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Mathematics Online Baseline Assessment: Senior Phase First-year Student Teachers' Views

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ABSTRACT
Problem-solving and enquiry-based learning are integral in the Mathematics and Science curriculum in South Africa through online-based assessment. Online assessment has rapidly gained recognition because of technology. In this paper, the authors explored the views of online baseline assessment among Senior Phase First-year Mathematics Student Teachers. The researchers adopted a qualitative research method. Data was collected from the participants using an online Google form developed into a questionnaire. The participants in this study were first-year students enrolled for the Bachelor of Education in Mathematics at a university in a rural province of South Africa. The first-year student teachers were exposed to the senior phase baseline assessments through the licensed online Computer Aided Mathematics Instruction (CAMI) tool. One hundred and sixteen (116) senior-phase student teachers completed the online questionnaire. This study used convenience sampling since it was the most appropriate method to conveniently invite the participant. The findings revealed that first-year student teachers were enthusiastic and motivated to write the baseline assessment on computers for the first time. The result also showed that several first-year student teachers experienced difficulties solving mathematics problems using computers. This study recommends more intensive research on student teachers' views on online assessment regarding gender and time.

KEYWORDS
Online baseline assessment; student teachers' views; mathematical knowledge; information; communication technology.

INTRODUCTION

Online assessments have become education's most rapidly evolving methods in recent decades. Formal summative educational assessment has concentrated chiefly on testing information and has overlooked skills required for the 21st century (Molnár & Csapó, 2019). The evolution of information and communication technology (ICT) has had a significant impact on society. With the advancement of technology and the widespread availability of computers, computer-based assessments are rapidly gaining recognition (Brunfaut et al., 2018). As a result, there is a shift from paper-based assessments to computer-aided assessments. Computer-based assessments have initiated academics to revisit their assessment strategies. This means that more and more academics are testing and examining students' competencies and skills through computer-based assessments. Most organisations started using computer-based assessments to test, examine and evaluate candidate's performances, competencies and skills in a various field (Alek et al., 2020). The flexibility of the computer-based assessment allows the examiner to test lower and higher-order skills. These skills include knowledge, understanding, application, analysis, synthesis, and evaluation. Furthermore, these assessments will help students improve their analysis, synthesis, and evaluation skills using more complex application software (Olumorin et al., 2013).

In the 1990s, e-learning (online learning assisted by network technologies) gained popularity in South Africa. Post 1994, the Department of Basic Education (DBE) developed a White Paper on E-education in 2004 to address the demands for the 'roll-out' of eLearning. The policy mandate was that teachers should expressly give opportunities for students to use ICT for learning (Bagarukayo & Kalema, 2015). This resulted in policy documents for higher education recommending a simple continuum of education provision with two imaginary poles, one representing completely online education and the other purely face-to-face education. Learning materials and telephone conferencing via ICT aided the strictly at-a-distance continuum (Department of Higher Education and Training [DHET], 2014). The continuum was developed and improved due to the increased use of ICT. As a result, the DHET recognised that a predominantly online course for full and part-time students should be offered in campus-based computer labs.

Furthermore, there were huge opportunities and advantages to use technology to improve the quality of distance education. The use of technology had a significant impact on improving student involvement and communicating with and supporting students remotely. The DHET (2014) emphasised that higher education institutions must ensure their graduates are prepared to participate meaningfully in the digital world.

Universities stay competitive by using innovative technology in teaching and learning to increase the quality of activities and attract new students (Mlitwa, 2006), as cited by Bagarukayo and Kalema (2015). As a result, the South African National Plan for Higher Education highlighted the importance of university activities in fostering an information society and advancing knowledge to improve education and promote the new educational system. Therefore, ICT

integration in SA universities was required for them to be a competitor in the global arena, be innovative and address the learning styles and preferences of digital natives who yearn to learn in a hands-on, realistic learning environment. Moreover, in South Africa, eLearning is an ICT-enhanced practice in universities. The practice includes everything from the e-mail, online journals, and networked libraries to developing innovative software solutions for information management tasks in teaching, research, and administrative systems. During the COVID-19 pandemic in 2020, the nation went into lockdown, forcing HEIs to revisit strategies of online teaching and learning. This shift from face-to-face teaching and learning has created a new platform for the introduction of ICT in teaching and learning in HEIs. This paper reports on Senior Phase First-year Student Teachers' view of online baseline mathematics assessment.

