Article DOI: https://doi.org/10.37284/eajhs.6.2.1650

East African Journal of Health and Science
eajhs.eanso.org
Volume 6 Issue 2, 2023
Print ISSN: 2707-3912 | Online ISSN: 2707-3920
Title DOI: https://doi.org/10.37284/2707-3920

EAST AFRICAN NATURE & SCIENCE ORGANIZATION

Original Article

Why and How is the Difference? Fixed and Growth Mindsets in Mathematics among O-level Secondary School Students in Wakiso District, Uganda

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Article DOI: https://doi.org/10.37284/eajhs.6.2.1650

Date Published: *20 December 2023*

Keywords: *Mindset, Fixed Mindset, Growth Mindset, O-level Secondary School Students.*

ABSTRACT

People's beliefs tend to impact them in all aspects of life. One of the things that can solve the puzzle of mathematics and science, in general, is the mindset, which is a view of one's ability as either static or malleable. This study evaluated the mindsets of Senior 3 students in Mathematics in Wakiso District and the reasons for adopting those mindsets as revealed in student and teacher narratives. Three hundred thirty-two (332) students participated in the quantitative study, while six students from each school took part in qualitative focus group discussions, and one O-level mathematics teacher from each school took part in a qualitative key informant interview. The quantitative results showed that more students had a growth mindset (M = 14.86, SD = 3.81) than a fixed mindset (M = 11.63, SD = 3.88). However, a considerable number of students held a fixed mindset; as also evidenced by the qualitative data, there were no statistically significant differences in mindsets among the various demographics. Qualitative findings showed that past performance, peers, parents, teachers, and other socialisers were influential in promoting growth or a fixed mindset. The study concludes that even though many students have a growth mindset, many external factors can cause them to adopt a fixed mindset in mathematics. Since mindsets can change at any time, it is everyone's responsibility to change students' mindsets toward mathematics for the best results.

APA CITATION

Nakasiita, K. N., Baguwem, A., Kibedi, H. & Olema, D. (2023). Why and How is the Difference? Fixed and Growth Mindsets in Mathematics among O-level Secondary School Students in Wakiso District, Uganda *East African Journal of Health and Science*, *6*(2), 92-104. https://doi.org/10.37284/eajhs.6.2.1650.

CHICAGO CITATION

Nakasiita, Kirabo Nkambwe, Ali Baguwem, Henry Kibedi and David Olema. 2023. "Why and How is the Difference? Fixed and Growth Mindsets in Mathematics among O-level Secondary School Students in Wakiso District, Uganda". *East African Journal of Health and Science* 6 (2), 92-104. https://doi.org/10.37284/eajhs.6.2.1650.

HARVARD CITATION

Nakasiita, K. N., Baguwem, A., Kibedi, H. & Olema, D. (2023) "Why and How is the Difference? Fixed and Growth Mindsets in Mathematics among O-level Secondary School Students in Wakiso District, Uganda", *East African Journal of Health and Science*, 6(2), pp. 92-104. doi: 10.37284/eajhs.6.2.1650.

Article DOI: https://doi.org/10.37284/eajhs.6.2.1650

IEEE CITATION

K. N., Nakasiita, A., Baguwem H., Kibedi & D., Olema, "Why and How is the Difference? Fixed and Growth Mindsets in Mathematics among O-level Secondary School Students in Wakiso District, Uganda", *EAJHS*, vol. 6, no. 2, pp. 92-104, Dec. 2023.

MLA CITATION

Nakasiita, Kirabo Nkambwe, Ali Baguwemu, Henry Kibedi & David Olema. "Why and How is the Difference? Fixed and Growth Mindsets in Mathematics among O-level Secondary School Students in Wakiso District, Uganda". *East African Journal of Health and Science*, Vol. 6, no. 2, Dec. 2023, pp. 92-104, doi:10.37284/eajhs.6.2.1650.

