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Article

The Assessment and Preference of Student-Centered Learning Under Subject of Chemistry among PERMATApintar Students

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Abstract: Teaching and learning chemistry at all levels of education have faced numerous challenges. These challenges include students' struggles with problem-solving skills, limited spatial visualization abilities, difficulties in grasping chemistry vocabulary, and inadequate communication between students and teachers. As a result, researchers across various educational contexts have consistently advocated for the creation of a learning methods that effectively addresses these difficulties. This research delves into an examination of the pedagogical approaches, both as currently perceived and preferred, among PERMATA@Pintar College students in the realm of chemistry education. The investigation concentrates on two primary pedagogical paradigms: student-centered teaching and teacher-centered teaching. The study encompasses a cohort of 150 students ranging in age from 13 to 18 years. To gauge the students' perceptions of their teachers' instructional methods and their own preferences, a revised version of the Approaches to Teaching Inventory (ATI) originally developed by Prosser and Trigwell was employed.The findings of this study reveal that the prevailing pedagogical approach in chemistry classes appears to strike a balance between teacher-centered and student-centered learning. However, in terms of the students' own inclinations, they exhibit a slight preference for the teacher-centered method, emphasizing information transfer, over the student-centered approach, which emphasizes conceptual change. Interestingly, when considering the desired shift in teaching methods as envisioned by the students, their preference leans significantly towards an increased frequency of student-centered methods, highlighting a distinct preference for these methods over teacher-centered ones.

Keywords: Pedagogy; education; student-centered; teacher-centered; chemistry

Introduction

Chemistry, like other physical and natural sciences, plays a pivotal role in our daily lives by providing learners with the tools to comprehend the world around them. Nevertheless, the realm of chemistry education, spanning all levels of learning, confronts a range of notable challenges. One prevailing approach to teaching, characterized as teacher-centered pedagogy, revolves around the teacher's dissemination of information, the demonstration of experiments, and limited interactions among students or between students and the teacher (Nzeyimana, &Ndihokubwayo, 2019). This approach aligns with a behaviorist perspective, positing that providing students with accurate information enables them to commit it to memory, attribute meaning to it, and make it available for future use. However, the current understanding of meaningful learning in chemistry classrooms points towards learner-centered, active, and cooperative teaching methods, rooted in the principles of social cognitive and constructivist theories (Kara, 2021).

In Malaysia, teacher centered learning is the traditional way of teaching and is most seen in classrooms. The learning process usually includes students copying notes written on the whiteboard by teachers and lectures by the teachers with the aid of slides. Students are dependent on the teachers' knowledge in classrooms. However, the education board has been slowly trying to implement more modern ways of teaching. For example, questions of higher ordered thinking (HOTs) are added to exam papers in accordance to the 4th Malaysian Education Development Plan (2013-2025). The objective of this approach is to produce students with high ordered thinking and the ability to compete on the global stage. Besides that, the Ministry of Education has also launched 21st Century Learning or Pembelajaran Abad ke-21 (PAK21). This is an initiative revolving around a student-centered learning process with 5 principle elements: communication, collaboration, critical thinking, creativity, and values and ethics (4C1V) (Education Performance and Delivery Unit, 2018).

In light of the mixed research findings, this study aims to explore preferences for both teacher-centered and student-centered teaching methods within the realm of the Chemistry subject. To this end, the research delves into the following specific research questions:

i. Do the students at PERMATA@Pintar College perceive their chemistry teachers to primarily implement student-centered or teacher-centered teaching methods in the chemistry class?
ii. What is the prevailing preference of students at PERMATA@Pintar College regarding learning in a student-centered or teacher-centered teaching environment?
iii. In terms of teaching methods in chemistry, what specific changes or adaptations do the students at PERMATA@Pintar College prefer or advocate for?

By systematically addressing these research questions, this study will provide valuable insights into the current dynamics and preferences related to teaching and learning in the field of chemistry at PERMATA@Pintar College.

