

# **An investigation of students' views about enzymes by fortune lines technique**

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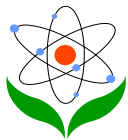
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## **Contents**

- **[Abstract](#)**
  - **[Introduction](#)**
    - **[Fortune lines technique](#)**
    - **[Implementation and analysis of fortune lines](#)**
    - **[Study importance](#)**
    - **[Purpose of study](#)**
  - **[Method](#)**
    - **[Participants](#)**
    - **[Data collection process](#)**
    - **[Data analysis](#)**
  - **[Findings](#)**
    - **[Findings related to enzymes activity](#)**
    - **[Findings related to Fortune Lines Technique Questionnaire](#)**
  - **[Discussion and conclusion](#)**
  - **[References](#)**
-



## Abstract

This study aimed to investigate ninth grade students' views about enzymes using fortune lines technique and to obtain the students' views about fortune lines technique. Participants were 38 ninth grade students in a Technique Vocational Girls High School in the city of Kocaeli, Turkey. After instruction of subject of enzymes, the participants were given an Enzymes Activity. 10 participants were also given the Fortune Lines Technique Questionnaire including three open-ended questions. Data were analyzed using fortune lines technique, descriptive, and content analysis techniques. The study results showed that many students drew developing fortune lines about the usage of enzymes in daily life.

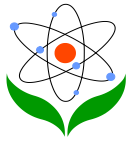
**Keywords:** enzymes, concepts of enzymes, fortune lines technique, secondary education, biology education

## Introduction

Many changes that have occurred in the world during the information era have also affected education. Significant changes have impacted the main philosophical approaches of education (Özsevgeç, 2008). According to constructivism, knowledge is the result of the interaction among experiences, observations, comments, and thoughts by individuals (Bağcı Kılıç, 2001). Individuals have made interactions between pre-existing knowledge and new information in this process. As a result of these interactions, knowledge is constructed in their minds.

Differences appearing in instructional programs thanks to constructivism approach have caused prominent changes with measurement and assessment techniques (Özsevgeç, 2008). Although traditional measurement and assessment techniques such as writing exams, short answer tests, true-false tests, and matching questions are presently used, alternative or complementary measurement and assessment techniques have also used by educators and researchers (Bahar, Nartgün, Durmuş, & Bıçak, 2010).

When attention is given to the distinction between traditional and alternative or complementary approaches and techniques, in which they are more authentic and student-centered than traditional techniques, the learning process is evaluated as much as the final product. It is thought that alternative or complementary techniques have an effect on increasing student motivation, skills, and improving



academic performance (Bahar et al., 2010). Techniques such as performance assessment, portfolio, project, interview, demonstration, poster, concept map, word association, drawings, writing composition, and fortune lines have been thought as alternative or complementary measurement and assessment techniques. These techniques help researchers and educators to obtain data related to students' characteristics such as learning process, knowledge, skill, attitude, understanding, and views (Atasoy, 2002; Ruiz-Primo, 2004; Bahar, Özel, Prokop, & Uşak, 2008; Bahar et al., 2010; Liew & Treagust, 1995; Prokop & Fančovičova, 2006; Taşkın, 2008).

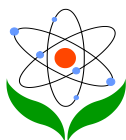
### **Fortune lines technique**

'Fortune lines technique' developed by Rush (1988, cited in White & Gunstone, 1998) can be used in many areas such as story, novel, poem, and in-service activities. Students try to express their feelings, thought, and understandings by drawing one or more lines for a whole course or any activity of the course. This technique can also be employed to determine the alterations in students' feelings such as happiness, excitement, self-confidence, ability (Feteris, 2008; Nottingham, 2009; White & Gunstone, 1998).




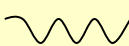
It can be used for investigating students' progress through the learning process and analyzing the changes as a result of the coursework and activities. Fortune lines technique can also be used successfully as pre- and posttest examinations. Fortune lines can also indicate as to what parts of the coursework were positive or negative situations for the students. Additionally, fortune lines can provide an opportunity for the students to interrogate each other by observing each of their fortune lines, which provides an opportunity for discussion in the classroom.

### **Implementation and analysis of fortune lines**

An A4 paper, pencil, and eraser are all students need to use the fortune lines technique. A subject is instructed by a teacher firstly, and then the teacher can develop an activity sheet including important points of the subject. Afterwards, the teacher explains the fortune lines technique and how they can use it. After the activity sheet is given to the students, the teacher asks the students to draw a line for each part of the subject. In other words, the students are asked to use symbols to draw each line to indicate their views (Rush, 1998, cited in White & Gunstone, 1998). Table 1 displays symbols and meanings of fortune lines.