INTRODUCTION

All science courses require the study of mathematics as a prerequisite (Duru & Okeke, 2021), and it is used in all aspects of life (Salifu & Bakari, 2022;). UNEB, the exam-accrediting body in Uganda has demonstrated that Science, Technology, Engineering, and Mathematics (STEM) subjects in Uganda face numerous difficulties, including low performance, a small number of students enrolling in mathematics courses, and numerous questions about the nature of the issue and potential solutions. It is more evidenced by the few students that continue studying mathematics beyond the O-level, despite it being compulsory at O-level. For instance, only 31,729 of the 330,080 who sat the UCE Mathematics paper in 2019 continued with it at A-level (UNEB, 2023). Whether students' mindsets are a factor in their mathematics problems, is the main unanswered question.

In contrast to other verbal subjects, mathematics requires entirely new abilities, concepts, or mental systems, which might be confusing. This uncertainty causes students to question whether their ability for mathematics is a gift, a talent that they either have or do not have, or something that can be learned, which challenges their desire for, interest in, and study of the subject (Dweck, 2007). We argue that the mystery around the performance and learning of mathematics can be explained using the concept of mindset, which was developed to address why learners with nearly equal abilities respond to challenges in different ways. According to Dweck (2017), a person's mindset refers to their beliefs about their characteristics, capacities, attributes, and abilities. This study aimed to evaluate the differences in mindsets in mathematics among O-level students. Learners' views about themselves can influence their lives, particularly when faced with difficulties.

Mindset is categorised as fixed and growth mindsets (Dweck & Yeager, 2019). People may have different mindsets on certain domains, such as their ability for science subjects generally versus their ability for mathematics specifically. Effects are often stronger for assessments of domain-specific ability (Burnette et al., 2020). Students who have a growth mindset in educational settings feel that human attributes, such as mathematical ability, can be improved, for instance, by learning and effort, whereas those who have a fixed mindset think that such features cannot be improved (Dweck 2006; Mofield & Peters, 2018; Huang et al., 2019). Depending on one's mindset, life might have different meanings (Dweck, 2006; Dweck & Yeager, 2019). In the following section, we discuss the differences in mindset that can potentially drive the learners' adaptation to and learning of mathematics.

Differences in Mindsets among Students

Dweck et al. (2014) advise paying attention to the psychology of the learner and noncognitive factors while attempting to understand how they learn, with mindset being one of these noncognitive factors. According to Dweck (2017), a person's belief in either a fixed or growth mindset might affect their psychology and quality of life. Students who have a growth mindset are more likely to see obstacles as learning opportunities not based on their current ability, accept and embrace their weaknesses, learn to give and receive constructive criticism, prioritise learning over seeking approval, concentrate on the process rather than the product, be motivated by others' successes, view learning as brain training, see failure as an opportunity to grow, persevere and persist in the face of setbacks, put effort into

Article DOI: https://doi.org/10.37284/eajhs.6.2.1650

their studies even when the content seems difficult. Those with a fixed mindset, on the other hand, shy away from challenges, are unable to handle feedback or criticism, believe that intelligence and talent are fixed and do not develop after birth, are constantly looking for approval, are threatened by other people's success, do not believe that effort is fruitful, and easily give up when faced with difficulties like failure (Claro & Loeb, 2019; Dweck, 2006, 2017; Dweck & Yeager, 2019; Jacobs, 2019). Gouëdard's (2021) study reveals, for instance, that students with a growth mindset valued school more, set more ambitious learning goals, reported higher levels of self-efficacy, showed higher levels of motivation, and experienced less math failure. The opposite was true for students with a fixed mindset. Students who had a fixed mindset, on the other hand, tended to have high levels of failure anxiety and low levels of mathematical motivation. Gouëdard further observed that the results from participants in 78 countries revealed that more students who participated in PISA exams had a growth mindset than a fixed mindset.

