The Relevance of Numbered Heads Together Learning Model to Students' Mathematical Communication Ability Based on Vygotsky's Theory

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ARTICLE INFO	ABSTRACT
Keywords: Numbered Heads Together, Mathematical communication skills, Vygotsky's theory of learning	Numbered Heads Together learning model is a cooperative learning model that aims to improve collaborative mathematical understanding. Mathematical communication ability is the ability to convey ideas or mathematical understanding. NHT can be applied in mathematics learning activities on campus to improve students' mathematical communication skills and is relevant or in accordance with Vygotsky's learning theory which emphasizes collaboration in learning activities. The results of the collaboration of the NHT learning model can improve students' mathematical communication skills because there is a process of social interaction and exchange of ideas in the learning model
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INTRODUCTION

Globalization has a universally significant effect on the development of education. Changing times and technological developments require every country to innovate in the field of education to create a balance between science and technology. Indonesia and other countries in the 21st century have entered the era of industry 4.0 and society 5.0. 21st-century education focuses on several areas of expertise, namely creativity, critical thinking, communication, and collaboration (Risdianto, 2019).

Through the ministries of education, culture, research, and technology, the government has made several efforts to face the challenges of the 21st century. As the highest educational institution, the university has a relevant and dynamic goal, namely directing students to become excellent and competitive graduates, following Key Performance Indicators (Dirjen Pendidikan Tinggi, 2020). One of the government's efforts is to create an Independent Learning Campus program (MBKM) focusing on literacy, numeracy, and character surveys (Mustagfiroh, 2020).

Implementing the MBKM program means that the academic community is free to develop scientific insights and competencies and is freed from convoluted bureaucracy (Urfatullaila et al., 2021). Innovation is needed in lecture activities to support and launch the program by applying a learning model relevant to the policy.

Integrated science in each course aims to develop students' scientific insights. This scientific insight is balanced by students' numeracy skills, which are available and sharpened in several subjects. *Mathematics* is the main foundation integrated according to the department or study program. Examples of several courses that aim to improve students' numeracy skills according to needs include Basic Mathematics, Economic Mathematics, Discrete Mathematics, Financial Mathematics, Calculus, Actuarial, and Statistics.

The important role of mathematics in tertiary institutions is to grow and develop students' mathematical power. In the National Council of Teachers of Mathematics (NCTM), five processes become standard in mathematics learning, including understanding, reasoning, communication, connection, and solving mathematical problems. (Darma et al., 2020). To support this process, a

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supportive and relevant learning model is needed. One learning model that aims to improve numeracy competence is NHT (Numbered Heads Together). The NHT learning model aims to influence students to develop interaction patterns and modify traditional classes (Khoiriyah, 2018).

According to Handayama (Tinambunan et al., 2020), the cooperative learning model is a learning model that groups students into various small groups. NHT is in the form of group discussions which are varied, and each student in the group gets a number. The cooperation that is created in each group can motivate students to develop thoughts, experiences, and activeness during learning activities (Yenni, 2016).

This learning will establish learning interactions between students in the hope of increasing student activity and learning outcomes in mathematics. This learning model can be applied in learning activities on campus, especially in mathematics courses.

Interaction patterns are basically related to communication skills. Communication is a series of social interaction activities that contain ideas and can be developed (Sumartini, 2019). The cooperative learning model is inseparable from the role of communication skills in interacting. Mathematics-based courses can improve mathematical communication skills. According to (Sumarno, 2003), mathematical communication skills can be applied in various forms, including a) Interpreting a problem and data into a mathematical model; b) Explaining it directly orally or in writing; c) Listening, discussing, and writing about mathematics; d) Reading with understanding a written mathematical representation; e) Making conjectures, constructing arguments, formulating definitions and generalizations; and f) Reconcile in your own language.

Several studies have examined the effect of the NHT learning model on mathematical communication skills, including the Effect of Numbered Head Together (NHT) Cooperative Learning Model on Mathematical Communication Ability (Lagur et al., 2018), Application of NHT Type Cooperative Learning to Improve Students' Mathematical Communication Ability (Istikomah & Nurmaliza, 2021).and The Effect of the NHT Type Cooperative Learning Model on Student Learning Outcomes (Eka Susilowati, 2020).