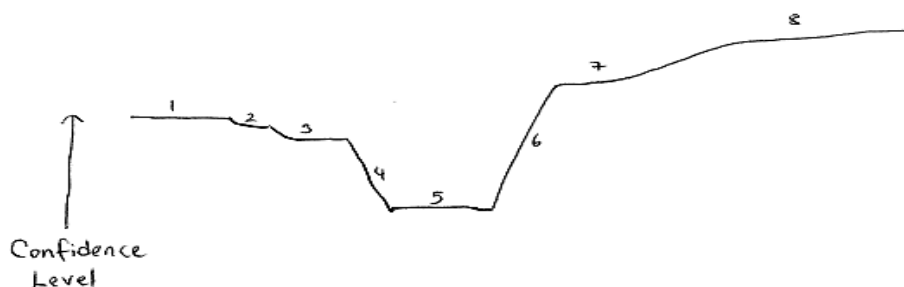
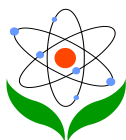
**Table 1:** Symbols and meanings of fortune lines technique (from Rush, 1988, cited in White & Gunstone, 1988)

Symbols of Fortune Lines	Meanings of Symbols Fortune Lines
	Developing, positive fortune lines
	Worsening, negative fortune lines
	Unchanging, constant fortune lines
	Changing, variable fortune lines

An example of an activity related to pre-service education was given below (White & Gunstone, 1988). Prospective teachers had pre-service education for a year, and pre-service education included eight sections:

1. The week before education begins,
2. Several days of education,
3. Five weeks in the university before first term,
4. Initial 3 weeks of first term,
5. Holiday for 2 weeks,
6. Three weeks in the university after holiday,
7. Second term,
8. Four weeks after instruction.

Prospective teachers were asked to draw fortune lines about the changes of their own self-confidence feelings regarding the 8 sections. Figure 1 shows an example of the fortune lines drawn by a prospective teacher. As shown in Figure 1, the confidence level of the prospective teacher was high for first section. His confidence started to fall slowly in the 2nd and 3rd sections. Although his confidence dropped in section 4 and his confidence level was stable in section 5. After his confidence level had increased in section 6, his confidence level continued to rise slowly in sections 7 and 8.



**Figure 1.** Fortune lines of a prospective teacher about changes of confidence level (from White & Gunstone, 1988)

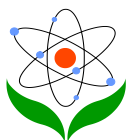
To analyze fortune lines drawn by students, firstly teachers should draw a graph of their own expected fortune lines for a course or an activity. Then, teachers should compare their expectations with the students' fortune lines. Lines that coincide with the expectations of the teachers should be marked with a '+'; whereas those that do not should be marked with a '-'; and those requiring explanation should be marked with a '?'. In addition, data can be converted into a numerical form (Feteris, 2008; Rush, 1998, cited in White & Gunstone, 1998).

### Study importance

A fortune lines technique is a technique that is used in the general evaluation of domains such as novel, play, poem, music, history, stories, and activities that are composed of more than one parts or stages. It can be preferred due to the fact that it is feasible, different, and it can be completed in a short time. This technique which is used to measure student's attitudes, satisfaction, and thoughts has been developed as a supplementary measurement tool in addition to traditional evaluation methods such as writing composition, and question-answer (Rush, 1998, cited in White & Gunstone, 1998).

There are limited studies on the fortune lines technique. For example, fortune lines were used during interviews and in some written surveys. Qualitative and quantitative data were obtained by fortune lines in a study conducted by Feteris (2008). The study results showed that students' skill developments were high in the first and third years of school although they were low in the second year. In another study, Yamaguchia et al. (2008) developed the 'Digital fortune Line System'.

There is some research about enzymes in biology courses (Sinan, 2007) such as misconceptions about enzymes (Selvi & Yakışan, 2004; Sinan, Yıldırım,



Kocakulah, & Aydın, 2006; Linenberger & Bretz, 2012); cognitive structures about enzymes (Kurt, 2013); and analogies for meaningful learning of enzymes (Atav et al, 2004). In these examples, it was observed that students had misconceptions about enzymes. Enzymes are a difficult subject for students (Bahar, 2002; Kurt, 2013). One of the reasons for this is that some topics regarding enzymes are abstract (Sinan, 2007). In this study, the topic of enzymes has been selected for the use fortune lines technique because some topics that seem abstract can be linked with daily life.

A review of the literature fails to reveal any study reported in Turkey related to fortune lines technique. This study is carried out to determine the thoughts of students about the usage of enzymes in daily life for the purpose of displaying fortune lines technique's feasibility in biology education. We believe that the findings of the present study will contribute to the literature regarding fortune lines technique.