LITERATURE REVIEW

Online-based assessment

Online-based assessment is a way of delivering assessments utilising computers rather than pen and paper. It is also called computer-based assessment, computer-based testing, electronic assessment, or online assessment. These names will be used interchangeably in this paper. Online-based assessment refers to examinations and assessments on computers using well-organised systems (Alek et al., 2020; Olumorin et al., 2013). According to Jeong (2014), computer-based assessments have several advantages for students, teachers, and educational systems. The real-time scoring and rapid feedback provided by online-based assessments are one of the advantages. The transition to online-based assessment reduces paper expenses, administration costs, and scoring costs, making it a more cost-effective way to test students' knowledge, skills and competencies. According to Astalini et al. (2019), advances in ICT in teaching and learning have significantly impacted assessment methods and opened new opportunities for conducting online-based assessments, including students' learning through computers and other technological devices.

According to Molnár and Csapó (2019), online-based assessment began with the production of first-generation computer-based examinations, which involved moving items primarily created for paper-and-pencil testing to the computer. The indication denotes that those traditional static tests were performed using a computer, which provided the benefits of automated scoring and feedback. Furthermore, to measure 21st-century skills, second-, and third-generation computer-based tests used technology to change item formats and replicate complex, real-life situations, using authentic tasks, interactions, dynamism, virtual worlds, and collaboration that went beyond providing automated feedback (Molnár et al., 2017). These factors have resulted in a significant increase in the productivity of assessment procedures. Therefore, using technology (online) assessment speeds up data collecting, enables real-time automatic scoring, speeds up data processing, provides quick feedback, and revolutionises the assessment process, including task presentation (Molnár & Csapó, 2019).

According to Abubakar and Adebayo (2014), Alek et al., (2020), and Olumorin et al. (2013), a computer-based test involves delivering, marking, and analysing all or part of the student's assessment process utilising computer technology. The use of computer-based tests is beneficial for various reasons, including increasing the frequency of assessment, encouraging students to acquire and practice skills, and broadening the range of knowledge examined. It also expands the number of evaluation methods and provides more feedback to students and teachers. Objectivity, consistency, and reducing script and other case marking loads result in administrative efficiency (Abubakar & Adebayo, 2014; Alek et al., 2020; Olumorin et al., 2013).

According to Alruwais et al. (2018), students prefer online baseline assessments because they have greater control, friendly interfaces, and tests that mirror learning environments and leisure activities. The online assessment also allows teachers to increase the quality of feedback they provide to their students. It allows teachers to keep track of their student's progress and analyse data from various assessments. Furthermore, direct feedback from online assessments allows teachers to identify and correct misconceptions students have before the final examination. Online assessment relieves teachers of the burden of evaluating large groups of students. It also reduces the time and cost of evaluating students for institutions (Alruwais et al., 2018; Al-Hattami, 2020). In terms of education, online assessment helps students develop higher order thinking skills like critical thinking, reflecting on cognitive processes, and facilitating collaborative projects. The new educational goals include comprehending and articulating issues, regulating variables, developing and testing hypotheses, and seeing patterns and linkages, which focus on problem-solving with mathematics and science that are assisted by technology and are reinforced by online assessment. Alruwais et al. (2018) state that the capacity to sort questions in an online assessment cannot be done with a paper test. Software simulation, for example, can assist in data representation simply and rapidly. Furthermore, compared to a paper test, it produces more accurate findings (Alruwais et al., 2018; Appiah & van Tonder, 2019).

Challenges with online-based assessment

When it comes to conducting online baseline assessments, both students and teachers need help with several problems. According to Kuzmanovi and Baljoevi (2021), evaluating students online is problematic; for example, online quizzes are challenging since mathematical problems are rarely short-answer questions. In solving problems in mathematics, the complete algorithmic work to arrive at the correct answer is significant and must be evaluated during the assessment. According to McClelland and Cuevas (2020), students need help answering differently in an online assessment, mainly when a diagram, such as geometric forms, is provided. Furthermore, the above authors discovered that students only preview part of the test to notice question correlations. Therefore, in an online-based assessment, students needed help to evaluate and change their answers.

