



## **Mathematics Students' Coping Behaviour, Happiness, and Self-efficacy in the New Normal: Correlation and K-means Cluster Analysis**

Leomarich F. Casinillo

### ***Abstract***

Students in distance education are expected to have low levels of happiness in learning. As such, they must possess coping behaviour and self-efficacy to become motivated in school. This article aims to depict the level of students' coping behaviour, happiness, and self-efficacy in learning mathematics amid the COVID-19 pandemic and determine their association. Primary data were gathered through Google Forms from 233 available samples of mathematics students at Visayas State University, Baybay City, Leyte, Philippines. The data were summarized through selected descriptive statistics and depicted their relationship with the aid of Spearman rho correlation. In addition, K-means clustering was employed to categorize the students into similar characteristics in regard to coping, happiness, and efficacy. The results showed that students during the pandemic are coping, moderately happy, and possess moderate self-efficacy. The correlation analysis revealed that students' coping behaviour, happiness level, and self-efficacy are highly and directly associated with each other. This suggests that the students' coping, happiness, and efficacy levels must go together to achieve a good academic performance in mathematics during distance education. Moreover, the K-means clustering analysis revealed that there are a group of students with significantly lower coping behaviour, happiness level, and self-efficacy in learning. In conclusion, mathematics teachers must encourage their students to engage in the classroom to boost their coping, happiness, and efficacy. Furthermore, teachers must give interesting and realistic mathematics activities, however, doable and suitable for online learning amid the health crisis.

**Keywords:** mathematics education, coping strategies, subjective happiness, self-efficacy, college students, Philippines

**Leomarich F. Casinillo** is an Assistant Professor of Department of Mathematics, College of Arts and Sciences, Visayas State University, Baybay City, Leyte, Philippines. Recent publications include: Valenzona, J. V., Casinillo, L. F., & Casinillo, E. L. (2022). Modeling students' innovativeness and its factors in learning mathematics amidst COVID-19 pandemic. *The Palawan Scientist*, 14(1), 43-50. Casinillo, L. F. (2022). Modeling Creativity and Enjoyment in Learning Statistics Online in the New Normal. *Philippine Social Science Journal*, 5(4), 100-108. Casinillo, L. F. (2023). Modeling Students' Self-Efficacy in Mathematics during the Covid-19 Pandemic. *Canadian Journal of Family and Youth/Le Journal Canadien de Famille et de la Jeunesse*, 15(1), 77-89.

## ***Introduction***

Low happiness in learning was experienced by many college students due to the adverse impact of the COVID-19 pandemic on the educational system (Wan Mohd Yunus et al., 2021; Lee et al., 2022). In particular, the learning setup in mathematics has abruptly shifted to distance education which brought about more difficulties for students (Mulenga & Marbán, 2020; Casinillo et al., 2022). In that case, students must have a good foundation of self-efficacy and coping behaviour to sustain their progress in learning amid the challenges and obstacles brought on by the pandemic. According to Simorangkir et al. (2021) and Casinillo (2022a), the educational setup has abruptly shifted from face-to-face learning to online (distance) learning where the guidance of the teachers is very limited. Students are having difficulty understanding their lessons because of the not conducive learning platform which caused them stress and depression resulting in low happiness levels (Osawa et al., 2022). In fact, several social scientists have revealed that distance education is not that effective due to the barriers and limitations associated with internet connectivity and misuse of technology (Irfan et al., 2020; Francom et al., 2021; Casinillo et al., 2022; Casinillo, 2023). Due to this issue, it is necessary to study the well-being or happiness of student learning in order to formulate a teaching method that will enhance their motivation to have a good cognitive attitude towards learning amid their online classes.

In the study by Casinillo and Casinillo (2020), it was portrayed that a happiness level is vital in progressing cognitive thinking in mathematics. Happiness gives motivation and interest in acquiring the necessary knowledge that is needed for problem-solving skills. In that case, to increase their happiness level, students must possess self-efficacy in learning mathematics to build confidence that they can do better and achieve despite the challenges during online learning (Casinillo, 2023). Another thing is that students must develop a coping behaviour or mechanism to execute their required activities properly while avoiding stress and depression brought on by the pandemic in the educational environment (Savitsky et al., 2020; Li & Che, 2022). Quansah et al. (2022a) stated that a coping mechanism in dealing with obstacles during the pandemic is necessary to divert attention from a stressful event. Hence, many educational researchers dealt with the behaviour of students during the pandemic as they faced online learning to improve the teachers' effectiveness as well as students' well-being (Frimpong et al., 2022; Li & Che, 2022; Quansah et al., 2022b). Especially in the field of mathematics where many students find the subject very technical, abstract, and complex, hence, some social scientist has investigated formulating teaching styles that is suitable and effective for online learning.

