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Journal of Social Sciences and Humanities Archives, Jan-Dec, 2024, 2 (1), 23-30

Effect of Kitchen Chemistry Method on Students Performance in the Subject of Chemistry at Secondary Level

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Abstract

The study was aimed to investigate the effect of kitchen chemistry method on student performance in the subject of chemistry at secondary level. The major objective of the study was (i) to investigate how students can learn chemistry from their surrounding (in kitchen), (ii) to explore how the chemistry, proved to be a fun (iii) to study that secondary school student can be scientist by learning chemistry from surrounding. All secondary school students learning chemistry was the population of the study. The study was experimental so 39 students of grade-IX of government girls higher secondary school Azakhel Payan were taken as a sample of study. The four weekly tests data were analyzed by AVP (average percentage report) while the pre-test and post-test data were analyzed by pair t-test. The analysis of the collected data revealed the following findings. The result of the study showed that Kitchen chemistry had significant effect on learning chemistry. It was concluded from the results that Kitchen chemistry had significant effect to be a fun for students. The result of the study showed that Elementary and Secondary school students can be scientists by learning chemistry from surrounding. Following recommendations were made, on the basis of conclusions. Elementary and secondary school teachers may use kitchen chemistry method in science to improve the academic achievement of students. It is also recommended that teachers may teach chemistry subject by using kitchen chemistry method. Government should arrange teacher's refresher course for kitchen chemistry method.

Keywords: Kitchen Chemistry Method, Academic Achievement, Secondary Level.

1. Introduction

Sharing scientific content and processes with people not considered traditionally as a part of the scientific community is science education. The learners are diverse, ranging from general public to college students and even children. Science education field deals with working on scientific content, scientific processes, social sciences and teaching pedagogy. Science being a universal subject extents the knowledge branch that scrutinizes the behavior and structure of the natural and physical world by observation through five senses and experimentation (Sawyer & Henriksen, 2024).

Chemistry is sometimes contemplated as the central science for providing a basis for providing an insight of both applied and basic scientific areas at a foundational level, occupying an intermediate position between physics and biology (Boeck, Nimmesgern & Wille, 2024). The study of the understanding, learning and teaching of chemistry at school, college and university level is considered as chemistry/chemical education. Chemical education includes the understanding of methods through which students can learn chemistry easily, how

to be the best at teaching chemistry, and the ways to improve outcomes of learning by changing teaching methodologies and proper training of the concerned instructors e.g. demonstrations, classroom lecture and practical activities in laboratory. Improvement and updating the skills and knowledge of chemistry instructor is the need of hour for the fruitful outcomes in the future (Raje & Stitzel, 2020).

Chemistry has frequently been regarded as a challenging discipline for numerous students. It encompasses numerous abstract concepts that are fundamental to advancing knowledge in chemistry as well as in other scientific disciplines (Raje & Stitzel, 2020). These abstract concepts hold significant importance, as a comprehensive understanding of advanced chemistry concepts or theories is not achievable if students do not grasp these complex ideas adequately. Numerous concepts, including the study of the periodic table, dissolution processes, the particulate nature of matter, periodicity, chemical formulas and equations, as well as chemical bonding, are essential for a comprehensive understanding of chemistry. Many challenges encountered by students in learning chemistry can be attributed to a insufficient comprehension of fundamental concepts, including periodicity (Hidayati et al., 2020).

1.1 Problem Statement

Kitchen chemistry method is an effective technique for pupils to acquire Chemistry. The aim of this study is to exercise this technique for secondary level pupils. The study was aimed at studying the effect of kitchen chemistry method on student in chemistry subject at secondary level.

1.2 Study Objectives

Following were the objectives of the study:

- To investigate how students can learn chemistry from their surrounding (kitchen).
- To explore how the chemistry, prove to be a fun.
- To study that secondary school student can be scientists by learning chemistry from surrounding (kitchen).

2. Related Researches

According to advanced organizer theory by Ausubel's, notions are evocative simply incase when the learner is able to visualize them and their incorporation within a cognitive-structure. This shows that the student already understands more generic concepts that include/incorporate the concept one is trying to teach. Utilizing resources from the environment, such as the kitchen, can facilitate this process when Chemistry teachers incorporate them into their lessons. This approach allows students to visualize familiar materials, serving as an advance organizer in the teaching and learning experience (Moses, 2020).