In a study about mindset and motivation in secondary schools in science among students aged 15-17 in England, Bedford (2017) found a variety of mindsets. Further, a growth mindset was more prevalent among students than a fixed mindset, and no significant difference existed between them. Glerum et al. (2020) conducted another study among VET students who had taken a mathematics and English exam and discovered that 13.9% of the students had a fixed mindset, 47.3% had a growth mindset, and 38.8% had a mixture mindset, but the findings were not statistically significant. Snipes and Loan (2017) found out that most of the students who participated in their study had beliefs consistent with the growth mindset in mathematics. This implies that if different students hold different mindsets, they can influence each other to change their mindsets from either growth to fixed or vice versa, or there may be other factors instilling these mindsets among learners.

In general, though mindsets are frequently considered as traits that one possesses or lacks, in reality, they may vary depending on the circumstance, and everyone experiences both growth and fixed mindsets on occasion. There are specific people, situations, or events that have an impact on our mindsets. For instance, being in a setting where one feels stereotyped judged, or where mistakes are not accepted may result in having a fixed mindset (Dweck, 2017). One of the elements linked to variations in mathematical mindset is gender. This is related to the assumption that girls are less naturally gifted than males in the domains of science, technology, engineering, and mathematics (STEM) and that this stereotyped threat has a negative impact on them. A growth mindset message can protect against the negative effects of the fact that mathematics ability is fixed and women have more fixed abilities than men, which messages diminish women's intent to continue in mathematics (Dweck, 2007; Burnette et al., 2020). Yet, prior research has produced contradictory findings. For instance, Claro and Loeb (2019), in a study of mathematics students in grades 4–7, discovered that girls demonstrated a higher growth mindset than boys. In contrast, Burnette et al. (2020), Mcpartlan et al. (2020), and Donohoe et al. (2021) discovered that there were no significant distinctions between the mindsets of females and males. Gouëdard's (2021) results indicated that in 39 countries out of 78, girls presented a higher growth mindset than boys in sciences; in only six countries, boys demonstrated a higher growth mindset than girls. In 32 countries, there were no significant differences in mindsets across gender.

Farrington et al. (2012) point to students' performance. Bedford (2017) lists influences on students' mindsets related to earlier beliefs of mathematics, parent or sibling experiences in mathematics and science, the setting in which students learn science and mathematics, and peer impact. Gouëdard (2021) mentions the socioeconomic status of the family, Donohoe et al. (2021) age and ability groups, and Dweck (2017) teachers, coaches, and significant others. Results

Article DOI: https://doi.org/10.37284/eajhs.6.2.1650

on the factors mentioned above show varying findings. King (2020) found out that peers affected one another's mindset in a study on the contagiousness of mindsets and concluded that mindsets are socially contagious and may be acquired from various socialising agents. However, Haimovitz and Dweck (2016) did not find a direct link between parental and children's mindsets. Likewise, Park et al. (2016) did not find a direct link between teachers' and children's mindsets, but Gouëdard (2021) showed that teachers influenced students' mindsets.

Regarding socioeconomic status, Claro and Loeb (2019), Gouëdard (2021), and Snipes and Loan (2017) found that there were differences in mindset according to socioeconomic status, with students from socio-economically advantaged backgrounds presenting a growth mindset more often and those from low socioeconomic backgrounds presenting a fixed mindset. Contrary to that, Mcpartlan et al. (2020) found no significant differences among students by socioeconomic status. Regarding age, Donohoe et al. (2021) did not find any significant differences in mindset across age. Concerning ability levels, Claro and Loeb (2019) found out that students with higher grades had a higher mindset (growth mindset) than low achievers. According to the contradicting results regarding mindset, every learner can cultivate a growth mindset. The literature points out that there still exist differences in mindset towards mathematics in other contexts. Still, no study has been done about mindsets in mathematics in Uganda and why students hold those mindsets. The literature in other contexts necessitates research about students' mindsets in Uganda.

