Negotiating the Transition from High School to Undergraduate Mathematics: Reflections by some Zimbabwean Students

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Abstract

In this paper we describestudents' views about undergraduate mathematics in relation to high school mathematics and the nature and sources of learning difficulties those students experience during the incorporation phase of the transitional shift from high school to undergraduate mathematics. A surveystudy involving 77 undergraduate mathematics students, 29 of whom were mathematics education students from one university in the second semester of their first year and 48 mathematics majors consisting of 16 first year and 32 second year students was conducted. Summative content analysis based on constructs of a met-before, the anthropological concept of rite-of-passage, and the synthetic and analytic model of definitions was carried out on the data.The results suggest that the dominant viewamong students was that mathematics is about logical reasoning, but contrary to literature very few of the students suggested that undergraduate mathematics learning is mainly about axiomatic formal proof. A significant proportion of the students expressed that undergraduate mathematics learning is about doing calculations a view that is consistent with high school mathematics learning. Content-related sources of difficulty were reported by both mathematics and mathematics education majors, which is consistent with the widely-held view of mathematics as comprising calculations. The findings suggest the need for students to assume responsibility of their learning in negotiating the transitional period rather than attributing difficulties encountered to factors such as mode of delivery. There is also need to address the effects of a robust synthetic model by promotingaxiomatic reasoning in school mathematics.

Keywords

Transitional challenges, undergraduate mathematics, synthetic definitions,

Motivation

In Zimbabwe, many students show declining interest in post primary mathematics despite the fact that mathematics is regarded as a core subject in the curriculum. Students with very good primary mathematics grades succumb to transitional challenges leading to abandonment of studies in mathematics. Learners' decision to "drop" mathematics is usually taken in spite of the learners' full awareness of career-oriented factors that influence the choice of a subject major (Fagan et al., 2004; Katcher, 2004). It was thus the focus of our study to understand the nature and sources of learning challenges experienced during the transition from high school to undergraduate mathematics.

Theoretical Considerations

Discrepancies characterizing the transition from high school to undergraduate mathematics are well illuminated in Clark and Lovric's (2009) description of them as the "shock" of the "new" inevitable process that should be embraced rather than avoided. Someresearch studies have unraveled many such hurdles marking the transitional phase that include: psychological stress that results from change in social environment, change in teaching style or mode of content delivery, the overwhelming multi-quantified symbolism that is a common characteristic of university mathematics teaching and learning (Hurst, in press , p. 8; Tall, 2008, p. 8; Tall, 2011, p. 21).

Here we examine some theoretical constructs which underpin the nature of discrepancies marking the transitional phase that have been identified. These constructs are used here to describe how students negotiate the shift from school to undergraduate mathematics. The constructs include the notions of met-befores and set-befores by (Tall, 2008, p.8) which are intertwined with Ausbel's theory of learning (Varghese, 2009, p. 50); the three worlds of mathematics namely conceptual embodiment, operational symbolism, and axiomatic formalism (Tall, 2004; Tall, 2008, p. 8; Tall, 2011, p.22); the anthropological idea of the rite-of- passage framework (Clark and Lovric in Hurst in press, p. 17); and the idea of synthetic and analytic definitions in mathematics teaching and learning (Selden & Selden, 2003).

A set-before is defined as a mental structure, or precisely, a genetic structure we are born with that shape our long-term learning and allows us to think in specific mathematical ways (Tall, 2008, p. 5). There are three basic set-befores identified by Tall as recognition, repetition (repeating a sequence of learning operations until they become automatic),and language use which form the foundation for the three worlds of mathematics of embodiment, symbolism, and formalism.Recognition refers to learners' ability to distinguish between boundaries of the mathematics discourses. This set-before is one of the major ideas embedded in Beinstein's theory of pedagogical discourse which is one of the construct that underpin our study. A set-before that makes humans distinct from other animal species is the use of language and the related use of symbols (Tall, 2004, 2008). The shift from high school to university mathematics is generally accompanied by an increase in number of symbols and complexity of such symbols. These multi-quantified symbols are often overwhelming for the students and this makes negotiation of the shift difficult.Further, the shift from high school to university mathematics is also marked by a change in language use from the informal intuitive to a more formal framework of axiomatic formalism (Tall, 2008, p. 5; Tall, 2011, p.19). Such changes in language use are usually drastic (Hurst, in press, p.6) making negotiation of the transitional phase uneasy.