According to Osuji (2012), students and teachers encounter challenges because of their lack of skills in online assessment. Furthermore, the above author explained that students with

low computer literacy might face difficulties in online assessment. In addition, the setting and internet connection can make it difficult for students and teachers to participate fully in the online baseline assessment (Wijaya et al., 2020). Students needed help with online assessment, according to Appiah and van Tonder (2019). For example, recently, South Africa has experienced load-shedding which has impacted students' ability to work on their computers since they need electricity. Students complained vociferously about power outages, compatibility concerns, an unstable network, inability to access online assessment tasks owing to server issues, trouble navigating through online assessment activities, login issues, and the inability to edit answers were all obstacles that students had to deal with about online assessment.

First-year student teachers' mathematical knowledge and online-based assessment

For student teachers to meet the demands of a new environment (technology), such as an online baseline assessment, mathematical knowledge, which is individual previously acquired knowledge, abilities, and understanding, is essential (Ardiyaningrum & Retnowati, 2019). According to Ball et al. (2008), teachers' mathematical knowledge must be strengthened to teach mathematics. Therefore, it is necessary to identify specific mathematical knowledge that supports the teacher's performance. Ball et al. (2008: p399) describe mathematical knowledge for Teaching (MKfT) as "the mathematical knowledge required to complete the recurrent tasks of teaching mathematics to learners." Common content knowledge (CCK), specialised content knowledge (SCK), knowledge of content and students (KCS), and knowledge of content and teaching (KCT) are the four key areas identified by MKfT.

CCK is the mathematical knowledge and skills utilised in settings other than education. SCK is the mathematical knowledge and skills specific to teaching. It also has to do with deconstructing mathematical information to make elements of specific topics obvious to learners and learnable. The combination of knowing about students and understanding mathematics is known as KCS. Teachers can also use KCS to predict what students will do with an assignment and understand students' incomplete thinking. KCT is the mathematical understanding of instructional design.

For first-year student teachers to respond to the online baseline assessment, mathematical knowledge and skills are needed. According to Nurannisa et al. (2021), understanding the concept of mathematics is an essential skill that new teachers must grasp to expand their knowledge. In this regard, the student teachers must think logically while dealing with online baseline assessment challenges and find appropriate solutions. In addition, the student teachers must determine the relationship between symbols and causal patterns, as well as how to use formulae correctly and come up with answers to the difficulties that arise throughout the assessment. Kuzmanović and Baljošević (2021) assert that inadequate mathematics knowledge and skills, lack of computer literacy, and inadequate teacher training may contribute to a lower quality of education for learners. The student teachers who participated in this study are the result of these. Therefore, the online baseline assessment

enables the teacher educators to evaluate the student teacher's performance, competence, and capability in mathematics.

Table 1

The curriculum for the senior phase (Grades 7 to 9) Mathematics

Content Area	Senior Phase Grades 7 to 9
Numbers, Operations, and Relationships	• Representation of numbers in a variety of ways and moving flexibly between representations. • Recognizing and using properties of operations with different number systems, solving various problems, using an increased range of numbers and the ability to perform multiple operations correctly and fluently.
Patterns, Functions, and Algebra	• Investigation of numerical and geometric patterns to establish the relationships between variables. • Analysis of situations in a variety of contexts; representation and description of situations in algebraic language, formulas, expressions, equations, and graphs.
Space and Shape (Geometry)	• Drawing and constructing a range of geometric figures and solids. • Descriptions and classification of geometric figures and solids. • Solving a variety of geometric problems drawing on known properties of geometric figures and solids.
Measurement	• Using formulas for measuring area, perimeter, surface area, and volume of geometric figures and solids. • Selecting and converting between appropriate units of measurement. • Using the Pythagorean theorem to solve problems involving right-angled triangles.
Data Handling	• Collecting, summarizing, representing, and analysing data to interpret, report, and make predictions. • Probability of outcomes including both single and compound events.

South African senior phase context

The General Education and Training (GET) Phase of primary schooling in South Africa is compulsory from Grades 1 to 9. The GET phase is made up of Foundation (Gr R-3), Intermediate (Gr 4-6) and Senior Phases (Gr 7-9) (DBE, 2011).

