

## Intelligent Adaptive Learning Systems in Competence Development: Modelling Secondary School Students' Competence for Family Empowerment in Rivers State

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### Abstract

The study investigated intelligent adaptive learning systems in competence development: modelling secondary school students' competence for family empowerment in Rivers State, Nigeria. Five research questions and four hypotheses guided the research, mixed-methods research design (quantitative to qualitative) was adopted for the study. The population of the study comprised 18,298 students enrolled in Senior Secondary Schools in Rivers State (2025-2026 session), 315 parents and 210 teachers were randomly involved in the study. Taro Yamane (1967) formula was used to obtain a sample size of 392 students. Multistage sampling technique was used to sample students. Intelligent adaptive learning, students' competence development and family empowerment questionnaire (IALSCFEQ) was used for data collection. The instrument were validated by two experts of Educational Technology and measurement and Evaluation. The reliability of the instrument was obtained using Cronbach's alpha yielding 0.81 for (IALSQ), 0.83 for (SCDQ) and 0.74 for (FEQ), the qualitative data was collected through interviews. The quantitative data collected were analyzed using Pearson Product Moment Correlation PPMC, Regression Model and regression Analysis. The findings of the study revealed that IALS and family empowerment predict students' competence in Rivers state. Therefore, it was recommended that Parents should be adequately sensitized and trained on the educational use of intelligent adaptive learning systems in Rivers state.

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## Introduction

The continuous improvement in the development of artificial intelligence (AI) has reorganized educational practices through the enhancement of learning environments to respond dynamically to learners' individual needs and abilities. In this direction, intelligent adaptive learning systems (IALS) employs learners' data, algorithms, adaptive assessment and feedback mechanisms to improve and adjust instruction to suit the characteristics of learners and to improve the efficiency of learning (McCallum & Tafazoli, 2025; Oxman & Wong, 2014). It has been observed that IALS possess the potential to move educational practice from a traditional approach which is teacher centred towards personalized and learner-centred approaches in which students receive learning experiences according to their levels of understanding and competence. The need for such is predicated on the advancement in technology especially the artificial intelligence in teaching and learning (Mbaba, et al., 2024). In fact, report of several studies supported the adoption of artificial intelligence driven adaptive learning in schools because of its potentials in enhancing personalized instruction.(Tijani & Adeduyigbe, 2026). Within Rivers State, Taylor et al. (2025) assessed the awareness and adoption of artificial intelligence tools among adult educators in Rivers State-owned universities and treated awareness and adoption as separate matters, which shows that the availability of AI tools does not by itself guarantee their use in teaching and learning.

However, IALS, should not be judged in respect of delivery of personalized content, but translating personalization into meaningful competence development that could empower the family. Competence development involves the continuous acquisition and improvement of knowledge base, skills, problem-solving abilities, critical thinking, digital capabilities and the capacity to apply the learning experiences to solving practical challenges. This understanding is significant to senior secondary schools students who are expected to demonstrate the ability to apply knowledge to solve problems, communicate effectively and function productively in a digital space. Some studies conducted within Nigeria suggests that AI-supported learning have the capacity to contribute to measurable learning gains especially when it is deliberately structured for such purpose (Isa & Balda, 2026; Adayilo, et al., 2025). Sam-Kalagbor (2026b) found that principals and vice-principals in public senior secondary schools in Port Harcourt Metropolis rated the role of artificial intelligence high in school record management but low in instructional supervision, which suggests that AI in Rivers State schools has so far served administration more than learning. Sanusi et al. (2022) likewise investigated learners' competencies for artificial intelligence education in an African K–12 setting, which supports the view that competence, rather than exposure alone, should be the measure of AI-supported learning.

The relevance of adaptive learning becomes more pronounced when considered in the context of competence development education. Competency-based approaches are invoke because several economies have shifted their focus of learning from certificates acquisition to completing prescribed instructional content that can determine what learners can actually do with the knowledge for the benefit of society. As a result, Ojo et al. (2026), investigated competency-based education in secondary schools in Ibadan, Oyo State, the study focused on student

engagement, learning outcomes, highlighting the continuing need to strengthen competence-oriented practices within Nigerian secondary education.