We now turn to the notion of a met-before. By a met-before we refer to a current mental facility determined by specific prior experience of the learner (Tall, 2008, p. 6). Previous experiences make connections in the brain and these connections influence the way we make sense of new situations. Hence a met-before may be consistent or inconsistent with new information encountered. Accordinglywe distinguish between negative and positive met-befores in mathematics teaching and learning (Tall, 2008). We call a met-before positive if it is consistent with the situation and therefore can lead to successful learning. A met-before is termed negative if it acts covertly so as to impede learning (Tall, 2008, p.7). We shall also draw ideas from Ausbel's theory of learning (Varghese, 2009, p. 50). Ausbel's theory posits that learning takes place by assimilating new information into the existing conceptual structures. Basing on Ausbel's learning theory and Tall's idea of a met-before, we can then see the existing conceptual frameworks in the student's mind as met-befores that determine how the student makes sense of new concepts to be learnt in university mathematics. The transition from school to university mathematics can be accompanied by confusion as links previously connected may be perceptually at variance with axiomatic formalism characterizing university mathematics.

Selden and Selden (2003) made a distinction between synthetic and analytic uses of definitions. Synthetic definitions are everyday contextual meanings as found in dictionaries that may vary from source to source. Synthetic definitions describe objects that already exist. On the other hand, an analytic definition brings something into existence (Selden & Selden, 2003, as cited by Hurst, in press, p.10). Analytic definitions are the onesoften used in mathematics, as they are composed of axioms. One major distinction between analytic and synthetic definitions is that the former is complete, meaning that one cannot assume anything more or less than what the definition gives. Selden and Selden (2003) posit that mathematical theories in form of theorems, lemmas and corollaries then build from analytic definitions. An exemplification of the difference between synthetic and analytic definitions can be seen in the dictionary and mathematical meanings of the term accumulation point or, alternatively, cluster/limit point. One dictionary meaning of an accumulation point is "process of gathering together and increasing in amount over a period of time"(Encarta Dictionaries, 2009). Other dictionaries may give slightly different meanings for the term limit/accumulation point. This is the synthetic use of the term. For the analytic meaning of the term limit point or accumulation point, we note thatin Topology a point or a number x is an accumulation point of a subset A of real numbers if given a real number $\varepsilon > 0$ (ε should be conceived of as a small radius), the interval $(x - \varepsilon,\ x + \varepsilon)$ contains at least one point of A distinct from x (Kirkwood, 1992). The topological meaning is complete in the sense that one cannot assume more or less than the one given in problem solving, conjecturing, and proof construction activity.

One marker of mathematical transition from high school to undergraduate mathematics is the lack of fundamental grasp by students of the distinction between analytic and synthetic definitions.In school mathematics learners are able to disguise their failure and "get away" with it (see Robert Koep's confession in (Mtetwa, 2001: p. 2). At university the analytic use of definitions of concepts receives prominence (Tall, 2008). The phase is characterized by changes in mathematical form and thought as the mathematics becomes more abstract. Therefore mathematical content and thinking processes change drastically over the secondary to undergraduate transition making negotiation of such a phase difficult (Hurst in press, p 7).

Another transitional hurdle in student shift from high school to university mathematics is related to method of content presentation. Usually at high school there is use of interactive strategies (learner centered methods). Tertiary teaching is dominantly through the lecture method. This change in the instructor's role can also contribute to difficulties as students may be unfamiliar with the new mode of delivery as suggested by Hargarty (2006) in Hurst (in press, p. 7).

One framework that models the school to university mathematics transition is based on (Clark &Lovric, 2008,2009)'s anthropological concept of rite-of-passage. The rite-of-passage model posits that the transition from school to undergraduate mathematics can be described in terms of three phases which we briefly describe in their chronological order:

- Separation phaserefers to a period when students are in high school and preparing for university.
- Liminal phase is the time lapse betweenend of high school and beginning of university mathematics as well as time in between.
- Incorporation phase covers first year university study duration (Clark &Lovric, 2008).