Based on the literature and differences in settings, it is anticipated that there would be differences in students' mathematical mindsets in Uganda. These differences are also expected across gender, age, school type, and school location. Furthermore, among O-level students in the Wakiso district, certain factors are anticipated to result in either a fixed or a growth mindset in mathematics. The study's findings are expected to contribute to the international body of knowledge on Ugandan students' mathematics mindsets and serve as a source of information for researchers. The study findings may be helpful to educators and policymakers in creating strategies to promote improved mindsets, such as a growth mindset in mathematics, which may serve as a foundation to enhance students' mindsets in all subjects and better outcomes.

THEORETICAL PERSPECTIVE

The study was guided by Dweck and Legget's (1988) Implicit Theories of Ability. Human functioning, psychology, and life are explained by self-theories of ability stemming from people's beliefs about human characteristics such as intelligence, talent, and personality. The two theories that relate to this are the incremental and entity theories. The entity theory stresses static features or traits that are easily assessable and have a well-defined reality. The incremental view, on the other hand, emphasises flexible characteristics and a more complex, less understood world (Dweck, 1999). This theory has been used to investigate mindsets, grit, motivation, goal orientation, attribution, social judgement, academic performance and achievement, self-regulated learning, perfectionism, personality, and interest (Bazelais et al., 2018; Hertel & Karlen, 2021; Mofield & Peters 2018; Qin et al., 2021; & Xu et al., 2021). When using self-theories of ability to explain learning, people's beliefs in either a fixed or a growth mindset affect their educational goals, belief in the value of effort, explanations of failures and achievement, and strategies utilised following setbacks (Dweck & Master, 2009). As it relates to the study, the researcher anticipates that there exist differences in mindsets held by students in mathematics

METHODOLOGY

The study used a mixed-methods approach that combined quantitative and qualitative approaches, following a pragmatic paradigm utilising closed-ended surveys, focus groups, and key informant interviews. A convergent parallel mixed methods

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design was used following the QUAN + qual technique.

Study Participants

The study participants were 335 Senior 3 (S3) students selected from an estimated population of 2,673 S3s in 16 schools from 8 sub-counties of Wakiso District in Uganda. Wakiso District has two counties. The subcounties were proportionately selected, one county contributed to three subcounties and the other five. Two schools were randomly selected from each sub-county using a stratified random sampling technique; the strata were constituted as private and government schools. Basing on the population from each school, the schools were represented proportionately. The school with the highest population was more represented and vise versa. The final sample was selected using systematic sampling. For qualitative data, 6 students were purposively chosen with the help of the class teacher from each school to participate in focus group interviews. And finally, one O-level mathematics teacher from each school was chosen purposively to participate in a key informant interview. Wakiso District is located in the Central region and it was chosen because it has been ranked as one of the best performing District in UCE for a number of years (Wakiso District website, 2020). Its location in the Central region of Uganda, also gives it a more advantage over other districts in terms of resources and good schools. Despite all that, all UNEB reports, have never excluded it from suffering from the challenges surrounding mathematics. (UNEB, 2020; UNEB, 2021; UNEB, 2023)

Data Collection Methods and Instrument

The questionnaire had two sections, including i) students' demographic characteristics of gender, age, and school type and ii) mindset. The mindset was measured using an implicit theory of intelligence questionnaire adopted by Burgoyne and Macnamara (2021). The questionnaire was slightly modified to fit the context of the respondents. Fixed mindset was measured using 4 negatively stated odd statements. These were not reverse scored because the study measured fixed and growth mindset separately. Growth mindset was measured using 4 even questions. A 5-point Likert scale was used- (1) Strongly Disagree, (2) Disagree, (3) Not sure, (4) Agree, (5) Strongly Agree. To ensure validity and reliability, all the tools were pretested, and the Cronbach Alpha Coefficient (α) for the fixed mindset was 0.65 and 0.71 for the growth mindset. Cronbach Alpha values of 0.7 are recommended by Amin (2005), although 0.6 is also acceptable, according to Tavakol and Dennick (2011).

