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# Students' Self-Efficacy in Senior Secondary School Mathematics: Academic Engagement as a Predictor Variable

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**ABSTRACT**

Students who lack confidence believe that they cannot accomplish a work, view the activity as pointless, and as a consequence, don't want to put any time or effort into it when properly engaged brings about traits that are needed in a student, hence academic engagement is seen as a potential antidote to the issue of students' self-efficacy in mathematics. Therefore, this paper investigated student's self-efficacy in senior secondary school mathematics as being predicted using academic engagement. An ex-post facto correlational research design was used. 1680 students from Senior Secondary School II made up the study's sample from the twenty-one randomly selected schools in the three Local Government Areas of Remo division of Ogun State, Nigeria. Mathematics Student Academic Engagement Scale (MSAES) with $r = 0.776$and Mathematics Self Efficacy Scale (MSES) with $r = 0.882$. . Findings showed that cognitive engagement significantly predicts self-efficacy of students in Mathematics (F = 527.320, p<0.05). Also, behavioural engagement significantly contributes to the variance in students' self-efficacy in Mathematics (F = 759.251, p<0.05). Furthermore, emotional engagement significantly contributes to the variance in students' self-efficacy in Mathematics (F = 667.409, p<0.05). Results also revealed that the predictor variables cognitive, behavioural and emotional engagement when taken together significantly contribute to the variance in students' self-efficacy in Mathematics (F = 380.151, p<0.05). This study concluded that cognitive, emotional and behavioural engagements are good predictors of senior secondary school students' mathematics self-efficacy. To increase students' self-efficacy in mathematics, stakeholders in Nigerian education are advised to ensure that students are engaged cognitively, emotionally, and behaviourally.

**KEYWORDS**
Academic engagement, behavioural, cognitive, emotional, mathematics, self-efficacy.

## INTRODUCTION

Every skill in human endeavours, including politics, economics, science, and technology, is influenced by the mentally stimulating topics of mathematics. Thus, mathematics serves as a framework for understanding and applying scientific ideas, demonstrating the significance of the topic (Asanre et al., 2021). The learning of mathematics is one of the most important tasks in the national education system, it is not only for the acquisition of knowledge and comprehension of mathematical ideas but also for the application of skills, attitudes, appreciation and interest in learners.

Mathematics is a core subject at various levels of formal schooling. This has made teaching and studying the subject so important. Bello and Ariyo (2014) reported that the importance of mathematics cannot be overstated because it permeates almost all academic disciplines, whether they mathematical or not, not to mention its effect on subjects that are mathematically connected. Mathematics is a branch of information that manages estimations, numbers and amounts. For understudies to move ahead in their coveted scholarly vocation, they must pass the subject legitimately with no less than a credit, Wachukwu et al. (2017).

Despite the importance of the subject, students fail mathematics because of the nature of the subject, the level of engagement, the methodology of teaching, communication problems and the failure of the teacher to relate the knowledge of mathematics to the immediate environment of the learner, which consequently hinders consolidation, application and transfer of learning, (Asanre, 2023). He further reports that stakeholders in mathematics are worried about what appears to be a deterioration in students' understanding of mathematical principles and their application to practical circumstances. Moreover, the decline in terms of self-efficacy in mathematics is thought to be addressed by increasing academic engagement.

Ayllon et al. (2019) reported that self-efficacy is an individual self-assurance or opinion concerning a student's competencies, and mostly evaluates one's cognition based on prior performance and skills to carry out a potential performance. Students who have strong self-efficacy tackle difficult tasks more frequently, stay on tasks longer, and put forth more effort. Highly effective students blame their lack of effort for their failures, whereas they give themselves credit for their accomplishments when they succeed (Yazachew, 2013). In the opinion of Bandura (1994), posits that self-efficacy influences human performance through four primary psychological processes: emotion, motivation, selection, and cognition. Thinking, evaluating one's level of motivation in one's tasks, evaluating one's emotional states and emotions, and exerting control over the individual's motivation are some of these processes. Therefore, Asanre (2024) submitted that Self-efficacy is the belief in oneself or one's assessment of one's abilities. This cognitive evaluation gauges a person's confidence in their potential for future success based on past results.

