Jurnal Ilmiah Potensia, 2025, Vol. 10 (1), 42-49
https://ejournal.unib.ac.id/index.php/potensia
e-issn: 2621-2382 p-issn: 2527-9270

Cooperative Learning Model with ICT Media Towards Children's Mathematical Literacy

Awalia Nor Ramadan[1]
awalianorramadan_9909821016@mhs.unj.ac.id

R Sri Martini Meilanie[2]
r.smartini@unj.ac.id

Wardani Rahayu[3]
wardani.rahayu@unj.ac.id

[1,2,3] Universitas Negeri Jakarta, Jakarta, Indonesia

Received: 25th October 2024 *Accepted: 25th January 2025* *Published: 29th January 2025*

***Abstract**: The learning problems in early childhood in Indonesia that are currently faced are increasingly complex, not only from the pedagogical side of teachers but also faced with low mathematical literacy learning outcomes. Therefore, in early childhood learning, it is necessary to design a cooperative model with ICT media that can answer the challenges of the needs of the times. The purpose study is to measure the influence of cooperative learning with the help of ICT media on the improvement of mathematical literacy skills in children. This study is a quasi-experimental research with treatment by level 2x2 factorial Nonequivalence Posttest-Only Control Design, using mixed methods such as interviews and observations. Based on intensive processes and observations, the findings of this study show that the cooperative model with ICT media affects children's mathematical literacy skills. This is proven by the results of the ANAVA test obtained $F_{count} = 7.437 < F_{table} = 161$ and a significance value of 0.008 < 0.05, then it is concluded that there is a difference in the results and the results of the t-test show the acquisition of a score $t_{count} = 23.662$ with df = 87, so that $t_{table} = 1.98761$, $t_{count} \geq t_{table}$ With the results of 23,662 > 1.9796, the literacy ability of children who were given the cooperative model treatment was higher than that of the group who were taught with the conventional learning model.*

***Keywords:** cooperative model, ICT media, mathematical literacy.*

How to cite this article:

Ramadan, A. N., Meilanie, R. S. M., & Rahayu, W. (2025). Cooperative Learning Model with ICT Media Towards Children's Mathematical Literacy. Jurnal Ilmiah Potensia, 10(1), 42–49. https://doi.org/10.33369/jip.10.1.42-49

INTRODUCTION

Indonesia must face many global challenges such as job skills, professional expertise and digitalization are becoming increasingly apparent. Indonesia has the fourth biggest populace in the world (Liska et.al, 2024). Indonesian teachers and children continue to face challenges in implementing a learning approach where teachers seek to change the paradigm from *controllers* to teachers as *facilitators* (Blackley et al., 2018).In PISA 2018, the average score of science and mathematics OECD nations is 489, but Indonesia has as it were come to a score of 396 (OECD, 2018). This value shows a decrease compared to the value in 2015 which was 403. This shows that there is a gap in learning science and mathematics learning. Public Education report card data from the analysis of the 2022 Indonesian National Competency Assessment

AKM shows that less than 50% of children have reached the minimum competency limit for reading and numeracy literacy. In the national education system, the concept and mindset of science learning use a scientific approach in which there is a process of exploration, *discovery*, and *inquiry*. However, it has not been implemented in classroom learning, based on the comes about of perceptions and interviews with kindergarten teachers in Gayungan District, there are still many kindergarten teachers who carry out learning related to science and mathematics content with the assignment method using children's worksheets (LKA), there are still many teachers who dominate and lack in providing opportunities for children to explore the surrounding environment and the learning process that only focuses on memorization without a deep understanding of the learning content. Currently, the Ministry of Education has established a new policy regarding the Independent Learning Curriculum. Based on the needs in the current era of Education and the order of Law Number 14 of 2005 concerning instructors and teachers, kindergarten instructors ought to have a solid and in-depth knowledge of concepts related to every science and mathematics activity that will allow a correct and appropriate approach to scientific concepts, because this will determine the nature (and accuracy) of knowledge that will be learned by children (Pereira et al., 2020). Teachers need day-to-day knowledge of science to understand possible learning situations in science and mathematics, clarify them at a day-to-day level, and give suitable back in these circumstances (Barenthien et al., 2020). In addition, teachers need to package science and mathematics learning in the form of games (Omaga & Alieto, 2019).