In seeking to determine how adaptive learning systems can leveraged artificial intelligence to enhance efficiency and efficacy in learning Adayilo et al. (2025) investigated AI-based Adaptive Learning Systems (AI-ALS) with respect to promoting personalized education in Nigerian secondary schools, its impact and user satisfaction. The results revealed that adaptive AI systems improves learning outcomes and engagement. Similarly, Kariuki, et al. (2025) compared AI-supported learning with conventional classroom learning across Kenyan universities using quantitative and qualitative evidence. The findings equally revealed significant improvement in learning outcomes and engagement. Again, Saal, et al. (2025), in a review of AI integration in primary and secondary schools between 2020 and 2024 in South Africa, the review indicates increased in AI-enabled personalized instruction and the potential therein to improve educational outcomes. Nwuke and Yellowe (2025) also reported that artificial intelligence could raise the efficiency and effectiveness of school supervision in public secondary schools in Rivers State, which indicates that AI tools are already finding a place in the secondary schools of the state.

The benefits of competence development extend beyond the learner but to the family, especially when a student develops digital, practical and problem-solving competencies, the student becomes better to participate in learning activities at home and to support siblings develop theirs. Family empowerment is the capacity of families to participate in, support and benefit from the educational development of their children. Aderiye and Adedayo (2025) in a study of secondary school students in Rivers State, found that parental involvement and provision assistance with schoolwork was associated with students' test performance, while time constraints constituted a major barrier to parental involvement. This study goes ahead to suggests that the educational benefits of technology cannot be understood independently of the home environment, because the availability of learning resources, parental support and students' ability to transfer learning into the family setting can shape educational outcomes (Anyanwu, 2023; Eremie & Oruitemeka, 2022).

Basically, there is increased digital technology role in homes that support the need to investigate the relationship between adaptive learning and family empowerment. This is because studies supporting digital parenting in Nigeria indicates that parents increasingly have responsibilities for guiding children's educational use of technology (Ezema-Kalu,2024). Above all, Ezema-Kalu (2024) identified potential benefits of effective digital parenting for students' learning and the barriers such as differences in parents' technological competence, unequal access to digital resources, distraction and online-safety concerns. These concerns bring to bear the need to study the extent to which improved student competence translates into family empowerment especially where family differs substantially. Nwafor and Alikor (2026) showed that inclusive education policies in Nigeria have been held back by inadequate funding and infrastructural deficits, which suggests that unequal access to devices and connectivity at home could widen the gap between learners who benefit from adaptive learning and those who do not.

### **Statement of the Problem**

The emergence of artificial intelligence (AI) and adaptive learning technologies offers new approach where content are not only transmitted but translated from content delivery to application in solving problems. As a result, many studies on AI-supported learning, adaptive

learning, digital parenting and competency-based education were conducted. However, these research were investigated separately (Tijani & Adeduyigbe, 2026; De-Simone et al., 2025; Ojo et al., 2026; Aderiye & Adedayo, 2025). What remains insufficiently established is whether intelligent adaptive learning systems contribute to students' competence and whether improved competence subsequently contributes to family empowerment, particularly among secondary school students in Rivers State.

The absence of an integrated empirical model creates both a knowledge gap and a practical problem for teachers, policymakers and families seeking to understand the broader value of intelligent adaptive learning systems in secondary school education in Nigeria. Hence, it is unclear whether intelligent adaptive learning systems directly relates to students' competence or whether students' competence contributes to family empowerment and whether competence serves as a mechanism through which adaptive learning produces broader family-level benefits. These issues trigger the need for this study.

**Research Questions** the following research questions were answered:

1. What is the relationship between intelligent adaptive learning systems and competence development among secondary school students in Rivers State?
2. To what extent do intelligent adaptive learning systems significantly predict secondary school students' competence in Rivers State?
3. To what extent does secondary school students' competence predict family empowerment in Rivers State?
4. To what extent does intelligent adaptive learning systems and family empowerment predict secondary school students' competence in Rivers State?
5. How do teachers, and parents explain the mechanisms through which intelligent adaptive learning systems influence competency development and contribute to family empowerment in Rivers State, Nigeria?