Jacobsen (2011) stated that kitchen can be considered as a place for daily scientific activities and students can utilize their kitchen as real-world lab, designing experiments that will test the outcome of changing variables in chosen recipes. The term "alchemy" gives us the feeling of mystery; in fact, it seems virtually magical that the ingredients with such dissimilar properties i.e., water, flour, butter and chocolate, which can't be eaten separately, meld so delightfully into devil's food cake. The answer is science if we look deeper into this phenomenon. Making candy with enzymes explain the chemistry tangled in the procedure of making a chocolate covered, liquid-center cherry.

The purpose of kitchen Chemistry was to produce innovative science resources that will make the scientific teachings easier for teachers and fun learning for students. Kitchen resources endorse team building, collaborative learning and enterprise in education resulting in supporting the weaker students as well as challenging the intelligent ones (Cannon et al., 2023).

Recommended kitchen resources that can be utilized for experiments and projects to investigate scientific concepts when access to or affordability of chemicals is limited. Kitchen Chemistry offers the concise explanation of science behind the cooking leading to the user understanding of cooking as an experiment while kitchen being the science laboratory where students can gain the understanding of daily use chemical compounds in the kitchen, i.e. starch, sugar, protein and fats. Chemistry understanding can result in creation of novel food recipes (Kharissova et al., 2019).

2.1 Hypotheses

The hypotheses were as:

- H₀₁. Kitchen chemistry has no effect on learning chemistry.
H₀₂. Kitchen chemistry has no effect to be a fun for students.
H₀₃. Kitchen chemistry has no effect on secondary school students.

3. Methodology

3.1 Population of the Study

Entirely secondary schools learner learning chemistry in district Nowshera constituted study population.

3.2 Sample of the Study

A sample of 39 students from the ninth grade at the Government Girls' Higher Secondary School in Azakhel Payan, District Nowshera, was selected for the study.

3.3 Research Design

One group pretest and posttest research design was used in the study.

Symbolic representation of design is:

(O₁ T O₂)

O₁ is the observation based on the pretest; T is the treatment was given to the sampled girls students while O₂ is the observation based on post-test

3.4 Study Tool

The instruments listed below were employed for the purpose of data collection.

- (i) For checking academic achievements before the treatment pretest was administered.
- (ii) For checking academic achievements after the treatment posttest was administered.
- (iii) Questionnaire

3.5 Treatment of Experiment

Different lesson planes (activities) were developed to deliver the lectures. The content of chapter was taught by using the chemicals and materials available in kitchen.

3.6 Procedure

Lesson planes were developed by researcher from selected text book lessons for the experimental group taught through Kitchen chemistry method. For conducting different activities teacher used preparation, presentation, practice and performance (4ps) format of lesson plan was used for activity Kitchen chemistry method. It created a lot of interest in students and slowly other skills activities were conducted, duration of the class was forty minutes. Nearly every factor, including duration of time, class schedule, length of the treatment, course content, and teachers' qualification were the same. After every week at the end a test (formative assessment) was conducted to measure the interest of the students. Treatment duration was four weeks. Activities of teacher were observed by the researcher as well. After treatment post-test was conducted. Then thirteen groups develop for a project and every group consist of three students. They design the project and present it in the class. It was observed by observers and award them marks.

3.7 Data Collection

Pretest and posttest were used to collect data for summative assessment. Weekly tests were taken for formative assessment. At the end of experiment a project were given to the students which was examined and evaluated by school committee of judges.

4. Analysis of Data

Collected data was tabulated and analyses through mean and SD. The four weekly test data were analyzed by AVP (average percentage report). While paired t-test was used to analyses pretest and posttest. The outcomes derived from statistical analysis were tested at a significance level of 0.05.

H₀₁. Kitchen chemistry has no effect on learning chemistry

Table 1 Effect of Kitchen chemistry on learning chemistry

Groups	N	Mean	SD	VR	df	Calculated t-value	Effect
Pre Experimental	39	5.10	2.436	5.936			
Post Experimental	39	11.71	1.621	2.628	38	15.24	Significant

T-Critical= 2.024

Table 1 describes that the t-value 15.24 which was greater than t-critical 2.024 which were significant at significance level (0.05); hence the null hypothesis is rejected. It shows that Kitchen chemistry has effect on learning chemistry.