### **Purpose of study**

The purpose of this study was to investigate the usage of fortune lines technique among ninth grade students.

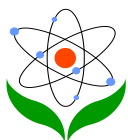
Two questions guided this study:

1. What are the students' views about fortune lines technique?
2. What are the students' views about the usage of enzymes in daily life according to fortune lines technique?

## **Method**

In this study a combination of quantitative and qualitative methodology was used to address the research questions. It was in quantitative nature that fortune lines drawn by the students were analyzed using fortune lines technique (Rush, 1998, cited in White & Gunstone), while it was in qualitative nature that the students' views about fortune lines technique were analyzed through descriptive and content analysis techniques (Yıldırım & Şimşek, 2000).

### **Participants**



Participants were 38 ninth grade students in a Technical Vocational Girls High School, whom the first researcher of the study had been teaching as a biology teacher in Kocaeli, Turkey in the 2010-2011 academic years. Participants were selected through a convenience sampling method (Büyüköztürk et al., 2013). All of the female participants were 15-16 years old and were from mixed ability class. They come from diverse areas throughout Turkey and are from middle socio-economic backgrounds.

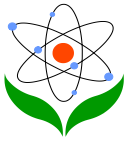
### **Data collection process**

In this study a book titled 'Probing Understanding' (White & Gunstone, 1988) was a basic reference for implementation and analysis of fortune lines technique.

In the beginning of the study the students were informed that they were not given any marks. Participants were also informed about the purpose of the study and how fortune lines technique would be implemented in the classroom.

The preliminary study was implemented in the classroom to introduce fortune lines technique to the students. The teacher asked the students to draw fortune lines regarding four sentences about daily life. Then, an example activity called 'Little Red Riding Hood' was given to the students, and they were asked to draw fortune lines related to Little Red Riding Hood. The Little Red Riding Hood Story (White & Gunstone, 1998; Little Red Riding Hood) is divided into 10 chapters:

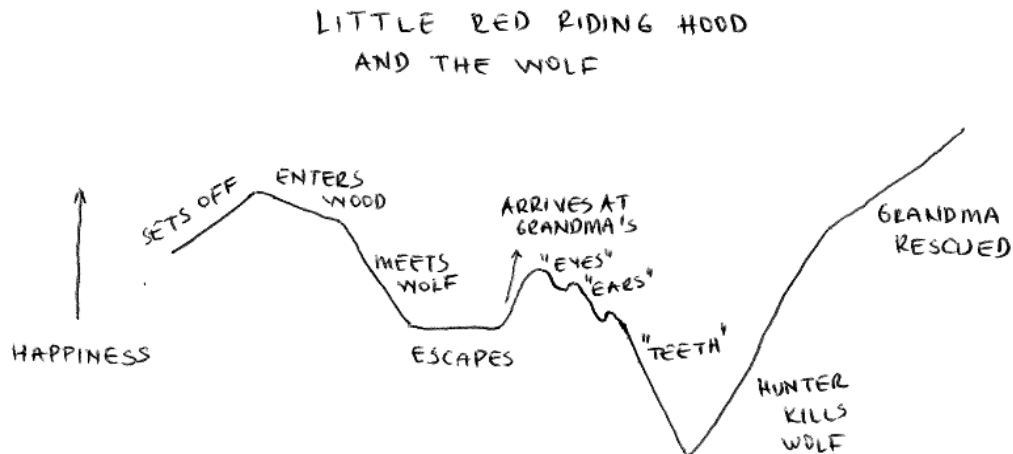
1. She leaves home,
2. She enters the forest,
3. She meets a wolf,
4. She goes to the forest to escape from the wolf,
5. She arrives at a shed of her grandmother,
6. The wolf asks what big eyes she has,
7. The wolf asks what big ears she has,
8. The wolf asks what big teeth she has.
9. The wolf tries to chase and eat her,



10. A woodcutter arrives and kills wolf,

11. Grandmother is rescued.

Figure 2 shows a graph of a student's fortune lines regarding the story.

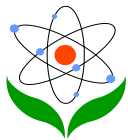


**Figure 2.** Fortune lines of a student about Little Red Riding Hood story (from White & Gunstone, 1988)

The core research was about the subject of enzymes. After the subject of enzymes was taught by the teacher (the first researcher of the study) through direct lecture and power point slides, the Enzymes Activity was implemented in the classroom. Then, the Fortune Lines Technique Questionnaire was given to the students in order to obtain students' views about fortune lines.