The Department of Basic Education (DBE, 2011) in South Africa encourages learners entering school for the first time to undergo a baseline assessment so that teachers can plan accordingly to accommodate all learners' ability levels. Mathematics is one of the subjects examined to determine learners' baseline knowledge and understanding of the subject. The information gathered from the tests enables teachers to fulfill the requirements of individual learners completely, highlighting their strengths and areas for improvement. The senior phase (Grades 7–9) mathematics curriculum is used for the online baseline assessment of first-year student teachers. The table below displays the mathematics curriculum for the senior phase (Grades 7 to 9).

Thus, this article explores student teachers' views of online baseline assessments in the senior phase. Despite several studies about online or computer-based assessment, more research must explicitly reflect student teachers' views and reflections on online baseline assessment. Hence, the first-year student teacher's views on the online baseline assessment in the senior phase are presented in this article.

The research question that guided this paper is:

- What are the views of senior phase first-year mathematics student teachers towards online baseline assessment?

METHODOLOGY

In this study, a qualitative research approach was used to conduct the research, using an interpretivist paradigm. The interpretivist paradigm allows the researchers to gain a deeper understanding of the lived experiences of the participants. Data was gathered using an online Google form questionnaire. The participants in this study were first-year students enrolled in a mathematics department at a university in a rural province of South Africa for a Bachelor of Education (B.Ed.) Senior Phase Mathematics education program. Through the licensed online Computer Aided Mathematics Instruction (CAMI) program, the first-year student teachers were introduced to the Senior Phase Baseline Assessments. CAMI mathematics software is a collection of K-12 mathematics topics that can be used to improve learners' mathematics skills. CAMI is a multi-levelled mathematics application with thousands of activities. The exercises are marked automatically by CAMI. The first-year mathematics student teachers from a rural Higher Education Institution (HEI) specialised in senior-phase mathematics training. This paper included one hundred and sixteen (116) student teachers, which comprised of 52 female and 64 male students. All students completed the questionnaire for all three grades (7, 8, and 9). Data was collected using the convenience sampling method.

The CAMI Baseline Assessments were done as a blocked session in a controlled environment in an invigilated computer lab for two weeks. CAMI was installed on the lab PCs, and all SP Mathematics student teachers were given passwords to log in and complete the Senior Phase online Baseline Assessments (Grades 7, 8, & 9). After logging in, student teachers select 'Do assessment' from the Assessment box, which displays Baseline and Grades

assessments. Following that, the student teachers chose Grades 7, 8, and 9 from the Baseline Assessment and completed each exam item one at a time. After that, the student teachers were asked to complete a Google form in which they reflected on each baseline exam. The goal of the reflection was to allow student instructors to comment on computerised writing assessments, online writing mathematics assessments and a general overview of writing tests employing technology. The participants responded to six open-ended questions about their experience of writing tests on a computer based online Baseline Assessment themes. The survey's results were examined using descriptive data analysis. The student teachers who participated freely satisfied all ethical standards.

RESULTS

The views of the first-year student teachers were descriptively analysed. The responses of the first-year student teachers to the questionnaire were analysed. The findings are categorised into four parts.

- First-year student teachers' view on writing mathematical tests and their interest in computers for the first time.
- First-year student teachers' view on presentations of the mathematics questions in CAMI
- First-year student teachers' view on the difficulty in mathematical concepts knowledge and questions in the English language
- The general view of First-year student teachers on writing mathematical tests on CAMI

The discussions of the categories are presented below. First-year student teachers in denoted as FYST and some responses (not in any order) are given.

First-year student teachers' view on writing mathematical tests and their interest in Computer for the first time

Almost all (95%) of the student teachers responded that they were writing a mathematics test on the computer for the first time.

Specifically, 95% of the student teachers responded “YES” that they were writing a mathematics test on the computer for the first time.

Only 5% of the student teachers answered “NO” because they were not writing a mathematics test on the computer for the first time.

