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The Analysis of Students' Design Thinking in Inquiry-Based Learning in Routine University Science Courses

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Abstract

Design thinking has garnered widespread recognition for its distinctive problem-solving and innovative approach, attracting the attention of both professionals and academics. It has expanded beyond its origins in the design field and is now being applied in diverse domains. This article focuses on the integration of design thinking into science education, particularly within the framework of inquiry-based learning. To comprehensively explore the study objectives, a mixed methods approach involving both quantitative and qualitative methods was employed. The study included 102 first-year university students enrolled in science courses. The assessment of students' design thinking dimensions is conducted using instruments that have been rigorously validated and proven to be reliable in terms of their psychometric properties. The findings revealed that students exposed to inquiry-based learning demonstrated significant improvements in their design thinking skills compared to those taught through conventional methods. Furthermore, interviews with lecturers provided additional support for the positive impact of inquiry-based learning on students' design thinking abilities.

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INTRODUCTION

Design thinking has garnered significant attention from both professionals and academics due to its unique approach to innovation and problem-solving (Kimbell, 2011; Micheli et al., 2019). Design field, plays a crucial role in advancing human society by transforming existing conditions into desired ones (Li & Zhan, 2022). Design thinking in the design field revolves around understanding expertise in design, including the definition of design expertise and how to support novice students in acquiring such expertise to become skilled and exceptional designers (Cross, 2004). According to Jonassen (2000), design problems are often complex and lack clear structures, making them challenging to address. As a result, expert designers, renowned for their creative problem-solving abilities, are considered innovative problem solvers who can provide valuable insights across various domains (Kimbell, 2011).

Design thinking, a problem-solving approach, has evolved beyond its professional roots and gained broader recognition (Brown, 2008). It has become known as a valuable methodology applicable to various domains, including IT, business, education, and medicine (Dorst, 2011). Experts and scholars have contributed their perspectives on design thinking. In the dynamic business landscape, it is described as a discipline that combines the sensibility and methods of designers to align people's needs with technological feasibility and viable business strategies, resulting in customer value and market opportunities (Brown, 2008). Design thinking as a means to identify human needs and generate innovative solutions using design principles. Researchers have also explored the integration of design thinking in education, highlighting its role in fostering abductive reasoning and its potential as a competitive advantage (Li & Zhan, 2022). Some proponents argue that design thinking can and should be taught and adopted by individuals outside the design field (Micheli et al., 2019). As a result, there is a growing interest in incorporating design education into widely contexts (Brenner et al., 2016).

Recently, the concept of design thinking has been associated with creative thinking in science education, especially in scientific experiments, and both forms of thinking are seen as strong supports for students' success in creating scientific innovations (Yang et al., 2022). Scientific researchers are increasingly realizing that the presentation of phenomena and successful outcomes in scientific research cannot be separated from innovative experiment design, and breakthroughs in scientific exploration also require adequate design thinking. Based on this understanding, science education researchers have begun to recognize the unique value of design thinking in the field of science education (Darbellay et al., 2017). This is based on the fact that scientific innovation and creativity cannot be achieved without design thinking (Goodspeed et al., 2016).

Training design thinking in students requires a suitable pedagogical framework that allows them to develop their cognitive skills freely to produce creative product designs. Generating creative products in modern pedagogy is currently pursued through inquiry-based learning (Verawati et al., 2020; Wahyudi et al., 2018). Through inquiry, students engage in structured activities and design scientific experiments to discover and demonstrate concepts or cause-effect relationships scientifically. Designing a scientific experiment is not easy; it requires advanced thinking, especially in the design process, and creating designs requires expertise in thinking, which is referred to as design thinking (Liu & Li, 2023). This is the main reason why design thinking has become a highly important context to be continuously trained in science education through scientific inquiry activities.