Student qualitative data was collected using a focus group interview guide with 5 questions. Teacher data was obtained using interviews with a key informant's interview guide containing 4 questions.

Research Procedure

Before collecting data, permission was obtained from DEO Wakiso and the school administration. Pre-visits to schools were conducted, and two trained research assistants participated in data collection. The head teachers and directors of studies were contacted to reach the class teachers and students at each chosen school. For sampling purposes, senior three student lists were provided by class teachers. The chosen students were asked to willingly participate in filling out the questionnaires. The class teachers aided the selection of students for the focus group discussions, and focus group discussions were held in a comfortable setting that the school offered. Data collection and focus group interviews were arranged during lunch periods and extracurricular activities, as determined by the school, to avoid interfering with in-class activity. A pre-designed and pretested interview guide with unstructured questions was employed, and interviews were conducted in English. Following the collection of data from the students, key informants who had been reached out for appointments were interviewed. Interviews were audio recorded with the participants and the school administrators' permission.

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Data Analysis

Quantitative Data

Data were analysed using SPSS version 23. Descriptive statistics such as frequencies, percentages, mean, and standard deviation were used to test for differences in fixed and growth mindsets. T-test tested for differences by gender, while Kruskal-Wallis tested for differences across other demographics.

Qualitative data

Qualitative data from focus group discussions and key informant interviews was analysed using manual rather than contemporary software analysis products. Familiarity with manual analysis enables one to immerse themselves in the data (Maguire & Delahunt, 2017). In order to further clarify the quantitative findings, the qualitative findings are provided as per the themes, subthemes, and categories using direct quotations from the data set.

Ethical Considerations

Permission for collecting data was sought from Kyambogo University, Wakiso district and from the schools. Ethical clearances were obtained from the Mbarara University of Science and Technology Research Ethics Committee (MUST-REC) and the Uganda National Council for Science and Technology. Confidentiality was ensured, informed consent from teachers was ensured, permission for students was obtained, no recordings were made without the participants' permission, and their opinions were respected.

RESULTS

General Information

Out of the 335 questionnaires distributed, 3 questionnaires that were not well filled were left out, indicating a 99.1% response rate. Data was collected from 332 students. 164 (49.4%) males and 168(50.6%) females. Government-aided schools contributed to 152 (45.8%) students while private schools contributed 180(54.2%) schools. Urban schools contributed to 253(76.2%) and rural schools 79(23.8%).

The mindset of students was investigated as a two-component model that included a growth mindset and a fixed mindset. The results are presented in *Tables 1* and *2*. The qualitative narratives were used to complement or refute the quantitative results.

Table 1: Descriptive results for a growth mindset in mathematics

Growth mindset	SD *n*(%)	D *n*(%)	NS *n*(%)	A *n*(%)	SA *n*(%)	Mean	SD
No matter who I am, i can significantly change my ability to do mathematics	15 (4.5)	42 (12.7)	12 (3.6)	148 (44.6)	115 (34.6)	3.92	1.13
I can always substantially change my ability to do mathematics	24 (7.2)	49 (14.8)	27 (8.1)	145 (43.7)	87 (26.2)	3.67	1.22
No matter how much ability i have, i can always change my ability to do mathematics quite a bit	28 (7.2)	52 (15.7)	14 (4.2)	146 (44.0)	92 (27.2)	3.67	1.27
I can change even my basic mathematics ability level considerably	25 (7.5)	42 (12.7)	24 (7.2)	129 (38.9)	112 (33.7)	3.78	1.25

Findings in *Tables 1* and *2* showed that most students had a growth mindset. This was indicated by the majority of the students agreeing to growth mindset items. It means that most students view their mathematics ability as something that can be improved

The quote below attests to the adoption of a growth mindset among the learners:

> *Even this belief where they say you will not make it because you do not have the ability to pass mathematics, makes you read hard, saying let me show them that I can make it. So, you read hard* (Female student 1, FGD 2).