**Hypotheses:** The following hypotheses were tested:

1. There is no significant relationship between intelligent adaptive learning systems and secondary school students' competence in Rivers State, Nigeria.
2. Intelligent adaptive learning systems do not significantly predict secondary school students' competence in Rivers State, Nigeria.
3. To what extent does secondary school students' competence predict family empowerment in Rivers State, Nigeria?
4. Intelligent adaptive learning systems and family empowerment does not significantly predict secondary school students' competence in Rivers State, Nigeria.

## **Methodology**

The research adopted mixed-methods research design (quantitative to qualitative), the population of the study comprised 18,298 students enrolled in Senior Secondary Schools in Rivers State. Taro Yamane (1967) formula:  $n = \frac{1 + N(e)^2}{N}$  was adopted to obtained 392 sample size.

Multistage sampling technique was used to sample the respondents. First, the senior secondary schools in Rivers State was stratified into 3 senatorial zones, simple random sample was used to sample 4 schools each from the three zones while proportionate sampling was applied to provide room for adequate distribution. This procedure help to ensure adequate representation of students from different schools and locations within Rivers State and reduce the possibility of sampling bias.

The quantitative phase involved the collection of numerical data using self-developed questionnaires tagged intelligent adaptive learning, students' competence development and family empowerment questionnaire (IALSCFEQ) having three sections: section A: Intelligent Adaptive Learning Systems Questionnaire (IALSQ) with 6 items, section B: Students' Competence Development Questionnaire (SCDQ) with 6 items and section C: Family Empowerment Questionnaire (FEQ) with 6 items. The instruments were subjected to face validation by two experts from Rivers State University. One expert in Educational Technology and one in Measurement and Evaluation. The consistency of the questionnaires were tested using 30 students from the schools not captured in the study, and the data obtained was analyzed using Cronbach's alpha yielding 0.81 for (IALSQ), 0.83 for (SCDQ) and 0.74 for (FEQ). These values were judged to be above the threshold of 0.70 indicating that the instruments were good for the study. The quantitative data collected were analyzed using Pearson Product Moment Correlation PPMC, Regression Model and regression Analysis. The qualitative phase followed the quantitative analysis and involved interviews with selected students and parents. The qualitative findings were used to explain, complement and provide contextual understanding of the quantitative results.

## Results

**Research Question One:** What is the relationship between intelligent adaptive learning systems and competence development among secondary school students in Rivers State, Nigeria?

**Null Hypothesis One:** There is no significant relationship between intelligent adaptive learning systems and secondary school students' competence in Rivers State, Nigeria.

Table 1: Pearson Product Moment Correlation result between intelligent adaptive learning systems and competence development among secondary school students in Rivers State, Nigeria

| Variables                             | Mean | Std. D | r-value | p-value | Remark              |
|---------------------------------------|------|--------|---------|---------|---------------------|
| Intelligent Adaptive Learning Systems | 2.72 | 0.7    | 0.831   | 0.000   | Strong relationship |
| Students' Competence Development      | 3.19 | 0.6    |         |         |                     |

Table 1 presents the Pearson Product Moment Correlation between intelligent adaptive learning systems and competence development among secondary school students in Rivers State, Nigeria. The result shows that intelligent adaptive learning systems had a mean score of 2.72 with a standard deviation of 0.70, while students' competence development had a mean score of 3.19 with a standard deviation of 0.60. The correlation coefficient obtained was  $r = .831$ , indicating a

strong positive relationship between intelligent adaptive learning systems and students' competence development. This implies that increases in the use or effectiveness of intelligent adaptive learning systems are associated with corresponding increases in students' competence development. The result also shows that the correlation p-value of .000 which is less than 0.05 significance level, signifying rejection of the null hypothesis. Thus, there is a significant strong positive relationship between intelligent adaptive learning systems and students' competence development ( $r = .831$ ,  $p < .05$ ).

**Research Question Two:** To what extent do intelligent adaptive learning systems significantly predict secondary school students' competence in Rivers State, Nigeria?

**Null Hypothesis Two:** Intelligent adaptive learning systems do not significantly predict secondary school students' competence in Rivers State, Nigeria.

