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Epistemological belief in control of knowledge and performance of Physics among secondary school students in Tharaka Nithi County, Kenya

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Abstract

The aim of this study was to investigate the extent to which students' epistemological beliefs in the dimension of control of knowledge acquisition relate to performance in the subject of Physics. The study used a mixed-methods research approach that included philosophical analysis, a descriptive survey and a correlational analysis. The research was steered by both the implicit intelligence philosophy and the constructivist learning theory. The sample size comprised 310 form two students, 60 Physics teachers and 20 heads of the science department. Quantitative data analysis techniques, including regression and correlation analysis, were used. The qualitative data from interviews provided deeper insights into how students' experiences and perceptions related to their beliefs about knowledge and Physics performance. The analysis of data was performed using tools in the SPSS version 26. The study revealed a positive correlation between sophisticated beliefs in control of knowledge acquisition and performance in Physics. From the findings of the study, the researcher concluded that sophisticated beliefs in control of knowledge acquisition contribute towards better performance in Physics. The study suggests the implementation of strategies aimed at fostering the development and adoption of sophisticated epistemological beliefs in control of knowledge acquisition among students to enhance their performance in Physics. The outcome of this study can inform educational policymakers, curriculum developers, and teachers in Kenya to design interventions that promote the development of students' epistemological beliefs in control of knowledge to stimulate performance in Physics.

Key terms: Control of knowledge, epistemological belief, knowledge acquisition, Physics performance, secondary schools.

INTRODUCTION

The immense efforts of improving performance in the sphere of science education are founded on its significance in solving the daily problems faced by humanity and the development of nations. In contemporary society, training in scientific literacy forms part basic of education in learning institutions. In the USA and Europe Physics community for a long time has been focusing on ways of improving teaching, learning and, consequently, the performance of Physics (Meltzer & Otero, 2015). Academic physicists in these developed countries of the world recommend student-centred approaches as part of the strategies for improving the performance of Physics (Calmer, 2019). However, Physics overall average points for students remain below 500 centre points for TIMSS advanced scale (Provasnik & Malley, 2019). This is despite the enormous resource allocation for the implementation of strategies and recommendations intended to improve the performance of Physics among the students. This being the case, it can be inferred that there exist other aspects that influence students' performance in Physics, even in developed countries, besides those already espoused by scientific studies. Developing countries like South Africa, Rwanda and Tanzania have adopted constructivist and interactive instructional practices like inquiry-based learning and problem-solving to enhance the caliber, attitude, and performance of Physics (Tambwe, 2017; Benek & Akcay, 2019; Mbonyiryivuze et al., 2021). Despite prospected benefits and projections of constructivist learning in improving the performance of science subjects, Physics education in developing countries schools continue to attract low students enrolment and poor performance, in addition to dismissive mind-set by learners

In Kenya, the enrolment and performance of Physics at various levels of education is low (Murei, 2016). Students also hold a belief that Physics comprises difficult tasks that are abstract and theoretical; the subject is boring and lacks employable opportunities (Muchai, 2016). This is despite publicising the immense benefits of Physics and robust studies based on the ideas of pragmatic epistemology and its ability to improve the performance of Physics. Studies in Physics learning in Kenya have revealed that there is an increasing student apathy towards sciences (Calmer, 2019; KICD, 2016). Students see Physics as boring and uninspiring. This has resulted in continued deprived enrolment, inadequate scientific inquiry skills, negative attitude and poor academic performance in Physics (MOEST-Kenya, 2015). For instant, the overall mean points of Physics in KCSE from the year 2017-2020 was 34.73 per cent out of the maximum score of 100 per cent. Although in the majority of schools, only high-achieving students choose to study Physics as an elective subject for the KCSE, the performance of Physics remains poor. Within Tharaka-Nithi County, the overall performance of Physics at KCSE is below that of the National level. This is as shown by the information in Table 1.

Table 1: Tharaka-Nithi County KCSE Physics Analysis from 2017 to 2021

Year	Total KCSE Candidates	KCSE Physics Candidates	KCSE Physics Average marks (%)
2018	15,980	3145 (19.68%)	26.80%
2019	16,899	3567 (21.10%)	23.11%
2020	17,603	3884 (22.06%)	24.43%
2021	18,999	4325 (22.76%)	25.50%
Overall	18,225	3,932 (21.49%)	25.71%

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Source: Tharaka-Nithi County Education Office (2021)

According to the data presented in Table 1, it can be observed that the collective academic performance and participation rate of students who study Physics at KCSE stood at 21.49 per cent and 25.71 per cent, respectively. The performance alongside the enrolment of Physics candidates in KCSE deviates significantly from the typical score of 50 per cent. Low enrolment and the dismal performance of Physics in Tharaka-Nithi County essentially is below the national statistics. The dismal performance is despite the persistent use of strategies recommended by CEMESTEA (2014), such as laboratory scientific inquiry, experimentation and project work that are perceived to promote Physics efficacy. This suggests that merely involving students in commonly employed scientific inquiry methods may not be enough to foster the growth of their learning and comprehension of Physics concepts. Conceptualising and interpreting epistemological concerns into realities can form a foundation for effective learning and improved academic performance. Therefore, the relation interactions between epistemological perceptions of individual students and efficacy in Physics were examined. Studies on the connections between epistemology and gaining knowledge in sciences have not received much research attention within Tharaka-Nithi County.

