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Influence of out-of-school experiences on students' choice of physics at advanced level in Uganda. A cross-sectional study.

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Abstract

Introduction

The study aims to identify the types of out-of-school experiences that students perceive as influential in choosing physics for the Advanced level and to establish the relationship between Out-of-school experiences and the decision to study physics at the Advanced level.

Methodology

The study adopted a cross-sectional survey and descriptive research design. A total number of 133 students from 9 (3 private and 6 government) advanced-level secondary schools in Kabale District participated in the study. Purposive and stratified sampling approaches were used in particularly for the schools to participate in the study. Instruments used for the study included a questionnaire and interview guide for S.5 Arts and Science students.

Results

The respondents are predominantly males (61%) compared to females (53%), and their age distribution (16 -18) is characterized by (55%). The subject combination shows a relatively balanced distribution between sciences (53%) and arts (50%), with sciences being slightly more represented. Findings of the study indicated that a number of out-of-school experiences significantly influence students' choice of Physics at the Advanced level. In addition, there is a strong relationship between out of school experiences and the decision to opt for the subject at A level. According to the chi-square test, results were statistically significant in all cases, with $p < 0.05$ in all cases.

Conclusion

Based on the study findings, it was concluded that out-of-school experiences significantly influence students' choice of physics at A level.

Recommendation

It was recommended that educators and policymakers should consider integrating activities like extracurricular involvement, informal learning engagements, and supportive peer and teacher relationships to serve as catalysts that enhance students' interest and motivation towards the subject to offer at the Advanced level, and experiences into educational frameworks to promote greater interest in Physics among students.

Keywords: Advanced level, Out-of-school experiences, students' choice, Physics
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Introduction

The selection of a science combination is one of many important choices students make in determining their future career (Nyambuya & Onyango, 2020). A career is the sequence of major positions occupied by a person throughout his/her lifetime. Everyone has to make choices at different stages in their lives. Career choice is influenced by multiple factors, including personality, interest, self-concept, culture identity, globalization, socialization, and the availability of resources such as the availability of information and finances (Nyambuya & Onyango, 2020). This decision of career choice is not well handled, which may impact them throughout their lives. The essence of who the student is revolves around what students want to do with their lifelong work at the Advanced level. Every student carries a unique history of their past, and this determines how they view the world. That history, created, in part, by the students' out-of-school experiences, will determine how students make subject choices. It then follows that how the student perceives their out-of-school experiences will also determine the subject choices students make.

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The decision to pursue physics at an advanced level is influenced by a multitude of factors, including classroom experiences, personal interests, and out-of-school encounters. Out-of-school experiences, such as participation in science fairs, tinkering with technology, or exposure to real-world applications of physics, can significantly shape students' perceptions and attitudes towards the subject (Bell et al., 2017; National Research Council, 2015). These experiences provide hands–on and minds-on learning opportunities, foster curiosity, and often make abstract concepts more tangible, real, and relevant. Research suggests that out-of-school experiences can play a pivotal role in sparking and sustaining students' interest in science, technology, engineering, and mathematics (STEM) fields, including physics (Potvin & Hasni, 2014; Maltese & Tai, 2016). For instance, Dabney et al. (2016) found that participation in science-related extracurricular activities was a strong predictor of students' interest in pursuing STEM careers. Similarly, Maltese and Tai (2016) highlighted the importance of informal learning experiences in shaping students' long-term interest in science.

Purpose

The study aims to investigate the influence of out-of-school experiences on students' decision to study physics at an advanced level, with a focus on identifying the types of experiences that are most impactful and understanding how they contribute to students' interest and confidence in physics.

Objectives of the study

1. To identify the types of out-of-school experiences students perceive as influential in choosing physics at the Advanced level.

2. To establish the relationship between Out-of-school experiences and the decision to study physics at the Advanced level.

Methodology

Research design

A cross-sectional survey design and descriptive method that employed both qualitative and quantitative techniques was adopted. The cross-sectional survey design was used because it was able to generate a sizeable amount of data from a cross-section of the target group – S.5 and S.6, both Arts and Science students from the sampled schools. The students should have studied the physics subject and passed it with at least a credit in Senior four.

Table 1. ***Sample size and Sampling Procedure***

Sample	Sample size	Sampling procedure
Schools	9	Stratified random sampling
Counties	3	Purposive
Students	103	Stratified random sampling
Teachers	5	Purposive and Stratified Random sampling
Parents	5	Purposive

Source : Primary data 2022

Note, Based on the Krejcie and Morgan table, a sample size corresponds to a population size of (N) of 140.