Design is an inherent and widespread human activity that begins with a vague notion of solving a user's problem (Koh et al., 2015). Throughout the design process, this idea gradually takes shape, transforming into a clear and comprehensive vision of a product. The relationship between the problem and its solution evolves through iterations until the final product effectively fulfills practical needs. The process of design also involves incorporating human-centered thinking approaches and placing importance on reflective action (Brown, 2008). Design thinking encompasses a range of skills, including experimentation, prototyping, feedback gathering, and redesigning (Tsai, 2021). Overall, design thinking has been recognized as a valuable approach for cultivating the capabilities of 21st-century students, equipping them with the necessary tools to tackle the ever-changing challenges of our global society in the future (Noweski et al., 2012; Wright & Wrigley, 2019).

In principle, the imbrication process of inquiry and design synergizes with each other (Nichols et al., 2022). By integrating design thinking into science inquiry-based learning, students can develop a well-rounded skill set that combines scientific inquiry, critical thinking, and creative problem-solving. This prepares them to navigate complex scientific challenges and contribute to solving real-world problems in a collaborative and innovative manner.

The objective of this study is to examine the design thinking of students in routine university science courses, specifically in the context of inquiry-based learning. The study aims to address the following research questions:

1. Do significant differences exist in students' design thinking between those exposed to inquiry-based learning (experimental group) and those taught through conventional methods (control group)?
2. What is the response from lecturers regarding inquiry-based learning to improve students' design thinking?

METHOD

Study approach and design

To ensure a thorough exploration of the study objectives, a combination of quantitative and qualitative methods was employed, following a mixed methods approach (Creswell & Creswell, 2018). The research design involved the collection and analysis of both types of data, allowing for the integration of their respective findings. The quantitative aspect relied on an experimental design. This study employed the quasi-experiment study with a post-test only control group design. A quasi-experimental study is a research design that resembles an experimental study but lacks some key elements of a true experiment, such as random assignment of participants to different groups (Fraenkel et al., 2012). The outcome or dependent variable is measured or assessed after the intervention has been implemented. Participants in both the treatment and control groups are evaluated at the same time to compare the effects of the intervention. Detailed comparisons were made between design-oriented inquiry-based learning (experimental group) and conventional teaching (control group). During the qualitative research phase, valuable insights were gathered by soliciting the viewpoints and perceptions of the instructors regarding the learning process. Subsequently, interviews were carried out with the lecturers after the implementation phase to comprehensively assess the influence of the learning program.

Participants

The study involved a total of 102 first-year students at a university in Indonesia, with an average age of 17.5 years. The participants were divided into two parallel classes, each comprising 52 students for the experimental group, and 50 students for the control group. The experimental group consisted of 25 males and 27 females, while the control group had 22 males and 28 females. The same lecturer taught both groups. It is important to note that prior to this study, neither group had been exposed to design thinking with inquiry learning interventions.

Data Collection Instruments

In this study, we utilized a questionnaire developed by Ladachart et al. (2022) known as the Design Thinking Scale to evaluate the changes in students' design thinking competence. This scale encompasses six dimensions that measure various aspects of design thinking: Comfort with uncertainty and risks (DT-1); Focus on human-centeredness (DT-2); Mindfulness regarding the process and its impact on others (DT-3); Collaboration with diverse perspectives (DT-4); Orientation towards learning through making and testing (DT-5); Confidence and optimism in utilizing creativity (DT-6). The questionnaire, which consisted of thirty items, employed a five-point Likert scale. The validity of the scale was assessed using Pearson's correlations (Table 1), and the reliability of the scale was assessed using Cronbach's α, resulting in a value of 0.914 (Table 2), exceeding the threshold of 0.9, which is considered acceptable for evaluating students' design thinking.

Table 1. The results of Pearson's Correlations

Variable		DT-1	DT-2	DT-3	DT-4	DT-5	DT-6
1. DT-1	Pearson's r	—					
	p-value	—					
2. DT-2	Pearson's r	0.494	—				
	p-value	< .001	—				
3. DT-3	Pearson's r	0.526	0.784	—			
	p-value	< .001	< .001	—			
4. DT-4	Pearson's r	0.606	0.622	0.625	—		
	p-value	< .001	< .001	< .001	—		
5. DT-5	Pearson's r	0.660	0.624	0.616	0.774	—	
	p-value	< .001	< .001	< .001	< .001	—	
6. DT-6	Pearson's r	0.595	0.683	0.678	0.589	0.734	—
	p-value	< .001	< .001	< .001	< .001	< .001	—
7. Ave. Score	Pearson's r	0.775	0.835	0.840	0.841	0.883	0.848
	p-value	< .001	< .001	< .001	< .001	< .001	< .001