*Enzymes Activity:* It was prepared by the researchers to obtain the students' views about the usage of enzymes in daily life. After the subject of enzymes was taught, the activity sheets were handed out to the students. They included a reading text and 10 important items about usage of enzymes in human life. After each student read the text, they were required to indicate their views using fortune lines technique in 10 minutes.





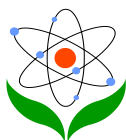
## Enzymes Activity

A living thing's reaction duration time to various stimulates is on the level with which they require. A fly can escape your hands in 65 milliseconds, but it cannot escape from a hostile insect that is faster than a fly by about 5 milliseconds. According to biochemists, if enzymes that act as catalyst had a slower reaction time, life wouldn't appear. There are 3000 different enzymes in a cell. These enzymes control almost all biochemical reactions and affect all stages of the functions of a cell. That's why they have several tasks from building of cell membrane to storing energy in nutrition molecules. Wilhelm Kuhne discovered in 1876 a biologic catalyst and it called enzymes that mean 'it is in yeast' in Greek.

Enzymes make reaction fast. For example, enzymes shorten duration in a hundred or thousand times that is necessary time for a sugar molecule fragmentation into CO<sub>2</sub> to H<sub>2</sub>O.

Otherwise, we would have to wait for months perhaps years. Enzymes provide much usefulness not only in human body but also all aspects of life for human beings. Once upon a time it was called as iron storage however after people have understood an exagrated statement, looked down spinach appears in different fields. In the latest studies spinach is a source of A and B vitamin, and folic acid. Furthermore, it is found that some enzymes in its cell make strong explosives undangerous. Researchers reported that nitroreductase enzyme and other enzymes in our stomach and intestine digest nutritions and digest some explosives and turn them into undangerous. A group of researchers in USA refined nitroreductase enzyme and other natural compounds from the sap of spinach's leaves. When it is investigated which substances are fragmentated by refined enzymes, it was determined that they are some explosives like TNT. It is observed surprisingly nitroreductase enzyme and other enzymes in our stomach and intestines digest nutritions, and digest some explosives and turn them into undangerous. It is also proved that the last product fragmentated by enzymes is environmentally friendly. It could be possible that this undengereaus last product can be turned into some useful compounds that could be used in industry. Biotechnological method which uses enzymes is described as an undengereous digestion function for environment. The most important advantage of this project is that it can be destroyed a tens of thousands explosives economically and environmentally friendly particularly USA and other countries stored. It is said that only United States has 500 thousand tons of stored explosive.

Various food productions by enzymes and uses of these products in industry have been common for 10-15 years. Enzymes industry has 1.3 billion dollars market potential in the world, and it gets bigger %10-15 every year. Some enzymes are used in detergent industry as super cleaner, in beverage industry to obtain glucose from starch, and in textile industry for special cleaning of textile. By means of this discovery, enzymes will be used for annihilaion of explosives. When enjected enzymes solution is sprayed far away to bomb places, they annililate all types explosives silently and explosives will be undengerous. To annilite these explosives in this way provide big advantages than the conventional methods such as blowing up, firing, annilite that is so expensive under high temperature and pressure in closed places. So during explosion, the risk of losing human



beings' lives and fire will decrease significantly. Moreover, their co-products will be kept in environmentally friendly. They will be used in market; especially it will facilitate annihilation of extra explosives in military under normal conditions. We don't know with new enzymes and proteins obtained by future studies may recover which illnesses and will get useful products in industry and technology (from <http://www.pnl.gov/news33>, cited in Aydın, 1998).

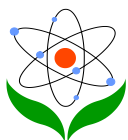
Note: Please draw on the back of this sheet your positive or negative feelings, thoughts, and emotions about the text above with fortune lines technique. Please write the corresponding number from below next to each fortune line.

#### **What Do You Think About The Following Sentences?**

1. Management of enzymes all biochemical reactions.
2. The case of enzymes that work slower than normal speed.
3. The nitroreductase enzyme which found in spinach can annihilate explosives like TNT.
4. West products after explosives are annihilated by enzymes can be used in industry in order to recycling.
5. The nitroreductase enzyme facilitates digestion in our stomach and intestines.
6. The United States has 500 thousand tons of stored explosives.
7. The increasing usage of enzymes in industry.
8. The usage of enzymes in detergent and cleaning supplies.
9. Enzymes can work not only within cells, but also throughout life.
10. Future expectations about enzymes.