Table 2: The regression model summary showing the predictive relationship between intelligent adaptive learning systems and secondary school students' competence in Rivers State, Nigeria

| Model Summary |                   |          |                   |                            |
|---------------|-------------------|----------|-------------------|----------------------------|
| Model         | R                 | R Square | Adjusted R Square | Std. Error of the Estimate |
| 1             | .831 <sup>a</sup> | 0.69     | 0.689             | 0.33506                    |

a. Predictors: (Constant), Intelligent Adaptive Learning Systems

|       |            | Coefficients <sup>a</sup>   |            |                           |        |      |
|-------|------------|-----------------------------|------------|---------------------------|--------|------|
| Model |            | Unstandardized Coefficients |            | Standardized Coefficients | T      | Sig. |
|       |            | B                           | Std. Error | Beta                      |        |      |
| 1     | (Constant) | 1.266                       | 0.067      |                           | 18.756 | 0    |
|       | IALSQ      | 0.709                       | 0.024      | 0.831                     | 29.451 | 0    |

a. Dependent Variable: SCDQ

Table 2 presents the regression model summary showing the predictive relationship between intelligent adaptive learning systems and secondary school students' competence in Rivers State, Nigeria. The model recorded  $R = .831$ ,  $R^2 = .690$ , Adjusted  $R^2 = 0.689$  and the standard error = 0.33506. The value of R indicating a strong predictive ability of intelligent adaptive learning systems on students' competence while the value of  $R^2$  shows that intelligent adaptive learning systems explain 69.0% of the variance in students' competence. Thus, intelligent adaptive learning systems significantly predict students' competence, explaining 69.0% of its variance.

The result further shows the unstandardized coefficient  $B = 0.709$ , standard error = 0.024, standardized Beta = .831,  $t = 29.451$ , and  $p = .000$  for intelligent adaptive learning systems. The positive coefficient indicates that an increase in intelligent adaptive learning systems is associated with an increase in students' competence. Since  $p = .000$  is below .05, the null hypothesis is rejected. Therefore, intelligent adaptive learning systems significantly and positively predict students' competence development ( $\beta = .831$ ,  $t = 29.451$ ,  $p < .05$ ).

**Research Question Three:** To what extent does secondary school students' competence predict family empowerment in Rivers State, Nigeria?

Table 3: The regression model summary showing the predictive relationship between secondary school students' competence and family empowerment in Rivers State, Nigeria

| Model Summary |                   |          |                   |                            |
|---------------|-------------------|----------|-------------------|----------------------------|
| Model         | R                 | R Square | Adjusted R Square | Std. Error of the Estimate |
| 1             | .646 <sup>a</sup> | 0.418    | 0.416             | 0.52721                    |

a. Predictors: (Constant), Students' Competence Development

Table 3 presents the regression model summary showing the predictive relationship between secondary school students' competence and family empowerment in Rivers State, Nigeria. The result shows  $R = .646$ , The  $R^2 = .418$ , Adjusted  $R^2 = 0.416$  and standard error = 0.52721. The value of R indicates a positive and moderately strong predictive ability of students' competence on family empowerment whereas  $R^2$  value of .418 indicates that students' competence explains 41.8% of the variance in family empowerment. The result therefore shows that students' competence makes a substantial contribution to the prediction of family empowerment.

**Null Hypothesis Three:** Intelligent adaptive learning systems do not significantly predict family empowerment among secondary school students in Rivers State, Nigeria.

Table 4: Regression Analysis result between intelligent adaptive learning systems and family empowerment among secondary school students in Rivers State, Nigeria.

| Coefficients <sup>a</sup> |            |                             |            |                           |        |
|---------------------------|------------|-----------------------------|------------|---------------------------|--------|
|                           |            | Unstandardized Coefficients |            | Standardized Coefficients |        |
| Model                     |            | B                           | Std. Error | Beta                      | T      |
| 1                         | (Constant) | 1.578                       | 0.122      |                           | 12.914 |
|                           | IALSQ      | 0.469                       | 0.044      | 0.478                     | 10.760 |

a. Dependent Variable: FEQ

Table 4 presents the regression analysis result between intelligent adaptive learning systems and family empowerment among secondary school students in Rivers State, Nigeria. The constant is

1.578 (SE = 0.122,  $t = 12.914$ ,  $p = .000$ ), while intelligent adaptive learning systems has  $B = 0.469$ , standard error = 0.044, standardized Beta = .478,  $t = 10.760$ , and  $p = .000$ . The positive coefficient indicates that higher levels of intelligent adaptive learning systems are associated with higher levels of family empowerment. The standardized beta of .478 indicates a positive predictive effect of moderate magnitude. Because the p-value is below .05, is rejected. Hence, intelligent adaptive learning systems significantly and positively predict family empowerment ( $\beta = .478$ ,  $t = 10.760$ ,  $p < .05$ ).