The study reported here focused on the incorporation phase of the model.The model's ideas are inextricably interwoven with Selden and Selden's (2003) notion of analytic and synthetic model in the way it illustrates a pattern in which students enroll for university mathematics with a "synthetic model," which is a mixture of preconceptions, beliefs, facts about mathematics,etc (or their met-befores), learned during the separation phase. The met-beforesmay be incompatible with new information in the incorporation phase (Clark &Lovric, 2008, p. 27). The "synthetic-model" of students' mathematical knowledge then hasbeen reported to be extremely robust and consequently interferes with assimilation of new information into their existing conceptual frameworks as suggested by Varghese (2009, p.50). In other words, content taught at the incorporation phase may not be compatible with the synthetic model. The robustness of met-befores (Tall, 2008) is a contributing factor to difficulty confronted by students in negotiating the school to university mathematics phase.

Another theoretical construct relevant to the discussion of discrepancies characterizing the transition from high school to undergraduate mathematics is Bernstein's theory of pedagogical discourse. Ideas drawn from the theory include concepts of classification and recognition. We describe both concepts briefly. The notion of knowledge classification refers to the strength of the boundaries between discourses and groups of actors (Bernstein in Jablonka et al(2012, p. 2). Strong knowledge classification is indicative of an awareness of strong boundaries between high school and tertiary mathematics which imply greater strict separation between informal intuitive and formal knowledge in the discourse. Undergraduate mathematics is a more classified knowledge system than high school mathematics.Jablonka et al., 2012 describe recognition rule as the need for students to understand principles for distinguishing between high school and undergraduate mathematics learning contexts. In this regard, students are drawn to the need to recognize the specialty of the discourse at tertiary level as a necessary condition for their capacity at producing what counts as legitimate mathematics in the undergraduate learning contexts.

Finally literature suggests the change in environment as another contributing factor (Hurst, in press) . Such changes include changes in residential set up, say from boarding school to rented accommodation. We view this challenge from the perspective of acute accommodation shortages that is a permanent feature of our universities. Renting a room for boarding inmost cases is accompanied with commuting to university campus by bus by the student. Commuting and residing away from campus are associated with many challenges that confound the student's synthetic model of existing mathematical knowledge again making negotiation of transitional phase difficult.Our study addressed the following research questions associated with the transition from school to undergraduate mathematics.

Research Questions

1. What are Zimbabwean undergraduate students' perceptions of the nature of mathematics?
2. What are the sources of difficulties faced by the students during the transition from school to university mathematics?
3. To what extent does high school mathematics prepare students for undergraduate mathematics?

Method

To explore students' views about undergraduate mathematics as well as the nature and sources of transitional challenges faced during the shift from high school to undergraduate mathematics, the researchers used a sample of students majoring in mathematics or mathematics education from two universities in Zimbabwe. The students in the study had done all first year courses which include Calculus, Mathematical Discourse and Structures, Linear Mathematics and Ordinary Differential Equations. One set of data was elicited from 29students enrolled for Bachelor of Science Education degree in mathematics at the first university who were accessible to the researchers. The students already possessed a diplomain mathematics education with some school teaching experience and wereon a continuous professional development (CPD) programme. Theprogramme is offered on a block release study format, with a three week intensive teaching period per block. During that period conventional courses are taught and tests for continuous assessment are administered. Two such 3-week teaching blocks constitute a semester that ends withexaminations on thetaught courses. The students were just about to write second semesterexaminations when the study was conducted, that is, the students were in their incorporation phase (Clark &Lovric, 2008, p. 26). Another set of data was collected by one of the researchers from 48 mathematics majors from the other university.

Instrument

The questionnaire instrument used was constructed by the authors and validated through piloting with comparable students to check for language and construct appropriateness. The instrument had the following items.

1. In what ways is mathematics different or distinct from other subjects? Illustrate your answer
2. At those moments when you have found mathematics difficult, what has been the nature or source of the difficulty? Illustrate your answer with a specific example.

3. At those moments when you have found mathematics difficult, suggest concrete ways in which the lecturer or teacher could make things easier for you. Illustrate your answer with a specific example.

4. Do you think school mathematics prepared you well for universitymathematics? Explain your answer

These items were deemed adequate to elicit information relevant for the research questions.

The first set of data was collected by one of the researchers during the second week of Block Release teaching period. No time limits were imposed and the students took about 45 minutes to complete the questionnaire while being urged not to discuss the instrument, but rather to respond to it individually in order to get independent views about the nature of undergraduate mathematics and challenges characterizing the school to university mathematics transition.