These previous studies have shown that the NHT learning model can improve mathematical communication skills. This learning model is inseparable from the important role of scientists who develop learning theories. One of the figures who developed the cooperative learning theory was Vygotsky. Based on this explanation, the researcher will explain the relevance of the NHT learning model to mathematical communication skills based on Vygotsky's theory.'

METHOD

This type of research is qualitative by collecting data from various scientific sources or previous research literature to explain the phenomena that occur (Anggito & Setiawan, 2018). The approach used is descriptive analytics which aims to obtain in-depth data (Sugiyono, 2018).

This research uses a library study method related to theoretical studies, references, and other scientific literature based on culture, values, and norms that develop in the social situation studied (Sugiyono, 2018). Data was taken based on the results of researchers' searches related to research or scientific literature regarding the NHT learning model, mathematical communication skills, and Vygotsky's learning theory which had been selected and then studied in more depth.

RESULTS AND DISCUSSION

NHT Learning Model

Numbered Head Together (NHT) cooperative learning method is a learning method based on the constructivist learning theory developed by Spencer Kagan (Ibrahim & Dkk, 2000). According to (Shoimin, 2017), the NHT learning model is a learning model that is carried out based on groups, and each member is responsible for their group assignments. Another definition

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explains that the NHT-type cooperative learning model aims to make students think together in groups where each student is given a number and has the same opportunity to answer a problem given by the teacher (K. . Lestari & Yudhanegara, 2015).

In applying the NHT learning method, appropriate steps are needed to achieve the learning objectives. Some of the steps or syntax of the NHT learning method can be developed as follows:

The steps of the NHT learning model according to (Huda, 2015), which researchers modified according to learning in universities:

1. Lecturers deliver lecture material to students according to the basic competencies to be achieved.
2. The lecturer gives quizzes to each student to get an initial score
3. The lecturer divides students into several groups consisting of 4-5 people. Every member
4. The group is given a number which will be its identity when randomly assigned to represent the group in answering
5. The lecturer gives problems to be solved together in groups.
6. View student understanding by calling one of the group member numbers. The student whose number is called answers the question, which is the answer from the group. The student becomes the representative of the group.
7. The lecturer directs students to make resumes and provide confirmation of the discussion before the lecture ends
8. The lecturer gives a quiz to each student
9. The lecturer gives awards to groups whose members experience an increase in individual quiz scores from the first to the second quiz.

The NHT learning model, according to (Trianto, 2014), has the following steps:

1. The lecturer divides students into several groups consisting of 4-5 people, and each group member is given a number between 1-5
2. The lecturer gives questions to students.
3. Students combine opinions about the answers to these questions and ensure that each member understands the answers.
4. The lecturer calls a number, and the student explains the answer.

(Suprijono, 2015) makes the steps of the NHT learning model through the following syntax:

Table 1. Syntax of the NHT Learning Model

No.	Phase	Lecturer Activity
1	Establishing Set: Delivering goals and preparing students	• Menjelaskan tujuan perkuliahan • Menginfokan latar belakang perkuliahan • Mengkondisikan Mahasiswa untuk belajar
2	Demonstrating: Demonstrating knowledge or skills	• Memberikan contoh yang benar • Menyajikan informasi secara bertahap
3	Guided Practice: Guiding training	• Merencanakan dan memberi pelatihan awal
4	Feedback: Check understanding and provide feedback	• Melakukan pengecekan apakah Mahasiswa berhasil melakukan tugas dengan baik • Memberikan umpan balik
5	Extended Practice: Provides opportunities to develop and apply	• Memberikan pembelajaran lanjutan yang lebih kompleks dan sesuai dengan kehidupan sehari-hari.

