

# Application of guided inquiry learning model based on inter-intrapersonal intelligence in chemistry classroom

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**Abstract.** This study aims to determine the differences in the inter-intrapersonal intelligence of students who are taught with guided inquiry learning models based on inter-intrapersonal intelligence with students who are taught with direct instruction models on electrolyte and non-electrolyte solution materials. This research is a quasi-experimental study using a post-test only research design. This study used one experimental group and one control group. Students in the experimental group (N = 34) was taught using the guided inquiry learning model based on inter-intrapersonal intelligence in learning activities, while the control group (N = 34) was taught using the direct instruction model. The instrument used in this study is an inter-intrapersonal intelligence questionnaire. The data analysis technique of the research results used in this study is the independent t-test technique with a significance level of 0.05 and was found 0.038. The mean scores of inter-intrapersonal intelligence questionnaire in the experimental class was 62.35 while in the control class was 58.96. This means that there is a significant difference in inter-intrapersonal intelligence between students taught in learning with guided inquiry learning models based on inter-intrapersonal intelligence and students who take learning using direct instruction learning models on electrolyte and non-electrolyte solution materials.

**Keywords:** *interpersonal, intrapersonal, intelligence, guided inquiry*

## 1. Introduction

Human resource development is one of the challenges in facing industrial revolution 4.0. That is because Indonesia received a demographic bonus (2010-2035) in the form of the largest number of productive ages (15-64 years). Improving the quality of human resources must be accompanied by improvements in education because education is an investment in improving the quality of human resources [1]. Through education in schools, students are required to have 21st-century skills which include critical thinking and problem solving, communication and collaboration, and creativity and innovation. Therefore, the government took steps to develop the curriculum-2013. Therefore, the learning components used must also support the implementation of the curriculum-2013.

One learning component that needs attention is the learning model used. Learning models is a conceptual framework that describes systematic steps in learning activities to achieve certain learning goals. The learning model serves as a guide for teachers in planning learning activities [2]. Regulation of the Minister of Education and Culture of the Republic of Indonesia Number 22 Year 2016 regarding the Standards for the Process of Primary and Secondary Education recommends two learning models that can be used to strengthen scientific approaches, integrated thematic (thematic inter-subject



learning), and thematic (in a subject). The two learning models are research-based learning namely discovery learning and inquiry learning. One example of thematic properties in chemistry such as electrolyte and non-electrolyte solution materials is related to the material's colligative properties and chemical bonds. However, the analysis of electrolyte and non-electrolyte solutions lesson plans used in several schools showed that learning models were used not yet varied and only a few teachers had applied the inquiry learning model.

There are four levels of inquiry [3]. Level 1 is confirmation inquiry, level 2 is structured inquiry, level 3 is guided inquiry, and level 4 is open/true inquiry. The guided inquiry learning model has learning steps that are aligned with the scientific approach. Guided inquiry is a learning model that directs students to investigate the questions given by the teacher employing procedures that they design themselves to then communicate the results of their investigation. In guided inquiry students are involved in every learning process from collecting information related to the problem given by the teacher to present their findings [4]. Besides that, student achievement is better than using traditional learning. This can be seen from the increase in student test scores and activeness in social science subjects [5]. The direct instruction model is a teacher-centered learning model that allows students to learn by observing, remembering and imitating what has been exemplified by the teacher.

Howard Gardner divided human intelligence into eight groups by calling it multiple intelligences. That eight intelligence are verbal-linguistic, logical-mathematical, visual-spatial, bodily-kinesthetic, musical, interpersonal, intrapersonal, and naturalist [6]. To mastering 21st-century skills, students need to develop personal intelligence which consists of interpersonal and intrapersonal intelligence. Interpersonal intelligence is the ability to understand and make a difference in the moods, intentions, motivations, and feelings of others, including sensitivity to facial expressions, voice and gestures; the capacity to distinguish between various types of interpersonal cues; and the ability to respond to these cues [7]. There are five indicators of interpersonal intelligence, namely empathetic processing, giving feedback, listening to others, team building, inquiry and questions [8]. Intrapersonal intelligence is self-knowledge and the ability to act adaptively based on that knowledge. This intelligence includes having an accurate picture of oneself (one's strengths and limitations); awareness of inner mood, intention, motivation, temperament, and desire; and the capacity for self-discipline, self-understanding, and self-esteem [7]. There are five indicators of intrapersonal intelligence, namely self-reflection, emotional processing, metacognition, values clarification, and self-identity [8].