The pertinence of science and science has expanded impressively in later a long time. The world is changing quickly since science, arithmetic and mechanical headways, which can be seen in natural challenges or innovative advancements, logical proficiency (SL), and science are fundamental to getting it and bargaining with such changes. (OECD, 2018). Mathematical literacy needs to be developed in children. A developing drift in early childhood instruction is the educating of arithmetic, as scientific competence is basic for children's victory afterwards in school and life. (Duncan et al., 2007; Halberda et al., 2008; Nguyen et al., 2016), instructors and guardians can encourage science learning by locking in joint talks about scientific concepts and locks in children in fun numerical diversions and exercises (Klibanoff et al., 2006; Levine et al., 2010; Ramani et al., 2015; Skwarchuk et al., 2014).

In making strides in children's scientific education abilities, it is vital to supply advancements within the learning handle. For this reason, this study offers learning innovations by Silvia & Rakhmawati (2021) Paying attention to the current developments in the era of Industry 4.0. According to the results of a survey conducted during the COVID-19 pandemic, it is difficult to carry out the learning process in schools. Learning interactions that are commonly carried out directly by involving all aspects of child development must switch to online/online learning. In pedagogical principles, good educational or instructional practice is represented by technology and combines three basic learning theories, namely behaviourism, cognitivism and constructivism (Alonso, Lopez, Manrique, & Viñes, 2005) . Thus, information technology support in the form of networks, tablets and androids so that learning proceeds to run amid the widespread is unavoidable. In the general phenomenon of the 21st century, it is very important to support information technology and effective communication. (Rakhmawati et al., 2021). The concept of learning must integrate content, approaches and ICT. (Fu & Technology, 2013; Mazur et al., 2015; Vatanartiran & Karadeniz, 2020).

Improving mathematical literacy skills will be carried out with a structural type learning cooperative learning model as carried out by Sri Rejeki (2012) the understanding of the concept of numbers can be increased by the structural type learning cooperative learning model

approach. Then, using a collaborative learning model can improve children's ability to receive learning provided by teachers and using this model can prevent the occurrence of academic stress experienced by children (Wulansuci et al., 2022). This is also revealed in the research of Setianingrum and Azizah (2021), that the cooperative learning model can be effectively applied to improve children's abilities.

From the previous explanation, there has been no research related to cooperative learning with the help of ICT media-stimulated for early childhood with mathematical literacy skills. In addition, researchers have made observations on several kindergartens in Surabaya. Children's low mathematical literacy ability is caused by general mathematics learning and is rarely associated with activities or daily life together with peers in groups who tend to work individually and use ICT media. Cooperative learning and ICT media provide many benefits for children.

Researchers are very interested in overcoming these problems based on the conditions that occur. This study was conducted by combining the influence of cooperative learning models with ICT media which are rarely combined in a study. ICT media are mostly practised individually, so in this study, the ICT media can be used together or in groups to stimulate children's mathematical literacy skills.

METHOD

This study uses a quantitative approach quasi-experiment method with treatment by level 2x2 factorial design, which consists of the first treatment variable of the learning model consisting of cooperative and conventional learning, and the second treatment variable is the learning media consisting of ICT-based learning media and card media. The variable is bound by mathematical literacy ability. This design also uses a Nonequivalence Posttest Only Control Design.

***Table 1**. Posttest-Only Control Design*

Class	Treatment	Test
E	X	O
K	-	O

* Information: E: Experiment Class, K: Control Class, X: Provision of cooperative learning model treatment with ICT media, - : Without the provision of learning model treatment, O: Provision of mathematical literacy tests.

The populace in this think about is all kindergarten children in Gayungan District in the 2022/2023 school year. There are 21 kindergarten schools in the Gayungan District area, both public and private schools are carried out with purposive sampling techniques, two schools were selected which were then used as affordable populations, namely Kindergarten L and Kindergarten K. Kindergarten L has 2 classes of group B where 11 children fill each class, while Kindergarten K has two classes of group B where each class is filled by 11 children.

RESULT AND DISCUSSION

From the results of the ANOVA test, $F_{count} = 7.437 < F_{table} = 161$ and the noteworthiness esteem of $0.008 < 0.05$, it was concluded that there was a contrast within the comes about. The processing of children's mathematical literacy ability data on groups of children who were treated with a structural-type cooperative learning demonstration and bunches of children

instructed with a customary learning demonstration with the assistance of media was carried out utilizing the two-track ANOVA test which can be seen in Table 2.