**Research Question Four:** To what extent does intelligent adaptive learning systems and family empowerment predict secondary school students' competence in Rivers State, Nigeria?

**Null Hypothesis Four:** Intelligent adaptive learning systems and family empowerment does not significantly predict secondary school students' competence in Rivers State, Nigeria.

Table 5: Predictive effect of intelligent adaptive learning systems and family empowerment on secondary school students' competence in Rivers State, Nigeria

| Model Summary |                   |          |                   |                            |
|---------------|-------------------|----------|-------------------|----------------------------|
| Model         | R                 | R Square | Adjusted R Square | Std. Error of the Estimate |
| 1             | .878 <sup>a</sup> | 0.77     | 0.769             | 0.28879                    |

a. Predictors: (Constant), FEQ, IALSQ

| Coefficients <sup>a</sup> |            |                             |            |                           |       |
|---------------------------|------------|-----------------------------|------------|---------------------------|-------|
| Model                     |            | Unstandardized Coefficients |            | Standardized Coefficients | Sig.  |
|                           |            | B                           | Std. Error | Beta                      |       |
|                           | (Constant) | 0.822                       | 0.07       |                           | 0.000 |
| 1                         | IALSQ      | 0.577                       | 0.024      | 0.676                     | 0.000 |
|                           | FEQ        | 0.281                       | 0.024      | 0.323                     | 0.000 |

a. Dependent Variable: SCDQ

Table 5 presents Predictive result of secondary school students' competence mediating the relationship between intelligent adaptive learning systems and family empowerment in Rivers State, Nigeria. The result shows  $R = .878$ ,  $R^2 = .770$ , The adjusted  $R^2 = .769$  and standard error of the Estimate = 0.28879. The value of  $R^2$  shows that intelligent adaptive learning systems and family empowerment jointly predict 77.0% of the variance in the secondary school students' competence in Rivers State, Nigeria. Also, the result revealed that intelligent adaptive learning systems has  $B = 0.577$ , standard error = 0.024, standardized Beta = .676,  $t = 24.426$ ,  $p = .000$ , while family empowerment has  $B = 0.281$ , standard error = 0.024, standardized Beta = .323,  $t = 11.661$ ,  $p = .000$ . Comparatively, intelligent adaptive learning systems exerted a stronger

predictive influence on secondary school students' competence ( $\beta = 0.676$ ) than family empowerment ( $\beta = 0.323$ ). Also, the result shows that the overall regression model was statistically significant, as indicated by an F-value of 651.774 and a significance value of 0.000 less than 0.05. Therefore, intelligent adaptive learning systems and family empowerment significantly and positively predict secondary school students' competence in Rivers State, Nigeria.

Research question five provide qualitative explanation of teachers and parents explanation on how intelligent adaptive learning systems relates to competency development and contribute to family empowerment in Rivers State. 210 teachers and 315 parents provided an explanatory perspective on the quantitative results showing that intelligent adaptive learning systems (IALS) relate and predict students' competence, while students' competence predicts family empowerment and IALS and family empowerment jointly predict students' competence. The predominant opinion presented by teachers and parents was that family education and access to appropriate technology devices were major mechanisms which IALS translate into competence development and family empowerment. The teachers explained that when students come from families where parents possess adequate educational awareness and understand the value of technology-supported learning, students are more likely to receive encouragement, supervision and opportunities to use IALS effectively. Parents similarly emphasized that family provide access to computers, internet connectivity and other digital devices enables students to interact regularly with adaptive learning resources, practice acquired skills and receive individualized learning support.

The teachers' and parents' responses further suggest that the relationship between IALS, students' competence and family empowerment is interactive and mutually reinforcing rather than linear. According to the participants, family education enables parents to understand, support and monitor students' engagement with adaptive learning systems, while access to technology devices provides the practical means for students to use IALS. This interpretation is supported by Kim (2022), whose second-order meta-analysis established a positive relationship between parental involvement and students' educational achievement.