Studies have accumulated evidence supporting the ideas of the roles played by students' epistemological beliefs in their learning (Florian et al., 2017; Yuan-Hsuan, 2018). Research dwelling on how epistemological perspectives dictate learning in the context of science education is becoming more popular. Within a particular domain like Physics, students' epistemological beliefs can be associated with both their choice to participate in Physics education and the outcome of their learning. Students in Tharaka-Nithi County's secondary schools consistently demonstrate poor performance in Physics. This could be partially attributed to the epistemological viewpoints held by the students regarding Physics knowledge. The current investigation examined the relationship between beliefs in the control of knowledge acquisition and performance of Physics amongst secondary school students in Tharaka Nithi County, Kenya.

LITERATURE REVIEW

Epistemology, as a philosophical field, delves into inquiries regarding characteristics of knowledge, knowledge backgrounds or sources, knowledge-acquiring workflow, structure and boundaries of knowledge, and related philosophical questions (Hofer, 2004; Barzilai & Zohar, 2014). Epistemological beliefs are personal ideas or assumptions that people have concerning epistemologies of learning (Hofer & Pintrich, 1997; Velasquez, 2005). These beliefs encompass the perspectives held by individuals regarding the characteristics of knowledge, the system of acquiring knowledge, and the reasoning behind knowledge justification. According to Kumar and Sumanta (2018), epistemological belief is a psycho-philosophical theory related to a learner's conviction about acquiring knowledge. Within the field of education, epistemological beliefs pertain to how students acquire knowledge, the philosophies and principles they embrace regarding knowledge acquisition, and how these epistemological principles shape an individual's intellectual development (Barzilai & Zohar, 2014). According to Arslantas (2016), epistemological beliefs evoke questions such as how one comes to know, how new knowledge is created, how inferences are drawn and how one makes sense of pertaining knowledge. Epistemological beliefs could rationally be described as the application of epistemology on an individual level. Scientific epistemological outlook might be perceived to be perceptions held concerning scientific awareness characteristics and progression of acquiring scientific knowledge. As stated by Yenice (2015), the epistemological belief concerning features and foundations of scientific acquaintance is connected to individuals' philosophical perspectives in the context of a scientific expedition.

Aspects of knowledge control present a system of belief that ranges from a belief that learning capacity is a set of established talents at birth to learning accomplished through experiences (Arlindo, 2006). Under this dimension, individuals with naive views

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believe learning is an innate skill that remains consistent with time (Florian et al., 2017). Those who possess advanced beliefs about control of acquiring knowledge consider that ability to learn is acquired from the learning environment, and it can be improved and refined with time and experience (Kumar & Sumanta, 2018). Researchers have analysed the connection between the convictions held by students and academic performance (Arlindo, 2006; Barger et al., 2018). In accordance with Hofer (2010), individuals who hold a position knowledge is predetermined and unwavering most likely approach education in a very different way than someone who views knowledge as uncertain, developing, and built by the learner. Yusuf (2017) posited when an individual holds the belief that they do not possess an inherent capacity for learning, they could experience a sense of despair when confronted with challenging academic assignments. Conversely, whereas students hold the notion that their learning capacity is something that can be improved, they tend to exert additional effort, experiment with various study techniques, and adopt a resolute attitude to overcome challenging learning tasks.

An inquiry conducted by Barger et al. (2018) surveyed concepts of constructivism alongside the growth of personal epistemology among college-level students in the United States. The results of their investigation unveiled that individual perspectives on how knowledge is acquired have a crucial part to play in an educational setting that promotes constructivist learning and performance in chemistry. The results of their research also suggested that there is difficulty in changing students' epistemological beliefs over single-semester classroom intervention. Students whose epistemological beliefs matched instructional context were found to perform better in their final exam. Andrea et al. (2021) conducted a study on students' ideologies about cognition and training in Sweden and Germany and explored the relationship between these beliefs and their classroom environments. The comparison of multiple groups' unveiled variations in the students' convictions regarding control of how knowledge is acquired, as well as the characteristics of their classrooms. In addition, regression analysis revealed that classroom characteristics significantly predicted the epistemic beliefs of students on the justification for knowledge and progress patterns differed amongst nations. Sharma et al. (2013) explored students' epistemological beliefs, their expectations, and their Physics learning in India. The observations of the scrutiny unveiled that there existed a need to put in place strategies that take into account the influence of learners' opinions, perspectives, and expectations .upon entering the classroom to enhance their performance. In addition, the study revealed that epistemological beliefs might influence students' motivation and performance in Physics. However, studies by Andrea et al. (2021) and Sharma et al. (2013) did not factor in the association amid control of the acquisition of knowledge and performance in Physics. The current study investigated the relationship between control of the acquisition of knowledge and Physics performance among secondary school students in Tharaka-Nithi County, Kenya.