***Table 2**. Results of the Two-Path ANAVA Test on the Influence of the Media-Assisted Learning Model on Mathematical Literacy Ability*

Tests of Between-Subjects Effects					
Dependent Variable: Mathematics Literacy Test Results					
Source	Type III Sum of Squares	df	Mean Square	F	Mr.
Model	.576	1	.576	7.437	.008
Media	1.321	1	1.321	17.048	<,001
Model * Media	.592	1	.592	7.647	.007
a. R Squared = ,277 (Adjusted R Squared = ,251)					

Source: Ramadan A.N. (2023)

As seen in Table 1, the results of data processing using the two-track ANAVA test, wherein the model variable a significance value of 0.008 was obtained less than the significance level value (0.008 < 0.05), at that point H_0 was rejected, in other words, there was a difference in mathematical literacy ability between the group of children who were given a structural type cooperative model and the bunch of children who were instructed with the ordinary learning demonstrate. The Media variable got a centrality esteem of 0.001 less than the centrality level (0.001 < 0.05), and after that H_0 was rejected, in other words, there was a distinction in mathematical literacy skills between children and ICT Media and Card Media. The Model*Media variable got a noteworthiness esteem of 0.007 less than the importance level (0.007 < 0.05), at that point H_0 was rejected, in other words, there was a difference in mathematical literacy ability between the learning model and the media at the same time. Other supporting analyses can be seen in Figure 1.

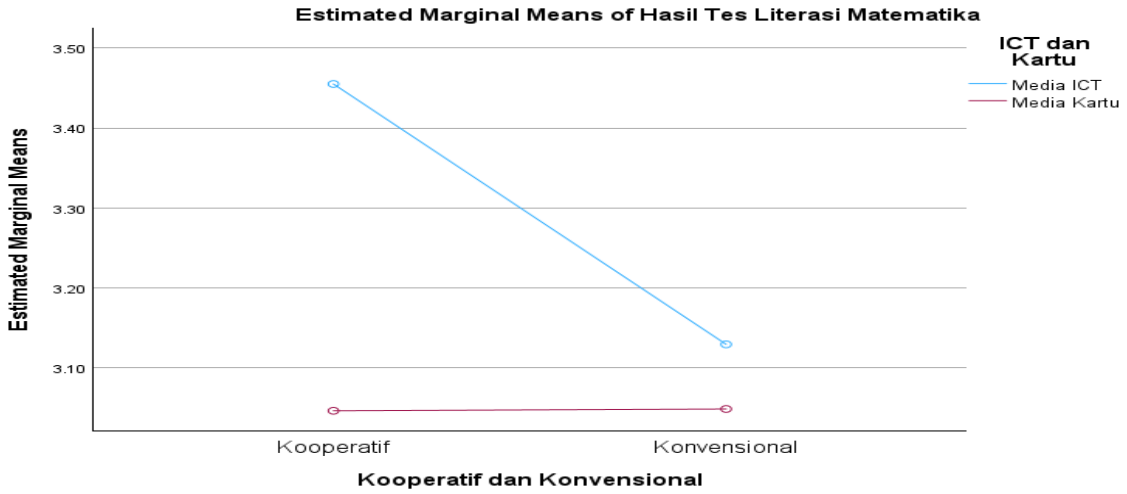

***Figure 1**. Graph of the Interaction of Mathematics Literacy Test Results to the Media-Assisted Learning Model (Source: Ramadan A.N., 2023)*

Figure 1 shows that the two lines that associate the learning model and the media are not parallel to each other, in other words, there are wedges on the two lines. It appears that there's an interaction between the learning show and the media on children's mathematical literacy skills. Media reinforces or weakens the impact of learning models on children's mathematical

literacy skills. Children with ICT media have higher abilities than children who use card media. ICT media children who are given cooperative model treatment have higher mathematical literacy skills than children who are taught with conventional learning models.

It was found that there was a significant interaction between the learning model and mathematical literacy skills reviewed with the help of the media, the data was then continued by conducting a t-test to find out where the contrast lies between the bunch of children who were treated with the cooperative model and children who were instructed with the routine learning show.