Furthermore, more than half of the student (65%) teachers responded that writing tests on the computer could be more interesting, while less than half of the students find writing tests on the computer enjoyable. The student teachers justified their responses with reasons. The sampled responses and reasons are as follows:

FYST 1: *No, because I couldn't express some numbers in a fractional way*

FYST 4: *No, because you can’t write a sum in your own style, the computer controls you*

FYST 7: *No, because the questions would automatically skip even when I was not yet done with them.*

FYST 9: *No, affected my confidence I was not aware we are going to write in the computer.*

FYST 11: *No, because it was my first time.*

FYST 6: *Yes, I didn't think Mathematics can be written like that*

FYST 8: *Yes, it doesn't consume a lot of time whereby you have to write down and sometimes you make mistakes.*

FYST 10: *Yes, I want to gain more experience in using the computer.*

FYST 13: *Yes, I've learnt so much.*

FYST 15: *Yes, it was a great experience.*

Sixty-five percent (65%) of the first-year student teachers reacted to both sides by saying that writing mathematics tests on the computer was not interesting because it was their first time. The student teacher also acknowledged that it was a great experience writing tests on the computer for the first time.

First-year student teachers' view on presentations of the mathematics questions in CAMI

Most of the student teachers expressed that they liked the presentation of the mathematics questions in CAMI, while some did not like the presentation. The responses and the reasons are enumerated below:

FYST 4: *Yes, it will also improve our quality of thinking and it will make things easier for us who don't know Computer.*

FYST 8: *Yes, the questions are clearly stated and not that hard to understand.*

FYST 19: *Yes, everything was easy and understandable.*

FYST 20: *Yes, they are simple but tricky at the same time.*

FYST 21: *Yes, I liked it even though I didn't know how CAMI fully functioned.*

FYST 22: *No, it automatically goes to the next question without a confirmation.*

FYST 26: *No, I'm not used to a computer.*

FYST 36: *No, because I was unable to go through my answers to check where I made mistakes.*

Many (70%) of the student teachers acknowledge that the questions are not difficult. However, because the student teachers were unfamiliar with the writing test on the computer, it took much work for them to answer the baseline assessment correctly.

First-year student teachers' view on the difficulty in mathematical concepts knowledge and questions in the English language

Many (75%) of the first-year student teachers responded that they had no difficulty understanding mathematical concepts. The sampled responses and the reasons are as follows:

FYST 24: *No, Mathematics is always taught in English, so the language isn't a problem.*

FYST 28: *No, I understand Mathematical terms clearly.*

FYST 30: *No, all the concept there was straight forward.*

FYST 32: *No, because in maths I just understand the terminology only.*

FYST 42: *No, everything is understandable.*

FYST 43: *No, I been studying maths for the past years so am familiar with its concepts familiar*

FYST 45: *No, because the questions were easier but difficult to write on the computer.*

FYST 39: *Yes, understood where I could and other parts it was just vague.*

FYST 40: *Yes, some concepts are tricky.*

FYST 41: *Yes, I'm not good at English.*

FYST 53: *Yes, I didn't remember what other concepts mean.*

In addition, many (75%) of the First-year student teachers expressed that the questions in the English language were not difficult to understand. Few (25%) need help understanding the language of the questions in English. A few of their responses and their reasons are given below:

FYST 4: *No, English is a common language, so there was no Difficulty*

FYST 8: *No, there were guidelines on how to answer question on the bottom of the computer*

FYST 79: *No, I did English in my previous school so I'm able to read and understand it*

FYST 81: *No, English is my first additional language.*

FYST 110: *No, it is because I learnt English maths from grade R to grade 12.*

FYST 111: *No, I understand English very well.*

FYST 114: *No, it was easy, and the layout was good.*

FYST 115: *No, that English was not difficult.*

FYST 33: *Yes, I'm failing to understand and interpret the questioning style.*

FYST 35: *Yes, some questions they have bold English, so it becomes so difficult to answer a question.*

FYST 69: *Yes, I am not used to questioning skills that were used.*

FYST 78: *Yes, I'm not fluent in English that's why I don't understand some questions.*

Seventy-five percent (75%) of the student teachers understand the language of the baseline assessment questions. The indication is that language (English) was not the problem in writing the baseline assessment test for the student teachers, but using the computer took much work.

