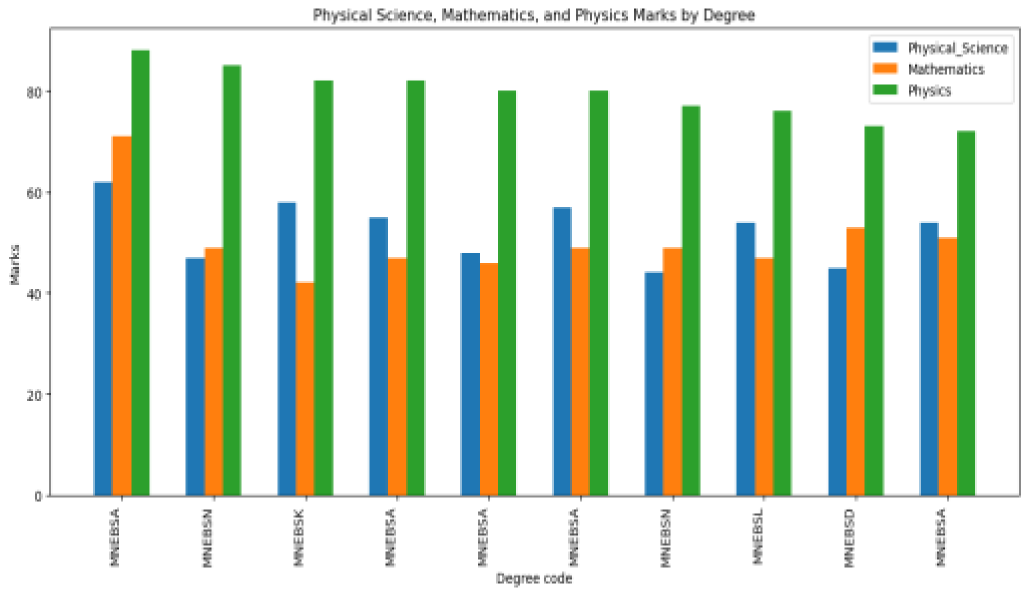


Figure 7a: Physical Science, Mathematics, and Physics Marks for the top 10 students for those who are good in Chemistry

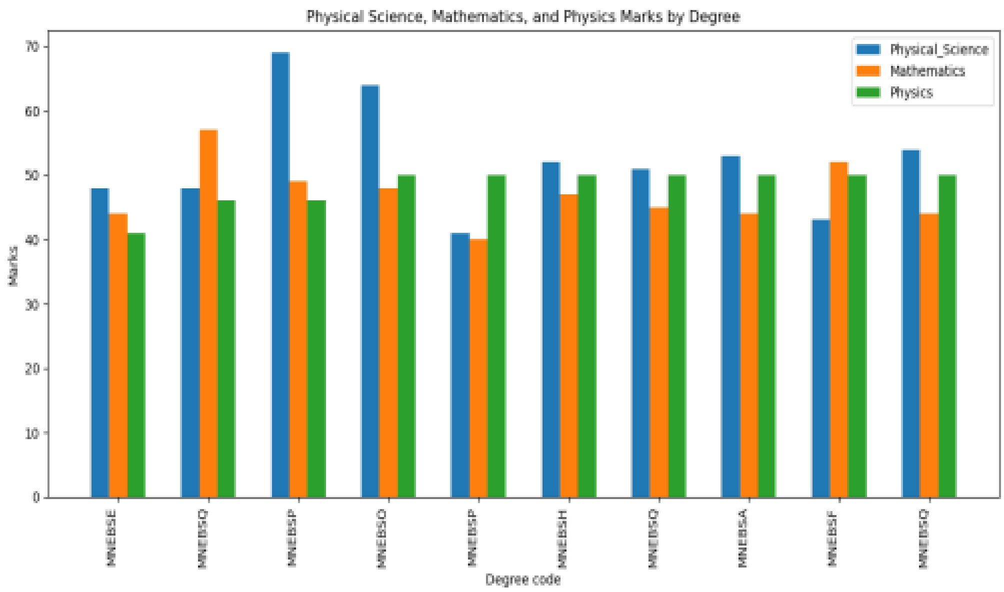


Figure 7b: Physical Science, Mathematics, and Physics Marks for Bottom 10 students for those who are good at Chemistry

RECOMMENDATIONS

Many first-year students misjudge their academic readiness. Over- or under-confidence leads to poor course choices, late help-seeking, and low throughput, particularly in ECP cohorts. This study recommends a system that measures and narrows the gap between students' self-assessment and actual performance early, then uses that information to tailor support. By standardizing early diagnostics, feedback, and targeted interventions across the Department of Basic Education (DBE), the Department of Higher Education & Training (DHET), and universities, we can raise ECP pass and credit accumulation rates, reduce attrition, and improve time-to-completion.