The second set of data was drawn from mathematics majors at the second university who had enrolled under a conventional study format. Under this format students follow a 12- week long semester of continuous learning. These students were largely fresh school leavers with little experience of tertiary education, unlike the mathematics education majors from the first university who provided the first data set. From this second university two groups of mathematics majors: 16 first yearand 32 second year students were involved in the study. We collected data under similar conditions for both kinds ofstudents who all took approximately the same time (about 45 minutes)to complete the questionnaire.

Analysis

Students' written responses were mapped onto the theoretical constructs of set-befores, met-befores, rite-of-passage anthropological concept dealing with phases of transition, Beinstein's theory of pedagogical discourse, and the synthetic and analytic model of definitions discussed earlier. Theresponses to the questionnaire were examined to determine the nature of the challenges met by students when negotiating the phase and students' views about the nature of university of mathematics in relation to pre-university mathematics. We do not claim that there was a one to one correspondence between the constructs and students expressions of their perceptions about the nature of university mathematics and the kinds of challenges characterizing their negotiation of the transitional phase. In anticipation of the possibility of categories not covered by our literature, however, we employed the summative content analysis technique (Berg, 2009).Thus we started by perusing students' responses noting words and phrases in the raw data (written student expressions) themselves. Those manifest elements (surface structure present in student expressions) were blended with latent meanings. Latent meanings refer toour inferences or interpretive reading of the manifest elements Holtsi (1969) in (Berg, 2009). Responses to item 1 were coded using the following scheme: expressions connoting students' perceptions of mathematics as challenging (CH), involving logical reasoning (LR), mostly computations (CL), related to problem solving (PR), applicable to everyday life (UV), and as requiring mathematical proving (MP) and abstract (AB).

For item 2 students' expressions were coded using (T) for time related issues, (M) for mode of content delivery, (C) for content concerns, resource matters (R), learning environment (E), and (O) for other issues not covered by the theoretical constructs. For item three we looked for indications of satisfactory, partial, or inadequate preparation.We used students' in vivo codes (excepts) to corroborate our inferences (Strauss,1990 in Berg, 2009). In the next section we present our findings

Results

A student's perception of a mathematical concept influences his/her level of engagement with the concept and the nature of the subsequent "synthetic" model formed.The first research question was addressed through summative content analysis of students' responses to the questionnaire item: *In what ways is mathematics different or distinct from other subjects? Illustrate your answer.* Content analysis gave the response distribution which we present after making the following clarification. Some responses had more than one category, so total frequency can be more than the total number of informants for some items. Responses to the first research question; (*What are Zimbabwean undergraduate students' perceptions of the nature of mathematics?)* are summarized in the table below.

Table 1.Students' perceptions about the nature of mathematics.

Category	University A	University B	
	(n = 29)	(n= 16)	(n= 32)
(PR) Problem solving	3	-	3
(OB) Obstrusive	2	2	1
(UV) Usefulness/ Everyday use	3	2	1
(CL) Calculations	8	4	3
(MP) Mathematical proof	3	1	5
(AB) Abstract	7	-	4
(LR) Logical reasoning	9	8	11
(CH) Challenging	1	1	3
(O) Other	-	5	3

Table 1 illustrates that the dominant student perception about the nature of mathematics is that it involves logical reasoning (9 out of 36) for university A and (6 out of 18 first year students) and (11 out of 32 second year students) for university B.We reiterate that the column totals are more than the number of informants because it is possible for a student to hold more than one view about the nature of mathematics. The view that mathematics is about logical reasoning is very much compatiblewith literature which suggests that university mathematics involves formal logical thinking (Tall, 2008).The view thatundergraduate mathematics involves abstraction was reported by a significant number of students from university A, in contrast to university B where no first year student expressed such a view and only 4 out 36 responses were in this category. Responses from universityA areconsistent with the fact that mathematics involves formal logical thinking as shown by (7 out of 36 responses). Tall (2001, p.19) suggests that undergraduate learning is mainly about axiomatic formal proof of mathematical results. It is therefore disturbing to note from the table that only (3 out of 36) and (1 out of 16 first year students), and (5 out of 34 second year) responsesfrom A and B respectivelyare consistent with this assertion. We note furtherfrom our table that a significant proportion of informants (8 out of 36) from University A and (4 out of 16 year one responses), and (3 out of 34 year 2 student responses) from university B expressed that mathematics learning is mostly doing calculations, a perception consistent with high school mathematics (Tall, 2008, p.5). Perhaps students holding such a view are likely to form a robust "synthetic 'model (Clark &Lovric, 2008) and hence finding negotiation of the incorporation phase more difficult.Our examination of responses from university B revealed the following categories in addition to the ones reported above. Some students suggested that one way in which mathematics is distinct from other subjects is that it requires students to engage in activities (3 out 16). Another category that emerged from thiswas constituted by students who perceive mathematics as being about certainty, in other words, mathematics consists of a set of certain procedures, it is not about individual opinions. We had 6 responses from 16 students in this category from first year students. Finally, the view that mathematics requires constant revision was shared by 2 out 16 first year and (3 out of 32 participants) for university B.Further, 3 responses by university B second year students indicated that mathematics requires a lot of creativity from the students.

