Exploring the Efficacy of Inquiry-Based Learning for the Human Respiratory System: Student Achievement in a High School Setting

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ARTICLE INFO

ABSTRACT

The current research has primary objective that is to assess the effect of implementing the Inquiry-Based Learning Model in enhancing students' academic performance in the field of Science at SMA Smart Indonesia. The Inquiry-Based Learning Model promotes proactive student engagement in exploring, gathering, and interpreting information through independent investigation. The study utilized a quasi-experimental design encompassing pre-test and post-test phases. The participants were selected randomly via a simple random sampling technique. The acquired data underwent analysis using the N-Gain method (T-test). The outcomes revealed a noticeable improvement in the academic performance of students in the experimental group who were exposed to the Inquiry-Based Learning Model, particularly in the context of the human respiratory system. Furthermore, the null hypothesis (H0) was invalidated, as was proven by the 2-tailed Significance value of 0.000 that was smaller than 0.05. This discovery underscores the substantial positive impact of applying the Inquiry-Based Learning Model on enhancing students' academic achievements when compared to conventional teaching methods employed in the control group. In conclusion, this study highlights the significant potential of integrating the Inquiry-Based Learning Model into the Natural Science curriculum at the secondary school level, which could potentially elevate the standard of education and overall student learning accomplishments.

ABSTRAK

Kata Kunci:
Model Pembelajaran Inkuiri, Hasil Belajar Peserta Didik, SMA Smart Indonesia.

Penelitian ini memiliki tujuan utama yaitu untuk menilai pengaruh penerapan Model Pembelajaran Inkuiri dalam meningkatkan prestasi akademik siswa di Mata Pelajaran Biologi di SMA Smart Indonesia. Model Pembelajaran Inkuiri mendorong keterlibatan siswa secara proaktif dalam mengeksplorasi, mengumpulkan, dan menginterpretasikan informasi melalui investigasi mandiri. Penelitian ini menggunakan desain kuasi-eksperimental yang mencakup fase pre-test dan post-test. Para peserta dipilih secara acak melalui teknik pengambilan sampel acak sederhana. Data yang diperoleh dianalisis dengan menggunakan metode N-Gain (T-test). Hasil penelitian menunjukkan adanya peningkatan yang nyata dalam kinerja akademik siswa dalam kelompok eksperimen yang terpapar dengan Model Pembelajaran Inkuiri, khususnya dalam konteks sistem pernapasan manusia. Lebih lanjut, hipotesis nol (H0) tidak terbukti, sebagaimana dibuktikan dengan nilai Signifikansi 2-tailed sebesar 0,000 yang lebih kecil dari 0,05. Penemuan ini menggarisbawahi dampak positif yang substansial dari penerapan Model Pembelajaran Inkuiri dalam meningkatkan prestasi akademik siswa jika dibandingkan dengan metode pengajaran konvensional yang digunakan pada kelompok kontrol. Sebagai kesimpulan, penelitian ini menyoroti potensi yang signifikan dalam mengintegrasikan Model Pembelajaran Inkuiri ke dalam kurikulum Ilmu Pengetahuan Alam di tingkat sekolah menengah, yang berpotensi meningkatkan standar pendidikan dan prestasi belajar siswa secara keseluruhan.

INTRODUCTION

Since ancient times until now, the foundation of a generation's growth and progress is based on education, which plays a very complex and significant role in the lives of every person. [1]explains that the formal education is an important element in social and national life. Individuals who receive quality education contribute significantly to the development of society and the country. In addition, education has a meaning that goes

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[1] S. Soeprapto, "Landasan Aksiologis Sistem Pendidikan Nasional Indonesia Dalam Perspektif Filsafat Pendidikan," *Jurnal Cakrawala Pendidikan Jurnal Cakrawala Pendidikan* 1, no. 2 (2013), https://doi.org/https://doi.org/10.21831/cp.v0i2.1485.

beyond learning, although learning is the main means of organizing education.

The view of [2] displays that the learning process is possible to develop students' talents, as seen in Biology learning. Biology is included in Curriculum 2013, which describes scientific concepts about natural phenomena to obtain knowledge that can be used as facts, principles, laws, and theories related to ongoing phenomena [3]. A scientific approach is used in building Biology knowledge, enabling learners to develop skills to search, analyze, and interpret information. The involvement of learners in this process does not only depend on educators, but encourages independence and productive activities in self-development [4].

The results of observations at SMA Smart Indonesia found that the students' achievement of students in learning Biology, notably in the material of the respiratory system, were not optimal. According to [5] this can be caused by ineffective learning methods or models used in Biology learning. Many students do not pay attention to educators and students more often do things outside of learning activities such as chatting with friends and being sleepy. For many students, biology is a difficult subject and can only be learned by memorizing [6]. After all, in terms of the concept of understanding, it is considered important to improve learners' abilities related to the material being taught.

In learning the respiratory system in humans includes many concepts regarding the functions and mechanisms of action that vary which that must be accomplished by the student, and students are expected to be able to relate one concept into another. In addition, [789] identify that after being

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[2] Avisha Puspita, Arif Didik Kurniawan, and Hanum Mukti Rahayu, "Pengembangan Media Pembelajaran Booklet Pada Materi Sistem Imun Terhadap Hasil Belajar Siswa Kelas Xi Sman 8 Pontianak," *Jurnal Bioeducation* 4, no. 1 (2017), https://doi.org/10.29406/524.