This implies that students with a growth mindset persist in their efforts rather than giving up readily in the face of unfavourable feedback.

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> *Now, my friends say that Mathematics is for those with a high IQ, and so if you have a low IQ, you cannot but the fact is that if you concentrate and put in effort, you can pass mathematics* (Male student 3, FDG 7).

This narrative shows that students believe that their mathematics ability is not something basic about them, but with effort, one can always improve and get the desired result. Findings in *Table 3* further show that most students had a growth mindset. This was indicated by mean and standard deviation results. The mean was higher for the growth mindset (M = 14.86, SD = 3.81) than for the fixed mindset (M = 11.63, SD = 3.88). Although results in *Tables 1* and *3* show that more students had a growth mindset, a considerable number of students agreeing to a fixed mindset in mathematics cannot be ignored. It shows that some students believe that mathematics is dependent on an ability that is fixed and cannot be changed. The students in the fixed mindset are easily threatened by the performance of others and easily give up, especially in case of challenges.

Table 2: Descriptive results for a fixed mindset in mathematics

Fixed mindset	SD	D	NS	A	SA	Mean	SD
I have a certain amount of ability to do mathematics and i can't really do much to change it	39 (11.7)	75 (22.6)	32 (9.6)	136 (41.0)	50 (15.1)	3.25	1.29
My ability to do mathematics is something about me that i can't change very much.	60 (18.1)	97 (29.2)	36 (10.8)	93 (28.0)	46 (13.9)	2.90	1.36
To be honest, i can't really change my ability to do mathematics	110 (33.1)	88 (26.5)	20 (6.0)	64 (19.3)	50 (15.1)	2.60	1.49
I can learn new things, but i can't really change my basic mathematics ability.	66 (19.9)	95 (28.6)	21 (6.3)	103 (31.0)	47 (14.2)	2.90	1.40

Table 3: Differences in fixed and growth mindset in mathematics

	Fixed mindset	Growth mindset
Mean	11.63	14.86
Std. Deviation	3.88	3.81
Range	16.00	16.00
Minimum	4.00	4.00
Maximum	20.00	20.00

Source: Survey data (2023)

Qualitative narratives also revealed that students believe that their mathematics ability is fixed. They either have it or not.

The quote below illustrates the notion of a fixed mindset.

> *Some people do not like mathematics. But I think it depends. If someone performs better than the person, he or she will get to know that this one is better, what am I doing? I am trying but it is not working so they give up* (Female student 6, FGD 4).

The narrative shows that students in the fixed mindset are after proving themselves and are threatened by the success of others. They easily give up in case they cannot prove they are better than others.

> *Now for me I want to become a doctor, but when you talk about science subjects of which mathematics is part of them my friends are like oh my God will you manage? Now you will say who am i? will I do it? So, you end up losing the hope* (Female student 3, FDG 10).

Other students said…

> *Some times our fellow students have this belief that no matter how much you read, when you are not meant for a subject, you*

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> *will not pass. So sometimes let us say when it comes to revising, you say, no matter how much I read, I will not pass, you lose interest. So, at times you give up* (Male student 1, FDG 7).

The narrative shows that students with a fixed mindset are easily threatened by negative feedback from others and can easily give up, especially when the feedback questions their ability. They further showed that the mindsets students hold can depend on their peers.

> *Everyone has his/ her natural ability. So, if your natural ability is not in mathematics, you cannot do it* (Male student 3, FDG3)

The narratives show that students believe that one should have a natural ability in mathematics to do it.

> *For me I have never got good marks in mathematics because of that, I feel mathematics is not my thing* (Female student 4, FDG 1)

The narrative indicates that students base their mathematics ability on prior performance.

Table 4: t-test results for fixed and growth mindsets across gender.