In another study, Bodin and Winberg (2012) examined how beliefs and emotions influence the strategies for solving numerical problems in the realm of studying Physics in Sweden. Their study's results indicated a limited connection between students' beliefs about knowledge and their objectives for achievement. The exploration also divulged that naive cognitive beliefs about knowing negatively affected students' performance. The study findings also uncovered the significance of epistemological beliefs in determining students' prowess to familiarise themselves with pragmatic solution-seeking situations. However, the study did not feature the aspects of epistemological beliefs and the performance of Physics among secondary school students. The present research explored the correlation between students' beliefs regarding their control over knowledge acquisition and their Physics performance. In Turkey, Ozlem (2015) conducted a study examining the epistemological beliefs, learning conceptions and personal effectiveness in relation to science education. The study's findings showed a correlation between students' epistemological views and their performance in biology which was satisfactory. The study further revealed that epistemological beliefs about justification positively related to the student's belief in their ability to learn biology. In another study, Sen et al. (2014) investigated relations between students' performance, motivation and the connections between educational approaches and fundamental beliefs about knowledge acquisition in Turkey. The study established there was an indomitable link between an individual's performance and the belief that learning relies on effort. However, the studies in Turkey investigated general epistemological beliefs under unspecified learning contexts. The current study examined the relationship intermediary to epistemological beliefs within the control of the acquisition of knowledge and performance of Physics among secondary school students.

An exploratory study in South Africa by Rudolf (2017) revealed that students have unique individual epistemological beliefs in the method used in the erudition of Physics principles. The studies on epistemological convictions carried out on learning Physics might be an essential resource that can be used to appraise the impacts of epistemological beliefs on the performance of Physics. In a preliminary investigation with Mozambican high school students, Arlindo (2006) noted that epistemological beliefs did not directly influence students' academic performance in sciences. Paradoxically, less sophisticated beliefs appeared to exhibit an optimistic learning outcome amongst the Mozambican learners. This contradicts the theory that holding naive beliefs about knowledge can result in poor performance, as these beliefs may encourage a proactive approach to learning. Philosophy of science highlights that learning Physics is an active and interactive mechanism that requires efforts to nurture meaningful learning and a profound conceptual understanding (Shin, 2015). The control of the knowledge dimension acknowledges that learning is flexible and evolving, challenging the notion that learning is fixed and inherent from birth (Basturk, 2016). Studies in various dimensions addressing the attitudes and epistemic convictions of beginners and experts have received a lot of attention from Physics education researchers (Bay et al., 2015). Investigations have also been carried out to reveal the possible link between the study habits of students and their epistemological convictions (Sharma et al., 2013; Dehui & Zwickl, 2018). However, the concept of the relationship between epistemological belief in control of attaining knowledge and performance of Physics has not received attention from Physics education researchers. In this study, the researcher investigated the relationship between beliefs in control of acquiring knowledge and performance in Physics. According to Blazer (2011), students who maintain the conviction that the capacity to acquire knowledge is experiential significantly outperform their counterparts who hold that learning ability is predetermined and innate.

METHODOLOGY

This study used a mixed-methods research approach that included a descriptive survey and correlational analysis. The choice of a descriptive survey methodology was adequate for this study due to its suitability in enabling the collection of quantitative data from closed-ended items for descriptive analysis. A correlational research design was employed to assess the level of association between epistemological beliefs and Physics performance. The sample size determination followed the formula proposed by Israel (2013).

$$n = \frac{N}{1 + N(e)^2} = \frac{15413}{1 + 15413(0.05)^2} = 390$$

The schools were categorised into the national, extra-county, county, and sub-county classifications from where samples were to be taken. A proportionate sample was used to get 20 public secondary schools and 310 students in each of the school categories. Purposive sampling was used to select 60 Physics teachers and 20 heads of the science department. The investigator adopted the drop-pick method as a means of distributing and collecting questionnaires from the participants. Heads of science departments of sampled schools were interviewed. Eight students in each school participated in the focus group discussion. The coded data was fed into a computer for analysis utilising Statistical Package for Social Sciences (SPSS) version 26. The qualitative data collected from the interview schedule and students' focus group interviews were analysed using a thematic approach. Measures of central trends, such as mean, coefficient of variation, and standard deviation, were used in descriptive statistics to examine quantitative data. Spearman's rho correlation (r) was employed to find out the magnitude and direction of the relationship between the variables examined in the study.

RESULTS AND DISCUSSION

Students' Responses on Naive Beliefs in Control of Knowledge

The participants were tasked with specifying their depth of consensus with several affirmations, which measured naive principles regarding control of knowledge acquisition and its connection to Physics performance. The findings are displayed in Table 2.

Table 2: Descriptive of Students' Naive Beliefs in Control of Knowledge

Statement	N	M	S.E	S.D
I believe that only certain students get good grades in Physics exam	304	3.52	0.071	1.243
I think that some students are just good at Physics experiments	304	3.95	0.058	1.012
I am sure that some students just understand Physics while others do not	304	4.08	0.052	0.901
I feel that how well you do in Physics depends on how clever you are	304	3.65	0.066	1.150
I think that some students are just good at solving Physics problems	304	3.86	0.058	1.017
Overall Mean Score	304	3.81	0.061	1.065

Information in Table 2 shows that respondents agreed that only certain students get good grades in Physics examinations (M=3.25, S.D= 1.243). Probing during the focus group discussion generated the following themes on the item that only certain students can get good grades in Physics.