[3] Suciati Sudarisman, "Memahami Hakikat Dan Karakteristik Pembelajaran Biologi Dalam Upaya Menjawab Tantangan Abad 21 Serta Optimalisasi Implementasi Kurikulum 2013," *Florea: Jurnal Biologi Dan Pembelajarannya* 2, no. 1 (2015), https://doi.org/http://doi.org/10.25273/florea.v2i1.403.

[4] Asih Widi Wisudawati and Eka Sulistyowati, *Metodologi Pembelajaran IPA : Disesuaikan Dengan Pembelajaran Kirikulim 2013*, 2017.

[5] R. Mutanaffisah, R. Ningrum, and A Widodo, "Ketepatan Pemilihan Pendekatan, Metode, Dan Media Terhadap Karakteristik Materi IPA," *Jurnal Inovasi Pendidikan IPA* 7, no. 1 (2021): 12–21, https://doi.org/10.21831/jipi.v7i1.32622%0A.

[6] I Nyoman Suardana, "Kesulitan Siswa SMA Memahami Konsep Daur Biogeokimia," *Jurnal Ilmiah Guru Kanderang Tingang* 1, no. 1 (2007): 46–51.

[7] Sulasfiana Alfiraida, "Identifikasi Materi Biologi SMA Sulit Menurut Pandangan Siswa Dan Guru SMA Se-Kota Salatiga," *Journal Of Biology Education.* 1, no. 209 (2018), https://doi.org/10.21043/jobe.v1i2.4118.

analyzed, there were difficulties in understanding the subject matter of the respiratory system in biology subjects experienced by students. In their findings, students are said to have not succeeded in linking the relationship of respiratory system material in humans with other systems due to the perception of hormones as a separate system.

From the above problems, several researchers have suggested that students' low understanding of learning materials has a negative impact on students' achievement, as revealed by [10][11][12][13]. To overcome this challenge, an alternative to the conventional learning model previously applied has been proposed, namely by implementing the Model of Inquiry Learning.

Accordingly, this model includes a series of engaging learning activities that promote the development of responsive and structured thinking in order to develop students' ability to find solutions to problems [14][15]. Added by [16] which explains that this learning model develops students' skills in gathering information regularly, sharply, rationally and deeply through the process of investigation and question and answer.

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[8] N Ritonga, "Analisis Kesulitan Belajar Pada Materi Pokok Sistem Pernapasan Manusia Di SMP Abdi Negara Asam Jawa," *Wahana Inovasi* 5, no. 2 (2016): 410–415.

[9] Safryadi. A, "Pembelajaran Biologi Pokok Bahasan Sistem Pernapasan Pada Manusia Melalui Media Gambar Di MTsN Jongar Kabupaten Aceh Tenggara," *BIOTIK: Jurnal Ilmiah Biologi Teknologi Dan Kependidikan.* 4 (2018), https://doi.org/4. 143. 10.22373/biotik.v4i2.1082.

[10] Asmad. Asmad, "Penerapan Pendekatan Inkuiri Untuk Meningkatkan Kemampuan Siswa Memecahkan Masalaah Soal Cerita Penjumlahan Dan Pengurangan Pada Pembelajaran Matematika.," *Pedagogi: Jurnal Penelitian Pendidikan* 4, no. 1 (2017), https://doi.org/10.25134/pedagogi.v4i1.1114.

[11] Hilman Latif, Dede Rohmad, and Epon Ningrum, "Pengaruh Pembelajaran Kontekstual Terhadap Hasil Belajar," *Jurnal Pendidikan Geografi* 14, no. 1 (2014).

[12] Puspita, Kurniawan, and Rahayu, "Pengembangan Media Pembelajaran Booklet Pada Materi Sistem Imun Terhadap Hasil Belajar Siswa Kelas Xi Sman 8 Pontianak."

[13] C. Selanno, C. Ayal, and H Tamalene, "Perbedaan Hasil Belajar Siswa Yang Diajarkan Dengan Model Pembelajaran Interaktif Setting Kooperatif Dan Model Pembelajaran Konvensional Pada Materi Operasi Hitung Bentuk Aljabar," *Jurnal Pendidikan Matematika Unpatti* 1, no. 2 (2021): 35–40, https://doi.org/10.30598/jpmunpatti.v1.i2.p35-40.

[14] A. Fadillah et al., "The Effect of Application of Contextual Teaching and Learning (CTL) Model-Based on Lesson Study with Mind Mapping Media to Assess Student Learning Outcomes on Chemistry on Colloid Systems," *International Journal of Science and Applied Science: Conference Series* 1, no. 2 (2017): 101–8, https://doi.org/doi:http://dx.doi.org/10.20961/ijsascs.v1i2.5128.

[15] Sumarni Sumarni, Budi Bimo Santoso, and Achmad Rantes Suparman., "Pengaruh Model Pembelajaran Inkuiri Terbimbing Terhadap Hasil Belajar Kognitif Peserta Didik," *Jurnal Komunikasi Pendidikan* 1, No. 1 (2018): 59–68, Https://Doi.Org/Https://Doi.Org/10.32585/Jkp.V1i1.17.