Table 2. The results of reliability (Cronbach's α)

Estimate	Cronbach's α	Average inter-item correlation
Point estimate	0.914	0.641
95% CI lower bound	0.884	0.552
95% CI upper bound	0.937	0.718

Following the integration of the educational program, an assortment of qualitative information was gathered via interviews held with educators. A semi-structured interview guide was employed as an instrument for this purpose. The interviews aimed to obtain the lecturers' perspectives on the learning activities associated with initiatives to enhance students' design thinking. The ultimate version of the interview guide was devised subsequent to incorporating the insights of three professionals in the field. Notably, the interviews conducted with lecturers in the experimental group were meticulously recorded and transcribed for further analysis.

Data Analysis

In order to address the first research question, an examination was conducted on student scores using the Design Thinking Scale. To determine disparities in scores across various design thinking dimensions, a MANOVA analysis was performed. Prior to conducting the MANOVA test, the collected data underwent a verification process to ensure normal distribution. The Shapiro-Wilks test was utilized for assessing normality since the sample size exceeded 30 individuals in each test group. Results from the test indicated that the design thinking scores from both groups exhibited a normal distribution, thus meeting the assumption of normality with a p-value greater than 0.05.

To address the second research question, a content analysis was conducted to examine the data acquired from interviews conducted with instructors. To uphold the credibility of the interview data, two specialists evaluated the transcripts and employed Miles and Huberman's (1994) framework for analysis. The assessment of interrater reliability indicated a 92% agreement on the design thinking theme found within the interviews. Instances where the two experts had differing opinions were revisited, and after thorough deliberation, they reached a consensus to classify those items under the design thinking theme.

RESULTS AND DISCUSSION

This study has been implemented to examine student design thinking in routine university science courses, particularly in the context of inquiry-based learning. An analysis of student design thinking was carried out between those exposed to inquiry-based learning (experimental group) and those taught through conventional methods (control group). The descriptive plots of students' design thinking across groups are presented in Figure 1.

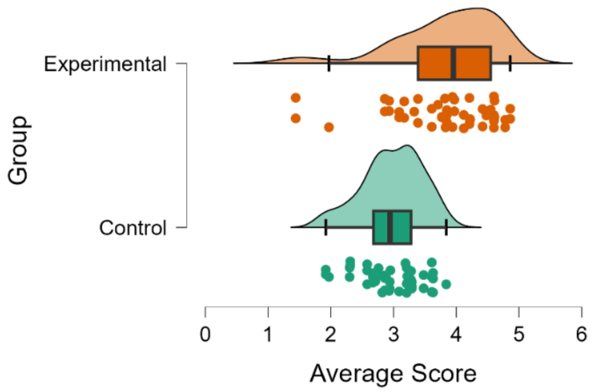

Figure 1. The descriptive plots of students' design thinking between groups

The analysis of the plot reveals noteworthy findings regarding students' design thinking in the experimental group. On average, students in the experimental group scored 3.859 (SD = 0.806), demonstrating superiority over the control group, which scored 2.979 (SD = 0.471). These results strongly suggest that students who were taught through inquiry-based learning exhibit better design thinking abilities compared to those who underwent conventional teaching methods. Additionally, Table 3 presents a comprehensive breakdown of the six dimensions of design thinking, further supporting these findings.