Literature Review

Pedagogy is vital in the education of students, particularly those pursuing primary and secondary education. This is because these students are more dependent on the pedagogy of the teacher in contrast to students in universities towards their lecturers. Because of this, many past researchers have studied different types of pedagogical techniques. Two opposite types of pedagogical techniques are student-centered and teacher-centered leaning.

In teacher-centered approaches, teaching aims and objectives, content, and methodology are finalized even before there is any encounter between teacher and learner (Tengku Kasim, 2004). Teacher-centered learning is whereby the students depend on the teacher's knowledge as their main resource. A teacher-centered classroom is very orderly with student's focus on the teacher. This technique may be preferred for going through syllabuses smoothly and quickly because there is no room to deviate from the curriculum as long as the teacher is in control.

On the opposite spectrum, student centered learning is a form of a more modern learning technique. This pedagogical technique circulates around the students independently attaining knowledge from being involved in the classroom and learning from hands on activities. The students help each other playing the roles of both the student and educator through group discussions and presentations which results in a nosier and more chaotic classroom. According to Wulf (2019), student-centered learning is a constructivist process whereby students expand on what they currently know with new experiences to create new constructs. It is rooted in the idea that knowledge cannot be transmitted but can only be created by the students themselves. Overby (2011) describes the concept of student-centered learning as 'to bring the classroom and students to life'. She refers to teachers as a "guide on the side", responsible for assisting and guiding student towards goal that have been set by both students and teacher. An example is problem-based learning which introduces students to open-ended problems in the form of real-world scenarios for them to independently gain conceptual knowledge (Ali, 2019).

Several studies have explored the use of a student-centered pedagogy and its effectiveness. A study by Bradford, Mowder and Bohte in 2016 suggests that use of any student-centered approaches in pedagogy will

improve learning outcomes and student engagement. This is similar to the findings of a study conducted on inquiry-based learning in Chemistry laboratories of Israeli high schools, the researchers noted that students in the inquiry laboratory supposed themselves to be more included in the learning process and the procedures to be more flexible. (Hofstein et al., 2001) While another study conducted in 2014 reveals that students in student-centered classrooms scored better on tasks that involved writing story problems and tasks that involved missing addends (Polly et al., 2014). A more recent study by Ibrahim and Jamaludin (2019) concluded implementation of problem-based learning succeeded in improving students' understanding in macroscopic, microscopic and symbolic representation levels of Chemistry.

However, there are also some studies that have suggested teacher-centered pedagogies to be beneficial to students. For example, a study concluded that low-achieving students improved more in a teacher-centered class. Low achievers in the student-centered class were less involved in class and rarely engaged in conceptual discussions (Wu & Huang, 2007). The preference of hearing and explanation over reading books and journals in a majority of students in a study indicates the students are dependent on the lecturer's explanation over critical thinking and independent learning (Malie & Akir, 2012). A different take by Blonder and Mamlok-Naaman (2019) identified overloaded chemistry curriculums as a challenge in science education and suggested teacher-centered pedagogies to be a consequence.

Based on past research, the difficulty of Chemistry as perceived by students vary from neither difficult nor easy (Salta & Tzougraki, 2004) to being one of the most difficult topics (Dahsah & Kruatong, 2010). Several studies imply that the difficulty of Chemistry is due to problems relating to concepts (Suaalii & Bhattacharya, 2007; Salta & Tzougraki, 2004). A study by Goksu and Inaltekin (2019) in Turkey examined students' science notebooks and discovered their mode of pedagogy was mainly teacher-centered. Conversely, a study in New Zealand on Science pedagogy reveals that a majority of the teachers do not regard content knowledge as important in teaching early childhood education. The study also finds that while a large majority of the teachers favour play-based pedagogy, their ability to link play with science was questionable (Zhang & Birdsall, 2016). This shows that while teachers believe in a more student-oriented pedagogy, many are still naïve and unequipped to deliver high quality education through said channel. This could be a leading factor of the ineffectiveness of student-centered learning.