[16] W. Gulo, *Strategi Belajar Mengajar* (Jakarta: Grasindo, 2008).

In contrast, [17] explains that all activities carried out by students that aim to find answers or solutions to questions or problems posed are types of Inquiry-Based Learning Models. This search process can help increase students' confidence because they have active roles in the process of learning. As for [18] reveal that once the Model of Inquiry Learning is applied, the educators are start to stimulate and encourage their students to involve in its process and this is able to attract students' curiosity and help them understand the processes behind the event.

The results of previous studies conducted by several researchers have compared the effectiveness of this Model to the Conventional one. Researchers such as [192021222324] show that the impact of the Inquiry-Based Learning Model had proven to give a positive insight on students' understanding. This research reveals that the scientific approach in learning Biology not only teaches the skills of being an independent researcher in finding and analyzing information, but also develops analytical thinking skills and skills to draw conclusions from existing evidence [25].

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[17] Haji Wina Sanjaya, *Strategi Pembelajaran Berorientasi Standar Proses Pendidikan* (Jakarta: Prenadamedia, 2016).

[18] M. Joyce, B., Weil and E. Calhoun, *Models of Teaching* (New York: New York: Pearson Education Inc, 2009).

[19] Ayu Dwi Candra, Sri Mulyani, and Ashadi Ashadi, "Penerapan Model Pembelajaran Inkuiri Terbiming Dan Model Pembelajaran Learning Cycle 4e Terhadap Prestasi Belajar Kimia Siswa Pada Materi Kelarutan Dan Hasil Kali Kelarutan (Ksp) Ditinjau Dari Kemampuan Berpikir Kritis," *PAEDAGOGIA: Jurnal Penelitian Pendidikan* 19, no. 2 (2016).

[20] N. K. Dewi Septiari, I. Nyoman Suardana, and Kompyang Selamet, "Efektivitas Model Pembelajaran Inkuiri Terbimbing Dalam Meningkatkan Pemahaman Konsep Ipa Siswa Smp," *JPPSI: Jurnal Pendidikan Dan Pembelajaran Sains Indonesia* 1, no. 1 (2018), https://doi.org/10.23887/jppsi.v1i1.21917.

[21] M. Heriyudanta, "Implementasi Metode Pembelajaran Inkuiri Dalam Meningkatkan Hasil Pembelajaran Mata Pelajaran PAI," *Jurnal Ibriez: Jurnal Kependidikan Dasar Islam Berbasis Sains* 6, no. 1 (2021): 74–83, https://doi.org/10.21154/ibriez.v6i1.157.

[22] R. Diyah Puspitasari et al., "Model Pembelajaran Inkuiri Terbimbing Berpengaruh Terhadap Pemahaman Dan Penemuan Konsep Dalam Pembelajaran PPKn," *Jurnal Ilmiah Pendidikan Dan Pembelajaran* 3, no. 1 (2019).

[23] Septiari, Suardana, and Selamet, "Efektivitas Model Pembelajaran Inkuiri Terbimbing Dalam Meningkatkan Pemahaman Konsep Ipa Siswa Smp."

[24] Sri Wardani and Laksmita Firdaus, "Pengaruh Model Inkuiri Terbimbing Berbasis Blended Learning Terhadap Kemampuan Kognitif-Psikomotor Pada Materi Larutan Penyangga," *Journal Tadris Kimiya* 4, no. 2 (2019), https://doi.org/10.15575/jtk.v4i2.5404.

[25] Wisudawati and Sulistyowati, *Metodologi Pembelajaran IPA: Disesuaikan Dengan Pembelajaran Kirikulim 2013.*

Furthermore, several researchers such as [26][27][28][29][30][31][32] also indicate that the usage of this model, that is the Model of inquiry Learning has significantly affects the students' cognitive aspects in science learning at school. In the context of learning, the interaction between educators and students has an important role. Educators act as facilitators while students play a role in understanding and conveying information, emotions, and skills [33].

However, despite a number of studies that have examined the effectiveness of implementing the Inquiry-Based Learning Model on students' achievement, there is limited literature that examines the utilization of the Inquiry-Based Learning Model in the context of human respiratory system material. Therefore, the present study proposes to explore the effectiveness of the Model Inquiry Learning on student' achievement at Smart Indonesia High School, in regards to the human respiratory system. Through this Inquiry-Based Learning Model approach, the researcher hopes that this study can make a significant contribution to the development of learners and become one of the valuable alternatives for teaching methods in science subjects.

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[26] Asmad, "Penerapan Pendekatan Inkuiri Untuk Meningkatkan Kemampuan Siswa Memecahkan Masalah Soal Cerita Penjumlahan Dan Pengurangan Pada Pembelajaran Matematika."

[27] Asrul Asrul, Abdul Rachman Tiro, and Heryani Risakotta, "Pengaruh Model Pembelajaran Inkuiri Terbimbing Terhadap Hasil Belajar IPA Pada Materi Panca Indra Manusia Bagi Siswa Sekolah Dasar," *Jurnal PAPEDA* 2, no. 1 (2020), https://doi.org/10.36232/jurnalpendidikandasar.v2i1.408.