Table 3. The analysis results of students' design thinking

Dimensions	Group	N	Mean	Std. Error of Mean	Std. Dev.
DT-1	Control	50	2.210	0.082	0.581

Dimensions	Group	N	Mean	Std. Error of Mean	Std. Dev.
	Experimental	52	3.295	0.130	0.938
DT-2	Control	50	3.045	0.106	0.750
	Experimental	52	3.813	0.133	0.960
DT-3	Control	50	3.200	0.116	0.819
	Experimental	52	3.860	0.133	0.958
DT-4	Control	50	3.108	0.103	0.729
	Experimental	52	4.104	0.114	0.822
DT-5	Control	50	3.010	0.117	0.827
	Experimental	52	4.163	0.130	0.935
DT-6	Control	50	3.305	0.104	0.733
	Experimental	52	3.918	0.125	0.898

The experimental group students outperformed the control group in all dimensions of design thinking. Within the experimental group, the highest design thinking score was observed for DT-5 (orientation towards learning through making and testing) with an average score of 4.163 (SD = 0.935). It was followed by DT-4 (collaboration with diverse perspectives) with an average score of 4.104 (SD = 0.822), DT-6 (confidence and optimism in utilizing creativity) with an average score of 3.918 (SD = 0.898), DT-3 (mindfulness regarding the process and its impact on others) with an average score of 3.860 (SD = 0.958), DT-2 (focus on human-centeredness) with an average score of 3.813 (SD = 0.960), and finally DT-1 (comfort with uncertainty and risks) with an average score of 0.938 (SD = 3.295). On the other hand, the control group's average design thinking scores were significantly lower than those of the experimental group in all dimensions of design thinking.

Furthermore, an analysis of variance (MANOVA) was conducted to assess disparities between the two groups across the six dimensions of design thinking, as outlined in Table 4.

Table 4. The results of MANOVA analysis of groups

Dimensions	Case	Sum of Squares	df	Mean Square	F	p
DT-1	Group	30.008	1	30.008	48.912	< .001
	Residuals	61.351	100	0.614		
DT-2	Group	15.015	1	15.015	20.135	< .001
	Residuals	74.571	100	0.746		
DT-3	Group	11.084	1	11.084	13.919	< .001
	Residuals	79.632	100	0.796		
DT-4	Group	25.279	1	25.279	41.814	< .001
	Residuals	60.456	100	0.605		
DT-5	Group	33.914	1	33.914	43.421	< .001
	Residuals	78.106	100	0.781		
DT-6	Group	9.587	1	9.587	14.220	< .001
	Residuals	67.420	100	0.674		

The results of the MANOVA analysis showed that the two groups differed significantly in all dimensions: DT-1, comfort with uncertainty and risks ($F = 48.912$, $p < .001$); DT-2, focus on human-centeredness ($F = 20.135$, $< .001$); DT-3, mindfulness regarding the process and its impact on others ($F = 13.919$, $p < .001$); DT-4, collaboration with diverse perspectives (F =

41.814, $p < .001$); DT-5, orientation towards learning through making and testing ($F = 43.421$, $p < .001$); and DT-6, confidence and optimism in utilizing creativity ($F = 14.220$, $p < .001$).

In order to complement the quantitative data, we carried out interviews with lecturers to gather their insights on the implementation of inquiry-based learning that impact on students' design thinking. The outcomes of these interviews are presented below.

- Comfort with uncertainty and risks:
  "I believe that by encouraging students to explore and question through inquiry learning, they can develop a deeper understanding of complex problems and learn to embrace uncertainty and risks, which are crucial for design thinking."
- Focus on human-centeredness:
  "Inquiry-based learning places a strong emphasis on understanding the needs and perspectives of users or stakeholders. I recognize that this approach encourages students to empathize with the end-users and design solutions that truly address their needs, leading to more human-centered design outcomes."
- Mindfulness regarding the process and its impact on others:
  "By engaging in inquiry-based learning, students are encouraged to reflect on their design process and the potential impact of their solutions on individuals, communities, and the environment. I appreciate this mindful approach as it promotes responsible and ethical design practices."
- Collaboration with diverse perspectives:
  "Inquiry-based learning often involves group projects or interdisciplinary activities. I acknowledge that this fosters collaboration among students with diverse backgrounds and perspectives, enhancing their ability to work effectively in teams and consider a broader range of ideas in the design process."
- Orientation towards learning through making and testing:
  "Inquiry-based learning encourages students to build prototypes and test their ideas in real-world situations. I value this hands-on approach as it enables students to learn from failures and iteratively improve their designs, ultimately leading to more innovative and successful solutions."
- Confidence and optimism in utilizing creativity:
  "Through inquiry-based learning, students are given the freedom to explore their creativity and take ownership of their learning. I see this as an opportunity for students to build confidence in their creative abilities and develop an optimistic outlook toward problem-solving and design challenges."