Interpersonal and intrapersonal intelligence can affect student learning achievement. A result of the study states that when students realize and utilize their personal intelligence, they will more easily understand and apply the lessons given [9]. The development of interpersonal and intrapersonal intelligence can be embedded in learning activities, but sometimes the teachers pay less attention to it. Talib and Kailani's research stated that one of the factors causing failure to use learning methods is because it is not focused on developing personal intelligence. They found that the model of problem-based learning in cooperative situations (PBLCS) could develop the interpersonal intelligence of high school students [10]. Thus, researchers want to determine the differences in the inter-intrapersonal intelligence of students who are taught with guided inquiry learning models based on inter-intrapersonal intelligence with students who are taught with direct instruction models on electrolyte and non-electrolyte solution materials.

## 2. Research method

This research is a quasi-experimental study using a post-test only research design. This study used one experimental group and one control group. Students in the experimental group were taught using the guided inquiry learning model based on inter-intrapersonal intelligence in learning activities, while those the control group were taught using the direct instruction model. The quasi-experimental post-test only research design is described in table 1.

**Table 1.** Quasi experiment with post-test only design.

Group	Treatment	Post-test
Experimental	X1	P1
Control	X2	P1

Description:

X 1: Guided inquiry learning models based on inter-intrapersonal intelligence

X 2: Direct instruction learning models

P 1: An instrument to measure students' inter-intrapersonal intelligence

The population in this study were all students of grade X MIPA (Natural Science Class) in Central Java Province which were equivalent to SMA Negeri 1 Tegal. The sample used was students from 2 class X MIPA from a total of 7 class X MIPA in SMA Negeri 1 Tegal which was divided into experimental and control class. The sample was obtained from a random sampling technique.

The instrument used in this study is an inter-intrapersonal intelligence questionnaire consisting of five indicators of interpersonal intelligence and five indicators of intrapersonal intelligence. Each indicator contains two statements so that in total there are 20 statements. All statements in the questionnaire are favorable. The data obtained from this questionnaire is in the form of qualitative (ordinal) data so it was converted into quantitative data (intervals) before being analyzed. The transformation of ordinal data into interval data in this study was carried out with the Successive Interval Method (MSI). In addition, researchers also prepare learning tools to support the learning activities such as syllabus, lesson plans, students' worksheets, and learning media (pocketbooks and powerpoint slides). The syllabus is used as a reference in making a lesson plan. The lesson plan was made according to the competency standards contained in the curriculum-2013 with the syntax of the learning model. Students' worksheets were used to write an experiment report. Chem is Fun is a chemistry pocketbook, structured as a learning media or supplement of teaching materials that is compatible with guided inquiry learning models based on inter-intrapersonal intelligence. Both research instrument and learning tools have been validated by two experts before being used in research.

There are two lesson plans in this study. The first lesson plan for the control class is by using the syntax of the direct instruction learning model adapted from Slavin [11]. The second lesson plan for the experimental class is using the syntax of the guided inquiry learning model based on inter-intrapersonal intelligence. The syntax of the guided inquiry learning model based on inter-intrapersonal intelligence was compiled by combining the syntax adaptation of the guided inquiry learning model from the National Research Council [12] with aspects of interpersonal intelligence and intrapersonal intelligence written by Lazear [8]. Both syntaxes are shown in table 2.

**Table 2.** Syntax of the direct instruction model and guided inquiry learning model based on inter-intrapersonal intelligence.

Direct Instruction (Control Class)			Guided Inquiry Learning Model Based on Inter-Intrapersonal Intelligence (Experimental Class)	
No.	The steps	Activity	The steps	Activity
1	Inform the learning objectives and lesson orientation to students	The teacher informs the things that must be learned and the student's expected performance.	Independent problem identification	The teacher presents events or phenomena, students make observations by discussing with their classmates and noting the problems found
2	Review prerequisite	The teacher asks	Submitting	Learners ask questions or

	knowledge and skills	questions to uncover the knowledge and skills that have been mastered by students.	feedback	submit comments based on the events and phenomena presented
3	Delivering subject matter	The teacher presents information, gives examples, demonstrates concepts and so on.	Plan an investigation with a group	The teacher asks students to form several groups and divide tasks. The teacher guides students to plan an investigation and develop appropriate work procedures.
4	Carry out guidance	The teacher asks questions to assess the level of understanding of students and correct concept errors.	Collect data and conduct an honest investigation	Students work together with their groups to carry out investigations and collect data based on work procedures that have been made.
5	Provide opportunities for students to practice	The teacher provides the opportunity for students to practice their skills or use new information.	Analyze data collaboratively	Students analyze the data by discussing it in groups by writing down the results of the analysis in the form of a short report.
6	Assess student performance and provide feedback	The teacher gives a review of the things that have been done by students, provides feedback on the correct response of students and repeats skills if needed.	Make conclusions	Each student makes a conclusion with his own sentence based on the results of the investigation.
7	Providing independent training	The teacher gives students independent assignments to improve their understanding of the material they have learned.	Communicating results confidently	Students take turns presenting the results of investigations that have been carried out. Students who don't make presentations can give comments, both about the style of presentation and the content.
8			Reflection	Learners write down the understanding that has been obtained from learning activities, assess the performance of a peer or group, and write things that want to be improved from the learning activities that day and things that will be done after the learning activities.