[28] H. Elselia, "Penggunaan Inkuiri Terbimbing Untuk Meningkatkan Keterampilan Sains Siswa Di Sekolah Menengah Pertama," *Jurnal Didaktika Pendidikan Dasar* 7, no. 2 (2023): 639–60, https://doi.org/10.26811/didaktika.v7i2.1025.

[29] E. Pratiwi, S. Wonorahardjo, and M. Arief, "Partisipasi Online Dalam Pembelajaran Community of Inquiry (COI) Pada Materi Distilasi," *Jurnal Pendidikan: Teori, Penelitian, Dan Pengembangan* 1, no. 7 (2016): 1410—1416, http://dx.doi.org/10.17977/jp.v1i7.6585.

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[31] Sumarni, Santoso, and Suparman., "Pengaruh Model Pembelajaran Inkuiri Terbimbing Terhadap Hasil Belajar Kognitif Peserta Didik."

[32] S. Suyuti et al., "Pengaruh Model Pembelajaran Inquiry Dan Gaya Kognitif Field Independent (FI) & Field Dependent (FD) Terhadap Hasil Belajar Siswa. Journal on Education, 6(1), 293-306.," 2023, https://jonedu.org/index.php/joe/article/view/2942.

[33] Ani Daniyati et al., "Konsep Dasar Media Pembelajaran," *Journal of Student Research* 1, no. 1 (2023): 282–94, https://doi.org/10.55606/jsr.v1i1.993.

Methods

This research uses a quasi-experiment method. According to [34] this approach involves a control group, but cannot function completely to precisely monitor external factors that may influence the implementation of the experiment. This study involved two groups of learners, namely the experimental and the control classes. In its implementation, the two classes underwent a pre-test before getting different treatments. After the treatment was given, both groups then underwent a post-test to evaluate the improvement of students' achievement in both groups. Information related to the research design is as follows:

Table 1. The Research Design

Class	N	*Pre-test*	Treatment	*Post-test*
Experiment	28 Students	O1	X	O2
Control	24 Students	O1	K	O2

The students in grade XI of Smart Indonesia High School in the academic year of the 2021/2022 were include as the population. In this research The sampling method applied follows [35] approach, namely using a simple random sampling technique. In the context of this study, the sample was the class XI IPA 1 and was chosen as the control class, in other hand, the class XI IPA 2 was chosen as the experimental class. In the experimental class, there was 28 students involved as the sample while 24 students were involved as the sample in control class. Data was then collected through pre-test, post-test, and observation sheet. The parameter measured in this study was student learning achievement, which was assessed using pre-test and post-test tests. Teacher activity was assessed through the teacher activity observation sheet, while student activity was measured by the student activity observation sheets.

Additionally, the obtained scores from both tests were then calculated using N-Gain value. The N-Gain formula according to Meltzer in [36] is as follows:

$$\text{N-Gain (g)} = \frac{Spos - Spre}{Smaks - Spre}$$

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[34] S Sugiyono, *Metode Penelitian Kuantitatif, Kualitatif, Dan R&D* (Bandung: Alfabeta, 2017).

[35] S Sugiyono, *Metode Penelitian Kuantitatif, Kualitatif, Dan R&D* (Bandung: Alfabeta, 2015).

[36] Latif, Rohmad, and Ningrum, "Pengaruh Pembelajaran Kontekstual Terhadap Hasil Belajar."

Description:
Spos : *Post-test* Score
Spre: *Pre-test* Score
Smaks: Maximum Score

Table 2. The Categories of N-Gain Score

Limitations	Category
g > 0,7	High
0,3 < g ≤ 0,7	Medium
g ≤ 0,3	Low

Furthermore, the T-test was used to calculate the hypothesis. [37] states that testing the hypothesis with the *t*-test formula as below:

$$t = \frac{\bar{X}_1 - \bar{X}_2}{\sqrt{S_1^2 + S_2^2}}$$

Description:
X1 : Average score of experimental group
X2 :Average score of control group
S_1^2 :Variance of experimental group scores
S^2 :Variance of control group scores

Before the hypothesis test is run, the initial step involves checking the data analysis requirements. These requirements include testing the data distribution for normality and homogeneity of variance. After ensuring that the analyzed data was normally and homogenously distributed, thus, the hypothesis were tested using the T-test. This aims to determine out if there is a significant effect in students' achievement through the application of the Inquiry-Based Learning Model at Smart Indonesia High School, particularly on the human respiratory system material.

RESULT AND DISCUSSION
Pre-test and Post-test

In the research in January 2022, the class XI IPA 1 was determined as the control class, in other hand, the class XI IPA 2 was selected as the experimental class. Furthermore, from the data obtained, the results of the pre-test and post-test are presented as follows:

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[37] S Sugiyono, *Metode Penelitian Kuantitatif, Kualitatif, Dan R&D* (Bandung: Alfabeta, 2010).

Table 3. The Descriptive Statistics Scores in Pre-test and Post-test

Class		N	Students' Achievements			Average
			Ideal Scores	Minimum Scores	Maximum Scores	
Pre-test	Control	24	100	30.00	50.00	43.47
	Experiment	28	100	46.47	60.00	53.33
Post-test	Control	24	100	46.67	80.00	59.17
	Experiment	28	100	66.67	93.33	80.12

The table 3 presents data on students' achievement in an experiment with both the control class and experimental class. The average score of the control group in the pre-test was 59.17. While the experimental group showed a more significant increase, with an average post-test score of 80.12. This data illustrates that the experimental group tends to achieve higher achievement than the control group after going through certain interventions or treatments, along with the comparison between the pre-test and post-test scores with the predetermined reference values.