The current study discovered notable distinctions between the experimental and control groups regarding students' design thinking competence. Specifically, following the learning intervention, only the experimental group demonstrated significant improvement in their design thinking abilities. Several variations were evident between the two groups in terms of six aspects of design thinking. The findings of the current study are in line with the results of previous study (Liu & Li, 2023) that the design thinking of students who are taught experimental by making is better than traditional teaching.

Existing research empirically shows that learning activities that involve design thinking tend to be more engaging than traditional pedagogical methods (Goldman et al., 2014; Noweski et al., 2012). In line with the existing literature, the design-oriented inquiry learning approach proposed in this study serves as an effective pedagogy to facilitate the design process and enhance students' design thinking skills. This approach encourages active exploration of problem solutions rather than searching for correct answers, and is more advantageous in the context of creating creative products (Verawati et al., 2020; Wahyudi et al., 2018). In addition, students are taught inherent design characteristics in relation to open problem solving in inquiry learning, enabling them to further explore the selection and application of design resources.

Design thinking plays a significant role in generating problem-solving ideas, fostering collaborative learning, and promoting student empathy and responsibility in the learning process (Yalçın & Erden, 2021). These attributes are inherent in inquiry learning, and recent research indicates that students who engage in inquiry learning tend to exhibit stronger design thinking skills compared to those who do not (Yalçın & Erden, 2021). This finding aligns with previous studies that have shown a close relationship between design thinking and scientific inquiry, suggesting that they mutually reinforce each other (Nichols et al., 2022).

Dorst and Cross (2001) note that design thinking forms the foundation for problem-solving solutions in all types of thinking activities. A study by Lundmark and Jonsson (2020) took this concept a step further by integrating design thinking into inquiry-based learning, resulting in a process-oriented and creatively explorative approach known as design inquiry learning. Within this framework, design thinking serves as scaffolding for tackling exploratory problems (Lundmark & Jonsson, 2020). The research conducted by Ejsing-Duun and Skovbjerg (2019) further supports these findings by demonstrating the potential of process design as an effective mode of academic inquiry across various subjects. By incorporating this inquiry method, students gain more opportunities for active engagement, as the design approach involves visualization, materialization, and expanded methods of knowledge production. As a result, design thinking holds promising implications for enhancing learning and inquiry practices (Orthel, 2015).

CONCLUSION

In conclusion, this study highlights the significance of inquiry-based learning in fostering students' design thinking abilities within routine university science courses. The experimental group, exposed to inquiry-based learning, demonstrated significantly superior design thinking skills compared to the control group taught through conventional methods. The six dimensions of design thinking were analyzed, and the experimental group outperformed the control group in all aspects. Interviews with lecturers further supported the positive impact of inquiry-based learning on students' design thinking. This study adds to the existing literature on the strong correlation between design thinking and scientific inquiry, reinforcing the notion that they mutually strengthen each other and have promising implications for effective learning and inquiry practices.

RECOMMENDATION

While this study provides valuable insights into the superiority of inquiry-based learning over conventional teaching methods in developing students' design thinking abilities, several limitations should be acknowledged. Firstly, the research design employed a quasi-experimental approach, which may not completely control for all potential confounding variables, and therefore, causal conclusions should be drawn with caution. Secondly, the study was conducted in a specific university setting, limiting the generalizability of the findings to other institutions or educational levels. Additionally, the reliance on self-report measures and lecturer interviews introduces potential bias and subjectivity. Future studies could benefit from employing a randomized controlled trial design and incorporating objective measures to assess design thinking. Furthermore, exploring the long-term effects of inquiry-based learning on students' design thinking and examining potential factors that may moderate the effectiveness of this approach would enhance the robustness of the conclusions. Despite these limitations, this study contributes valuable evidence supporting the effectiveness of inquiry-based learning in promoting design thinking skills among university students.