Some responses supporting the view of mathematics as requiring logical reasoning include:

> Mathematics requires reasoning and logic while with other subjects its just memorizing. (Student 26)
>
> Mathematicsrequires a lot of reasoning. (Student 3)
>
> Responses which express the view that mathematics is about calculations include … a lot of calculations are involved (Student 23)
>
> Mathematics involves calculations and there exact solutions to a problem (Student 8)

Next we present our findings toresearch question 2**:** What are the sources of difficulties faced by the students during the transition from school to university mathematics? Students' responses to item 3: (*At those moments when you found mathematics difficult, what has been the nature of or source of difficulty? Illustrate your answer with a specific example*.) wereused to answer research question 2. Summative content analysis revealed the categories most of which had a one to one correspondence with theoretical constructs discussed earlier (Varghese, 2009). Issues not matching any of the theoretical constructs were classified as "other" and we had some cases of these. Emerging categories from data were:

- Time related issues (T). The category encompasses issues to do with of duration of content coverage.
- Mode of delivery (M). This category includes matters concerning style of content presentation (teaching method), pacing and sequencing of content.
- Content (C). Subject matter issues such as failing to integrate, failure to apply Laplace Transforms in solving initial value problems in Ordinary Differential Equations, and difficulties in thinking in abstract terms were encompassed by the category.
- Resource (R). Issues covered here include those to do with students' access to learning materials such as library textbooks and mathematics computer laboratory.
- Change of environment (E). Included students' responses that carried connotations to do with inconveniences brought by things like switching of lecture venues, commuting to campus.
- Other (O). Covered issues emerging from data that failed to map to theoretical constructs. We had few of such cases such as alleged racist tendencies by instructors from university A while university B had a significant number of responses in this category. Responses falling

in this category from university B included matters to do with learner behaviour, study habits, and loss of concentration by the student.

Our summative content analysis revealed the following response distribution.

Table 2.Sources of difficulties faced by student teachers during transition from school to university mathematics.

Category	University A (n = 29)	University B (n = 16)	(n =32)
Time (T)	3	1	4
Environment (E)	1	0	0
Mode of delivery (M)	5	2	10
Content (C)	17	6	8
Resources (R)	1	1	2
Other (O)	1	5	6

Content related sources of difficulties were dominant among participants from both universities. The results areconsistent with our findings from the first research question where most students perceived mathematics as a discipline involving calculations, a view not compatible with university mathematics (Tall, 2008). The results suggest a robust "synthetic" model among undergraduate students which made negotiation of the transitional phase difficult for them. In other words students' negative met-befores in the form of intuitive informal mathematics dominated by calculations from primary and secondary mathematics made the shift to axiomatic reasoning difficult for the students.The mode of delivery of content by at university featured prominently as a source of difficulties faced by university students during the incorporation phase of the transition from high school to university mathematics. The mode of delivery was expressed by a significant proportion (10 responses from 32 participants) from second year students from university B. Responses included in the category "Other"included students expressions in students attribute transitional challenges to lack of appreciation of meaning and relevance of content learnt which ultimately lead to boredom and failure to interpret questions in problem solving.

Quoting responses on student expressions on content related sources of difficulties.

… failing to understand limits. (Student 8)

… the use of many variables (Student 6)

Transforming second order ODEs, to Laplace Transform and also finding some

Inverse LaplaceTransforms. (Student 23)

Finally we present our findings to research to the third research question. Research question three assessed the extent to which high school mathematics prepared students for undergraduate mathematics. Research question 3: To what extent does high school mathematics prepare students for undergraduate mathematics? This question was addressed by qualitatively analyzing elicited students expressions to the item: Do you think school mathematics prepared you well for university mathematics? Explain your answer. Table 3 below summarizes students' responses to research question 3.