Certain students get better grades in Physics exams because of their natural ability to grasp scientific concepts quickly. While effort and study play a role, some individuals have a natural liking and abilities for the subject that makes it easier for them to understand and excel in the subject.

Respondents strongly agreed (M=4.08, S.D= 0.901) that some students just understand Physics while others do not. These findings present that the majority of participants believed that students who are perceived to be brilliant in Physics were likely to pass Physics examinations. Respondents also agreed that some students are just good at doing Physics experiments (M=3.95, S.D= 1.012). They agreed with the suggestion that some students are just good at solving Physics problems (3.86, S.D= 1.017) and that how well you do in Physics depends on how clever one is (3.65, S.D= 1.150). These findings imply that most of the respondents believe that there is a cream of students with some sort of natural ability to learn and comprehend Physics. Probing students in focus group discussions on beliefs that some students were better at solving problems as well as carrying out Physics experiments, the following themes emerged:

Some students believe that certain individuals possess a natural aptitude for Physics, problem-solving and experimentation. They perceive these students as having an inherent ability to understand and apply concepts more effectively, resulting in better performance in problem-solving tasks and experiments.

According to the research results presented in Table 2, it is noticeable that the intermediate score for five specific measures of uninformed beliefs related to controlling the acquisition of knowledge was 3.81, with a standard deviation of 1.243. This suggests that a vast of students hold naive beliefs of control of knowledge acquisition in relation to the performance of Physics and that the performance of Physics was pegged on the innate ability of individual students rather than experience.

Students' Responses on Sophisticated Belief in Control of Knowledge

Information was sought on sophisticated epistemological beliefs in control of knowledge acquisition. Analysis of the respondents' opinion on sophisticated beliefs in control of knowledge acquisition is presented using Mean, standard deviations and standard errors in Table 3.

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Table 3: Descriptive of Students' on Sophisticated Beliefs in Control of Knowledge

Statement	N	Mean	S.D	S.E
I am sure that success in Physics has no relationship to the brightness of a student	304	2.41		0.077
I admit that any student can be good at doing a Physics experiment	304	2.65		0.075
I believe that any student has the potential of getting good grades in Physics	304	2.07		0.073
I am sure that it is possible to learn how to improve grades in Physics exams	304	1.97		0.061
I am sure that it is possible to learn how to improve grades in Physics exams	304	2.08		0.071
I believe that everyone has the potential of contributing ideas to a Physics lesson	304	2.41		0.077
Overall Mean Score	**304**	**2.27**		**0.072**

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The results displayed in Table 3 demonstrate that the participants held a contrary opinion, expressing their disagreement that it was possible to learn how to improve grades in Physics exams (Mean = 1.97, SD = 1.349, S.E = 0.077) and that any student has the potential of getting good grades in Physics Respondents disagreed (Mean = 1.97, SD = 1.349, S.E = 0.077). This implies that the respondents generally held a trust that good performance is for only selected individuals who are deemed as bright and talented in Physics. The respondents also disagreed that success in Physics has no relationship to the brightness of a student (Mean = 2.41, S.D = 1.349, S.E = 0.077) and that any student can be good at doing Physics experiments (Mean = 2.65, S.D = 1.309, S.E = .075). Upon probing students' reasons for their belief that not all other students possess the same level of ability to carry out experiments and solve problems in Physics generated the following themes:

Not all students are indeed equally good at solving Physics practical problems. Some students seem to have a natural ability for it, while others struggle.

Information in Table 3 indicates an overall mean score (Mean = 2.27, S.D = 1.263, S.E = 0.072) for the parameters used to measure the level of sophisticated beliefs in the control over knowledge procurement. The statements used to assess the students' agreement regarding their regulation of ideologies about the regulation of knowledge accession were phrased negatively. The overall mean scores imply that the majority of respondents agreed that a student's capacity to learn Physics depends on an individual's natural ability.

Teachers' Responses on Students' Naive Beliefs in Control of Knowledge

A thorough examination was conducted to produce statistical data regarding the average, variability, and uncertainty of the teachers' feedback on students' misconceptions about controlling knowledge acquisition. The findings are presented in Table 4.

Table 4: Teachers' Responses on Naive Beliefs in Control of Knowledge

Statement	N	M	S.D	S.E
Students admit that only certain students can get good grades in Physics exams	60	3.28	1.263	0.163
Students think that some students are just good at Physics	60	3.75	1.083	0.140
Students are sure that some students just understand Physics while others do not	60	4.05	1.064	0.137
Students feel that how well a student performs in Physics depends on their natural ability	60	3.45	1.171	0.151
Students admit that some of their classmates are just good at solving problems	60	4.02	1.017	0.131

in Physics				
Overall Mean Score	**60**	**3.71**	**1.120**	**0.144**

The ramifications presented in Table 4 advance that participants acknowledged only specific students are capable of achieving high grades in Physics exams (mean = 3.28, standard deviation = 1.263, standard error = 0.163). The respondents also agreed strongly agreed (M= 4.05, S.D = 1.064, S.E = 0.137) that students are sure that some students just understand Physics while others do not. These findings imply that a preponderance of students opined that good performance in Physics was a preserve of few individuals who were perceived to possess special academic talents and gifts that are inborn. Information in Table 4 conveys that the participants agreed that students believe that only some of their classmates are just good at solving problems in Physics (M= 4.02, S.D = 1.017, S.E = 0.131). This finding implies that students' teachers find that during problem-solving, the majority of the students believe that perfection in solving problems in Physics requires some natural endowment that is inborn. These findings illustrate that students held a naive belief that problem-solving skills in Physics depend on individual innate ability.