Methodology

1. Participants

The respondents were students from PERMATA@Pintar College ages between 13 to 18 years old. The population consists of all students from foundation 2, foundation 3, level 1, level 2 and pre-university totalling to 390 students. The evaluation of their perceptions towards Chemistry class was based on their experienced in the previous year to ensure a more absolute insight after a year of being in their Chemistry class environment. The sample was taken using stratified sampling with proportional allocation to better represent the population because of the large difference in strata size. The sample size is 150 students whereby each grade will be considered a strata.

2. Instrument

In this research, the method involved a comprehensive adaptation of the Approaches to Teaching Inventory (ATI), originally proposed by Prosser and Trigwell in 2005, to specifically address the context of a Chemistry class. This adaptation primarily focused on rephrasing the original 22 questions to capture a student's perspective on teaching styles, where 11 items represented the conceptual change/student-focused approach, and the other 11 reflected the information transmission/teacher-focused approach. The questions were meticulously modified to align with the nuances of a Chemistry class, transforming phrases like 'In this subject...' to 'In Chemistry class...' for enhanced relevance. Moreover, an additional dimension was introduced in the questionnaire, prompting respondents to rate the current teaching methods and express their desires for the frequency of these methods in their Chemistry learning experience, inspired by a methodology outlined in the research conducted by Juuti et al. in 2009. Prior to its implementation, a pilot test was conducted with a

sample of 30 respondents to evaluate the reliability of the modified instrument. The pilot study's results provided insights into the internal consistency and reliability of the adapted ATI within the context of Chemistry education, ensuring that the instrument effectively captured the nuances of teaching approaches.

3. Procedure

The questionnaire was distributed to all participants over the course of one week. The distribution took place at PERMATA@pintar Negara, where participants were provided with the questionnaire. The authors conducted a brief orientation session to explain the study's objectives and to ensure that participants understood how to accurately complete both Section A (demographics survey) and Section B (the modified Revised Approaches to Teaching Inventory - ATI). After participants completed the questionnaires, the data collection phase was concluded. The collected data was subsequently analysed using the statistical software SPSS (Statistical Package for the Social Sciences) to draw meaningful insights from the responses.

4. Data Analysis

The reliability of the research instrument was rigorously assessed through the application of the Cronbach's Alpha test, specifically focusing on the CCSF (Current Chemistry Teaching Method) and ITTF (Idealized Teaching Method) scales. Cronbach's Alpha is a well-established statistical measure for evaluating the internal consistency and reliability of the questionnaire items within these scales. A high Cronbach's Alpha value, typically exceeding 0.7, signifies that the questionnaire items within each scale are reliable and accurately capture the constructs they intend to measure.

Moreover, to provide a comprehensive understanding of the data, descriptive analyses were conducted. These analyses yielded valuable insights into the central tendencies and the degree of variability within the CCSF and ITTF scales for both assessed and preferred teaching methods. The means and standard deviations were computed to summarize the data, allowing researchers to identify the typical responses and the extent to which responses diverged from the mean for each scale.

In addition to this, Pearson correlations were employed to examine the relationships between the assessed and preferred teaching methods. This analysis elucidated whether there was a significant association or connection between how the teaching methods were evaluated and how they were subjectively preferred by the participants. Pearson correlations provided researchers with a quantitative understanding of the strength and direction of the relationships between these two variables, thus contributing to a nuanced assessment of the data and the alignment between assessment and preference. The outcomes of these statistical analyses are pivotal in drawing meaningful conclusions from the dataset, ensuring that the research is founded on solid statistical foundations and robust instrument reliability.

Results and Discussions

1. Demographics

Out of the 150 respondents, 66% are female and 34% are male. A Pearson correlation test shows no correlation between gender and ITTF or CCSF scales. Gender does not appear to be a significant factor influencing the participants' choices or perceptions regarding teaching methods in chemistry. This finding underscores the importance of considering other variables or factors that may have a more substantial impact on teaching method preferences and assessments within our study.