H₀2. Kitchen chemistry has no effect to be a fun for students.

Table 2: Effect of Kitchen chemistry to be a fun for students Week 1

Experimental Group	Week	N	Mean Score	Total Score	Percentage
	Week 1	39	336	390	86.15%

Table 2 reveals that in week 1 student's scores 86.15% greater than 50% showed that Kitchen chemistry has effect to be a fun for students.

Table 3: Effect of Kitchen chemistry to be a fun for students Week 2

Experimental Group	Week	N	Mean Score	Total Score	Percentage
	Week 2	39	243	390	62.30%

Table 3 reveals that in week 2 student's scores 62.30% greater than 50% showed that Kitchen chemistry has effect to be a fun for students.

Table 4: Effect of Kitchen chemistry to be a fun for students Week 3

Experimental Group	Week	N	Mean Score	Total Score	Percentage
	Week 3	39	301	390	77.17%

Table 4 reveals that in week 3 student's scores 77.17% greater than 50% showed that Kitchen chemistry has effect to be a fun for students.

Table 5 Effect of Kitchen chemistry to be a fun for students Week 4

Experimental Group	Week	N	Mean Score	Total Score	Percentage
	Week 4	39	347	390	88.97%

Table 5 reveals that in week 4 student's scores 88.97% greater than 50% showed that Kitchen chemistry has effect to be a fun for students.

Table 6: Effect of Kitchen chemistry to be a fun for students

	Weeks	N	Mean Score	Total Score	Percentage
Experimental Group	Week 1	39	336	390	86.15%
	Week 2	39	243	390	62.30%
	Week 3	39	301	390	77.17%
	Week 4	39	347	390	88.97%

Table 6 reveals that in week 1, week 2, week 3 and week 4 student's scores 86.15%, 62.30%, 77.17% and 88.97% respectively showed that Kitchen chemistry has effect to be a fun for students.

H₀3. The kitchen chemistry has no effect on secondary school students.

Table 7: Secondary school students can be scientists by learning chemistry from surrounding

Groups	N	Mean	SD	VR	df	Calculate d t-value	Effect
Pre-Exp Score	Project ₁₃	4.53	2.436	0.935			
					12	10.75	Significant
Post-Exp Score	Project ₁₃	7.84	1.621	0.807			

T-Critical = 2.178

Table 7 showed that t-value 10.75 was greater than t-critical 2.178 which were significant at significance level (0.05); there for the null hypothesis is dismissed. It means that Secondary school students can be scientists by learning chemistry from surrounding.

Following analysis is of questionnaire sheets.

Table 8 Effect of kitchen chemistry method on students' performance in the subject of chemistry at secondary level Questionnaire

S.No	Questions	N	Pre-test Yes	No	Post-test Yes	No
1	Chemistry is uses in school only.	39	24 61%	15 39%	36 92%	3 8%
2	Experiments can only be perform in lab.	39	27 69%	12 31%	38 97%	1 3%

3	Chemistry is only in text book.	39	24 61% 15 39% 4 10%	35 90%
4	Chemistry is in surrounding.	39	15 39% 24 61% 35 90%	4 10%
5	All chemicals are toxic.	39	29 74% 10 26% 7 18%	32 82%
6	Chemicals are available in your kitchen.	39	9 23% 30 77% 33 85% 6 15%	
7	You are afraid to use chemical.	39	29 74% 10 26% 10 26%	29 74%
8	You like to do experiments.	39	36 92% 3 8%	39 100% 0 0%
9	You can do experiments by yourself.	39	5 13% 34 87% 33 85%	6 15%
10	You can do experiments in your kitchen.	39	12 31% 27 69%	39 100% 0 0%
11	Chemicals are present in your kitchen.	39	5 13% 34 87%	39 100% 0 0%
12	Chemistry can be learn in kitchen.	39	6 15% 33 85% 36 92%	3 8%
13	Chemical reactions take place in the cooking process.	39	12 31% 27 69%	37 94.8% 2 5.2%
14	You ever eat chemical product.	39	11 28% 28 72%	37 94.8% 2 5.2%
15	Cake baking is a chemical process.	39	6 15% 33 85%	39 100% 0 0%
16	Kitchen is a laboratory.	39	3 8% 36 92% 35 90%	4 10%
17	You enjoy to learn chemistry.	39	12 31% 27 69%	39 100% 0 0%
18	You feel bore to learn chemistry.	39	27 69% 12 31% 31 79%	8 21%