In conformity with the data presented in Table 4, the average tally of the chosen statements assessing students' naive epistemological beliefs regarding control of knowledge acquisition was found to be 3.71. The standard deviation of the scores was 1.120, and the standard error was 0.144. This implies that the participants agreed that students in Tharaka Nithi County had a simplistic belief regarding their ability to control the acquisition of knowledge, specifically in relation to their performance in Physics. This data suggests that the bulk of students thought their ability to perform in Physics was a fixed gift given from birth.

Teachers' Responses on Sophisticated Beliefs in Control of Knowledge

Information on students' naive epistemological assumptions regarding control over knowledge acquisition was obtained from the teachers in this study. Their response frequency is depicted in Table 5.

Table 5: Teachers' Opinions on Sophisticated Beliefs in Control of Knowledge

Statement	N	Mean	S.D	S.E
Students admit that any student can be good at doing a Physics experiment	60	2.62	1.379	0.178
Students believe that any student has the potential of learning Physics	60	2.73	1.351	0.174
Students are sure that success in Physics has no relationship to a student's special talent	60	2.25	1.348	0.174
Students are certain that it is possible to learn how to improve grades in Physics exams	60	2.17	1.167	0.151
Students are confident that everyone has the potential of contributing ideas in a Physics lesson	60	2.17	1.342	0.173
Overall Mean Score	60	2.39	1.317	0.170

The analysis highlighted in Table 5 illustrates that those who were surveyed were neutral that students admit that any student can be good at doing Physics experiments (M = 2.62, SD = 1.379, S.E = 0.178). During interviews with the HODs on whether students believed that 'any student can be good in doing Physics experiments' the following responses:

I am neutral on whether students believe that anyone of them can be good at doing Physics experiments because I believe it depends on various factors. Some students exhibit a notion that if they get proper guidance and practice, they can improve their skills in Physics experiments.

The respondents disagreed that students were sure that success in Physics has no relationship to a student's special talent (Mean = 2.25, S.D = 1.348, S.E =

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0.174) and that students were certain that it is possible to learn how to improve grades in Physics exams (Mean = 2.17, S.D = 1.167, S.E = 0.151). During interviews with the HODs on whether students believed that 'any student can be good in doing Physics experiments' the following responses:

I think most of the students believe that there is a strong connection between inborn cognitive aptitudes and their performance in Physics. The majority of students hold to believe that some individuals naturally possess the ability to think abstractly and make connections between theoretical concepts.

The findings showcased in Table 5 illustrate the average mark of the phrases utilised to assess the level of advanced beliefs in controlling knowledge acquisition and Physics achievement among high school students in Tharaka-Nithi County. The average score was 2.39, with a standard deviation of 1.317 and standard error = 0.170. The average scores, in general, illustrate that the bulk of the Physics teachers fathomed believed that students did not possess advanced beliefs regarding control of the process of acquiring knowledge in relation to their performance in Physics. Additionally, the research conducted interviews with Heads of Science Departments (HODs) to gather their perspective on students' perceptions regarding the connection between Physics performance and inherent special talents. Most of the HODs argued that students generally believe that some students are born with special competencies and talents that are directly related to success in Physics.

Correlation of Control of Knowledge and Performance of Physics

The motive of this study was to analyse how the beliefs of secondary school students in Tharaka-Nithi County regarding their control over knowledge acquisition affected their performance in Physics. The researchers used Spearman's correlation to explore the connections between naive beliefs, sophisticated beliefs, and Physics performance. The specific correlation outcomes can be found in Table 6.

Table 6: Correlation of Control of Knowledge and Performance of Physics

		Performance of Physics	Naive Belief in Control of Knowledge	Sophisticated Belief Control of Knowledge
Performance of Physics	Spearman's rho	1		
	Sig. (2-tailed)			
	N	304		
Naive Belief in Control of Knowledge	Spearman's rho	0.071	1	
	Sig. (2-tailed)	0.217		
	N	304	304	
Sophisticated Belief Control of Knowledge	Spearman's rho	0.246**	0.057	1
	Sig. (2-tailed)	0.000	0.318	
	N	304	304	304

*** Correlation is significant at the 0.01 level (2-tailed)*

The findings, displayed in Table 6, suggest that there exists minimal and inconclusive connection intermediary to measures of naive belief in control of knowledge acquisition and Physics performance. The correlation observed is weakly positive (r = 0.071) but lacks statistical significance (p-value = 0.127 > 0.01). The implication of the weakly positive correlation (r = 0.071) that lacks statistical significance (p-value = 0.127 > 0.01) on the performance of Physics is that there is a slight association between the two variables, but it is not strong enough to confidently conclude that the correlation is meaningful. This demonstrates that an increase in naive belief in control of knowledge acquisition would result in a minimal or insignificant improvement in performance. Therefore, based on these results, it is not appropriate to conclude that there is a significant impact of naive belief in the

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regulation of acquiring knowledge on the performance of Physics.