The ideas of students' coping behaviour, happiness, and self-efficacy are well-researched in the literature, however, the association of the said variables is not rigorously investigated during the online learning setup. Henceforth, the researcher initiated to depict the relationship of the three variables that involve mathematics students at the college level. The main aim of this study is to measure and associate the students' coping behaviour, happiness, and self-efficacy in mathematics online during the pandemic as well as to cluster a group of students with more or less the same characteristics. Specifically, this article is motivated on answering the following goals: (1) to measure the students' coping behaviour, happiness, and self-efficacy level in mathematics during the pandemic; (2) to determine the relationship between the students' coping behaviour, happiness, and self-efficacy in mathematics; (3) to cluster the students in regards to coping behavior, happiness, and self-efficacy level in mathematics. The results of this article may help resolve the students'

stressful cognitive behaviour in online learning. Plus, the study's result may give information to mathematics teachers concerning their students' learning experience in improving their strategies in distance education. Moreover, the findings of this article may serve as a piece of baseline information for many researchers in online education and as a whole, the study will contribute to the advancement of education in the literature.

### ***The Framework of the Study***

Learning mathematics amid the pandemic online has revealed many issues (Irfan et al., 2020; Casinillo, 2022a). Students and teachers were not able to execute their best parts due to the limitations of distance learning (Francom et al., 2021; Casinillo et al., 2022). The barriers and limitations in online learning have resulted in students' anxiety and low happiness levels in learning mathematics. In fact, the effect of the COVID-19 pandemic on every individual is distress which reduces happiness or well-being (Yıldırım & Güler, 2021). Apparently, a low level of happiness in learning can adversely affect the student's ability to think straight which resulted in frustration and depression (Tannert & Gröschner, 2021; Osawa et al., 2022). In that case, students must possess a coping mechanism to overcome the challenges they have encountered and increase their happiness in learning. According to Baloran (2020), a coping mechanism can amend the students' feelings during the challenges they are facing and it provides intellectual comfort since it diverts the focus of students to a relaxing attitude.

Similarly, Umar et al. (2021) depicted that the coping skills of students will help them survive the difficult situation they are in and supports them to be successful in online learning. In that case, coping strategies during the COVID-19 pandemic may help students progress in their happiness and interest in learning mathematics (Diesta & Ferolino, 2021). On the other hand, self-efficacy is also part of the picture, it is the student's capacity to do things necessary to accomplish goals. In the study of Casinillo (2023), it is mentioned that self-efficacy helps students overcome the challenges during the pandemic in learning mathematics. Nurhikmah et al. (2021) stated that a high level of students' self-efficacy results to lower anxiety and increases the students' well-being in doing the required task in the learning environment. Hence, the conceptual framework of this article is to investigate the association of students' coping attitudes, happiness, and self-efficacy level in learning mathematics amid the pandemic.

### ***Methodology***

This article dealt with correlational research design to elucidate the association between the students' coping behavior, happiness, and self-efficacy in mathematics in the time of the COVID-19 pandemic. Students who took Mathematics in the Modern World (MMW) subject at Visayas State University is the population of interest in this study. Availability sampling was employed because of distance learning. In that case, a Google form survey was used and students who willingly responded to the said survey were part of the participants in the current study. Before that, consent was done first through a letter to the head of the mathematics department to ask permission in conducting the study. After this, another formal letter was also given to the MMW teachers to ask for their consent for their students. Then, students were oriented about the survey and its purpose. They were also informed that the survey does not collect sensitive information that may harm their

reputation as students and told them that their participation is voluntary and data gathered was only used for research purposes wherein their privacy is highly concerned. The survey was sent to the student's respective emails and posted to the Facebook group. The survey was open for about four weeks in the middle of the second semester of the school year 2021-2022. When the survey was done, 233 students responded and filled up the Google form.