Side and Cuevas (2020) suggested that an elevated sense of self-efficacy increases confidence in intended learning outcomes and that persistence in achieving objectives is crucial for the actualisation of a learner's goal. Additionally, Kefyalew (2020) opined that students that

have self-efficacy believe they can learn new activities and abilities, usually in an academic setting. Furthermore, self-efficacy is the conviction that one can plan and carry out the actions necessary to achieve specific results. Oshakuade et al. (2023) gives an insight that in comparison to less effective peers, highly effective students may reject flawed solutions more rapidly, solve more problems, and revise more previously challenging tasks.

According to Ugur (2019), students who lack confidence believe that they cannot accomplish work, view the activity as pointless, and as a consequence, do not want to put any time or effort into it. They do not wish to perform such a duty as a result. He further asserts that students who are highly engaged have greater self-efficacy ratings than less engaged students, who are also seen to devote more time to studying. Additionally, Loo and Choy (2013) reported that academic engagement was the primary driver of success in mathematics and related subjects, and that sources of self-efficacy were linked to mathematics achievement. More so, Asanre (2023), reports that, self-efficacy is a result of participating in academic activities. This is because a student has to believe he can complete the learning task if he has a strong intellectual connection to it. On the other hand, students who don't think they can accomplish a task could think of it as pointless and choose not to put in the time and effort required to do it.

Nimisha and Mohammad (2018) report that students who have low efficacy beliefs avoid mathematics because of fear and reluctance, but raising their efficacy focus must be at their level of engagement, which implies adequate academic engagement. They further asserted that students' learning is psychologically involved regarding academics. To motivate learners to be positively engaged, teachers should build a sense of high self-efficacy. Selim (2014) suggested that academic engagement in students refers to their readiness, needs, wants, drive and achievement in the learning process. Hidayah et al. (2020) reported that students' academic engagement is not only the number of times students respond but also the quality of their responses on the degree and calibre of their involvement during the instructional procedure. More so, results of short, long, and lifelong learning may be predicted by student academic engagement, according to Boxer et al. (2010).

According to Lo and Hew (2021), student engagement is a crucial component of learning because it is related to a number of preferred learning results, including increased academic success and low disengagement. Additionally, Kathleen (2015) opines that understanding students' academic engagement may be seen as a critical component for gaining a complete understanding of their overall well-being. Some researchers have concluded that attentive students participate actively in class discussions, put forth effort during class activities, and display an interest in and excitement for learning (Hassan et al., 2013). Gunuc and Kuzu (2014) further report that to attain good educational results, student academic engagement refers to the "quality and quantity of students' psychological, cognitive, emotional, and behavioural reactions to the learning process as well as to in-class/out-of-class academic and social activities." Student academic involvement is seen as multifaceted and includes students' cognitive, emotional, and behavioural responses to in-class activities.

Before students become cognitively engaged, they must be attentive in class (behaviorally engaged) and emotionally connected to others to some extent (emotionally involved). Since this three-dimensional model was created by a thorough synthesis of the available information, it very well encompasses everything in educational contexts (Lo & Hew, 2021). According to Wang and Eccles (2012), cognitive engagement is the ability to pay attention and concentrate during learning tasks. A student may develop better levels of self-efficacy if they place more emphasis on his or her abilities than his or her limitations. Additionally, Cognitive engagement is the use of appropriate learning strategies, such as flexible thinking and connecting new and old information, to match academic results (Wei et al., 2020).

Students' self-efficacy has been demonstrated to be correlated with behavioural engagement (Wang et al., 2011). According to Li and Lerner (2011), there is a greater likelihood that students will engage in class activities if they attend class more regularly and bring their books and materials. Additionally, students who frequently participate in class activities are more likely to graduate from high school and exhibit high levels of self-efficacy in their academic achievement. When students plan and reflect on their achievement to examine their learning or an academic task using metacognition tactics, they engage in their cognitive processes, Al-Mutawah et al. (2017). Behavioral engagement may be gauged, for example, by looking at students' effort, good conduct, and involvement, (such as extracurricular activity participation, attendance, and work habits) (Oqab et al., 2016).