Comparison variables		N	Mean	SD	F	t	p
Fixed mindset	Male	164	11.41	3.80	0.33	-1.00	0.32
	Female	168	11.84	3.95			
Growth mindset	Male	164	15.32	3.48	0.08	1.38	0.17
	Female	168	14.78	3.59			

Source: Survey data (2023)

The results in *Table 3* indicate no statistical difference in the fixed and growth mindsets in mathematics by gender.

However, qualitative narratives from teachers and students showed that students still believe that mathematics is for males.

> *Some of my friends say that I cannot do mathematics because I am a girl. That mathematics and science subjects are for boys. They say that because I have told them I want to be a doctor* (Female student 2, FDG 4)

One teacher said,

> *Some students especially girls believe that mathematics is for boys. As teachers we are trying to change this mentality and I think it is easier for me as a female mathematics teacher to help them change it* (Female teacher 2)

These narratives show that some students have a fixed mindset about mathematics because of gender.

Results in *Table 5* show no significant differences in fixed and growth mindsets in mathematics by age, school foundation (government-aided or private), school location (urban or rural) and parents' or guardians' occupation. According to the findings in *Table 4*, neither a fixed or a growth mindset is facilitated or hindered by a student's gender, age, tribe, parents' or guardians' occupations, or the schools they attend. Contrary to that, the qualitative results show that some students' mindsets were based on the parents'/guardians' careers or occupations.

Narrative…

> *I want to continue with mathematics because I want to be a doctor, which requires one to study mathematics. My father is a doctor so I want to be like him. I feel I can be it. In my family there are no lawyers so I cannot be a lawyer* (Male student 1, FDG 1)

The narrative indicates that the belief in doing mathematics is more emphasised by the parents' occupation.

> *If you get like a 40 and the teacher continues to discourage you that you cannot do better than that you get discouraged and*

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concentrate on other subjects you can pass (Female student 5, SDG 5)

Further, one teacher had this to say

Some students have been discouraged by teachers who tell them that they are not mathematicians. Especially those teachers who teach only clever students in their classes (Male teacher)

The narratives indicate that students' mindsets can depend on their teachers.

Table 5: Kruskal-Wallis test for differences in fixed and growth mindset by age, school foundation, school location and parents'/guardians' occupation.

Demographics		Variable					
		Fixed			Growth		
		N	Mean rank	P	N	Mean Rank	P
Religion	Catholic	117	171.29	0.49	117	156.47	0.01
	Protestant	78	157.11		78	198.81	
	Muslim	76	178.18		76	151.86	
	Pentecostal	52	157.64		52	158.47	
	Adventist	9	138.11		9	187.00	
	Total	332			332		
Age	13-14	8	168.75	0.13	8	126.31	0.29
	15-17	296	163.14		296	169.15	
	18-20	28	201.41		28	150.02	
	Total	332			332		
School Foundation and location	Urban-Government	116	170.55	0.38	116	169.26	0.84
	Rural-Government	36	156.47		36	167.14	
	Urban-Private	138	172.08		138	161.46	
	Rural-private	42	145.57		42	174.89	
	Total	332			332		
School type	Day only	11	118.00	0.08	11	173.91	0.96
	Boarding only	120	178.08		120	165.43	
	Mixed day and boarding	201	162.24		201	166.74	
	Total	332			332		

DISCUSSION

According to the descriptive statistics (*Table 1 and 2*), more students had a growth mindset. *Table 3,* containing means and standard deviation, also revealed a difference in the students' mindsets, with more students exhibiting a growth mindset than a fixed mindset. The results show that more students believe that their ability in mathematics can be cultivated through effort as opposed to being viewed as a natural talent or skill that they either have or do not have. This was in line with most of the students' qualitative narratives, in which they expressed their determination to improve their mathematical abilities despite negative feedback or poor performance in the subject.