***Table 3**. t-Test Results Differences in Mathematical Literacy Ability in Experimental and Control Classes*

Paired Samples Test									
	Paired Differences					t	df	Significance	
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				One-Sided p	Two-Sided p
				Lower	Upper				
Mathematics Literacy Test Results	1.66955	.66190	.07056	1.52930	1.80979	23.662	87	<,001	<,001

Source: Ramadan A.N. (2023)

Table 3 shows that the score of $t_{calculation}$ = 23.662 with df = 87, so that t_{table} = 1.98761 is obtained. The test criteria proposed, reject H_0 if $t_{calculate} \geq t_{table}$ with results of 23.662 > 1.9796, then H_0 is rejected, in other words, the literacy ability of the group of children who are given cooperative model treatment is higher than the gather of children who are instructed with the conventional learning demonstrated. Another supporting analysis is seen that the significance value of 0.001 is less than the significance level (0.001 < 0.05), then H_0 is rejected, in other words, the agreeable learning demonstrated is superior to the conventional learning demonstrated in children's mathematical literacy skills. Based on the results of the t-test investigation, it can be said that the numeracy capacity of the gather of children who were given the cooperative model treatment was higher than that of the group of children who were instructed with the ordinary learning model with each using the help of media.

The comes about of the information elucidation that have been carried out appear that there's an interaction between the learning demonstrate and media help on children's mathematical literacy skills. The impact of the interaction can be seen in Figure 1. Children with ICT media in both learning models tend to have a high level of mathematical literacy, but children with card media have a low level of mathematical literacy, especially the group of children who are given the treatment of conventional learning models.

The cooperative learning model requires children to work together to think actively and creatively about daily life, where children are asked to ask questions about the information provided. Children understand information first to find out what problems need to be solved together in a problem. Children who already understand the existing problems can then build a joint solution plan that is appropriate for the problem. In line with the research that has been conducted by Segundo, Carillo and Gonzalez who stated that cooperative learning activities encourage children to actively and creatively explore daily problems in children's lives that are solved together (Segundo-Marcos et al., 2023). The cooperative model is group or joint learning, where children investigate problems together to find concepts or principles for material so that it can improve children's cognitive activity (Segundo-Marcos et al., 2022).

With cooperation then with ICT media, children who are given ICT media treatment gain learning experiences together with other children or through interaction with experts with ICT-based communication media, provide new experiences to children virtually, can communicate with other friends without having to meet face-to-face, and can increase children's interest in learning. ICT media encourages children to be more aware that teachers are facilitators or places to interpret information, teachers are not the source of all information. With this ICT media, children can improve their mathematical literacy skills through the digitization of learning. Agreeing with the statement put forward by the previous researcher, that children who start learning through ICT media will easily solve the problems they face and play an imperative part in learning and scholastic advance as well as children's mathematical literacy (Novita & Herman, 2021; Nurjanah & Mukarromah, 2021). By jointly learning is carried out using a cooperative model with peers with the help of ICT media, it can produce a successful learning process that can help children in their future lives (Nikolopoulou, 2020; Novita & Herman, 2021; Nurjanah & Mukarromah, 2021; Segundo Marcos et al., 2020; Segundo-Marcos et al., 2022; Usmadi et al., 2020).

The mathematical literacy ability of these models and media in children influences every child's learning process. However, the learning process of the two models and media have different results in the end. This indicates that applying an inappropriate learning model in mathematics literacy learning can potentially confuse the learning process in children. Based on the description above, it shows that the media strengthens the influence of the learning model on the level of children's mathematical literacy skills.

CONCLUSION

The test and discussion of the investigation found several facts that can be concluded as follows: (1) The structural-type cooperative learning model significantly influences children's mathematical literacy skills compared to the conventional learning model. This is proven when the group of children given a structural type cooperative learning model has a higher average score of mathematic literacy ability than the conventional learning model; (2) ICT media significantly influences children's mathematical literacy skills rather than card media. This is proven when the group of children learning with the help of ICT media has an average score higher than with the help of card media on children's mathematical literacy skills; (3) Learning media strengthens the influence of learning models on children's mathematical literacy. This can be seen from the interaction between the learning model and the media on children's mathematical literacy. Several possibilities are worth considering for future research. In particular, the present study accurately depicts the integral nature of the group within the school setting, meaning that there were no cases where children were selected from different classes (e.g., randomly). Thus, a larger sample would provide a more representative view of the trajectory of mathematical literacy skills and the impact of learning models on that development.