The survey instrument used in this study were adapted from existing questionnaires of coping behavior, subjective happiness, and self-efficacy in literature. The modification of the questions of these instruments was based on the current situation of educational learning (online) during the COVID-19 pandemic. First, a 13-item scale questionnaire for coping behavior (Holahan and Moos, 1987) was modified to capture the coping mechanisms of mathematics students during online learning. They were given 4 options (1 to 4 scaling) for each coping question (1 - Not true about me; 2 - A little true about me; 3 - Somewhat true about me; 4 - Mostly true about me). Secondly, a questionnaire for the happiness scale (Lyubomirsky & Lepper, 1999) was also modified to capture students' subjective happiness in learning mathematics online during the pandemic. The students were given 7 options (1 to 7 scaling) for a 4-item scale questionnaire for happiness where 1 indicates lower happiness and 7 indicates higher happiness. Thirdly, the general efficacy scale developed by Schwarzer and Jerusalem (1995) was also revised relating to online learning amid the pandemic. The students were given 4 options (1 to 4 scaling) for each self-efficacy question (10-item) namely: Not at all true (1), Hardly true (2), Moderately true (3), and Exactly true (4). The scores for each item in every questionnaire (coping, happiness, and efficacy) were summed up and treated as a continuous variable. Table 1 presents the summary of students' perception scores and their interpretation.

**Table 1: Students' Coping Behaviour, Subjective Happiness, and Self-efficacy Scores and their Interpretation**

Coping Score	Interpretation	Happiness Score	Interpretation	Efficacy Score	Interpretation
42.40 - 52.00	Highly coping	23.80 - 28.00	Very Happy	32.51 - 40.00	High efficacy
32.80 - 42.40	Coping	19.60 - 23.80	Happy	25.01 - 32.50	Moderate efficacy
23.21 - 32.80	Moderately coping	15.41 - 19.60	Moderately happy	17.51 - 25.00	Slight efficacy
13.61 - 23.20	Low coping	11.21 - 15.40	Unhappy	10.00 - 17.50	Absence of efficacy
4.00 - 13.60	Not coping	7.00 - 11.20	Very unhappy		

Source: Author's guidelines (2023).

In addition, the questionnaires for coping (Holahan & Moos, 1987), happiness (Lyubomirsky & Lepper, 1999), and efficacy (Schwarzer & Jerusalem, 1995) were validated and found that captures the individual's behavior, motivation, emotions, optimism, and well-being, among others. Moreover, the 3 questionnaires have undergone a reliability check (Table 2) and it is found that they are reliable to use.

**Table 2: Reliability Test for Coping, Happiness, and Efficacy Questionnaires**

Questionnaire	No. of Items	Reliability Coefficient
Coping	13	0.802
Happiness	4	0.620
Efficacy	10	0.819

As for the data management, descriptive statistics such as percentages (%), mean average (M), median average ( $M_d$ ), standard deviation (SD), minimum (min), and maximum (max) values were computed to provide desirable descriptions to the data set. Additionally, to know if the students' responses are consistent, the coefficient of variation (CV) was computed. According to Reed et al. (2002), if the computed CV is less than 20%, then the students' response is considered consistent. After this, Spearman correlation ( $r_s$ ) was used to determine the relationship between students' coping behavior, happiness, and self-efficacy perception scores in mathematics in the form of matrix correlation and tested at a 5% and 10% level of significance. Moreover, the  $K$ -means clustering was employed. A  $K$ -means cluster analysis is an approach that intends to partition  $n$  observations into  $K$  clusters, that is, if  $(a_1, a_2, \dots, a_n)$  is a set of observations,  $k$ -means clustering aims to partition the  $n$  observations into  $K(\leq n)$  sets  $S=\{A_1, A_2, \dots, A_K\}$  that minimizes the within-cluster sum of squares (that is, the variance). In other words, the observation that belongs to each cluster has the nearest mean which is called the cluster centroid (Likas et al., 2003; Lletí et al., 2004). Since the association of the pairwise variables namely coping behavior, self-efficacy, and happiness are dense (minimal sum of squared errors or variation, see Figure 1), then it suffices to choose  $K=3$  (3 clusters or groupings) as the optimal number of clusters (Casinillo, 2022b). Furthermore, the statistical calculations were done with the help of statistical software called STATA version 14.0.