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Mathematical Communication Skills

Mathematical communication skills in the NHT cooperative learning model are needed because this learning model involves active social interaction. Several reasons put forward (Barrody, A, 1993), show the importance of mathematical communication skills, namely: 1) mathematics is essentially a language; and (2) mathematics and mathematics learning are, at heart, social activities. From this opinion, it can be concluded that Mathematics is a tool for thinking, finding a pattern, solving problems, and making conclusions, as well as communicating clearly and precisely.

Mathematical communication skills contribute to and play a role in successful problem-solving (Stacey, 2005). This opinion shows that one of the factors that determine someone's in solving mathematical problems is the ability to mathematical communication.

The results of the mathematics learning activities are that students are able to improve their mathematical communication skills from the problems they solve. This is relevant to the opinion (Lindquist & Elliot, 1996), which explains that mathematical communication is one of the goals of learning and understanding mathematics. In addition, this opinion was reaffirmed by (Lim & Pugalee, 2005), who explained that communication (language) is an important component in understanding mathematical concepts.

Vygotsky's Learning Theory

Lev Semenovich Vygotsky is one of the scientists from Russia in the fields of psychology, philosophy, and literature. One of Vygotsky's famous philosophical studies is about humans and the environment. Vygotsky explains the differences between humans and animals in interacting in the environment. In addition to interacting, humans have the ability to change their environment according to their needs at that time (Schunk, 2012).

Vygotsky's social constructivism theory has a basic understanding written "What the child can do in cooperation today he can do alone tomorrow" (Warsono & Hariyanto, 2012). The purpose of this explanation is that learning that is done today in groups will be learned easily in the future independently. Vygotsky explained two different levels of development that students have, namely actual and potential development (Arrends, 2008). The level of actual development is to use cognitive abilities independently in solving a problem. In contrast, the level of potential development is when students or students use their cognitive abilities through the help of others, such as teachers or friends who are more competent. Based on these assumptions, Vygotsky provides recommendations so that teachers or lecturers can collaborate with students or students in learning activities.

CONCLUSION

Based on the discussion, it can be concluded that the Numbered Heads Together learning model can be applied in mathematics learning activities on campus to improve students' mathematical communication skills and is relevant or in accordance with Vygotsky's learning theory which emphasizes collaboration in learning activities. The results of the collaboration of the NHT learning model can improve students' mathematical communication skills because there is a process of social interaction and exchange of ideas in the learning model.

REFERENCES

Anggito, A., & Setiawan, J. (2018). *Metodologi Penelitian Kualitatif* (E. D. Lestari (ed.); 1st ed.). CV Jejak.

Arrends, R. I. (2008). *Learning to Teach*. Pustaka Belajar.

Barrody, A, J. (1993). *roblem Solving, Reasoning, and Communicating, (K-8): Helping Children Think*

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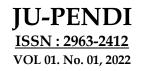
4

Mathematically. Merill as imprint of Macmillan Publishing Company.

Darma, I. K., Karma, I. G. M., & Santiana, I. M. A. (2020). Blended Learning, Inovasi Strategi Pembelajaran Matematika di Era Revolusi Industri 4.0 Bagi Pendidikan Tinggi. *Prosiding Seminar Nasional Pendidikan Matematika*, 3, 527–539.

Dirjen Pendidikan Tinggi. (2020). *Buku Panduan Indikator Kinerja UTAMA PERGURUAN TINGGI* (pp. 1–42).

Eka Susilowati. (2020). PENGARUH MODEL PEMBELAJARAN KOOPERATIF TIPE NHT WITH RANDOM NAME NUMBER TERHADAP HASIL BELAJAR MAHASISWA. *Journal of Mathematics Education, Science and Technology*, 5(2), 182–196.

Huda, M. (2015). *Cooperative Learning: Metode, Teknik, Struktur dan Model Penerapan*. Pustaka BBelajar.

Ibrahim, & Dkk. (2000). *Pembelajaran Kooperatif*. Universitas Negeri Surabaya.