REFERENCES

Barenthien, J., Lindner, M. A., Ziegler, T., & Steffensky, M. (2020). Exploring preschool teachers' science-specific knowledge. *Early Years*, *40*(3). https://doi.org/10.1080/09575146.2018.1443321

Blackley, S., Rahmawati, Y., Fitriani, E., Sheffield, R., & Koul, R. (2018). Using a makerspace approach to engage Indonesian primary students with STEM. *Issues in Educational Research*, *28*(1).

Duncan, G. J., Dowsett, C. J., Claessens, A., Magnuson, K., Huston, A. C., Klebanov, P., Pagani, L. S., Feinstein, L., Engel, M., Brooks-Gunn, J., Sexton, H., Duckworth, K., & Japel, C. (2007). School Readiness and Later Achievement. *Developmental Psychology*, *43*(6). https://doi.org/10.1037/0012-1649.43.6.1428

Fu, J. S., & Technology, C. (2013). ICT in Education: A Critical Literature Review and Its Implications Jo Shan Fu. *International Journal of Education and Development Using Information and Communication Technology*, *9*(1).

Halberda, J., Mazzocco, M. M. M., & Feigenson, L. (2008). Individual differences in non-verbal number acuity correlate with maths achievement. *Nature*, *455*(7213). https://doi.org/10.1038/nature07246

Klibanoff, R. S., Levine, S. C., Huttenlocher, J., Vasilyeva, M., & Hedges, L. V. (2006). Preschool children's mathematical knowledge: The effect of teacher "math talk." *Developmental Psychology*, *42*(1). https://doi.org/10.1037/0012-1649.42.1.59

Levine, S. C., Suriyakham, L. W., Rowe, M. L., Huttenlocher, J., & Gunderson, E. A. (2010). What counts in the development of young children's number knowledge? *Developmental Psychology*, *46*(5). https://doi.org/10.1037/a0019671

Liska, F., Tiara, V., & Barella, Y. (2024). Menyelami Tren Populasi Dunia: Fakta, Angka, dan Implikasinya. *SOSIAL: Jurnal Ilmiah Pendidikan IPS*, *2*(3), 01-07.

Mazur, A. D., Brown, B., & Jacobsen, M. (2015). Learning designs using flipped classroom instruction. *Canadian Journal of Learning and Technology*, *41*(2).

Nguyen, T., Watts, T. W., Duncan, G. J., Clements, D. H., Sarama, J. S., Wolfe, C., & Spitler, M. E. (2016). Which preschool mathematics competencies are most predictive of fifth grade achievement? *Early Childhood Research Quarterly*, *36*. https://doi.org/10.1016/j.ecresq.2016.02.003

Nikolopoulou, K. (2020). Preschool Teachers' Practices of ICT-Supported Early Language and Mathematics. *Creative Education*, *11*(10). https://doi.org/10.4236/ce.2020.1110149

Novita, R., & Herman, T. (2021). Digital technology in learning mathematical literacy, can it helpful? *Journal of Physics: Conference Series*, *1776*(1). https://doi.org/10.1088/1742-6596/1776/1/012027

Nurjanah, N. E., & Mukarromah, T. T. (2021). Pembelajaran Berbasis Media Digital pada Anak Usia Dini di Era Revolusi Industri 4.0: Studi Literatur [Digital Media-Based Learning in Early Childhood in the Industrial Revolution Era 4.0: Literature Study]. *Jurnal Ilmiah Potensia*, *6*(1).

OECD. (2018). PISA for Development Assessment and Analytical Framework: Reading, Mathematics and Science. In *OECD Publishing* (Vol. 1, Issue 1).

Omaga, J. F., & Alieto, E. O. (2019). Teaching Literacy Through Play: Perspective from Filipino Early Childhood Teachers. In *Sci.Int.(Lahore)* (Vol. 31, Issue 3).