## ***Results and Discussion***

### **Descriptive Statistics**

It is shown in Table 3 that, on average, students are coping ( $M=35.51$ ,  $SD=5.79$ ) in their mathematics online experience during the pandemic. This implies that students are using coping strategies to face the challenges and difficulties that they are encountering in online education to manage stress and anxiety. According to Savitsky et al. (2020), students has to face their responsibilities in school despite the obstacles to continue learning, hence, a coping mechanism is vital to surviving anxiety and depression brought on by health crisis. The coefficient of variation ( $CV=16.31\% < 20\%$ ) revealed that the students' response in regard to coping is consistent. This indicates that the students are more likely to persevere in coping if online learning will continue to happen in the teaching-learning process during the pandemic for the sake of knowledge acquisition in mathematics. Apparently, Casinillo and Aure (2018) stated that students' main goal is to progress their academic performance in mathematics and it is positively correlated to interest, hence, coping is helpful to cultivate interest in the middle of challenges during the pandemic.

During online learning in mathematics, students are just moderately happy ( $M=18.38$ ,  $SD=3.81$ ) (Table 3). It is worth noting that during the health crisis, some limitations and barriers diminish the students' happiness level in learning mathematics, hence, they experience unpleasant emotions in the learning environment. In the study of Kok et al. (2022), every individual has persistently experienced a lower level of happiness because of the adverse impact of the pandemic on almost every aspect of an individual's lifestyle. Likewise, Hu et al. (2022) depicted that students are having difficulty catching up on their lessons due to stress and an unhealthy learning environment brought about by the pandemic which negatively affects their happiness or well-being. However, the coef-

ficient of variation ( $CV=20.73\%$ ) has revealed that students' happiness perception score is not consistent. This goes to infer that happiness levels might change depending on the learning situation, how they are treated by their teacher, and how they are feeling, among others.

Table 3 also revealed that students during their online learning in mathematics possess a moderate efficacy ( $M=26.61$ ,  $SD=5.05$ ) level. This implies that students are moderately desiring or have a moderate ability to accomplish their goals and tasks in the learning environment. According to Casinillo (2023), students' efficacy levels are adversely affected due to the anxiety and depression brought on by the pandemic. In that case, students have doubtfulness in doing their required learning assessments and tasks which reduces their self-efficacy in learning mathematics. Based on the coefficient of variation ( $CV=18.98\% < 20\%$ ), their efficacy perception score is consistent. This implies that students have revealed a compact efficacy level that represents their experience in online learning in mathematics.

**Table 3: Descriptive Statistics for Students' Coping, Happiness, and Efficacy**

	Mean	SD	Interpretation <sup>a</sup>	CV (%)	Is it consistent?
<b>Coping</b>	35.51	5.79	Coping	16.31	Yes
<b>Happiness</b>	18.38	3.81	Moderately happy	20.73	No
<b>Efficacy</b>	26.61	5.05	Moderate efficacy	18.98	Yes

Note: a - See Table 1.

### ***Correlation Analysis***

The coping behavior of students is positively correlated ( $r_s=0.29$ ,  $p\text{-value}<0.001$ ) to the students' happiness level in learning mathematics and vice versa (Table 4). In fact, this positive correlation is highly significant at the 1% level. This implies that as the students apply coping strategies as they face the challenges in online learning in mathematics amid the pandemic, their level of happiness is increasing. In the study of Umar et al. (2021), it is stated that students who used some coping management in their studies are more likely to survive college life and naturally promote well-being. It is also revealed that coping attitude is directly correlated ( $r_s=0.36$ ,  $p\text{-value}<0.001$ ) to students' self-efficacy at a 1% level of significance and vice versa. This goes to infer that as students use the coping mechanism as they do their required tasks in online learning, they are more likely motivated to finish their work since the coping behavior of students reduces unpleasant emotions. In fact, studies have shown that coping behavior and self-efficacy must take place in students' aspects as they face the challenges in online learning to accomplish good academic achievement (Baloran, 2020; Budimir et al., 2021; Casinillo, 2023). Moreover, students' efficacy level is positively associated ( $r_s=0.30$ ,  $p\text{-value}<0.001$ ) with their happiness in learning mathematics online at a 1% level of significance and vice versa (Table 4). This means that a student who is self-determined to accomplish the mathematics task is more likely happy in learning mathematics online. In fact, Tannert and Gröschner (2021), stated that a self-efficacy level will influence the students to positive emotions and results in joy in distance learning. Overall, the students' coping, happiness, and efficacy in learning mathematics must go together to achieve a good academic performance despite the challenges in distance education amid the COVID-19 pandemic.