General view of First-year student teachers on writing mathematical tests on CAMI

The first-year students responded differently in this aspect. Some of the first-year students reacted positively to the CAMI test while some reacted negatively to the test. Some of the responses are given below:

FYST 3: *CAMI are not good for first year students some of us don't even know how to use computers.*

FYST 5: *It was so interesting and enjoyable.*

FYST 9: *It is not difficult, it is fair, but it wants someone who is open minded.*

FYST 15: *CAMI test was not difficult that much, but the computer gives me some difficulties by submitting by itself.*

FYST 36: *CAMI test it good and interesting because it makes me to see where I need assistance and where I to improve.*

FYST 37: *I think I enjoyed the CAMI test; they boost us and our knowledge.*

FYST 40: *Nothing interesting at all*

FYST 42: *It was challenging.*

FYST 78: *They are enjoyable, but they should alert or give a second chance and also let you confirm your answer what they are doing is not right at all.*
FYST 79: *CAMI tests are good, but the method that is used to conduct them is not good.*
FYST 80: *I don't know.*
FYST 93: *Bit difficult*
FYST 97: *Actually, it wasn't difficult at all.*
FYST 98: *Trick, but good to attend it often to get used to it.*
FYST 101: *Its easy, have enough time to write.*
FYST 104: *Impressing*
FYST 105: *Exceptional*
FYST 106: *Complicated*
FYST 112: *It really helpful*

A high percentage (98%) of the first-year student teachers were excited about writing the baseline assessment on the computer for the first time. The CAMI presentation motivated them to write the baseline assessment. However, writing baseline assessment tests on the computer was difficult for many student teachers. The reason being that many of the student teachers were unfamiliar with an online baseline assessment, they considered the experience uninteresting. The expression also revealed that some of the mathematics questions on the baseline assessment test are challenging and that using the computer is challenging for many first-year student teachers. The findings indicated that many first-year student teachers struggle with computerized test writing. Many first-year student teachers are from rural areas and have yet to be exposed to computer use in high schools, which could explain the trend.

DISCUSSIONS

This paper reported on the views of first-year student teachers toward the online baseline assessment. The results revealed that the first-year student teachers were excited and motivated to write the baseline assessment tests on the computer for the first time. This view contrast with Wijaya et al. (2020), who found that new experience (online learning) for students could be more effective and exciting. Furthermore, the findings revealed that many (95%) first-year student teachers faced challenges writing baseline assessments on computers. The findings concurred with Alruwais et al. (2018), who discovered that students prefer online baseline assessments because of friendly interfaces and leisure activities.

On the other hand, the findings also consisted of Appiah and van Tonder (2019); McClelland and Cuevas (2020); Osuji (2012); and Wijaya et al. (2020) where all the authors found that students faced challenges in writing online baseline assessment. According to Huda et al. (2020), students are uncomfortable with e-assessment, making it difficult to concentrate. It has been a new system since the COVID-19 epidemic, even though students in higher education accepted it.

Khan and Khan (2019) concluded that students need to appreciate the value of transitioning to online assessments. The above researchers explained that traditional assessment methods were the norm for students. They needed to be convinced of the value of the move to online assessment before the students happily accepted it. Khan and Khan (2019) said that students needed help finding online assessment approaches to be convenient. On the other hand, students (25%) found the transition inconvenient due to their personal experiences. They felt unprepared and distrusted technology, even though it was crucial to their education. As a result, a gradual shift to online assessments and technical training for both students and educators would boost student acceptance. Students must have active, one-on-one interaction with instructors to integrate online assessments into higher education successfully.

CONCLUSION

Online assessments have been shown in the literature to be more trustworthy and objective, with the advantage of being evaluated by an automated system, reducing human error. Furthermore, it gives students immediate feedback, allowing them to comprehend their progress immediately after completing the test. In addition, it enhances the learning experience of students. It enables teachers to monitor the progress of their students. It relieves teachers of the stress of evaluating large groups of students while also reducing evaluation time and cost. The online baseline evaluation, however, elicited both positive and negative responses from first-year student instructors in this study. Therefore, student teachers must acquire knowledge, abilities, and understanding when exposed to online baseline assessment.

As a result, teacher educators at Higher Education Institutions (HEIs) must educate students about online assessments and prepare them for writing assessments on a computer by exposing them to online assessments regularly.

Recommendations

Although studies have shown the benefits of online assessment, there are few studies on students' views on writing online assessments. As a result, this study recommends

- that further research be done on student teachers' expression at HEIs and the use of online-based assessment.
- Further investigation into the gender variable as a construct to determine student teachers' views on online assessment and
- using the time variable to determine the student's ability to complete the online based assessment within a particular timeframe.

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