### **Discussions of Findings**

The findings of Research Question One and hypothesis one revealed a strong positive significant relationship between (IALS) and students' competence development in Rivers State. This finding suggests that students' access and utilization of IALS enhances their competence development. This equally indicates that IALS provide a learning environment where students can receive experiences that improve their abilities and meet individual learning needs. The finding is equally consistent with the findings of Wang et al. (2024), who conducted a meta-analysis of 45 independent studies on artificial intelligence-enabled adaptive learning systems and reported positive effect of adaptive learning systems on students' cognitive learning outcomes. The finding also align with García-Martínez et al. (2023), whose systematic review and meta-analysis found that artificial intelligence and computational technologies have a positive influence on students' performance. Their finding is particularly relevant because competence development involves more than the acquisition of factual knowledge; it includes

the ability to apply knowledge, solve problems, make decisions, and perform tasks effectively. Sam-Kalagbor (2026a) also found that learning styles, peer relationships and time management were positively related to students' educational development in higher institutions in Rivers State, which supports the view that systems which respond to individual learning patterns are likely to strengthen competence.

The finding of Research Question two showed that intelligent adaptive learning systems significantly predict students' competence development. This finding goes beyond the result of Research Question One. While Research Question One established that IALS and competence development are strongly related, the predictive result indicates that variation in students' competence development can be statistically explained to an extent, by their involvement with intelligent adaptive learning systems. The present finding is supported by the same meta-analysis, which found that AI-enabled adaptive learning had a positive effect on cognitive learning outcomes. Most importantly, their analysis showed that adaptive targets such as navigation and assessment were significant moderators of learning outcomes. Ikechukwu et al. (2026) examined teachers' digital competence in relation to effective classroom instructional delivery in senior secondary schools in Port Harcourt Metropolis, and their work suggests that the gains from adaptive systems will depend on teachers who are able to guide students in using them.

The finding of Research Question three revealed that students' competence development significantly predicts family empowerment. It suggests that when students develop relevant competencies, the benefits may extend beyond the individual learner and become useful within the family environment. One basic fact from this study is that competence provides students with the capacity to translate acquired knowledge into practical actions within the home. This finding provides better perspectives to the relationship between student learning and parental involvement. Kim's (2022) second-order meta-analysis of 23 meta-analyses involving 1,177 primary studies found a positive association between parental involvement and student achievement. The strong effects were associated with parental expectations and aspirations. Jeynes (2022) similarly found that the parental expectations component of parental involvement was related to students' academic achievement, while Wang and Wei (2024) reported a positive influence of parental involvement on students' mathematics performance, and both results support the link between the learner and the family that this study has established.

The finding of Research Question Four indicated that intelligent adaptive learning systems and family empowerment jointly predict secondary school students' competences in Rivers State. This finding is indeed important because it brings together the variables of this study and presents empirical evidence to the relationship among IALS, family empowerment and students' competence development. The result suggests that family empowerment is not necessarily produced by technology alone. Rather, IALS align with family empowerment to create the conditions through which students develop competencies. Those competencies provide the mechanism through which educational benefits can extend back to the family again. Nwuke and Osuji (2024) examined the management of digital learning environments for students with special needs in public schools in Rivers State, and their work shows that digital learning

benefits learners only when the environment around them is planned and supported, which agrees with the joint role of technology and the family found in this study.

## **Conclusion**

The study examined Intelligent Adaptive Learning Systems (IALS) in competence development: modelling secondary school students' competence for family empowerment in Rivers State. The research was triggered by the desire to uncover how technology-enabled adaptive learning benefit students' competence development and family empowerment. The findings revealed a strong relationship between IALS and students' competence development; IALS significantly predicted students' competence; students' competence significantly predicted family empowerment; and IALS and family empowerment jointly predicted students' competence. The qualitative findings from interviews with 210 teachers and 315 parents explained that family education and access to technology devices are important enabling conditions for effective adoption of IALS.

## **Recommendations**

The following recommendations were forwarded for the success of IALS in Rivers state:

1. Secondary schools in Rivers State should integrate IALS into teaching and learning activities.
2. Government and educational authorities should improve students' access to technology devices and reliable internet connectivity.
3. Parents should be adequately sensitized and trained on the educational use of IALS.
4. Teachers should be professionally developed in the pedagogical use of IALS for personalized learning.

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