Author Contributions

The authors have sufficiently contributed to the study, and have read and agreed to the published version of the manuscript. Conceptualization, S. Prayogi and H.A. Mustofa; Methodology, S. Prayogi, R.E. Yazidi and K-C. Tseng; Validation, R.E. Yazidi; Formal analysis, H.A. Mustofa and R.F.P. Ardi; Investigation, S. Prayogi; Writing—original draft preparation, S. Prayogi and R.F.P. Ardi; Review and editing, R.E. Yazidi and K-C. Tseng.

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Declaration of Interest

The authors declare no conflict of interest.

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Appendix A

Design Thinking Questionnaire (Adapted from Ladachart et al., 2022)

Name :
Student ID Number :
Course Name :

Provide a response to the following statement based on your learning experience in the mentioned course.

Being comfortable with uncertainty and risks

Item of statement	Respons				
	1	2	3	4	5
I feel comfortable with what is unknown	○	○	○	○	○
I prefer new contexts to familiar ones	○	○	○	○	○
I am comfortable dealing with problems that I cannot solve yet	○	○	○	○	○
I enjoy when a solution does not result in what I expect	○	○	○	○	○
I do not worry while solving problems that I do not know if it will be successful	○	○	○	○	○
I like taking many chances, even if it leads me to make mistakes	○	○	○	○	○

Human-centeredness

Item of statement	Respons				
	1	2	3	4	5
I actively involve users in diverse phases of the design process	○	○	○	○	○
People are a source of inspiration while identifying the direction of the design solution	○	○	○	○	○
During the design process, I try to understand what users need	○	○	○	○	○
I can tune into how users feel rapidly and intuitively	○	○	○	○	○

Mindfulness to the process and impacts on others

Item of statement	Respons				
	1	2	3	4	5
I easily empathize with the concerns of other people	○	○	○	○	○
I am able to recognize when I am in a divergent or convergent phase of the process	○	○	○	○	○
I am able to understand what the impacts on the external environment of the proposed solution might be	○	○	○	○	○

Collaboratively working with diversity

Item of statement	Respons				
	1	2	3	4	5
I am comfortable to share my knowledge with my teammates	○	○	○	○	○
I think in a team it is preferable to have different competences	○	○	○	○	○
I am comfortable to work with people having diverse perspectives from mine	○	○	○	○	○
I am comfortable changing my original opinions after listening to others	○	○	○	○	○
I am open to collaborating with people having different backgrounds	○	○	○	○	○

Orientation to learning by making and testing

Item of statement	Respons				
	1	2	3	4	5
I am comfortable transforming ideas into something tangible	○	○	○	○	○
I like transforming a hypothesis into something to be tested	○	○	○	○	○
I am often curious about what I do not know and try to find answers	○	○	○	○	○
In new situations, I generally seek as much information as I can	○	○	○	○	○

Being confident and optimistic to use creativity

Item of statement	Respons				
	1	2	3	4	5
I can foresee different outcomes of designing the same thing	○	○	○	○	○
I am comfortable using prototypes to represent new ideas	○	○	○	○	○
I think I can use my creativity to solve complicated problems	○	○	○	○	○
I am sure I can solve problems requiring creativity	○	○	○	○	○
I believe in my ability to creatively solve a problem	○	○	○	○	○
I desire to create valuable things by designing new products	○	○	○	○	○
I think I can overcome difficulties by using creativity	○	○	○	○	○
I can see problems or crises as opportunities	○	○	○	○	○