Additionally, students' behavioural engagement may be summed up as being focused, participating actively, or having an interest in mathematics. Students' participation and readiness to ask and respond to questions throughout the teaching and learning process are indicators of behavioural engagement, Alrajeh and Shindel (2020). More specifically, emotional involvement is seen as an affective orientation toward both learning itself and school-related objects such as peers, instructors, and schools (Wei et al., 2020). Additionally, Elizabeth (2023) submit that positive and negative affective responses that students make to the academic environment and assignments are referred to as emotional engagement. Positive affective responses include happiness, excitement, curiosity, contentment, and vitality while the negative affective response is lack of interest. Affective responses to classmates, classrooms, instructors, and schools are included in emotional engagement. Over time, students who exhibit less behavioural and emotional engagement are more prone to hold unfavorable perspectives about education hence, displaying a low level of self-efficacy (Li & Lerner, 2011). Additionally, the expectancy-value theory states that people's degree of self-efficacy shapes their behaviour and emotional involvement (Olivier et al., 2019). Therefore, this study looks at academic engagement as an indicator of mathematics self-efficacy in senior secondary schools in Ogun State's Remo Division.

**Objectives of the Study**

This research aims to determine the degree to which several aspects of students' academic engagement (behavioural, emotional and cognitive) predict senior secondary school students' self-efficacy in Mathematics.

**Statement of Hypotheses**

The 0.05 level of significance will be used to assess the following hypotheses that were developed for this investigation.

**$H_1$**: Cognitive engagement will not significantly predict senior secondary school students' self-efficacy in mathematics

**$H_2$**: Behavioural engagement will not significantly predict senior secondary school mathematics students' self-efficacy.

**$H_3$**: Emotional engagement will not significantly predict senior secondary school mathematics students' self-efficacy.

**$H_4$**: Cognitive, behavioural and emotional engagements, when taken collectively, will not significantly predict senior secondary students' mathematics self-efficacy.

## MATERIALS AND METHODS

**Design and Participants**

This study used a descriptive survey approach. The sample comprises a thousand six hundred, eighty students (1680) who were selected from twenty-one (21) public senior secondary schools in the Ogun East Senatorial District (Remo Division) of the Ogun state, Nigeria, using multistage sampling technique. At the initial stage, the Senatorial district was stratified based on the existing number of Senatorial districts in the state; one (1) of the two divisions (the Remo and Ijebu divisions) was selected purposively because there is a lack of studies on student academic engagement as an indicator of learning outcomes in Senior Secondary School Mathematics; therefore, the Remo division was selected as the study area. In the second stage, twenty-one (21) Senior Secondary Schools were chosen from the existing forty-one schools in the whole Remo division and the selected Local Government Areas based on a determined proportion of 50%, that is, four (4) schools out of eight (8) schools in the Remo North L.G.A., six (6) schools out of eleven (11) schools in Ikenne L.G.A. and eleven schools out of twenty-two (22) schools in the Sagamu L.G.A. In the final stage, one thousand six hundred and eighty (1680) Mathematics students were selected from the twenty-one (21) selected schools based on a straightforward method of random sampling. Each school has eighty chosen pupils (80 students/school).

**Survey instrument**

The Mathematics Students' Academic Engagement Scale (MSAES) and Students' Responses to the Mathematics Self-Efficacy Scale were utilized to gather information. The MSAE scale is a thirty (30)-item scale adapted from the scale of Lam and Jimerson (2008). The original scale initially comprises thirty-three items based on the dimension of academic engagement ranging from affective to behavioural to cognitive engagement. The reliability of the scale was assessed