2. Reliability Test

The reliability test of 30 respondents has a Cronbach alpha of 0.855 and 0.828 for CCSF scales in both assessment and perception columns, respectively. The Cronbach alpha for ITTF scales are 0.751 and 0.776. Reliability coefficients of 0.7 and higher are acceptable for most social science research situations. All scales have a high reliability score and the data analysis may proceed.

3. The Current Teaching Style Perceived by Students

The observed means and standard deviations in Table 1, specifically related to students' perceptions of their teachers' current teaching methods, offer insights into how these methods are perceived.

Table 1. Descriptive of student responses on teaching method items

Teaching Method	Current (A)		Preferred (B)	
	Mean	SD	Mean	SD
1AB ITTF: In Chemistry, I am told to focus my study only on what the teacher provides.	3.39	1.092	3.44	1.173
2AB ITTF: It is important that Chemistry should be completely described in terms of specific objectives that relate to the exams	3.84	0.942	3.91	1.042
3AB CCSF: My Chemistry teacher tries to develop a conversation with the class about the topics we are studying	4.09	0.969	4.37	0.816
4AB ITTF: My teacher presents a lot of facts to students so that we know what we have to learn for this subject	3.82	1.004	4.44	0.719
5AB CCSF: My teacher sets aside some time to allow us to discuss, among ourselves, key concepts and ideas in Chemistry class	3.74	1.120	4.04	0.955
6AB ITTF: In Chemistry, my teacher concentrates on covering the information from the syllabus	4.09	0.797	4.13	0.902
7AB CCSF: My teacher encourages us to restructure our existing knowledge in terms of the new way of thinking about Chemistry	3.73	0.969	4.11	0.879
8AB CCSF: In Chemistry class, the teacher deliberately encourages debate and discussion	3.13	1.257	3.65	1.063
9AB ITTF: My Chemistry teacher structures their teaching in such a way to help students to pass the exams	4.09	0.846	4.28	0.852
10AB ITTF: My teacher gives students a set of notes for Chemistry class	3.65	1.227	4.33	0.923
11AB ITTF: In Chemistry, my teacher provides the students with the information we will need to pass the tests.	3.99	0.976	4.38	0.872
12AB ITTF: My teacher always knows the answers to any questions that we may ask during Chemistry class	4.23	0.772	4.57	0.699
13AB CCSF: My teacher makes available opportunities for students to discuss our changing understanding of Chemistry	3.70	1.041	4.08	0.909
14AB CCSF: My teacher believes it is better for students in Chemistry to generate our own notes rather than copy theirs	4.05	0.972	3.81	1.163
15AB CCSF: A lot of teaching time in Chemistry class is used to question our ideas	3.32	1.051	3.69	0.998
16AB ITTF: In Chemistry class my teacher focuses on the good presentation of information to students	3.71	0.922	4.07	0.828
17AB CCSF: My teacher helps us develop new ways of thinking in Chemistry	3.65	1.148	4.19	0.831
18AB CCSF: My teacher monitors our' changed understanding of the subject matter	3.63	1.064	4.25	0.761
19AB ITTF: My Chemistry teacher focuses on delivering what he/she knows to the students	4.17	0.888	4.50	0.702
20AB ITTF: My teacher helps students question our own understanding of Chemistry	3.85	1.039	4.22	0.810
21AB CCSF: My teacher helps students find their own learning resources (websites, videos)	3.21	1.103	4.05	0.951
22AB ITTF: My teacher presents material to enable us to build up an information base in this subject	3.73	0.939	4.19	0.839

Notably, six items—3A, 6A, 9A, 12A, 14A, and 19A—show mean scores exceeding 4.00. Among these items, four are affiliated with information transmission (teacher-focused), while only two pertain to conceptual change (student-focused). Items 12A and 19A exhibit the highest mean scores, registering at 4.23 and 4.17, respectively. These items specifically highlight a teacher-centered approach, emphasizing the

teacher as the primary source of knowledge and information. Additionally, items 6A and 9A, with relatively high mean scores of 4.09, revolve around syllabus and examination focus. This trend indicates that while PERMATA@pintar College endeavors to emphasize student-centered learning, certain constraints exist due to the educational context in the country, notably influenced by teaching content, syllabi, and the structure of public examinations (Tengku Kasim, 2004).