**Table 4: Correlation (Spearman) Matrix for Students' Coping, Happiness, and Efficacy**

	Coping	Happiness	Efficacy
<b>Coping</b>	1.00 (0.000)	-	-
<b>Happiness</b>	0.29* (<0.001)	1.00 (0.000)	-
<b>Efficacy</b>	0.36* (<0.001)	0.30* (<0.001)	1.00 (0.000)

Note: \*-significant at 1% level; *p*-values are enclosed with parenthesis.

### *K-Means Clustering Analysis*

Table 5 depicts the *K*-means clustering results for students' coping behavior, happiness, and self-efficacy with three clusters ( $K=3$ ) (See also Figure 1). The first cluster (1) represents the lowest perception scores for students' coping behavior, happiness, and self-efficacy with the corresponding category as moderately coping ( $M=28.61$ ;  $M_d=28$ ), unhappy ( $M=15.16$ ;  $M_d=16$ ), and slight efficacy ( $M=19.13$ ;  $M_d=20$ ), respectively. This fraction (16.31%) of students are the most affected by the adverse effect of the health crisis in distance education. This implies that these students have a lower level of coping strategies and self-efficacy which results to lower happiness or well-being in learning mathematics online. This is due to the stress and anxiety they have encountered in the difficulties and obstacles in mathematics online learning (Baloran, 2020; Casinillo, 2022a).

In fact, Figure 1 has shown that there are some students' perception scores (cluster 1) that are far from the actual mean averages concerning coping behavior, happiness, and self-efficacy. According to some research studies, students might have lower academic achievement if they have a lower level of coping behavior (Umar et al., 2021; Li & Che, 2022), happiness (Casinillo & Casinillo, 2020; Wan Mohd Yunus et al., 2021), and self-efficacy (Tannert & Gröschner, 2021; Casinillo, 2023). The study of Yıldırım and Güler (2021) portrayed that the effect of pandemic causes distress that leads to students' uncomfortable behavior which affects their learning ability and reduces their well-being. Moreover, Kok et al. (2022) stated that the pandemic has affected the mental well-being of individuals which is a hindrance to positive thinking. Hence, it affects the cognitive behavior of students which is vital in learning.

**Table 5: K-Means Clustering Analysis for Students' Coping, Happiness, and Efficacy**

Cluster	Descriptive Statistics	Coping	Happiness	Efficacy
1	N	38		
	%	16.31		
	Min	20	4	10
	Median	28	16	20
	Mean	28.61	15.16	19.13
	Max	39	24	27
	Interpretation	<i>Moderately coping</i>	<i>Unhappy</i>	<i>Slight efficacy</i>
2	N	99		
	%	42.29		
	Min	37	5	19
	Median	40	20	28
	Mean	40.67	19.47	28.36
	Max	52	27	28
	Interpretation	<i>Coping</i>	<i>Moderately happy</i>	<i>Moderate efficacy</i>
3	N	96		



	%	41.20		
	Min	22	9	20
	Median	34	18.5	28
	Mean	32.93	18.52	27.77
	Max	37	26	36
	Interpretation	<i>Coping</i>	<i>Moderately happy</i>	<i>Moderate efficacy</i>

As for the second cluster (2), this is a group of students who has the highest perception scores concerning their coping behavior, happiness, and self-efficacy in learning mathematics online categorized as coping ( $M=40.67$ ;  $M_d=37$ ), moderately happy ( $M=19.47$ ;  $M_d=20$ ), and moderate efficacy ( $M=28.36$ ;  $M_d=28$ ), respectively (Table 5). Also, cluster (3) has the same category such as coping ( $M=32.93$ ;  $M_d=34$ ), moderately happy ( $M=18.52$ ;  $M_d=18.5$ ), and moderate efficacy ( $M=27.77$ ;  $M_d=28$ ) with a little lower perception scores (Table 5). Figure 1 has shown that there is just a little difference between clusters 2 and 3. This implies that students belonging to clusters 2 and 3 are students with significantly higher perception scores in coping behavior, happiness, and self-efficacy. This type of student is expected to perform well in their online class as opposed to students belonging to cluster 1. According to Frimpong et al. (2022), coping strategies help reduce stress and anxiety in dealing with the required task in school amid the health crisis. Likewise, Salman et al. (2022) depicted that students with suitable coping strategies during the pandemic tend to perform better in the classroom.