in seventh to ninth-grade English language students in California, was found to be $0.65 \leq \alpha \leq 0.95$. In this study, the adapted instrument was modified to suit the purpose of this study; it comprises four (4) point-type scale with strongly agree to strongly disagree options. The instrument is split into four sections A to D. Section A consists of the demographic information of the students. The demographic information included the student's name, name of school, sex and class. Section B contains 10 items eliciting information on the behavioral engagement of the student's offering mathematics; items 1, 2, 4 and 8 provide information on effort and persistence, while items 3, 9 and 10 talk about class participation. Section C contains 10 items eliciting information on the emotional engagement of the student's offering mathematics; items 1,5,7 and 8 on affection for learning mathematics; items 2 and 3 on affection for the mathematics teacher; items 4 and 9 on affection for the mathematics class; and items 6 and 10 on affection for peers, Section D also contains 10 items eliciting information on the cognitive engagement of the student's offering mathematics. The items were scored as follows: Strongly disagree as one, disagree as two, agree as three and Strongly Agree as four. This instrument allows the researcher to predict the dimensions of academic engagement of students in the learning of mathematics. Face and content validity are types of validity used in ascertaining the instrument's appearance, surface level relevance, comprehensiveness and accuracy, it is therefore used to determine the instrument's validity by taking the instruments to both mathematics experts and experts in the Department of Psychology at Olabisi Onabanjo University and Tai Solarin University of Education, their contributions and suggestions were utilized to enhance the instrument's quality. The validated instrument (MSAES) was tested on students from another school different from the sample for the research and the reliability coefficient was 0.776. The MSES consists of self-efficacy statements adapted from Xing and Hari (2009), with an initial reliability coefficient of $\alpha = 0.933$. The study's customized tool has two divisions. A consists of demographic data about the students, and the demographic information includes the student's name and school, class and sex. B consists of 20 items eliciting information on the self-efficacy of the students. The students responded to the instrument by indicating their agreement level on a four-point scale ranging from strongly in agreement to strongly disagree. The reliability coefficient of the revalidated instrument is 0.882. The data collected were analysed with multiple regression analysis.

## RESULTS AND DISCUSSION

### Results

**$H_1$**: Cognitive engagement will not significantly predict senior secondary school students' self-efficacy in mathematics.

**Table 1.**

*Regression of Cognitive Engagement on Students' Self-efficacy in Mathematics*

Multiple R = 0.489
Multiple $R^2$= 0.239
Adjusted $R^2$= 0.239
Std. Error of the Estimate = 8.075

| Model | Sum of Squares | Df | Mean Square | F | Sig. of F |
|---|---|---|---|---|---|
| Regression | 34385.447 | 1 | 34385.447 | 527.320 | <.001 |
| Residual | 109418.981 | 1678 | 65.208 | | |
| Total | 143804.428 | 1679 | | | |

* indicates a significant F at α = .05

Table 1 displays the impact of the regression of cognitive engagement on respondents' self-efficacy scores in mathematics. The results revealed a significant difference (F = 527.320, p<0.05). This finding implies that cognitive engagement significantly contributes to the variance in mathematics students' self-efficacy. The results showed a multiple correlation coefficient of 0.489 and an $R^2$ value of 0.239, thus revealing that cognitive engagement accounted for 23.9% of the dependent variable's volatility (students' mathematics self-efficacy). Hence, hypothesis 1 is rejected. Thus, cognitive engagement significantly predicts the self-efficacy of senior secondary school students in mathematics, accounting for approximately 24% of the variance in the dependent variable. In other words, cognitive engagement strongly predicts mathematics students' self-efficacy in senior secondary school.

**$H_2$**: Behavioural engagement will not significantly predict senior secondary school mathematics students' self-efficacy.

**Table 2.**

*Regression of Behavioural Engagement on Students' Self-efficacy in Mathematics*

Multiple R = 0.558
Multiple $R^2$= 0.312
Adjusted $R^2$= 0.311
Std. Error of the Estimate = 7.681

| Model | Sum of squares | Df | Mean Square | F | Sig. of F |
|---|---|---|---|---|---|
| Regression | 44797.879 | 1 | 44797.879 | 759.251 | <.001 |
| Residual | 99006.549 | 1678 | 59.003 | | |
| Total | 143804.428 | 1679 | | | |

* indicates a significant F at α = .05

Table 2 displays the regression findings of behavioural engagement on respondents' self-efficacy scores in mathematics. The results revealed a significant difference (F = 759.251,

p<0.05). This finding implies that behavioural engagement significantly contributes to the variance in mathematics students' self-efficacy. The result showed a multiple correlation coefficient of 0.558 and an $R^2$ value of 0.312 thus revealing that behavioural engagement accounted for 31.2% of the variance in the dependent variable (students' mathematics self-efficacy). As a result, null hypothesis 2 is rejected. Thus, behavioural engagement significantly predicts the self-efficacy of senior secondary school students in mathematics, accounting for approximately 31% of the variation in the dependent variable. Therefore, behavioural engagement is a major predictor of students' mathematics self-efficacy in senior secondary school.

**$H_3$**: Emotional engagement will not significantly predict senior secondary school mathematics students' self-efficacy.