Table 3.Students' evaluation of the extent to which high school mathematics prepared them for university mathematics.

Response	University A n =29	University B (n=16)	University B (n= 32)
Yes	20	10	11
Partial	6	3	5
No	3	0	8
Unanswered	0	3	8

The results show that most students had indeed appreciated the link between high school and undergraduate mathematics. Very few students expressed that high school and undergraduate mathematics are two disjointed knowledge system, pointing to weak knowledge classification or, alternately, weaker boundaries in the mathematical discourse in Beinstein's terms. Such students probably had not developed recognition rules to distinguish the highly intuitive school mathematics involving numerous calculations and the highly specialized formalism in tertiary mathematics (Tall, 2008; Bernstein in Jablonka et al., 2012).

Quoting responses indicative of student recognition of connections between university and school mathematics:

> Most of the material found in the first courses Linear maths 1 and Calculus 1 are covered at A level except that some of the methods were being discarded but some of the methods were being discarded in Linear Maths (Student 11)

> Most complex concepts we meet at this level actually build from school mathematics. (Student 9)

Student responses pointing to lack of recognition of mathematical linkage between high school and university mathematics include:

> The lecturers at college spent time bridging 'A' level mathematics to students at a snail pace. Digging deeper was rare. (Student 4)

Responses classified as partial include:

> ….for other courses school mathematics is used at the university but for other courses completely new courses are learnt. (Student 18)

Discussion and Concluding Remarks

Overall, our results reveal inconsistencies in students' responses. First, while many students acknowledge the interrelatedness of mathematics concepts by pointing out that high school mathematics had prepared them for university mathematics, however this view is not compatible with those given earlier where undergraduate mathematics was conceived in terms of just doing mathematical computations by a significant number of students. For compatibility in student responses it was thought that high grasp of recognition rule (Jablonka et al, 2012), meaning theability to see coherence or linkage in school and university mathematics, would be accompanied by students' expressions of university mathematics as involving logical deductive reasoning using axioms and definitions (Tall, 2008) thereby pointing to strong boundaries in the mathematical discourse (Bernstein in Jablonka et al, 2012). This inconsistency can be explained in terms of factors fostering inductive reasoning in mathematics (Harel & Sowder, 1998). Students have a natural tendency to resort to use of specific examples, "calculations," in mathematics and hence lack of appreciation of meaning of logical deductive reasoning typical of university of mathematics.

Second, our results demonstrate the dominance of the synthetic model of definitions (Selden & Selden, 2003) as a strong met-before among undergraduate negotiating the transition from school to tertiary scholastic levels. We believe that the synthetic model of definitions is so robust in the students that it makes the transition from mainly intuitive high school to the largely axiomatic undergraduate mathematics. Thus while participants in our study acknowledged that high school mathematics had prepared them for tertiary mathematics, doubts still remain as to whether such students can withstand further learning at undergraduate level. Students experiencing transitional challenges that are content related may find things challenging and would consequently be forced to develop a wait and see attitude during learning in the hope that they will cope—the so called "delayed gratification" in the sense suggested by (Varghese, 2009, p. 10). The idea of "delayed gratification" is taken here to mean that a student may continue to take a mathematics course without a profound understanding of the concepts involved hoping to develop a deep understanding of those concepts when he/she enrolls for an advanced related undergraduate mathematics course. An example of this tendency would be a case where a student is introduced to the notion of least upper and greatest lower bounds of a bounded set in elementary Calculus courses, then proceeding without deep understanding hoping a full grasp of such concepts will be attained when students study Real Analysis and use such concepts in proof theorems such as the Archimedean principle.

Third, this study has uncovered learner characteristics which reflect a self- attribution tendency in negotiating the incorporation phase. While the difficulties learners encounter with undergraduate mathematics have been attributed by the students to issues like mode of delivery of content by the instructors, where they suggest a preference for step-by step mode of delivery. Such comments by students highlight the point that students do not take responsibility for their learning and they look up to the teacher to help negotiate the transitional shift. Students should also try to alleviate their transitional hurdles by striving to achieve a balance between mode of delivery of content and learner behavior in terms of a re-examination of learning habits and level of individual concentration as students engage with undergraduate mathematics.

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