The limitation on fully embracing student-centered learning at PERMATA@pintar College might be attributed to several factors embedded within the educational landscape. These influential elements often compel educational institutions to strike a balance between promoting student-centered learning and adhering to standardized curriculum and assessment criteria, which tend to be more teacher-focused. Therefore, while there's an apparent aspiration towards student-centered approaches, the current system's structures and requirements might pose inherent challenges in fully implementing such methodologies. This echoes the complex interplay between institutional goals for innovative teaching methods and the broader educational frameworks they must operate within, emphasizing the need for careful navigation and adaptability within the existing context.

Figure 1A illustrates that, according to students' perceptions, the current teaching style at PERMATA@pintar reflects a balance between student-centered and teacher-centered approaches, albeit slightly leaning towards a more teacher-centered model.

Figure 1A. Current teaching style perceived by students

The breakdown reveals that approximately 48% of their learning experience aligns with contextual change/student-focused (CCSF), while about 52% is related to information transfer/teacher-focused (ITTF). This observation seems contrary to PERMATA@pintar's educational philosophy, which strives to implement more student-centered teaching methodologies and discourage rote learning. Despite this ideological aim, the frequency of student-centered teaching within this mix appears relatively higher compared to other schools in Malaysia that tend to adopt more traditional, teacher-focused approaches. These observations align with prior research by Tengku Kasim (2004) and Yunus & Raper (2004), which suggest the challenges faced in the nationwide shift towards student-centered learning despite governmental initiatives in this direction.

It's important to note that the ATI, while calculating ITTF and CCSF scales, primarily focuses on measuring information transfer and conceptual change. However, the dichotomy between student-centered and teacher-centered methods is more multifaceted and subjective in actual practice. For instance, various studies perceive student-centered approaches as forms of constructivism (Gilis et al., 2008) or andragogy (Tasir et al., 2008). This nuanced view underscores the complexity of categorizing teaching methodologies and emphasizes the need for a more comprehensive understanding of the diverse interpretations and applications of student-centered learning within the educational landscape.

4. The Current Teaching Style Perceived by Students

The data in Table 1 showcases means and standard deviations related to the preferred teaching method among students. Figure 2A presents students' inclinations regarding the teaching methods in Chemistry.

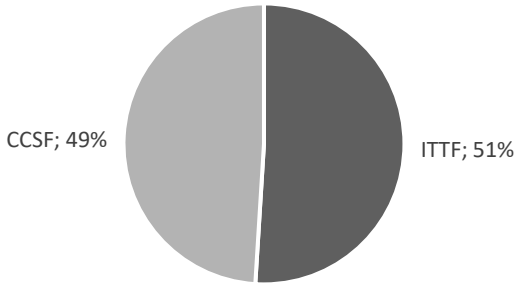

Figure 2A. Teaching style preferred by students.

The pie chart visually emphasizes that students marginally favor a teacher-centered learning approach (ITTF) over a student-centered approach (CCSF), with a mere 2% difference between the two. Table 3 further specifies that items 4B, 12B, and 19B, all belonging to the ITTF scale, exhibit the highest means. This alignment with Figure 1 reinforces the notion that teachers at PERMTA@pintar predominantly employ teaching methods that are highly preferred by students. This preference for teacher-centered learning might indicate that students gravitate towards this approach due to its familiarity and the perceived success they've experienced with it.