There were a series of stages in analyzing the pre-test and post-test results obtained from the control group and the experimental group, including the normality test using the Kolmogorov-Smirnov method (KS-21) and the homogeneity test using the Levene-Test. Further information regarding the results of testing the normality of pre-test and post-test data in the control group and experimental group can be seen in Table 4 below:

Table 4. The Normality Test Results in Pre-test and Post-test

DataType	Class	Normality Test Results			
		Asymp.Sig (2-tailed)	α	Decision	Description
Pre-test	Control	0.364	0,05	Accept H_0	Normal
	Experiment	0.432	0,05	Accept H_0	Normal
Post-test	Control	0.424	0,05	Accept H_0	Normal
	Experiment	0.544	0,05	Accept H_0	Normal

The result of the normality test of pre-test and post-test data in the control group and experimental group is shown in Table 4. The normality test was conducted using the α (significant) criterion of 0.05. The normality

test results were analyzed by comparing the Asymp. Sig (bilateral) with the predetermined α value. In all conditions tested, the Asymp. Sig (bilateral) was greater than α, namely 0.364, 0.432, 0.424 and 0.544. Since the Asymp. Sig (two-sided) values were greater than α, the H0 hypothesis was accepted, and the data of each group and condition tested were declared as normal data. Therefore, it is clear that the normality test results indicate that all groups and conditions in this study fulfill the assumption of normality.

Table 5. The Homogeneity Test Results in Pre-test and Post-test

Data type	*Sig.(2-tailed)*	*a*	Decision	Description
Pre-test	0.508	0.05	Accept H0	Homogeneous
Post-test	0.721	0.05	Accept H0	Homogeneous

The table contains the results of statistical tests to analyze homogeneity between pre-test and post-test data in a study. In accordance with the α value set both Sig. (2-tailed) values were greater than α where the Sig. (2-tailed) for pre-test data was 0.508, while for post-test data was 0.721. Therefore, the decision taken was H0 is accepted for both types of data. Since the previous results of data analysis showed that the data were normally distributed and homogeneous, then the T-test was conducted. This was done to see the level of significance of the data, and can be seen in Table 6 below:

Table 6. The Results of T-test in Pre-test and Post-test

Data Type	*Sig.(2-tailed)*	*a*	Decision	Description
Pre-test	0.514	0.05	Accept H0	Not significantly different
Post-test	0.000	0.05	Reject H0	Significantly different

On the Table above, there are statistical analysis results that evaluate the difference between two types of data, using a two-sided test with a significance level α of 0.05. Experimental results show that the Sig. (2-tailed) value for Pre-test is 0.514 as greater than the significance level α, so the null hypothesis (H0) was accepted. It implies that a significant difference does not exist between the Pre-test scores in the experimental and control classes.

In contrast to the pre-test value, the Sig. (2-tailed) for Post-test was 0.000 significantly smaller than the significance level α. It implies that significant differences exist between the Post-test scores of the experimental and control classes. It is also reinforced by the decision H0 was accepted, which means a significant difference existed in Post-test data between the

experimental class using the Inquiry-Based Learning Model and the control class using the Conventional Model.

N-Gain Data Analysis

N-Gain reveals the extent to which students' understanding improved after the learning intervention. By looking at the recapitulation of N-Gain data obtained from the control class and experimental class, the researcher would be able to identify whether the intervention applied to the experimental class gave better results in improving learners' understanding than that of the control class:

Table 7. The Descriptive Statistics of N-Gain Data in Control and Experiment Classes

No.	Class	N	N-Gain			Avg	Category
			Ideal Value	Score Minimum	Score Maximum		
1	Control	24	1.00	0.11	0.63	0.28	low
2	Experiment	28	1.00	0.38	0.86	0.57	Medium

Table 7 above presents the measurement results in the study comparing the control class and the experimental class, in terms of student achievement. Furthermore, the mean value for the control group has a value of 0.28 and the experimental group has a mean value of 0.57. This shows that there was a variation in achievement between the control group and the experimental group. Afterward, the average value showed that experimental class that applied the Inquiry-Based Learning Model tended to achieve more than those of the control class in this study. Furthermore, the N-Gain normality test was conducted as follows:

Table 8. The Results of N-Gain Normality Test

Type	Class	N-Gain Normality Test			
		Asymp. Sig (2-tailed)	α	Decision	Description
N-Gain	Control	0.225	0,05	Accept H0	Normal
	Experiment	0.317	0,05	Accept H0	Normal

The table explains the results of the pretest and posttest data normality test in the control class and the experimental class. It was tested using the α (significant) criterion of 0.05. The normality test results were analyzed by comparing the Asymp. Sig (two-sided) with the predetermined α value. In all conditions tested, the Asymp. Sig values were greater than α,

namely 0.225 and 0.317. Because the value of Asymp. Sig (two-sided) is greater than α, the H0 hypothesis was accepted, and the data of each group and condition tested were declared as normal data. Therefore, on the basis of the normality test results, all the groups and conditions in this study fulfill the assumption of normality. In addition, having the N-Gain data normally distributed, the homogeneity test was conducted using the Levene-Test as follows:

Table 9. The Results of N-Gain Homogeneity Test

Data type	*Based on trimmed mean*	*α*	Decision	Description
N-gain	0.643	0,05	Accept H0	Homogeneous

As shown in the table above, results of interpretation related to the "N-gain" data type were analyzed based on the "trimmed mean" method with an α (significance level) of 0.05. As a result of the analysis, concluded that the null hypothesis (H0) was accepted. This indicates that the observed data was homogeneous, or in other words, a significant difference does not exist between different groups of data. This result confirms that the N-gain values have significant similarities in the context of the analysis conducted. Since the results of the analysis found that the N-Gain data had normal and homogeneous distribution, the 2 Independent Samples T-Test was conducted. Its results can be seen in the table below:

Table 10. The Results of N-Gain T-test

Data type	*Sig (2-tailed)*	*α*	Decision	Description
N-gain	0.000	0.05	Reject H0	Significantlydifferent

Table 10 contains the results of hypothesis testing related to N-gain data using the 2-tailed statistical test. With a significance level α of 0.05, the Sig (2-tailed) value of 0.000 was obtained, which is smaller than α. This result indicates that there was a significant difference between the observed N-gain data and the expected value if the null hypothesis (H0) was accepted. Therefore, the T-test indicates that H0 was rejected and it can be concluded that there was a significant difference in the N-gain data. Furthermore, for the experimental class that used the Inquiry-Based Learning Model, it was concluded that the significance was inversely proportional to the class that used the Conventional Learning Model, namely the control class.

Educator and Learner Activity

The observed activities of educators and students were then analyzed and the results were tabulated in the following table:

Table 11. Recapitulation of Educator Activities in Control and Experimental Classes

Class	Meeting I	Meeting II	Average Percentage %
Control	63.63%	68.00%	65.81%
Experiment	75.10%	100,00%	87,55%

Table 11 illustrates the breakdown of the results from the two classes that had a series of meetings. Whereas these meetings highlighted the percentage of educator performance within each class. In Meeting I, the Control Class achieved a percentage of 63.63%, while the Experimental Class showed a percentage by reaching 75.10%. In Meeting II, the Control Class performance increased to 68.00%, while the Experimental Class maintained a high level by reaching 100.00%. Overall, the average performance percentage of the Control Class was 65.81%, while the Experiment Class achieved a higher average of 87.55%. This data gives an idea of the difference in performance between the two classes during the observed meeting period that summarize that the activity of the educators in the experimental class was much higher. Other than that, learners' activities in both classes are shown in the following table:

Table 12. The Recapitulation of Students' Activities in Control and Experiment Classes

Class Control	Activity %					Average Percentage
	1	2	3	4	5	
Meeting I	58.33%	64.16%	61.00%	57.16%	64.16%	61%
Meeting II	66.66%	72.00%	65.83%	72.45%	65.83%	68.6%
Experiment Class	**Activity %**					**Average Percentage**
	1	2	3	4	5	
Meeting I	70.00%	71.57%	80.14%	73.00%	71.57%	73.25%
Meeting II	85.71%	84.28%	92.00%	85.71%	81.38%	85.81%

As shown in the table above, there are a percentage of student activity in two different classes, namely the control class and the experimental class at several different meetings. In the control class, at the

first meeting, the percentage of activity tended to be dynamic and was in the range of 58.33% to 64.16% at the last meeting, with an average percentage of around 61%. Then, in the second meeting, despite the increase, the percentage of activity remained dynamic and was in the range of 66.66% to 65.83%, with an average percentage of around 68.6%. Likewise, the first meeting in the experimental class, the percentage of activity was in the range of 70.00% to 71.57%, with an average percentage of around 73.25%. Then, it was revealed that the percentage of student activity at the second meeting in the experimental class greatly increased, with numbers between 85.71% to 81.380%, and an average percentage of around 85.81%.

In comparison between the two classes, the experimental class showed a higher level of activity compared to the control class in both meetings. The experimental class' increase in activity percentage in the second meeting was also more significant compared to the control class. This indicates that there are several factors in the experimental class that influence and able to encourage better student participation, comprehension and involvement compared to the control class, including educator activities.

After all, the information on research results from the experimental class (XI IPA 2) and control class (XI IPA 1) has been obtained and further interpreted. The gathered data consists of pre-test and post-test and it were used to evaluate the difference in students' achievement before and after the application of the Inquiry-Based Learning Model. In addition, N-Gain was used to measure the level of effectiveness in students' achievement.

The results of the analysis indicate that the N-Gain score of the experimental class that applied the Inquiry-Based Learning Model had a more significant increase compared to the control class that used the conventional learning approach. This indicates a meaningful difference between the two class groups, illustrating a significant improvement in students' achievements in the experimental class utilizing the Inquiry-Based Learning Model.

As a result, the increase in student achievement is in line with existing findings. [38][39][40][41] previously proved that there were differences in

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[38] Asrul, Tiro, and Risakotta, "Pengaruh Model Pembelajaran Inkuiri Terbimbing Terhadap Hasil Belajar IPA Pada Materi Panca Indra Manusia Bagi Siswa Sekolah Dasar."