**Table 3.**

*Regression of Emotional Engagement on Students' Self-efficacy in Mathematics*

Multiple R = 0.533
Multiple $R^2$= 0.285
Adjusted $R^2$= 0.284
Std. Error of the Estimate = 7.830

| Model | Sum of Squares | Df | Mean Square | F | Sig. of F |
|---|---|---|---|---|---|
| Regression | 40920.939 | 1 | 40920.939 | 667.409 | <.001 |
| Residual | 102883.489 | 1678 | 61.313 | | |
| Total | 143804.428 | 1679 | | | |

* indicates a significant F at α = .05

Table 3 displays the regression findings of the effect of emotional engagement on respondents' self-efficacy scores in mathematics. The results revealed a significant difference (F = 667.409, p<0.05). This finding implies that emotional engagement significantly contributes to the variance in the mathematics students' self-efficacy. The results showed a multiple correlation coefficient of 0.533 and an $R^2$ value of 0.285, thus revealing that emotional involvement was responsible for 28.5% of variance in the dependent variable (Mathematics self-efficacy). Therefore, null hypothesis 3 is rejected. Thus, emotional engagement strongly influences the prediction of students' mathematics self-efficacy in senior secondary school, accounting for approximately 29% of the variance in dependent variable. Therefore, emotional engagement is a major predictor of students' mathematics self-efficacy in senior secondary school.

**$H_4$**: Cognitive, behavioral and emotional engagement, when considered together, are not significant predictors of mathematics students' self-efficacy in senior secondary school.

Table 4 displays the findings of the regression analysis using all three predictor variables together (emotional, behavioral, and cognitive engagement) on the respondents' self-efficacy scores in mathematics. The results revealed a significant difference (F = 380.151, p<0.05). This

finding suggested that the predictor variables, when considered as a whole, significantly contribute to the variance in mathematics students' self-efficacy. The results showed a multiple correlation coefficient of 0.636 and an $R^2$ value of 0.405 thus revealing that a combined 40.5% of the variation in the dependent variable was accounted for by the predictor factors (students' self-efficacy in mathematics). Therefore, null hypothesis 4 is rejected. Thus, the combined predictor variables significantly contribute to forecasting the mathematical self-efficacy of senior secondary school students, accounting for approximately 41% of the variation in the dependent variable. Therefore, cognitive, behavioural and emotional engagement, when considered together, are significant predictors of self-efficacy in mathematics among senior secondary school students.

**Table 4.**

*Regression of the Predictor Variables on Students' Self-efficacy in Mathematics*

Multiple R = 0.636
Multiple $R^2$= 0.405
Adjusted $R^2$= 0.404
Std. Error of the Estimate = 7.146

| Model | Sum of Squares | Df | Mean Square | F | Sig. of F |
|---|---|---|---|---|---|
| Regression | 58230.085 | 3 | 19410.028 | 380.151 | <.001 |
| Residual | 85574.343 | 1676 | 51.059 | | |
| Total | 143804.428 | 1679 | | | |

* indicates a significant F at α = .05

**Regression equation**

The cumulative effects of the three predictor variables, cognitive engagement, behavioural engagement, and emotional engagement on mathematics students' self-efficacy can be expressed mathematically considering the Beta values in the table below;

**Table 5.**

*Summary of the step-wise regression of independent variables on students Self-efficacy in Mathematics*

| Model | Unstandardized Coefficients | | Standardized Coefficients | T | Sig. |
|---|---|---|---|---|---|
| | B | Std. Error | Beta | | |
| Constant | 7.105 | 1.581 | | 4.495 | <.001 |
| Cognitive Engagement | .466 | .052 | .207 | 9.018 | <.001 |
| Behavioural Engagement | .694 | .054 | .311 | 12.812 | <.001 |
| Emotional Engagement | .484 | .049 | .244 | 9.921 | <.001 |

The mathematical equation is expressed as,

$$Y = 0.466CE + 0.694BE + 0.484EE + 7.105$$

where Y represents students' self-efficacy in mathematics. The results showed that bahavioural had the highest contribution followed by emotional engagement and cognitive engagement whose contribution was moderate. Additionally, enhancing any of the variables (cognitive, behavioural and emotional engagement) will improve students' mathematical self-efficacy. Therefore, cognitive, behavioral with emotional engagement when combined are reliable indicators of students' mathematical self-efficacy.