Conversely, the item with the lowest mean score (3.44) is item 1B, indicating that students feel they are instructed to focus their studies solely on what the teacher provides. This lower mean score suggests that students are inclined towards exploring the subject matter on their own terms, seeking a more student-driven learning experience. However, it's vital to note that this item also possesses the largest standard deviation, hinting at potential outliers or a wider variance in responses. This variance implies that while there is a general trend towards students desiring more autonomy in their learning, there might be a subset of individuals who deviate significantly from this inclination. This highlights the diversity in students' preferences and underscores the importance of acknowledging individual learning styles and needs within the educational framework.

5. Changes Preferred Towards the Teaching Methods of Chemistry Subject

The correlation test as in Table 2A and Table 2B shows correlation is significant between ‘how it is’ items and ’how I’d like it to be’ items for both CCSF and ITTF scales. The scatter plots of Figure 2A and Figure 2B indicate positive correlations between the perceptions of how the current teaching methods are against the students’ preferred methods. Since there is no negative correlation, we can assume the students do not have any significant dislike for either methods, instead they want more student-centered learning and more teacher-centered learning.

Table 2A. Correlation between current and preferred teacher-centered teaching methods

		ITTFA	ITTFB
ITTFA	Pearson Correlation	1	.469**
	Sig. (2-tailed)		.000
	N	150	150
ITTFB	Pearson Correlation	.469**	1
	Sig. (2-tailed)	.000	
	N	150	150

**. Correlation is significant at the 0.01 level (2-tailed).

Table 2B. Correlation between current and preferred student-centered teaching methods

		CCSFA	CCSFB
CCSFA	Pearson Correlation	1	.445**
	Sig. (2-tailed)		.000
	N	150	150
CCSFB	Pearson Correlation	.445**	1
	Sig. (2-tailed)	.000	
	N	150	150

**. Correlation is significant at the 0.01 level (2-tailed).

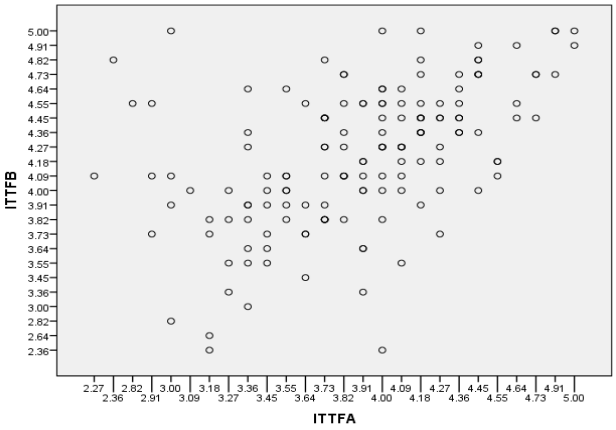

Figure 2A. Scatterplot between current and preferred teacher-centered teaching methods

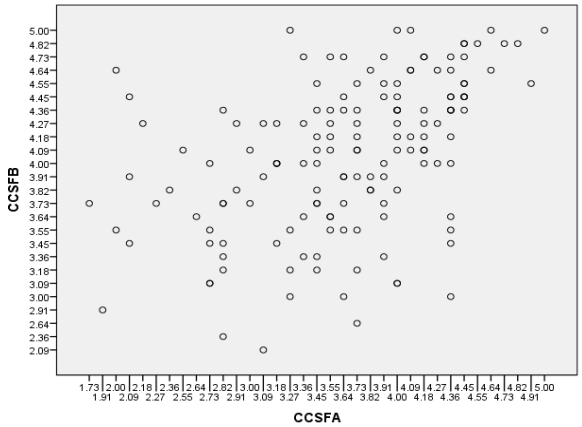

Figure 2B. Scatterplot between current and preferred teacher-centered teaching methods

6. The Students' Desired Change in Chemistry Teaching Methods

Table 3 shows mean of the change in ITTF and CCSF scales between current teaching methods and preferred teaching methods. In other words, the table represents the students' desired change in Chemistry teaching methods.