Tables 8 indicate that before treatment 61% and after treatment 8% students used Chemistry in school only, before treatment 69% and after treatment only 3% students performed Experiments in lab, before treatment 61% and after treatment 10% students explore chemistry in text book, before treatment 39% and after treatment 90% students discover chemistry in surrounding, before treatment 74% and after treatment 18% students found chemicals are toxic, before treatment 23% and after treatment 85% students found chemicals in kitchen, before treatment 74% and after treatment 26% students afraid to use chemicals, before treatment 69% and after treatment

only 3% students performed Experiments in lab, before treatment 92% and after treatment 100% students like to do experiments, before treatment 13% and after treatment 85% students can do experiment by their self, before treatment 31% and after treatment 100% students can to do experiment in their kitchen, before treatment 13% and after treatment 100% students found chemistry in their kitchen, before treatment 15% and after treatment 92% students can learn chemistry in their kitchen, before treatment 31% and after treatment 94.8% students found Chemical reactions take place in the cooking process, before treatment 24% and after treatment 98.4% students can ever eat chemical product, before treatment 15% and after treatment 100% students found Cake baking is a chemical process, before treatment 8% and after treatment 90% students found Kitchen is a laboratory, before treatment 31% and after treatment 100% students enjoy to learn chemistry, before treatment 69% and after treatment 79% students feel bore to learn chemistry.

4.1 Discussion

The study aimed at studying the effect of kitchen chemistry method on student performance in the subject of chemistry at secondary level. According to Jacobsen (2011) stated that kitchen can be considered as a place for daily scientific activities and students can utilize their kitchen as real-world lab, designing experiments that will test the outcome of changing variables in chosen recipes. The term “alchemy” gives us the feeling of mystery; in fact, it seems virtually magical that the ingredients with such dissimilar properties i.e., water, flour, butter and chocolate, which can't be eaten separately, meld so delightfully into devil's food cake. The answer is science if we look deeper into this phenomenon. Making candy with enzymes explain the chemistry tangled in the procedure of making a chocolate covered, liquid-center cherry (Jacobsen, 2011).

The purpose of kitchen Chemistry was to produce innovative science resources that will make the scientific teachings easier for teachers and fun learning for students. Kitchen resources endorse team building, collaborative learning and enterprise in education resulting in supporting the weaker students as well as challenging the intelligent ones. Cannon et al. (2023) suggested kitchen resources that can be used for experiments and projects to explore science where one cannot find or afford chemical. Kitchen Chemistry offers the concise explanation of science behind the cooking leading to the user understanding of cooking as an experiment while kitchen being the science laboratory where students can gain the understanding of daily use chemical compounds in the kitchen, i.e. starch, sugar, protein and fats. Chemistry understanding can result in creation of novel food recipes (Kharissova et al., 2019).

Study objectives were (i) to investigate how we can learn chemistry from our surrounding (ii) to explore how the chemistry, prove to be a fun (iii) to study the elementary and secondary school students can be scientists by learning chemistry from surrounding.

5. Conclusion

- The result of the study showed that Kitchen chemistry had significant effect on learning chemistry.
- The use of Kitchen chemistry in teaching of chemistry at secondary level was more constructive than conventional learning.
- Result of study concluded that Kitchen chemistry had significance effect to be a fun for students.
- The result of the study showed that Elementary and Secondary school students can be scientists by learning chemistry from surrounding.
- After treatment the result showed that kitchen chemistry technique students change their views about chemistry which were different before the treatment.

5.1 Recommendations

- Elementary school teachers may use kitchen chemistry method in science to improve the academic achievement of students.
- It is recommended that teachers may teach chemistry subject by using kitchen chemistry method. Government should arrange teacher's refresher course for kitchen chemistry method.
- It is recommended that teachers and students should follow kitchen chemistry method to get maximum benefits from this innovation. Teachers training institutes may make kitchen chemistry method as a part of their curriculum content and teacher educators may be trained in kitchen chemistry method.

- Training may be provided through refresher courses to in-service teachers to instruct them in application of kitchen chemistry method, so that they can implement useful approach of kitchen chemistry method.

Acknowledgements

The authors would like to thank all of the participants for their contributions.

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