**Discussion of the Results**

Table 1 demonstrates a substantial relationship between cognitive engagement and students' self-efficacy in mathematics. This finding follows Wang et al. (2011) who report that cognitively engaged students pay attention, focus on learning and possess a high level of confidence, meaning that students in Remo division of Ogun State, Nigeria possess a high level of cognitive engagement that in turn brought about their increase in self-efficacy in mathematics subject. Moreover, according to Table 2, students' self-efficacy in mathematics is found to be substantially predicted by behavioral engagement in senior secondary school. This implies that a participatory student possesses self-confidence in studying mathematics. The result aligns with Wang and Eccles (2012), who report that behavioural engagement and self-efficacy are related. Additionally, Li and Lerner (2011) conclude that students who contribute more to class activities display a high level of self-efficacy. Additionally, the findings of this study revealed that emotional engagement significantly predicts Senior Secondary School students' self-efficacy in mathematics as shown in Table 3. This implies that students with good feelings toward peers and school possess a high level of competence which is in line with the suggestion of Hassan et al. (2013) that emotionally engaged students find school rewarding thereby boosting their level of confidence in mathematics.

Additionally, it corroborates the findings of Kanaparan et al. (2017), who point out that there is a strong link between self-efficacy and emotional engagement. The outcomes also indicated that cognitive, behavioural and emotional engagement strongly predict students' self-efficacy in mathematics at the senior secondary level, as shown in Table 4. This finding is supported by Suarez et al. (2009) who showed that students' self-efficacy is a result of academic engagement. Additionally, in agreement with these findings Ugur (2015), that higher academic involvement among students is associated with greater self-efficacy than lower academic engagement is. To corroborate these findings, Nimisha and Mohammad (2018) concluded that students with poor efficacy beliefs exhibit fear and unwillingness to study mathematics: however, to ensure high self-efficacy, the focus must be on their level of academic engagement (cognitively, behaviorally and emotionally). This is further supported by Zhen et al., (2017); Singh and Abdullah (2020); and Elizabeth (2023) who highlight that self-efficacious students are highly engaged and that self-efficacy is related to academic engagement. Table 5 shows the mathematical regression that can be used to predict the self-efficacy of students in mathematics. This aligns with the findings of Ifamuyiwa et al. (2024) reveal that dimensions of

academic engagements when taken together in a strong indicator of both male and female students' self-efficacy.

## CONCLUSION AND RECOMMENDATION

Student academic engagement is a clear indicator of a potential solution to the declining mathematics self-efficacy of secondary school students. Furthermore, numerous studies have shown that the three aspects of students' academic engagement cognitive, behavioural, and emotional have not been studied in tandem, particularly in Ogun State's Remo Division. The researcher investigated aspects of students' academic engagement as predictors of senior secondary school mathematics self-efficacy because of the necessity of increasing the level of academic engagement among secondary school students. Therefore, the findings of the study lead to the conclusion that when students are cognitively, behaviorally and emotionally engaged in their studies, it improves their self-efficacy in mathematics at the senior secondary level, in the Remo Division of Ogun State, Nigeria. It is recommended that comparable studies be carried out in secondary schools, both public and private, universities and that other science courses, such as computers, physics, chemistry, and biology, be taken into account in the Ogun state generally or in Nigeria.

Additionally, because the dimensions of students' academic engagement predict their self-efficacy in mathematics, teachers should utilize these dimensions to connect with learners during mathematics instruction and learning processes in Nigerian senior secondary schools. That is, teachers should create a fearless setting for learning and abstractness about the subject to promote a favourable attitude toward the study of mathematics. Moreover, teachers should provide room for student-teacher interaction (which is an avenue for emotional engagement) to stimulate learner participation (behavioural engagement) during instruction. Despite carrying out this study, part of the limitation is that a limited sample size was used, therefore it cannot be generalised to all senior secondary school students in Nigeria considering the complex nature, diversities and states within the country. More so, the study relies on using mathematics achievement tests to get the achievement scores, which may be limited in generalising on the self-efficacy of the students. Therefore, further studies can make use of other factors that contributes to students' achievement and more samples can be considered.

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