The findings in Table 6 also suggest that there is a modest yet statistically meaningful relationship between measures of sophisticated convictions of control of knowledge acquisition and the performance in Physics (r = 0.246, p-value = 0.000 < 0.01). The correlation coefficient (r) of 0.246 suggests a positive relationship between these factors, indicating that as the convictions of control of knowledge acquisition become more sophisticated, there tends to be an increase in Physics performance. The low p-value of 0.000 (< 0.01) further supports the significance of this relationship. The results of correlation analysis show that students who have sophisticated ideas about the factors influencing knowledge acquisition score better in Physics than their peers who have simplistic beliefs about how people learn new things, that is, whether they learn through experience or not. The positive correlation between a sophisticated belief in control of knowledge acquisition and performance in Physics implies that students who believe that knowledge of Physics does not depend on inborn capability have control over their learning process. These students are more likely to perform well in Physics than those who believe that only students born with unique skills can learn Physics.

Regression Analysis and Hypothesis Testing

The objective of the study was to investigate the association between beliefs in control of knowledge acquisition and the performance of Physics. The study assessed whether collected data adhered to the assumptions of ordinal regression by running a parallel lines assessment. Based on the findings of Alexopoulos (2010), if the parallel lines test yielded non-remarkable results, it would manifest that the model satisfied the assumptions of ordinal regression, leading to acceptance of the equality hypothesis. The null hypothesis postulated that location parameters for criterion and predictor variables were identical across response categories. The output of this analysis were presented in Table 7.

Table 7: Control of Knowledge Test of Parallel Lines

Model	-2 Log Likelihood	Chi-Square	df	Sig.
Null Hypothesis	435.837			
General	429.481	6.355	6	0.385

Link function: Logit

The data presented in Table 7 support the acceptance of the null hypothesis, as indicated by the p-value of 0.385, surpassing the critical value of 0.05. This advances that likelihood of epistemological beliefs in control of knowledge acquisition falling into different performance categories in Physics is equal across all response categories. It implies that the effects of these beliefs on performance levels in Physics are consistent, making the data suitable for ordinal logistic analysis. For the tenacity of evaluating the potency of relationship relationships between the variables under investigation, the subsequent hypothesis underwent examination.

There is no statistically significant relationship between beliefs in control of knowledge acquisition and performance of Physics among secondary school students in Tharaka-Nithi County.

A non-parametric nominal regression analysis was conducted to scrutinise the supposition due to the ordinal nature of the collected data, which did not follow a normal distribution. The nominal regression analysis was executed with a 95 per cent confidence interval (α = 0.05). The study examined the relationship between naive beliefs in the control of knowledge acquisition, sophisticated opinions in control of knowledge acquisition, and the performance of Physics. Various measures were harnessed to gauge the inclusive significance and entity essence of the regression modelling technique. They include model fitting information, goodness-of-fit, pseudo-R-square, and parameter estimates. Goodness-of-fit information was examined to determine if the model adequately described the data obtained in the study. This information included the Deviance and Pearson Chi-Square tests, which are

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useful for evaluating the adequacy of the model. According to Vakhitova and Alston-Knox (2018), significant test outputs for the model fitting data indicate a well-matched integration of the model and the information provided. The statistics related to the model fitting information can be found in Table 8.

Table 8: Control of Knowledge Model Fitting Information

Model	-2 Log Likelihood	Chi-Square	df	Sig.
Intercept Only	184.281			
Final	166.373	17.908	2	0.000

Link function: Logit

Table 8 displays the values that correspond to the -2 log-likelihood for two models: the null model, which only includes an intercept, and the final model, which includes all predictors. The outputs in Table 8 indicate a substantial augmenting of the final model's coherence when compared to the null model [$\chi^2(2)$ = 17.908, p-value = 0.000 < 0.05]. This suggests that the final model provides a significantly better explanation or prediction compared to the null model. The chi-square test statistic of 17.908 with 2 degrees of freedom and a p-value of 0.000 affords formidable substantiation to rebuff the null hypothesis. Thus, the ultimate model presents a markedly superior fit to the data than the null model.

The investigation determined the alignment of the actual data with the model that was created. This was done by conducting a test to evaluate the goodness of fit. The test involved using Pearson's chi-square statistic and the chi-square statistic based on deviance. The statistics offer valuable insights in determining whether the acquired data is in line with the optimised model. The yield of the Goodness-of-Fit test for control of knowledge acquisition and performance of Physics can be found in Table 9.

Table 9: Goodness-of-Fit for the Control of Knowledge Acquisition

Test Statistics	Chi-Square	df	Sig.
Pearson	41.779	56	0.921
Deviance	42.023	56	0.917

Link function: Logit

Table 9 presents valuable information regarding the Deviance and Pearson chi-square assessments, which are instrumental for assessing the adequacy of a model fit to the data. The findings in Table 9 indicate Pearson chi-square test [$\chi^2(56)$= 41.779, p-value = 0.921>0.05] and the deviance test [$\chi^2(56)$= 42.023, p-value = 0.917 > 0.05] did not reach statistical significance. The implication of Pearson chi-square assessments and the deviance test is the non-existence of pronounced evidence to reject the null hypothesis. To clarify, the outcome suggests that the model being tested exhibits adequate, appropriate alignment with data. The p-values, which outstrip the predetermined level of significance of 0.05, display that the observed differences between predictable and detected standards are likely due to random chance rather than any systematic deviation. According to Field (2018), inconsequential assay outcomes are pointers that the model precisely captures the data. Therefore, the representation's conformity to the data affords the flexibility of being considered acceptable based on these assessments.