It is worth noting that coping mechanisms can change the channel of the mind to positive thoughts in such a way that students can think optimistically in learning despite the challenges in distance education. In addition, Heo et al. (2021) have depicted that the learning engagement of students can be enhanced through a higher level of self-efficacy in doing the different responsibilities of students in an online class. In fact, students have a higher chance of getting a higher performance in mathematics if they apply self-efficacy in their time management, use of technology in an online class, and in doing the learning task (Heo et al., 2021; Casinillo, 2023). Moreover, enjoyment or happiness in learning mathematics can give motivation and interest in doing their assignments and learning tasks (Casinillo & Casinillo, 2020; Casinillo, 2022a). In that case, the happiness of students will give them positive thinking and mood that will result in productive and efficient cognitive behavior in the learning environment.

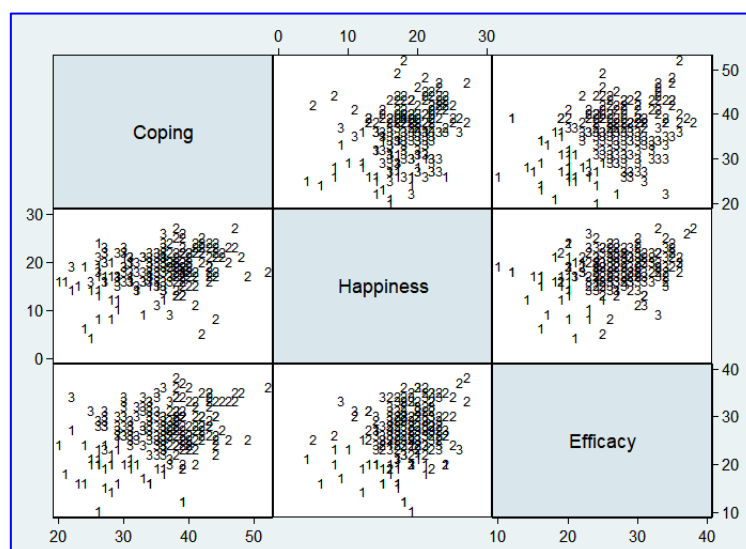


Figure 1: K-means Clustering ( $K=3$ ) for Students' Coping, Happiness, and Efficacy



## Conclusion and Recommendations

The main aim of this research article is to stipulate an argument that explains the students' coping attitude, happiness level, and self-efficacy in learning mathematics online during the health crisis. The results have revealed that students are coping, moderately happy, and have shown moderate self-efficacy in distance education amid the pandemic. This implies that students are using some coping mechanism to divert their attention from stress and depression in dealing with the challenges, barriers, and obstacles in mathematics online learning. Additionally, students have only moderate happiness levels in learning because of the difficulties and limitations they have encountered in online setup while following the health protocols imposed by the local government. Plus, moderate self-efficacy was determined because students are facing anxiety that makes their future uncertain. The findings showed that students' coping behavior, happiness level, and self-efficacy are positively correlated with each other and vice versa. This concludes that coping strategies, happiness, and self-efficacy of students must go together to progress academic performance in learning mathematics at a distance. Additionally, the *K*-means clustering analysis showed that there are a group of students with lower coping attitude, happiness level, and self-efficacy level in learning online. This implies that there are students that need monitoring and encouragement by teachers to somehow compete with other students. Conclusively, teachers must encourage their students to engage and participate in classroom activities to boost their coping, happiness, and efficacy level which helps their cognitive thinking in mathematics. Moreover, teachers must provide interesting, catchy, and realistic activities, however, doable and suitable for online mathematics learning. It is highly recommended that teachers must integrate classroom time management for their students to avoid procrastination and develop a good self-efficacy level in accomplishing their mathematics outputs. Furthermore, the study also recommends incorporating other variables like students' attitudes, anxiety, and interest in mathematics for future investigation to supplement the current findings of this article.

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