[39] Candra, Mulyani, and Ashadi, "Penerapan Model Pembelajaran Inkuiri Terbiming dan Model Pembelajaran Learning Cycle 4e Terhadap Prestasi Belajar Kimia Siswa Pada Materi Kelarutan Dan Hasil Kali Kelarutan (KSP) ditinjau dari Kemampuan Berpikir Kritis."

[40] Puspita, Kurniawan, and Rahayu, "Pengembangan Media Pembelajaran Booklet Pada Materi Sistem Imun Terhadap Hasil Belajar Siswa Kelas Xi Sman 8 Pontianak."

students' achievement between students in experimental and control classes. However, students' achievement in the experimental class was significantly affected by the use of the Inquiry-Based Learning Model, which was identified as a factor influencing the effectiveness of learning. According to [42] the application of a model that is relevant to the characteristics of students was able to improve the learning system, encouraging alignment between knowledge in the class and experience to be gained beyond the class.

These findings support the effectiveness of the Inquiry-Based Learning Model in the enhancement of students' achievement on human respiratory system material. [434445464748] also suggest that using the Inquiry-Based Learning Model makes a positive contribution to students' understanding and achievement of learning. This conclusion supports an Inquiry-Based Learning Model as a more effective alternative to conventional methods in teaching human respiratory system material [49].

Furthermore, [5051] explain that the Inquiry-Based Learning Model is an educational approach in which it focuses on the exploration and

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[41] Suyuti et al., "Pengaruh Model Pembelajaran Inquiry Dan Gaya Kognitif Field Independent (FI) & Field Dependent (FD) Terhadap Hasil Belajar Siswa. Journal on Education, 6(1), 293-306."

[42] Ariana Annisa and Ulum Fatmahanik, "Efektivitas Model Pembelajaran Contextual Teaching and Learning (CTL) Berbasis STEM Terhadap Kemampuan Berpikir Logis Siswa Pada Pembelajaran IPA," *Jurnal Tadris IPA Indonesia* 3 (2023): 30–43, https://doi.org/10.21154/jtii.v3i1.693.

[43] Syaiful Arif and Milan Fatimah, "Penerapan Model Pembelajaran Inquiry Berbantuan Metode Role Playing Dalam Meningkatkan Kemampuan Menggali Informasi," *Jurnal IPA Terpadu* 7, no. 1 (2023), https://doi.org/10.35580/ipaterpadu.v7i1.37755.

[44] Asmad, "Penerapan Pendekatan Inkuiri Untuk Meningkatkan Kemampuan Siswa Memecahkan Masalah Soal Cerita Penjumlahan Dan Pengurangan Pada Pembelajaran Matematika."

[45] Asrul, Tiro, and Risakotta, "Pengaruh Model Pembelajaran Inkuiri Terbimbing Terhadap Hasil Belajar IPA Pada Materi Panca Indra Manusia Bagi Siswa Sekolah Dasar."

[46] Puspitasari et al., "Model Pembelajaran Inkuiri Terbimbing Berpengaruh Terhadap Pemahaman Dan Penemuan Konsep Dalam Pembelajaran PPKn."

[47] Selanno, Ayal, and Tamalene, "Perbedaan Hasil Belajar Siswa Yang Diajarkan Dengan Model Pembelajaran Interaktif Setting Kooperatif Dan Model Pembelajaran Konvensional Pada Materi Operasi Hitung Bentuk Aljabar."

[48] Septiari, Suardana, and Selamet, "Efektivitas Model Pembelajaran Inkuiri Terbimbing Dalam Meningkatkan Pemahaman Konsep Ipa Siswa Smp."

[49] Suyuti et al., "Pengaruh Model Pembelajaran Inquiry dan Gaya Kognitif Field Independent (FI) & Field Dependent (FD) Terhadap Hasil Belajar Siswa. Journal on Education, 6(1), 293-306."

[50] Arif and Fatimah, "Penerapan Model Pembelajaran Inquiry Berbantuan Metode Role Playing Dalam Meningkatkan Kemampuan Menggali Informasi."

[51] Elselia, "Penggunaan Inkuiri Terbimbing Untuk Meningkatkan Keterampilan Sains Siswa Di Sekolah Menengah Pertama."

discovery of students in understanding concepts. Meanwhile, conventional learning tends to be dominated by educators using the lecture method and textbook-based learning [52].

However, a number of factors support this Inquiry-Based Learning Model's effectiveness. [53] explains that learning can be interpreted as a series of efforts or teaching-learning processes that aim to create processes efficiently and effectively. Throughout the process of applying the Inquiry-Based Learning Model in the experimental class, students experienced a more interactive learning experience in the classroom environment. This finding was in line with the results of research by [54][55][56] which state that a learning approach that encourages student involvement can be a driving force for them to be more independent, innovative, and effective in the learning process.

In addition, the use of Inquiry-Based Learning Model triggers an increase in students' participation in the learning process, which affects students' foresight and involvement in understanding a concept. The results of research by [57] was in line with this, revealing that learning approaches that focus on students have a substantial impact, especially in face-to-face learning situations. This confirms that the effectiveness of classroom teaching will be better maintained when educators choose the appropriate learning model [58][59]. Therefore, the progress made by the Inquiry-Based Learning Model is also related through the concept of skill-based learning and encouraging the development of learner creativity. According to [60] by

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[52] Ramanda Rizky and Yetty Zainil, "The Use of the Bits and Pieces Game on Students' Achievement on Writing Report Text," *Al-Ishlah: Jurnal Pendidikan* 13, no. 1 (2021): 301–6, https://doi.org/10.35445/alishlah.v13i1.463.