To examine how much of the disparity in Physics performance can be vindicated by beliefs in control of knowledge (naive and sophisticated), a regression analysis was conducted. Kutty (2021) stated that in logistic regression models, pseudo-R-squared statistics are used to fulfil a similar role as the coefficient of determination in linear regression. Pseudo R-Square values generated were presented in Table 10.

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Table 10: Pseudo R-Square for Beliefs in Control of Knowledge

Parameter Measure	Pseudo R-square
Cox and Snell	0.363
Nagelkerke	0.364
McFadden	0.075

Link function: Logit

The data presented in Table 10 displays the Pseudo R-square values for Cox and Snell method (0.363), Nagelkerke method (0.364), and McFadden method (0.075). These values indicate a span of the alternation in the outcome variable can be justified by the model. Based on the Nagelkerke Method, the Pseudo R-square value of 0.364 indicates that about 36.4 per cent of the inconsistency in Physics performance is susceptible to convictions regarding control of knowledge acquisition using this method. Similar to the Cox and Snell method, the remaining variation is influenced by other factors. In contrast, the Pseudo R-square value of 0.075 obtained from the McFadden Method suggests that only 7.5 per cent of diversity in Physics performance can be rationalised by beliefs in the control of knowledge acquisition according to this method. Overall, these findings reflect that while beliefs in the control of knowledge acquisition have some explanatory power for Physics performance, they only account for a relatively small portion of the total variation. Factors beyond the scope of the model exert a significant influence on determining Physics performance.

The research strived to ascertain the weight and impact of specific variables in the mode by utilising parameter estimates statistics. These estimates indicate the likelihood of a case falling into a specific category on the dependent variable, either above or below. The parameter estimates obtained were then displayed in Table 11.

Table 11: Parameter Estimates of Control of Knowledge

		B	SE	Wald	df	Sig.	Exp(B)
Threshold	[Performance = 1]	-1.288	0.616	4.372	1	0.037	0.276
	[Performance = 2]	-0.353	0.611	0.334	1	0.563	0.703
Location	Naive belief in control knowledge	-0.158	0.132	1.443	1	0.230	0.854
	Sophisticated belief in control knowledge	0.226	0.086	6.932	1	0.008	1.254

Link function: Logit

According to data in Table 11, sophisticated epistemological views depicted substantial predictability of Physics knowledge acquisition (B = 0.226, SE = 0.086, p-value = 0.008 < 0.05). As the level of sophisticated epistemological views increases, there is a predicted increase in knowledge acquisition. Additionally, the standard error (SE) of 0.086 provides an estimate of the precision of the coefficient, indicating the variability around the estimated effect size. Furthermore, the p-value of 0.008 suggests that the interaction between sophisticated epistemological views and knowledge acquisition is statistically significant. In other words, the likelihood of obtaining such a relationship due to random chance is very low. These findings suggest that sophisticated epistemological views significantly predict knowledge acquisition. Students with augmented sophisticated views are susceptible to demonstrating higher levels of knowledge acquisition compared to those with less sophisticated views.

The study did not find naive epistemological beliefs in the control of knowledge acquisition to be a significant positive antecedent to performance in Physics (B = -0.158, SE = 0.132, p-value = 0.230 > 0.05). The parameter estimate (B) of -0.158 suggests that there is a negative relationship between naive epistemological beliefs in controlling knowledge acquisition and performance in Physics. However, since the value is negative, it implies that an increase in

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naive beliefs is associated with a decrease in Physics performance. The p-value of 0.230 is greater than the significance level of 0.05, which means that the relationship between naive epistemological beliefs and Physics performance is not statistically significant. In other words, the observed association is likely to have occurred by chance. These findings suggest that naive epistemological beliefs in the control of knowledge acquisition do not have a significant positive impact on performance in Physics. It implies that students with naive beliefs may not necessarily perform better in Physics compared to those with different beliefs.

DISCUSSION

The finding of both quantitative and qualitative data present that students' disagreed that not any students could be able to solve and carry out Physics experiments. These findings imply that students believed that innate ability was key to success in Physics experiments and problem-solving skills. Andrea (2021) found that believing innate ability is crucial in carrying out experiments and solving problems in Physics might inculcate a fear of failure in students. This fear might limit students' readiness to learn Physics which can hinder their overall growth in knowledge and performance. The students may also avoid challenging Physics problems or experimental tasks because they fear not measuring up to their peers who are perceived as naturally talented. This might lead to a lack of inclusivity of all cadres of students in the events of learning Physics, which can be part of the reasons for poor performance. The aforementioned themes reflect the viewpoints of the cross-examined students who expressed their agreement with the assertion that some students are better at solving problems and carrying out Physics experiments. These findings imply that the respondents held a belief that some students were naturally talented and, therefore, they had superior capacities for learning Physics compared to others. This finding can adversely influence the performance of Physics because students who consider themselves lacking the inborn ability to understand and solve Physics-related problems are likely to give up on learning the subject. Reddy (2020) noted that students who come into a Physics course with the belief that only gifted students are capable of problem-solving are liable to perform poorer than their colleagues who think that learning happens gradually.