Appendix B

Quantitative raw data of students' design thinking

No	Group	DT-1	DT-2	DT-3	DT-4	DT-5	DT-6	Average Score
1	Experimental	4.67	4.75	4.67	4.20	4.50	4.88	4.61
2	Experimental	3.33	3.50	3.00	5.00	4.25	4.00	3.85
3	Experimental	4.17	4.75	4.67	4.60	5.00	4.50	4.61
4	Experimental	1.67	4.00	3.67	4.60	4.50	4.50	3.82
5	Experimental	3.17	3.50	4.33	4.00	3.75	3.50	3.71
6	Experimental	3.33	4.25	4.33	3.80	5.00	4.00	4.12
7	Experimental	4.00	4.50	4.00	5.00	5.00	4.38	4.48
8	Experimental	4.50	4.00	4.67	5.00	5.00	4.13	4.55
9	Experimental	3.00	3.00	3.00	3.00	3.00	4.00	3.17
10	Experimental	3.67	5.00	5.00	5.00	5.00	5.00	4.78
11	Experimental	4.00	3.50	3.33	4.80	4.00	4.00	3.94
12	Experimental	1.83	3.00	3.67	3.60	4.50	3.75	3.39
13	Experimental	4.67	5.00	5.00	4.60	5.00	4.88	4.86
14	Experimental	2.17	3.25	3.33	3.80	3.00	3.00	3.09
15	Experimental	4.17	4.50	4.67	4.40	5.00	4.88	4.60
16	Experimental	2.17	3.00	3.00	3.60	3.00	2.38	2.86
17	Experimental	2.83	2.25	2.67	4.20	3.00	2.63	2.93
18	Experimental	2.33	2.00	2.00	2.00	2.00	1.50	1.97
19	Experimental	3.83	4.75	4.67	4.60	5.00	4.75	4.60
20	Experimental	3.83	3.25	4.00	3.40	4.00	4.13	3.77
21	Experimental	3.67	4.75	3.67	4.00	4.50	4.75	4.22
22	Experimental	3.33	5.00	5.00	4.20	5.00	4.00	4.42
23	Experimental	2.17	4.50	4.67	4.40	4.00	3.38	3.85
24	Experimental	2.00	4.25	3.67	4.80	4.50	4.63	3.97
25	Experimental	3.00	3.75	3.33	3.80	4.25	3.50	3.61
26	Experimental	1.67	1.25	1.00	1.60	1.50	1.63	1.44
27	Experimental	4.83	3.00	5.00	5.00	5.00	4.75	4.60
28	Experimental	3.83	4.50	4.00	4.40	4.25	4.25	4.21
29	Experimental	3.50	4.00	4.00	4.00	3.75	3.75	3.83
30	Experimental	3.50	3.25	3.00	3.00	3.75	3.50	3.33
31	Experimental	3.33	4.25	4.33	3.80	5.00	4.00	4.12
32	Experimental	4.00	4.50	4.00	5.00	5.00	4.38	4.48
33	Experimental	4.50	4.00	4.67	5.00	5.00	4.13	4.55
34	Experimental	3.00	3.00	3.00	3.00	3.00	4.00	3.17
35	Experimental	3.67	5.00	5.00	5.00	5.00	5.00	4.78
36	Experimental	4.00	3.50	3.33	4.80	4.00	4.00	3.94
37	Experimental	1.83	3.00	3.67	3.60	4.50	3.75	3.39
38	Experimental	4.67	5.00	5.00	4.60	5.00	4.88	4.86
39	Experimental	2.17	3.25	3.33	3.80	3.00	3.00	3.09
40	Experimental	4.17	4.50	4.67	4.40	5.00	4.88	4.60
41	Experimental	2.17	3.00	3.00	3.60	3.00	2.38	2.86
42	Experimental	2.83	2.25	2.67	4.20	3.00	2.63	2.93
43	Experimental	3.83	4.75	4.67	4.60	5.00	4.75	4.60
44	Experimental	3.83	3.25	4.00	3.40	4.00	4.13	3.77
45	Experimental	3.67	4.75	3.67	4.00	4.50	4.75	4.22
46	Experimental	3.33	5.00	5.00	4.20	5.00	4.00	4.42
47	Experimental	2.17	4.50	4.67	4.40	4.00	3.38	3.85