The validation of the instrument was carried out by two experts. Then, empirical validation was done by testing the test instruments to 221 grade XI students. The analysis using the Rasch Model aims to find out the suitability of the items with the model (item fit). The criteria used to check the suitability of the Rasch Model are shown in table 3.

**Table 3.** Suitability criteria for the rasch model.

<b>MNSQ INFIT Value</b>	<b>OUTFIT T Value</b>	<b>Information</b>
$0.77 \leq \text{MNSQ INFIT} \leq 1.33$	$\text{OUTFIT T} \leq 2.00$	Fits the Rasch model

Instrument reliability is determined by the value of Person Reliability and Item Reliability. The value of Person Reliability and Item Reliability are used to find out the consistency of answers from students and know the quality of the items in the instrument. The criteria for Person Reliability and Item Reliability are shown in table 4 [13].

**Table 4.** Value criteria for person reliability and item reliability.

<b>Value</b>	<b>Criteria</b>
<0.67	Bad
0.67 - 0.80	Pretty good
0.81 - 0.90	Well
0.91 - 0.94	Very good
> 0.94	Very well

The data analysis technique of the research results used in this study is the independent t-test technique with a significance level of 0.05. This analysis technique aims to determine the differences in cognitive achievement between students of control class and experimental class. Some assumptions that must be met in the independent t-test are 1). sample comes from an independent group, 2). variance between groups should be homogeneous, and 3). sample comes from normally distributed groups.

### 3. Results and Discussion

The theoretical validation results stated that the instrument is appropriate for use with minor revision. Then, the results of empirical validation were analyzed using the Rasch Model. It was found that all items were declared valid because they met the criteria of item fit. The Person Reliability value is 0.73 and the value of Item Reliability is 0.98. Based on those reliability values, it can be concluded that the instrument is reliable. After validity and reliability meet the criteria, the assumptions of the independent sample t-test must also be tested. The sample in this research comes from the independent group. The variance between groups must be homogeneous. This assumption is met with the significance level of 0.05. Homogeneity assumption test results shown in table 5.

**Table 5.** Test of homogeneity of variance.

	<b>Levene Statistics</b>	<b>df1</b>	<b>df2</b>	<b>Sig.</b>
Based on Mean	0.073	1	66	0.788

Sig. value is found 0.788 which is greater than the significance level of 0.05. This shows that the variance between groups is homogeneous. The third assumption is that each group has a normal distribution. This assumption is met with the Sig. greater than 0.05. The results of the normality assumption test shown in table 6.

**Table 6.** Tests of normality.

Class	Shapiro-Wilk		
	Statistics	df	Sig.
Experimental	0.984	34	0.899
Control	0.963	34	0.301

Based on table 6 it is known that the Sig. is greater than 0.05 so that it can be concluded that the data of each group is normal. After the three assumptions are met, the independent sample t-test can be performed. The hypothesis is:

H<sub>0</sub>: There is no significant difference in inter-intrapersonal intelligence between students taught in learning with guided inquiry learning models based on inter-intrapersonal intelligence and students who take learning using direct instruction learning models on electrolyte and non-electrolyte solution materials.

H<sub>a</sub>: There is a significant difference in inter-intrapersonal intelligence between students taught in learning with guided inquiry learning models based on inter-intrapersonal intelligence and students who take learning using direct instruction learning models on electrolyte and non-electrolyte solution materials.

H<sub>0</sub> is rejected when the Sig. of the independent sample t-test results are less than 0.05. Independent sample t-test results are shown in table 7.

**Table 7.** Independent samples test.

	t-test for Equality of Means					95% Confidence Interval of the Difference	
	T	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Equal variances assumed	2.122	66	0.038	3.39265	1.59868	0.2007	6.5845
Equal variances not assumed	2.122	65.147	0.038	3.39265	1.59868	0.2000	6.5853

A comparison of the mean scores between the two classes is shown in table 8.