Pereira, S., Rodrigues, M. J., & Vieira, R. M. (2020). Scientific literacy in the early years–practical work as a teaching and learning strategy. *Early Child Development and Care*, *190*(1). https://doi.org/10.1080/03004430.2019.1653553

Rakhmawati, N. I. S., Mardliyah, S., Fitri, R., Darni, D., & Laksono, K. (2021). Pengembangan Learning Management System (LMS) di Era Pandemi Covid-19 pada Pendidikan Anak Usia Dini [Development of Learning Management System (LMS) in the Era of Covid-19 Pandemic

in Early Childhood Education]. *Jurnal Obsesi : Jurnal Pendidikan Anak Usia Dini*, *6*(1). https://doi.org/10.31004/obsesi.v6i1.991

Ramani, G. B., Rowe, M. L., Eason, S. H., & Leech, K. A. (2015). Math Talk During Informal Learning Activities in Head Start Families. *Cognitive Development*, *35*. https://doi.org/10.1016/j.cogdev.2014.11.002

Rejeki, S. (2012). Meningkatkan kemampuan pemahaman konsep bilangan dengan media gambar melalui model pembelajaran kooperatif tipe struktural mencari pasangan pada anak kelompok a paud puri mandiri sragen [Improving the ability to understand the concept of numbers using picture media through the structural type cooperative learning model of looking for partners in group A children at Paud Puri Mandiri Sragen].

Segundo Marcos, R. I., López Ferández, V., Daza González, M. T., & Phillips-Silver, J. (2020). Promoting children's creative thinking through reading and writing in a cooperative learning classroom. *Thinking Skills and Creativity*, *36*. https://doi.org/10.1016/j.tsc.2020.100663

Segundo-Marcos, R., Carrillo, A. M., Fernández, V. L., & Daza González, M. T. (2023). Age-related changes in creative thinking during late childhood: The contribution of cooperative learning. *Thinking Skills and Creativity*, *49*. https://doi.org/10.1016/j.tsc.2023.101331

Segundo-Marcos, R., Carrillo, A. M., Fernández, V. L., & González, M. T. D. (2022). Development of executive functions in late childhood and the mediating role of cooperative learning: A longitudinal study. *Cognitive Development*, *63*. https://doi.org/10.1016/j.cogdev.2022.101219

Setianingrum, I., & Azizah, N. (2021). Teams Games Tournament untuk Meningkatkan Kemampuan Mengenal Lambang Bilangan pada Anak Usia Dini [Teams Games Tournament to Improve Number Symbol Recognition Skills in Early Childhood]. *Jurnal Obsesi : Jurnal Pendidikan Anak Usia Dini*, *6*(1). https://doi.org/10.31004/obsesi.v6i1.1268

Silvia, E. F., & Rakhmawati, N. I. S. (2021). Analisis Kompetensi Pedagogik Guru Pendidikan Anak Usia Dini Tersertifikasi Terhadap Minat Belajar Anak Selama Pandemi [Analysis of Pedagogical Competence of Certified Early Childhood Education Teachers on Children's Learning Interests During the Pandemic]. *Jurnal Ilmiah Pesona PAUD*, *8*(1).

Skwarchuk, S. L., Sowinski, C., & LeFevre, J. A. (2014). Formal and informal home learning activities in relation to children's early numeracy and literacy skills: The development of a home numeracy model. *Journal of Experimental Child Psychology*, *121*(1). https://doi.org/10.1016/j.jecp.2013.11.006

Usmadi, U., Hasanah, H., & Ergusni, E. (2020). The Impact of the Implementation Three-Step Interview Cooperative Learning Model in Mathematics Learning Toward the Learners' Activities and Outcomes. *Malikussaleh Journal of Mathematics Learning (MJML)*, *3*(1). https://doi.org/10.29103/mjml.v3i1.2447

Vatanartiran, S., & Karadeniz, S. (2020). A Needs Analysis for Technology Integration Plan: Challenges and Needs of Teachers. *Contemporary Educational Technology*, *6*(3). https://doi.org/10.30935/cedtech/6150

Wulansuci, G., Hunafa Lestari, R., & Munggaraning Westhisi, S. (2022). Pemahaman Guru PAUD Terhadap Stress Akademik Pada Anak Usia Dini [Preschool Teachers' Understanding of Academic Stress in Early Childhood]. *Golden Age: Jurnal Pendidikan Anak Usia Dini*, *6*(1). https://doi.org/10.29313/ga:jpaud.v6i1.9714