Current ECP support is strong but often reactive and not tightly coupled to early evidence of miscalibration. The objective is therefore to establish a nationally coherent, institutionally implemented framework to diagnose academic readiness and self-perception early, calibrate students' self-assessment via structured feedback, and assign tailored supports that are tracked for uptake and impact, thereby accelerating success in ECP.

The first measure is early, dual-channel diagnostics in Weeks 1–4. Institutions implement standardized discipline-specific diagnostic assessments while administering a structured self-assessment instrument in the same. Using these paired inputs, each institution computes an individual miscalibration index, predicted versus actual, to flag risk and tailor support.

The second measure is a feedback and calibration protocol that delivers automated feedback reports to each student within 72 hours: actual scores, where predictions diverged, a brief strengths-and-needs analysis, and clear "next steps." Feedback-literacy micro-modules (60–90 minutes) are embedded in orientation and ECP tutorials to teach students how to read feedback, set goals, and plan study time. For students with high miscalibration, advisors conduct check-ins during Weeks 3–6 and co-create a short learning plan with concrete commitments.

The third measure is to build tailored support pathways, with default enrolment for students flagged as high-risk and opt-in nudges for moderate-risk students. Each institution offers support mapped to diagnostic profiles: Supplemental Instruction, tutoring, writing and math labs, digital skills boosters, psychosocial support, and financial aid navigation. Time-management and study-strategy coaching is emphasized for overconfident or under-prepared students, while confidence-building and challenge tasks are provided for underconfident but well-prepared students.

The fourth measure is data integration and privacy. Institutions enforce an early-alerts dashboard that combines LMS data (early assignments), diagnostic results, self-assessment responses, and support attendance.

The fifth measure is staff development. Academic advisors and tutors receive training on interpreting miscalibration profiles and providing motivational, culturally responsive feedback. Lecturers receive briefing packs on designing low-stakes early tasks that produce actionable evidence without a high-grading burden.

CONCLUSION

The aim of this research was to assess the effectiveness of ECP, particularly within the Faculty of Science, Engineering, and Agriculture. Key focuses included the relationship between self-reported high school physics and chemistry proficiency and academic performance in university-level physics courses. The Analysis reveals substantial impacts on the enrollment, persistence, and performance within university physics courses, aligning with contemporary research findings. We have found that students who express greater proficiency in physics are often more concentrated and successful in their university physics course. Experiences during secondary education significantly influence choices related to higher education and resultant performance, with mathematical ability identified as essential for attaining success in physics and chemistry.

BIBLIOGRAPHY

Aslan, Sumeyye, Greta Fastrich, Ed Donnellan, Daniel J. W. Jones, and Kou Murayama. "People's Naïve Belief about Curiosity and Interest: A Qualitative Study." *PLOS ONE* 16, no. 9 (September 30, 2021): e0256632. https://doi.org/10.1371/journal.pone.0256632.

Bøe, Tore Dag. "Ethical Realism before Social Constructionism." *Theory & Psychology* 31, no. 2 (April 14, 2021): 220–36. https://doi.org/10.1177/09593543211004756.

Breetzke, Jonas, and Carla Bohndick. "Expectancy-Value Interactions and Dropout Intentions in Higher Education: Can Study Values Compensate for Low Expectancies?" *Motivation and Emotion* 48, no. 5 (October 20, 2024): 700–713. https://doi.org/10.1007/s11031-024-10088-9.

Britner, Shari L. "Motivation in High School Science Students: A Comparison of Gender Differences in Life, Physical, and Earth Science Classes." *Journal of Research in Science Teaching* 45, no. 8 (October 24, 2008): 955–70. https://doi.org/10.1002/tea.20249.