Instruments

Instruments which are valid and reliable were used, which included the questionnaire and interview guide. The S5 Science and Arts students attempted the Self-administered questionnaire to obtain their independent views. The researcher also used an interview guide to get respondents' opinions about the issues under investigation. Only 30 students (17 boys and 13 girls) were interviewed from five schools chosen both girls and boys from S5 Science and Arts classes. During interviews with students, the researcher concentrated on the factors influencing students from opting for Physics to a higher level. Interviews were also administered to teachers and parents from the schools around.

Data analysis

Quantitative data was coded and entered into the computer software (SPSS), is run, and analyzed using cross tabulation, chi-square, and later presented in the form of frequency count /score tables and cross tabulations. Inferential analysis was employed to draw conclusions concerning differences in research results using Pearson's chi-square test. χ 2-test was used to determine whether the variables are statistically significant or if there are associated. Data from interviews were content analyzed, and from each item, responses were grouped into key

themes, and later interpretations were drawn. Verbatim quotations were also used where necessary.

Ethical consideration

Neuman (2006) looks at ethics in research as what is or is not legitimate to do, or what moral research procedure involves. It is acknowledged that the need to obtain valid and reliable data shall oblige the researcher to seek and access information that participants may rather keep under wraps. Permission in selected schools and departments was secured from heads of the respective organisations. All physics teachers and their students were informed about the study rationale and were asked to sign consent forms. Therefore, all ethical issues like informed consent, privacy of all respondents, and confidentiality were all observed.

Findings

Four questionnaire items were used to capture the key information pertaining parents'/guardians' knowledge in Physics, what friends /peers /relatives /neighbors that completed school before used to say about Physics/education trips, how people known to students performed in Physics at Advanced level /having or attending science fair / school clubs before, and parents'/guardians' interest in Physics.

Table 2.(a) ***Description of respondents by school***

School	**No. of students**	**Percentage (%)**
Apos	15	14.56
Bashaps	10	9.71
Kic	5	4.85
Fck	5	4.85
Smago	10	9.71
Smacorush	9	8.74
Spasco	29	28.16
Buks	15	14.56
Rusem	5	4.85
Total	**103**	**100.00**

Note that these are not real names of schools visited.
Source: Primary data, 2022

Table 2. (b): ***Description of students by age, sex and subject combination***

Age group	**Frequency**	**Percentage (%)**
16-18	55	53.40
19-21	41	39.8
22-24	5	4.85
25-27	0	.00
28-30	1	.97
Missing system	1	.97
Sex		
Male	61	59.2
Female	39	37.9
Missing response	3	2.9
Combination		
Arts	50	48.54
Sciences	53	51.46

Source: Primary data,2022

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Table. 3. ***Variation of frequencies of measures of out-of school experiences with choice of physics***

Items		SD		D		A		SA		TOTAL	
1	My parents/guardians have limited knowledge about physics	8	10	17	16	8	11	10	11	43	48
2	My parents/guardians show limited or no interest in physics	5	9	3	10	20	14	14	16	49	43
3	My friends/ peers / relatives/ neighbors that completed schools before used to tell me physics is learnt well through education trips/science fairs	5	7	7	12	15	21	16	10	43	50
4	Most of the people known to me who took physics at Advanced level before did not pass it	8	10	1	4	14	17	20	18	49	43

Whereby; SD = Strongly disagree. D = Disagree. A = Agree. SA = Strongly Agree.

According to cross tabulations, it shows that a total of 51 students either disagreed or strongly disagreed, their parents had limited knowledge in physics. It is apparent that majority of the parents did not have limited knowledge in physics. The other group of 40 students either agreed or strongly agreed that their parents/ guardians had limited knowledge in physics. Of these 18(45%) chose physics while 22(55%) did not choose physics.

The chi-square test produced results which were statistically significant ($\chi^2 = 0.419$, df = 3, p = 0.05). For item 2 according to Table 3 analysis showed that Students who either agreed or strongly agreed were 64. Of these, 34(53%) chose physics while 30(50%) did not choose physics. Almost equal number of students whose guardians had limited / no interest in physics did not choose physics at A level. Chi square statistics showed the association between the choice of physics and parents/ guardians. ($\chi^2 = 5.842$, df = 3, p = 0.03). This implies that parents/guardian's interest in physics was responsible for students' choice of physics at A level.

For item 3, 26(28%) students strongly agreed while 36(38.7%) agreed, that they were told about physics for A level being difficulty by people who completed school before. Thus, a total 62(66.7%) were told that physics is difficult, of these 31(50%) chose physics and an equal number did not 31(50%). Of these 12 (38.7%) chose physics while 19(71.3%) did not. Thus, majority of the students that were not told of physics being difficult went ahead to choose it. Chi-square test suggests that the association between the two variables is statistically significant ($\chi^2 = 5.842$, df = 3, p = 0.03). This implies that students' choice of Physics was highly impacted by the following factors like parents'/guardians' knowledge in Physics, what friends /peers /relatives /neighbors that completed school before used to say about Physics/education trips, how people known to students performed in Physics at Advanced level / students' attendance of science fair / school clubs before. This is also a call for schools not only concentrating on formal classrooms but also invest in other avenues like education trips, science clubs /fairs to mention.