The results of the study revealed that students had a belief that problem-solving in Physics depends on inherent capabilities. Problem-solving in Physics entails the application of several methods of analysing a problem and devising clarification. To accomplish the objective of Physics problem solving, students ought to perceive learning as a process that takes place gradually and requires effort rather than innate potentiality. To believe that gifted students would perform better in Physics problem-solving is an indicator that there were deficiencies in problem-solving skills among students. This finding agrees with that of Blazer (2011) indicated that students who maintain the conviction that learning ability is inherent performed poorly than their counterparts who hold that ability was gradual and experiential. Oktay and Oktay (2021) observed that students' appreciation and understanding that problem-solving was not reliant on individual students' innate ability had a prominent part in improving their performance in Physics. The belief that the ability to solve Physics problems depends on inborn mental capability could be part of the motives for the unsuccessful performance of Physics.

The findings from the focus group discussion are in line with the quantitative data on whether students believed that it is only some students who can get good grades in Physics. Both the quantitative and qualitative data imply that the respondents held a belief that some students were naturally talented and, therefore, they had superior capacities of getting good grades in Physics compared to others. These results concur with findings by Oguzhan and Oktay (2021) that high school students believed that inborn intelligence was essential in learning Physics. In contrast, the study conducted by Arslantas (2016) revealed that students with the belief that their acumen for learning was predetermined faced challenges in understanding Physics texts and implementing effective self-regulated learning methods. This suggests that students who think that their capacity to grasp Physics is solely based on innate abilities could experience lower academic performance in this particular subject. In Tharaka Nithi County, the majority of the students believe that

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innate ability is an essential component of learning Physics. This could be part of what led to the poor performance witnessed among the students.

Further probing of HODs revealed that students held deterministic views that success in Physics was based on what you are born with and no more. There was a notion that individual intelligence was not akin to a skill that could be refined by zeal. The respondent, in addition, strongly opposed the idea that students' view that success in Physics has no relationship to a student's special talent. This assertion displays that HODs perceived that students held the belief that intelligence is prioritised over diligence when it comes to achieving success in the field of Physics. The HODs also indicated that students do not consider it possible for any other student to learn how to improve grades in Physics exams and that everyone is capable of contributing ideas in a Physics lesson. Sengul (2020), through an interview, also revealed that students believed that performance in sciences was more related to adopting the right study habits rather than innate abilities. If students believe that their natural talent is the sole factor determining success in Physics, they might have reduced inspiration to entrust time and vigour to learning. They may feel that if they do not possess the innate ability, their efforts will be futile. As a result, they may not dedicate the necessary time and energy to fully understand and master Physics concepts and skills.

The overall ascertainment gleaned from the study reveals that although many factors affect the performance of Physics, it was not possible to separate success in Physics from the concept of natural ability. They argued that being smart is frequently associated with performance in Physics. Believing that innate ability is superior in determining student performance in Physics can undermine the importance of effort and deliberate practices of learning Physics concepts. This could contribute to overall poor performance among the students. This finding concurs with that of Ozlem (2015), who found that ingenuous belief in the regulation of knowledge accession had negative relations with conceptions and learning of sciences. In addition, the results corresponded with research conducted by Bodin and Winberg (2012) regarding the significance of beliefs in the process of solving numerical problems in Physics. The study discovered that students' performance was adversely affected by their naive epistemological beliefs. Students who hold naive beliefs in control of knowledge acquisition may overlook the significance of consistent practice, perseverance, and seeking help when needed to overcome the challenges of their learning. This could mistakenly attribute the success of learning Physics solely to talent rather than hard work and might lead to poor performance.

CONCLUSION AND RECOMMENDATIONS

Conclusion: The overall mean tally for naive beliefs in the influence of acquisition knowledge indicated that respondents agreed with the parameters measuring naive beliefs in control of knowledge acquisition and performance of Physics. The overall mean outcome for sophisticated beliefs in the control of knowledge acquirement for the students and teachers revealed that the respondents disagreed with the selected statements assessing sophisticated beliefs in the control of knowledge acquisition and performance of Physics. Findings from the interviews and students' focus group discussions revealed that the respondents had views that most of the students held believe that performance in Physics was dependent on special abilities that some students possess at birth. The correlation between naive beliefs in control of knowledge acquisition and performance in Physics was very weak and statistically insignificant, while the relationship between sophisticated beliefs in control of knowledge acquisition and performance in Physics was modestly positive and statistically significant. Ordinal regression analysis demonstrated that sophisticated beliefs in control knowledge acquisition significantly and positively predicted performance in Physics, whereas naive beliefs in control knowledge acquisition manifested a detrimental and inconsequential correlation with performance in Physics.

Recommendations: Encouraging students to embrace sophisticated beliefs in control knowledge acquisition can improve Physics performance. This can be done by fostering a growth mindset that emphasises the development of intellectual abilities through effort and practice. Teachers should create a supportive and inclusive environment to promote sophisticated beliefs in control of knowledge acquisition during

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Physics education by empowering students to believe in their potential and strive for success.

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