Table 3. Descriptives of desired change in Chemistry teaching methods

		CHANGEITTF	CHANGECCSF
N	Valid	150	150
	Missing	0	0
Mean		.3194	.3933
Std. Deviation		.51542	.66475

The comparative analysis of Figure 1A, Figure 1B, and the mean changes of desired teaching methods in Table 3 reveals an interesting trend. Although both current and preferred teaching methods display a relatively larger frequency toward information transmission/teacher-focused (ITTF), the mean shift in desired methods indicated by students in Table 3 shows a more significant change for the conceptual change/student-focused (CCSF) scale compared to the ITTF scale.

This discrepancy might initially seem perplexing since students still display a preference for teacher-centered methods, albeit with a very small difference and a trend toward a near balance of 50% for each scale. However, a closer analysis highlights that the percentage difference in current methods slightly leans toward a 4% variation between the two scales, whereas the desired methods showcase a smaller difference, indicating a more balanced preference.

The results suggest a noteworthy implication: PERMATA@pintar College should potentially introduce more student-centered teaching methods to approach a nearly balanced mix of student and teacher-centered teaching methodologies in Chemistry. This recommendation aligns with research by Juuti et al. (2009), where the majority of students expressed a desire for changes in teaching methods, although these desired alterations were not significantly drastic.

The findings underscore the significance of recognizing and addressing students' preferences for a more balanced approach to teaching methods. This suggests the need for a strategic shift within the educational framework to accommodate a more balanced mix of student-centered and teacher-centered methodologies, aligning more closely with the students' desired approach while ensuring an effective and engaging learning environment in Chemistry education at PERMATA@pintar College.

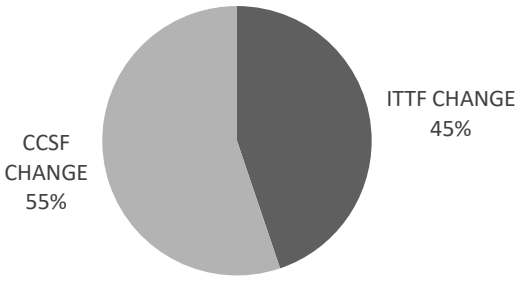

Figure 3. Desired Change in Chemistry teaching methods

The findings from Table 4, presenting results from the paired samples test, offer valuable insights into specific areas teachers should focus on while determining their teaching methods. Notably, all paired items demonstrate statistical significance (with a p-value < 0.05), except for pairs 1A1B, 2A2B, and 6A6B. Among these pairs, certain items stand out due to their substantial relative mean differences and significant t-values, including pairs 21A21B, 10A10B, 18A18B, and 4A4B in descending order. Remarkably, two of these pairs are from the CCSF scale, while the other two belong to the ITTF scale.