Durk, Jessie, Amy Smith, Bilgesu Aydın, Adèle Julia, and Isabel M. Rabey. "Using Expectancy-Value Theory to Understand the Teaching Motivations of Women Physics Lecturers." *Physical Review Physics Education Research* 20, no. 1 (June 28, 2024): 010157.

https://doi.org/10.1103/PhysRevPhysEducRes.20.010157.
Eccles, Jacquelynne S., and Allan Wigfield. "The Development, Testing, and Refinement of Eccles, Wigfield, and Colleagues' Situated Expectancy-Value Model of Achievement Performance and Choice." *Educational Psychology Review* 36, no. 2 (June 17, 2024): 51. https://doi.org/10.1007/s10648-024-09888-9.
Fielding-Wells, Jill, Mia O'Brien, and Katie Makar. "Using Expectancy-Value Theory to Explore Aspects of Motivation and Engagement in Inquiry-Based Learning in Primary Mathematics." *Mathematics Education Research Journal* 29, no. 2 (June 17, 2017): 237–54. https://doi.org/10.1007/s13394-017-0201-y.
Honicke, Toni, and Jaclyn Broadbent. "The Influence of Academic Self-Efficacy on Academic Performance: A Systematic Review." *Educational Research Review* 17 (February 2016): 63–84. https://doi.org/10.1016/j.edurev.2015.11.002.
Kostovicova, Denisa, and Eleanor Knott. "Harm, Change and Unpredictability: The Ethics of Interviews in Conflict Research." *Qualitative Research* 22, no. 1 (February 8, 2022): 56–73. https://doi.org/10.1177/1468794120975657.
Kricorian, Katherine, Michelle Seu, Daniel Lopez, Elsie Ureta, and Ozlem Equils. "Factors Influencing Participation of Underrepresented Students in STEM Fields: Matched Mentors and Mindsets." *International Journal of STEM Education* 7, no. 1 (December 21, 2020): 16. https://doi.org/10.1186/s40594-020-00219-2.
Meli, Kalliopi, Dimitris Pantazatos, and Sofoklis Goulas. "Achievement in Secondary-School Physics as a Predictor for University Physics Studies Choice and Acceptance." In *Research in Science Education. Pre-Print* . Pre-print on ResearchGate, 2023.
Meral, Mustafa, Esma Colak, and Ertan Zereyak. "The Relationship between Self-Efficacy and Academic Performance." *Procedia - Social and Behavioral Sciences* 46 (2012): 1143–46. https://doi.org/10.1016/j.sbspro.2012.05.264.
Narueponjirakoon, Pawinee, and Suwattana Eamoraphan. "A Comparative Study on Self-Efficacy For Performing Learning Inquiry Tasks and Attitudes Toward Learning Chemistry Through Inquiry-Based Laboratories In Grades 9-12 Students at Concordian International School, Thailand." *Scholar* 10, no. 1 (2018): 77.
Padmanabhan, P, R. R. Karle, and S. N. Jangle. "Assessment of Attitude and Approach Adopted for Studying Biochemistry amongst First-Year MBBS Students." *International Journal of Clinical and Biomedical Research*, 2015, 38–45.
Panergayo, Albert Andry E. "Self-Efficacy, Epistemological Beliefs, and Academic Performance in Physics: A Mediation Analysis." *Philippine Social Science Journal* 6, no. 2 (October 13, 2023): 46–52. https://doi.org/10.52006/main.v6i2.749.
Rieder, Annamina, U. Yeliz Eseryel, Christiane Lehrer, and Reinhard Jung. "Why Users Comply with Wearables: The Role of Contextual Self-Efficacy in Behavioral Change." *International Journal of Human–Computer Interaction* 37, no. 3 (February 7, 2021): 281–94. https://doi.org/10.1080/10447318.2020.1819669.
Sağlam, Havva, and Ayşenur Yontar Toğrol. "High School Students' Physics Achievement in Terms of Their Achievement Goal Orientations, Self-Efficacy Beliefs and Learning Conceptions of Physics." *Bogazici University Journal of Education* 35, no. 1 (2018): 31–50.
Scharrer, Erica, and Srividya Ramasubramanian. *Quantitative Research Methods in Communication*. New York : Routledge, 2021. | Series: Routledge social justice communication activism series: Routledge, 2021. https://doi.org/10.4324/9781003091653.
Silverio, Daniel L., Eugenia Villa-Cuesta, Alison Hyslop, Kevin Kolack, and Sabrina G. Sobel. "We Have More in Common than We Think: A Comparison of Scientific Skills and Disciplinary Practices in the Guiding Documents for Biology, Chemistry, and Mathematics." *Journal of College Science Teaching* 53, no. 5 (September 2, 2024): 472–79. https://doi.org/10.1080/0047231X.2024.2373027.
Sithole, Alec, Edward T. Chiyaka, Peter McCarthy, Davison M. Mupinga, Brian K. Bucklein, and Joachim Kibirige. "Student Attraction, Persistence and Retention in STEM Programs: Successes and Continuing Challenges." *Higher Education Studies* 7, no. 1 (January 16, 2017): 46.