[53] Daniyati et al., "Konsep Dasar Media Pembelajaran."

[54] Heriyudanta, "Implementasi Metode Pembelajaran Inkuiri Dalam Meningkatkan Hasil Pembelajaran Mata Pelajaran PAI."

[55] Selanno, Ayal, and Tamalene, "Perbedaan Hasil Belajar Siswa Yang Diajarkan Dengan Model Pembelajaran Interaktif Setting Kooperatif Dan Model Pembelajaran Konvensional Pada Materi Operasi Hitung Bentuk Aljabar."

[56] Wisudawati and Sulistyowati, *Metodologi Pembelajaran IPA : Disesuaikan Dengan Pembelajaran Kirikulim 2013.*

[57] Pratiwi, Wonorahardjo, and Arief, "Partisipasi Online Dalam Pembelajaran Community Of Inquiry (Coi) Pada Materi Distilasi."

[58] Annisa and Fatmahanik, "Efektivitas Model Pembelajaran Contextual Teaching and Learning (CTL) Berbasis STEM Terhadap Kemampuan Berpikir Logis Siswa Pada Pembelajaran IPA."

[59] R. Ramadansur et al., "Promoting Critical Thinking Skills through Contextual Teaching and Learning," *Lectura : Jurnal Pendidikan* 14, no. 2 (2023): 340–51, https://doi.org/10.31849/lectura.v14i2.15030.

[60] Elselia, "Penggunaan Inkuiri Terbimbing Untuk Meningkatkan Keterampilan Sains Siswa Di Sekolah Menengah Pertama."

stimulating active thinking, encouraging questions, and stimulating efforts to explore answers, the use of the Inquiry-Based Learning Model has the potential to foster learners' ability to resolve problems and increase self-creation, which has important relevance in the learning process and the application of knowledge in everyday life.

On the other hand, it was observed that student activity through observation sheets in the experimental class showed a significant increase. This finding is in line with previous research conducted by [61][62]. They discovered that the experimental class was still adapting to their group at the first meeting, so their understanding of the material was still limited. However, in the second meeting, the classroom atmosphere became more conducive and structured in the learning process. Students seemed more active in conducting inquiry learning, such as asking questions, contributing with ideas and answers, respecting friends' opinions, and showing responsibility for tasks and cooperation in groups.

Additionally, a positive impact was also noted from the application of the Inquiry-Based Learning Model on the development of students' critical thinking skills. They showed better development in the experimental class than those in the control class. This is consistent with the work conducted by [63][64][65]. These studies showed differences in thinking patterns between students in the experimental class. This finding becomes one of the indicators of success in the implementation of learning.

With the positive results achieved, educators should feel motivated to adopt the inquiry-based learning model as a more effective option in teaching material about the human respiratory system. It provides an interactive learning environment, encourages learners to actively participate in the learning process, and enhances their sense of critical thinking and creativity. This will prepare them to face various challenges in everyday life. Meanwhile, in terms of the approach to student-centered, it is important for educators to choose an appropriate learning model to optimize students' achievement.

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[61] Elselia.

[62] Pratiwi, Wonorahardjo, and Arief, "Partisipasi Online Dalam Pembelajaran Community Of Inquiry (COI) Pada Materi Distilasi."

[63] Annisa and Fatmahanik, "Efektivitas Model Pembelajaran Contextual Teaching and Learning (CTL) Berbasis STEM Terhadap Kemampuan Berpikir Logis Siswa Pada Pembelajaran IPA."

[64] Septiari, Suardana, and Selamet, "Efektivitas Model Pembelajaran Inkuiri Terbimbing Dalam Meningkatkan Pemahaman Konsep Ipa Siswa Smp."

[65] Wardani and Firdaus, "Pengaruh Model Inkuiri Terbimbing Berbasis Blended Learning Terhadap Kemampuan Kognitif-Psikomotor Pada Materi Larutan Penyangga."

CONCLUSION

Referring to the results of research conducted at SMA Smart Indonesia, it was found that the Inquiry-Based Learning Model has effectively improved student' achievement in terms of the human respiratory system. However, the results of this study showed that students in the experimental class who were taught through the Inquiry-Based Learning Model experienced a significant enhancement in students' achievement, in contrast to the control class who used the Conventional learning approach. This learning approach supports the use of innovative methods and makes a considerable contribution to the development of education in the future.

In this context, this research plays an important role in developing education by promoting the investigative approach and utilizing visual media as a more creative and efficient learning tool. Future researchers can continue this research to explore other factors that influence the effectiveness of the Inquiry-Based Learning Model, as well as testing it in a wider scope of education. Not only that, the long-term effects of implementing inquiry-based learning also need to be known on students' skills in critical thinking, aiding problem solving, and creative thinking. Furthermore, educators have the opportunity to use the Inquiry-Based Learning Model with visual aids to improve students' understanding and mastering of the material, while stimulating active participation in the teaching-learning process.

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