For item 4, Results show that 69 of the 92 students answered the questionnaire. Of these, 35(50.7%) went ahead to choose physics while 34(49.3%) did not. Students, 34(37%) chose physics at Advanced level while 37 (40%) did not. It is therefore possible, that students' perception about whether physics is passable, influenced their choice of physics at Advanced level. Chi square results are as shown below. ($\chi^2 = 5.842$, df = 3, p = 0.02). This shows that the association is statistically significant.

Data from the interview guide was content analyzed and responses coded into major and minor categories upon which the interpretation and discussion were made as in Table 4.

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Table 4. ***Major categories and minor categories were identified in Qualitative interview***

Theme	Major category	Minor category
School background	Mixed or Single sex schools	Mixed, Single schools
Application	Major topics	Calculations, mechanics, motion, trigonometry,
Attitude to physics	Areas of interests	Electricity, careers Involving physics, marketable courses, daily application in physics
Societal attitude and influence	Very key in choice, Students may help their fellows than those outside i.e. peer influence	
External influence and learners' exposure to physics related	Influences learners' choice	
Extracurricular activities dominance in teaching/learning	Students highly change their attitudes towards physics	

When parents were interviewed, one parent [Po1] had this to say;

"Attending studies outside class…. and allowing learners to see what others have done in science fairs…… really adds interest and morale to take on these subjects."

According to teachers and parents, the physics syllabus demands a lot and if it is poorly handled, causes students from choosing it at the Advanced level. Teacher **T1** had this to say;

"*Haaa, the misconception our learners developed from their peers and looking at the results of their friends as the root causes of not opting for the subject*."

Discussion

Out-of-school experiences significantly influence students' choice of physics at the advanced level, with hands-on activities, real-world applications, and role models / mentors playing a crucial role in shaping their interests and attitudes (Veznedaroglu et al., 2020; Bello & Adefolarin, 2023). For instance, hands on activities and practical experiences foster deeper understanding and appreciation for physics by students (Nicholas, et al, 2017). This implies that integrating real-world examples into physics education makes learners love the subject. Furthermore, real-world applications make physics more relevant, implying that more opportunities for hands on activities and projects. It is also noted that role models and mentors inspire and motivate students to pursue physics, to advance the implication of promoting diversity and inclusion in physics education. Therefore, by acknowledging the impact of out-of-school experiences, educators can develop targeted strategies to encourage students to pursue physics to an advanced level.

Conclusion

From the findings, out-of-school experiences significantly influence students' choice of physics at A level. These experiences, encompassing family and community influence, extracurricular activities, media exposure, and peer interactions, collectively shape students' perceptions and interests in offering physics to higher levels. Understanding these experiences can help educators and policymakers develop strategies to support and encourage students in pursuing physics, ultimately contributing to the development of a scientifically literate and innovative society.

Limitations

Key limitations of out-of-school experiences on students' choice of physics include;

Limited access and equity: Not all students have equal access to out-of-of school experiences, creating disparities in interest and motivation.

Variable quality and relevance: The quality and relevance of out-of-school experiences can vary, potentially reducing their impact on students' interest in physics.

Short-term impact and lack of follow-up: Out-of- school experiences may have a short-term impact, require sustained support and follow up to maintain students' interest in physics to an advanced level.

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Recommendations

Educators and policymakers should consider integrating activities like extracurricular involvement, informal learning engagements, and supportive peer and teacher relationships to serve as catalysts that enhance students' interest and motivation towards the choice of physics subject to the Advanced level, and experiences into educational frameworks to promote greater interest in Physics among students.

Acknowledgement

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List of Abbreviations

A Level = Advanced Level
SPSS = Statistical Package for Social Scientists
STEM = Science, Technology, Engineering, and Maths

Source of funding

The study was self-funded.

Conflict of Interest

The author had no conflict of interest.

Author Contribution

Evaristo Tukamuhabwa (PhD) came up with **the** idea by developing a study idea and design, went ahead to think about the relevant methodology, tools to use, and all other essential /necessary areas to make the paper fit for publication.

Data availability

The data used in this study are available from the corresponding author upon reasonable request. By following the journal guidelines, the data will be freely accessible.

Author Biography

Evaristo Tukamuhabwa (PhD), as an Educationist and an assessor, and above all, a senior researcher, is passionate about small numbers of students who opt for physics in the advanced level, amidst sciences being compulsory, and in addition, physics being the backbone of all STEM subject combinations!

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