However, a considerable number of students had a fixed mindset, as also evidenced by the qualitative findings. Some student and teacher narratives were characterised by a fixed mindset. The findings suggested that many students in schools still believe their mathematics ability and skills are static, that they have a fixed level of mathematics ability, and that nothing can be done to change or improve them. The growth mindset results are consistent with the incremental theory of ability, which emphasizes adaptable traits and a complex, less understood world. The fixed mindset results are in accord with the entity theory of ability, which stresses static characteristics that are simple to evaluate and with a more well-known reality; this means that a student's belief in their mathematical ability can lead them to believe that their mathematical ability is fixed or that it

Article DOI: https://doi.org/10.37284/eajhs.6.2.1650

can be improved, which can lead them to exert more effort, persevere, and persist in the face of difficulties like failure, or it can cause them to view effort as futile and give up easily when faced with difficulties. The findings are in line with those of Snipes and Loan (2017), who discovered significant mindset differences, with more students exhibiting a growth mindset. The findings, however, contradict the findings of Bedford (2017) in England, who found no significant differences in student mindset.

According to the results in *Table 4*, there were no statistically significant gender differences in the students' fixed or growth mindsets in mathematics. However, conflicting findings are presented in the literature. Due to gender stereotypes in society, it has been found that gender has an impact on people's mindsets, with more females having a fixed mindset in mathematics than a growth mindset and more males having a growth mindset than a fixed mindset. The quantitative findings support those of Rothrock (2019), Mcpartlan et al. (2020), Burnette et al. (2020), and Donohoe et al. (2021), who discovered that there were no significant differences in mindset between men and women but in disagreement with qualitative findings which revealed that some female students hold a fixed mindset in mathematics because of their gender. Both quantitative and qualitative results disagree with Claro and Loeb (2019) and Gouëdard (2021), who found that females had a more growth mindset than males. The qualitative results from teachers align with most literature that shows that mathematics mindset was dependent on gender, with males more inclined to mathematics than females. Although there are contradictions in the literature, the study results indicate that both males and females can hold a growth mindset.

Results in *Table 5* indicated no statistically significant difference in the fixed and growth mindsets among the students by age, school foundation and location, or parents'/guardians' occupation. The results agree with Donohoe et al. (2021), who found no significant differences in mindsets across ages. Qualitative results yielded different themes showing that mindsets depended on parents/guardian's occupation, previous performance, peers, and teachers. These are in line with literature that shows that students can have a fixed mindset or growth mindset depending on previous and current performance (Farrington et al., 2012), peers (Bedford, 2017), teachers (Gouëdard, 2021), and parents/guardians (King, 2020). Even though there appear to be discrepancies between the study's findings and previous literature findings about various global demographics, it is clear that anyone can possess better mathematical mindsets. The presence of no significant differences in mathematical mindsets across various demographics demonstrates that any student can overcome a fixed mindset. Qualitative findings indicate that everyone must work together to help students develop a growth mindset.

CONCLUSIONS

According to the findings of this study, more students had a growth mindset. This indicated that the majority of students thought learning might improve their ability to do mathematics rather than being static. Qualitative findings indicate that students' fixed mindsets in mathematics are caused by various factors, such as their perceptions of mathematics and the influence of others. Despite the fact that many students have a growth mindset, a mindset is not something static that cannot be changed. Numerous factors can cause students to switch from a growth mindset to a fixed mindset or vice versa at any time, suggesting that everyone's responsibility in society is to promote a growth mindset in mathematics among students. This can enhance general learning, interest, and mathematical proficiency.

Recommendations

The researchers recommend that educators and education stakeholders collaborate to develop programs in schools aimed at transforming students' fixed mindsets into growth mindsets because it was discovered that a sizeable portion

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of students have a fixed mindset in mathematics for the various reasons cited. According to the study, teachers and other social figures should be included in mindset training, as mindsets are socially contagious. Training may also alter societal attitudes towards mathematics that support a fixed mindset. There is also a need to study mindsets throughout Uganda, using parents as key informants, as the study was only conducted in one district of Uganda, Wakiso.

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