https://doi.org/10.5539/hes.v7n1p46.
Tong, Tong, Feipeng Pi, Siyan Zheng, Yi Zhong, Xiaochun Lin, and Yajun Wei. "Exploring the Effect of Mathematics Skills on Student Performance in Physics Problem-Solving: A Structural Equation Modeling Analysis." *Research in Science Education* 55, no. 3 (June 7, 2025): 489–509. https://doi.org/10.1007/s11165-024-10201-5.
Tuan *, Hsiao-Lin, Chi-Chin Chin, and Shyang-Horng Shieh. "The Development of a Questionnaire to Measure Students' Motivation towards Science Learning." *International Journal of Science Education* 27, no. 6 (January 17, 2005): 639–54. https://doi.org/10.1080/0950069042000323737.
Vishnumolakala, Venkat Rao, Daniel C. Southam, David F. Treagust, Mauro Mocerino, and Sheila Qureshi. "Students' Attitudes, Self-Efficacy and Experiences in a Modified Process-Oriented Guided Inquiry Learning Undergraduate Chemistry Classroom." *Chemistry Education Research and Practice* 18, no. 2 (2017): 340–52. https://doi.org/10.1039/C6RP00233A.
Vuolo, Mike, Jeylan T. Mortimer, and Jeremy Staff. "The Value of Educational Degrees in Turbulent Economic Times: Evidence from the Youth Development Study." *Social Science Research* 57 (May 2016): 233–52. https://doi.org/10.1016/j.ssresearch.2015.12.014.
Wigfield, Allan, and Jacquelynne S. Eccles. "35 Years of Research on Students' Subjective Task Values and Motivation: A Look Back and a Look Forward." In *Advances in Motivation Science*, edited by Andrew J. Elliot, 7:161–98, 2020. https://doi.org/10.1016/bs.adms.2019.05.002.
———. "Expectancy–Value Theory of Achievement Motivation." *Contemporary Educational Psychology* 25, no. 1 (January 2000): 68–81. https://doi.org/10.1006/ceps.1999.1015.
Zhu, Zheng. "Learning Content, Physics Self-Efficacy, and Female Students' Physics Course Taking." *International Education Journal* 8 (November 1, 2007): 204–12.

ABOUT THE AUTHOR(S)

Dr. Nekhubvi oversees the curriculum review processes, quality assurance, and effective interventions to support at-risk students, including developing comprehensive early warning systems at the University of Venda. These proactive efforts improve student support and overall academic outcomes and facilitate the seamless integration of the Extended Curriculum Program into mainstream academic programmes. Dr Nekhubvi's focused work on ECPs in STEM education addresses pressing global challenges related to educational inequities and overall student success. The research conducted by Dr Nekhubvi herein addresses critical knowledge gaps, promotes student self-awareness and accurate self-assessment, and refines ECP frameworks to support underprivileged students more effectively. Dr Nekhubvi has published several peer-reviewed papers in the DHET-accredited list.

Miss Randela manages the review of courses, ensures quality, and creates support programs for struggling students at the University of Venda. This includes setting up methods to identify students who might need help early on. These actions help students get better support and improve their academic results, making it easier to include ECP in regular academic programs. Miss Randela's work on ECPs in STEM education tackles important world issues like educational inequality and helping students succeed. Miss Randela's study focuses on important knowledge gaps, helps students understand themselves better, improves how they assess their own skills, and enhances ECP frameworks to better support underprivileged students.