48	Experimental	2.00	4.25	3.67	4.80	4.50	4.63	3.97
49	Experimental	3.00	3.75	3.33	3.80	4.25	3.50	3.61
50	Experimental	1.67	1.25	1.00	1.60	1.50	1.63	1.44
51	Experimental	4.83	3.00	5.00	5.00	5.00	4.75	4.60
52	Experimental	3.83	4.50	4.00	4.40	4.25	4.25	4.21
1	Control	2.00	3.00	2.33	2.80	2.50	2.88	2.58
2	Control	1.67	3.50	3.00	2.60	3.25	3.63	2.94
3	Control	2.17	2.75	4.67	2.20	2.50	3.00	2.88
4	Control	1.33	3.75	3.67	4.00	2.75	3.75	3.21
5	Control	2.67	3.50	4.33	4.00	3.75	3.50	3.63
6	Control	2.33	3.75	4.33	3.20	2.75	3.38	3.29
7	Control	2.17	4.50	4.00	2.40	2.25	4.38	3.28
8	Control	1.50	3.25	2.67	2.60	3.25	2.75	2.67
9	Control	2.50	2.25	2.00	2.40	2.25	2.38	2.30
10	Control	1.50	1.75	2.67	2.20	2.50	3.25	2.31
11	Control	2.67	2.25	3.33	2.40	2.25	4.00	2.82
12	Control	1.50	2.50	3.67	3.60	4.50	3.75	3.25
13	Control	2.33	2.75	3.00	2.80	2.25	2.38	2.58
14	Control	2.17	3.25	3.33	3.80	3.00	3.00	3.09
15	Control	4.17	3.00	3.00	3.00	5.00	4.88	3.84
16	Control	2.17	3.00	3.00	3.60	3.00	2.38	2.86
17	Control	2.83	2.25	2.67	4.20	3.00	2.63	2.93
18	Control	2.33	2.00	2.00	2.00	2.00	1.50	1.97
19	Control	1.83	4.75	4.67	3.00	2.50	2.38	3.19
20	Control	2.83	3.25	4.00	3.40	4.00	4.13	3.60
21	Control	2.67	3.25	3.67	4.00	2.50	3.25	3.22
22	Control	2.50	2.25	2.67	3.00	5.00	4.00	3.24
23	Control	1.67	2.75	2.67	3.20	4.00	3.38	2.94
24	Control	2.00	2.75	3.67	2.40	2.25	4.63	2.95
25	Control	3.00	3.75	3.33	3.80	4.25	3.50	3.61
26	Control	1.50	1.75	1.67	2.00	2.25	2.38	1.92
27	Control	2.83	3.00	2.00	3.00	2.75	3.00	2.76
28	Control	2.67	3.00	2.33	4.40	4.25	4.25	3.48
29	Control	2.33	2.50	3.33	4.00	2.50	2.50	2.86
30	Control	1.33	3.75	3.67	4.00	2.75	3.75	3.21
31	Control	2.67	3.50	4.33	4.00	3.75	3.50	3.63
32	Control	2.33	3.75	4.33	3.20	2.75	3.38	3.29
33	Control	2.17	4.50	4.00	2.40	2.25	4.38	3.28
34	Control	1.50	3.25	2.67	2.60	3.25	2.75	2.67
35	Control	2.50	2.25	2.00	2.40	2.25	2.38	2.30
36	Control	1.50	1.75	2.67	2.20	2.50	3.25	2.31
37	Control	2.67	2.25	3.33	2.40	2.25	4.00	2.82
38	Control	1.50	2.50	3.67	3.60	4.50	3.75	3.25
39	Control	2.33	2.75	3.00	2.80	2.25	2.38	2.58
40	Control	1.83	3.25	3.00	2.40	2.25	3.50	2.71
41	Control	3.00	3.75	3.33	3.80	4.25	3.50	3.61
42	Control	1.50	1.75	1.67	2.00	2.25	2.38	1.92
43	Control	2.83	3.00	2.00	3.00	2.75	3.00	2.76
44	Control	2.67	3.00	2.33	4.40	4.25	4.25	3.48
45	Control	2.33	2.50	3.33	4.00	2.50	2.50	2.86
46	Control	1.33	3.75	3.67	4.00	2.75	3.75	3.21
47	Control	2.67	3.50	4.33	4.00	3.75	3.50	3.63
48	Control	2.33	3.75	4.33	3.20	2.75	3.38	3.29
49	Control	2.17	4.50	4.00	2.40	2.25	4.38	3.28
50	Control	1.50	3.25	2.67	2.60	3.25	2.75	2.67