Istikomah, E., & Nurmaliza, N. (2021). Penerapan Pembelajaran Kooperatif Tipe NHT untuk Meningkatkan Kemampuan Komunikasi Matematika Siswa. *PRISMA*. https://jurnal.unsur.ac.id/prisma/article/view/1406

Khoiriyah, S. (2018). Implementasi Model Pembelajaran Kooperatif Tipe Nht Dalam Pembelajaran Matematika. *JURNAL E-DuMath*, 4(2), 30. https://doi.org/10.26638/je.754.2064

Lagur, D. S., Makur, A. P., & Ramda, A. H. (2018). Pengaruh Model Pembelajaran Kooperatif Tipe Numbered Head Together (NHT) terhadap Kemampuan Komunikasi Matematis. *Mosharafa: Jurnal Pendidikan Matematika*, 7(3), 357–368. https://doi.org/10.31980/mosharafa.v7i3.160

Lestari, K. ., & Yudhanegara, M. R. (2015). *Penelitian Pendidikan Matematika*. PT Refika Aditama.

Lim, L., & Pugalee, D. . (2005). *Using Journal Writing to Explore "They Communicate to Learn Mathematics and They Learn to Communicate Mathematicall*.

Lindquist, M. ., & Elliot, P. S. (1996). *Communication an imperactive for Change: A Conversation with Mary Lindquist*. NCTM.

Mustagfiroh, S. (2020). Konsep " Merdeka Belajar " Perspektif Aliran Progresivisme di Perguruan Tinggi. *Jurnal Studi Guru Dan Pembelajaran*, 3(1), 141–147.

Risdianto, E. (2019). Analisis Pendidikan Indonesia di Era Revolusi Industri 4.0. *Research Gate*, *April*, 0–16.

Schunk. (2012). *Learning Theories An Educational Perspective*. Pustaka Belajar.

Shoimin. (2017). *68 Model Pembelajaran Inovatif dalam Kurikulum 2013*. Ar Ruzz Media.

Stacey, K. (2005). The Place of Problem Solving in Contemporary Mathematics Curriculum Document. *Journal of Matehmatics Behaviour*, 23, 341–350.

Sugiyono. (2018). *Metode Penelitian Kuantitatif, Kualitatif, dan R&D*. Alfabeta.

Sumarno. (2003). *Pembelajaran Keterampilan Membaca Matematika. Makalah pada Pelatihan Nasional TOT Guru Matematika dan Bahasa Indonesia SLTP di Bandung*.

Sumartini, T. S. (2019). Kemampuan Komunikasi Matematis Mahasiswa melalui Pembelajaran Think Talk Write. *Mosharafa: Jurnal Pendidikan Matematika*, 8(3), 377–388.

Suprijono, A. (2015). *Cooperative Learning: Teori dan Aplikasi PAIKEM*. Pustaka Belajar.

Tinambunan, D. D., Fathurrohman, M., & Khaerunnisa, E. (2020). Pengaruh Model Pembelajaran Kooperatif Tipe Numbered Head Together (Nht) Terhadap Kemampuan Pemecahan Masalah Matematis Siswa Smp. *TIRTAMATH: Jurnal Penelitian Dan Pengajaran Matematika*, 2(1), 30. https://doi.org/10.48181/tirtamath.v2i1.8322

Trianto. (2014). *Mendesain Model Pembelajaran Inovatif, Progresif dan Kontekstual*. Prenamedia Grup.

Urfatullaila, L., Rahmawati, I., Lestari, H., & Ismail, Z. (2021). Reslaj : Religion Education Social Laa Roiba Jornal Reslaj : Religion Education Social Laa Roiba Jornal. *Reslaj: Religion Education Social Laa Roiba Jornal*, 3(1), 14–22. https://doi.org/10.47476/reslaj.v4i1.435

Warsono, & Hariyanto. (2012). *Pembelajaran Aktif Teori dan Assesmen*. Rosda.

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5

Yenni, R. F. (2016). Penggunaan metode numbered head Together (NHT) dalam pembelajaran matematika. *Jurnal Penelitian Dan Pembelajaran Matematika*, *9*(2), 263–267. http://jurnal.untirta.ac.id/index.php/JPPM/article/view/1006

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