**Table 8.** Comparison of mean.

Class	Inter-Intrapersonal Intelligence		
	The mean	Maximum	Minimum
Experimental	62.36	78.70	48.20
Control	58.96	68.89	44.69

Based on the Sig. (2-tailed) which is shown in table 7, the significance values are found 0.038 < 0.05 so that H<sub>0</sub> is rejected. This means that there is a significant difference in inter-intrapersonal intelligence between students taught in learning with guided inquiry learning models based on inter-intrapersonal intelligence and students who take learning using direct instruction learning models on electrolyte and non-electrolyte solution materials. This is consistent with the results of a research that collaboration and solidarity between students develop and increase in communication between students and between students and teachers after students are taught with multiple intelligence-based learning [14]. The mean scores of inter-intrapersonal intelligence questionnaire in the experimental

class was 62.35 while in the control class was 58.96. The highest score in the experimental class was 78.70 and the lowest score was 48.20. The highest score in the control class is 68.89 and the lowest score is 44.69. Based on that mean scores, it is known that students who are taught with a guided inquiry learning model based on inter-intrapersonal intelligence are better than students who are taught using the direct instruction learning model. A research result that is in line with the results of this study shows that learning strategies based on multiple intelligences applied in science lessons can improve multiple intelligences (including interpersonal intelligence and intrapersonal intelligence) and students' science process skills [15].

Indicators of inter-intrapersonal intelligence of students who are the most mastered can be known from the number of items that get the most scores, while the indicators of inter-intrapersonal intelligence that are not overly developed can be known from the number of items that get the least score. In the experimental class, the items of interpersonal intelligence statements that get the highest score are items number 5, 9, and 10. Item number 5 is a statement of the indicators of empathetic processing. Items number 9 and 10 are statements of the inquiry and questioning indicator. Based on this, it is known that almost all students in the experimental class have a high sensitivity to the feelings or moods of their friends. The ability to investigate that stands out in the experimental class is due to the syntax of the guided inquiry learning model that involves students in each learning process from collecting information related to the problem given by the teacher to present their findings [4]. The interpersonal intelligence statement item that gets the lowest score is item number 4. Statement number 4 represents the team building indicator. This shows that the application of the guided inquiry learning model based on inter-intrapersonal intelligence has less effect on the ability to build teams.

The intrapersonal intelligence statement item that gets the highest score is item number 18. Item number 18 reads "I do certain activities (for example hobbies) because I know the benefits for myself." The high score on item number 18 shows that almost all students in the experimental class have been able to choose activities that are useful for themselves. Almost all students channel their hobbies or interest one of them by joining in the extracurricular activities accordingly. Students who have not channeled their talents and interests are interested in honing their talents and interests after going through a guided inquiry learning model based on inter-intrapersonal intelligence. This shows that the application of the guided inquiry learning model based on inter-intrapersonal intelligence has a positive effect because students already have intelligence following their talents or interests. The intrapersonal intelligence statement item that gets the lowest score is item number 11. Item number 11 is a statement of self-reflection indicators. This shows that most of the students in the experimental class still did not develop their self-reflection abilities. Self-reflection by writing is needed for high-level education students to produce ongoing critical thinking involved in journaling [16].

In the control class, the interpersonal intelligence statement item that gets the highest score is item number 5. Item number 5 is a statement of the empathetic processing indicator. The interpersonal intelligence statement item that gets the lowest score in the control class is item number 4. This means item number 4 gets the lowest score both in the experimental class and in the control class. This can be of more concern to teachers because team building or collaboration is a 21st-century skill that students need to have. Based on this, it is known that almost all students in the experimental class and students in the control class have a high sensitivity to the feelings or moods of their friends. Students in the experimental class master 2 indicators of interpersonal intelligence, while students in the experimental class only master 1 indicator of interpersonal intelligence. The intrapersonal intelligence statement item that gets the highest score in the control class is item number 19. Item number 19 reads "I think of my goals that I want to achieve." These results can be a concern to the teacher so that students can be directed properly according to the goals they want to achieve. The intrapersonal intelligence statement item that gets the lowest score in the control class is item number 11. This means item number 11 gets the lowest score both in the experimental class and in the control class.

#### 4. Conclusions

There is a significant difference in inter-intrapersonal intelligence between students who take learning with guided inquiry learning models based on inter-intrapersonal intelligence and students who take learning using direct instruction learning models on electrolyte and non-electrolyte solution materials. Students' inter-intrapersonal intelligence who take learning with guided inquiry learning models based on inter-intrapersonal intelligence is better than students' inter-intrapersonal intelligence who take learning using direct instruction learning model.

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