Table 4. Paired samples test between current and preferred teaching methods

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower	Upper			
Pair 1	1A ITTF - 1B ITTF	-.047	1.155	.094	-.233	.140	-.495	149	.621
Pair 2	2A ITTF - 2B ITTF	-.073	1.188	.097	-.265	.118	-.756	149	.451
Pair 3	3A CCSF - 3B CCSF	-.287	1.101	.090	-.464	-.109	-3.188	149	.002
Pair 4	4A ITTF - 4B ITTF	-.620	.994	.081	-.780	-.460	-7.636	149	.000
Pair 5	5A CCSF - 5B CCSF	-.300	1.180	.096	-.490	-.110	-3.114	149	.002
Pair 6	6A ITTF - 6B ITTF	-.040	.996	.081	-.201	.121	-.492	149	.623
Pair 7	7A CCSF - 7B CCSF	-.387	1.054	.086	-.557	-.217	-4.492	149	.000
Pair 8	8A CCSF - 8B CCSF	-.513	1.110	.091	-.692	-.334	-5.666	149	.000
Pair 9	9A ITTF - 9B ITTF	-.187	1.058	.086	-.357	-.016	-2.161	149	.032
Pair 10	10A ITTF - 10B ITTF	-.680	1.233	.101	-.879	-.481	-6.753	149	.000
Pair 11	11A ITTF - 11B ITTF	-.393	1.009	.082	-.556	-.230	-4.773	149	.000
Pair 12	12A ITTF - 12B ITTF	-.333	.791	.065	-.461	-.206	-5.158	149	.000
Pair 13	13A CCSF - 13B CCSF	-.380	1.028	.084	-.546	-.214	-4.529	149	.000
Pair 14	14A CCSF - 14B CCSF	.240	1.180	.096	.050	.430	2.492	149	.014
Pair 15	15A CCSF - 15B CCSF	-.367	1.026	.084	-.532	-.201	-4.377	149	.000
Pair 16	16A ITTF - 16B ITTF	-.360	.813	.066	-.491	-.229	-5.421	149	.000
Pair 17	17A CCSF - 17B CCSF	-.540	1.091	.089	-.716	-.364	-6.064	149	.000
Pair 18	18A CCSF - 18B CCSF	-.620	.988	.081	-.779	-.461	-7.688	149	.000
Pair 19	19A ITTF - 19B ITTF	-.327	.823	.067	-.459	-.194	-4.860	149	.000
Pair 20	20A CCSF - 20B CCSF	-.367	.847	.069	-.503	-.230	-5.303	149	.000
Pair 21	21A CCSF - 21B CCSF	-.833	1.120	.091	-1.014	-.653	-9.114	149	.000
Pair 22	22A ITTF - 22B ITTF	-.453	1.103	.090	-.631	-.275	-5.035	149	.000

The item 21A21B holds the largest mean and t-value at 0.833 and 9.114, respectively. It encompasses a 95% confidence interval difference ranging from 0.653 (lower interval) to 1.014 (upper interval). This specific item within the CCSF scale queries students about whether their teachers aid them in discovering their learning resources. The pronounced mean difference and high t-value imply a substantial desire among students for a teaching approach that encourages them to seek and utilize varied learning resources independently, thereby lessening their dependence on teachers for all learning materials.

This finding highlights the students' inclination towards a more self-directed and resourceful approach to learning. It suggests an expressed desire for educators to facilitate and encourage autonomy in accessing diverse learning resources, supporting a shift towards a more student-centered approach that fosters independent inquiry and resource utilization within the educational framework. Hence, it signifies an area where educators can focus their efforts to align more closely with students' preferences in teaching methods.

Conclusion

In summary, the analysis and findings support the first hypothesis, confirming that students perceive a blend of both student-centered and teacher-centered teaching methods in Chemistry classes at PERMATA@pintar College. This assertion is upheld based on the observed balance between these teaching styles, as evidenced by the data.

However, the second hypothesis, which anticipated a clear preference among students for student-centered learning, is rejected. Instead, the results indicate a subtle inclination towards both student-centered and teacher-centered methods, albeit slightly favoring a teacher-centered approach.

On the other hand, the final hypothesis, proposing that students desire more student-centered teaching methods, is supported and accepted. The data demonstrates a clear preference among students for increased incorporation of student-centered methodologies in Chemistry classes.

These findings suggest that while a balanced approach to teaching methods is evident, there remains a scope for change and adaptation to better align with students' preferences. Educators at PERMATA@pintar College are recommended to take into account these preferences in Chemistry teaching methods to enhance

classroom effectiveness. The data implies that even though the desired changes might not be extensive, there's room for adaptation, highlighting the importance of collaboration between educators and students.
When teachers actively engage with students, considering their suggestions and adapting teaching methodologies accordingly, it fosters an environment where both parties work collaboratively towards shared educational objectives. This synergy between educators and students ultimately enhances the efficiency and effectiveness of the learning process in Chemistry classes at the college.

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