*Fortune Lines Technique Questionnaire:* 10 participants were given the Fortune Lines Technique Questionnaire including three open-ended questions:

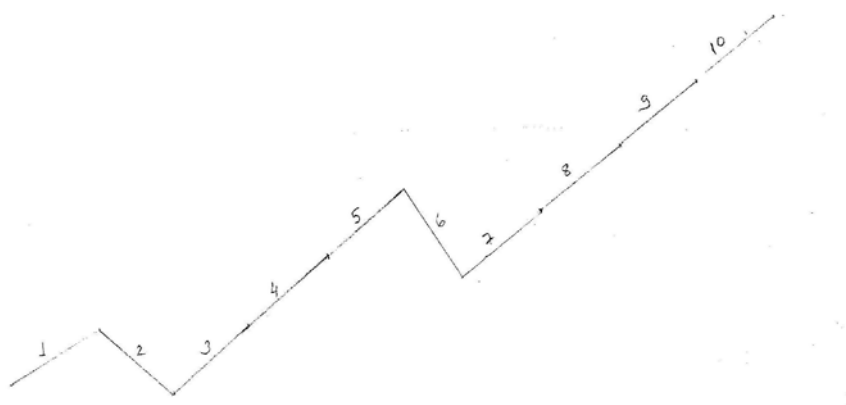
1. What do you think about the fortune lines technique?
2. How efficient is this technique to express your emotions, thoughts, and feelings?
3. What are the pros and cons of this technique?



## Data analysis

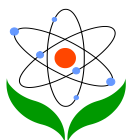
Two techniques were used for data analyses related to the Enzymes Activity: Fortune lines technique (Rush, 1998, cited in White & Gunstone) and content analysis technique (Yıldırım & Şimşek, 2000). The students' fortune lines about enzymes were first analyzed using fortune lines technique. Table 1 shows the symbols and meanings associated with the fortune lines technique.

Before analyzing the data, the students' Enzymes Activity answer sheets were numbered from 1 to 38. A graph of fortune lines for 10 items was provided in each of the student's sheets. These symbols found in the fortune lines' graph were analyzed separately according to the symbols in Table 1 (developing fortune lines, changing fortune lines, unchanging fortune lines, and worsening fortune lines). Each graph was analyzed using symbols for each item, and percentages were calculated for each symbol. The results are shown in Table 2. The expected fortune lines were drawn by the researchers to compare with the students' fortune lines for the Enzymes Activity, and they can be found in the last column of Table 2. Figure 3 shows expected fortune lines for the Enzymes Activity. The students' developing fortune lines, changing fortune lines, unchanging fortune lines, and worsening fortune lines for the Enzymes Activity were compared with the expected fortune lines and presented in the findings section.



**Figure 3.** Expected fortune lines for the enzymes activity

Expected fortune lines for the Enzymes Activity were drawn again by the researchers and one biology teacher who had been teaching biology for 16 years by the end of the study. They analyzed some of the data from the Enzymes Activity and calculated the percentages. As there was no significant difference between the



results of the researchers and the biology teacher for the Enzymes Activity, it is assumed that inter-rater consistency was established.

Moreover, data related to the Fortune Lines Technique Questionnaire were analyzed by descriptive and content analysis techniques (Yıldırım & Şimşek, 2000). The students' Fortune Lines Technique Questionnaires were numbered 1-10. Three questions in the Fortune Lines Technique Questionnaire were analyzed separately. The responses to the questions were divided into themes and sub-themes, and a table was created by calculating the sub-themes' percentages. All of the results are summarized in Table 3. Students' real names were not provided and numbers were assigned to each student. Notable responses were quoted and referred to by their assigned numbers.

Inter-rater consistency of themes and sub-themes about Fortune Lines Technique Questionnaire were supplied by the article writers.

## Findings

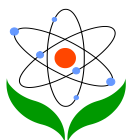
### Findings related to enzymes activity

Findings related to the Enzymes Activity were summarized in Table 2 to demonstrate the students' views about the usage of enzymes in daily life.

As shown in Table 2, the expected fortune lines were all developing fortune lines except for Items 2 and 6. Items 2 and 6 were worsening fortune lines.

Most of the students drew developing fortune lines for Item 1: Management of enzymes for all biochemical reactions (84%); Item 10: Expectations about enzymes in the future (71%); Item 9: Enzymes can work not only within cells, but throughout life (68%). It is assumed that the students had better understanding about Items 1, 10, 9 with respect to the other items.

However, the percentages of Items 3, 4, 5, 8 were at a moderate level (63%; 53%; 63%; 63%). For example, the students' percentages regarding Item 3 were 63% (developing fortune lines), 18% (changing fortune lines), 3% (unchanging fortune lines), and 16% (worsening fortune lines). The percentages of Items 2 and 6 were not high (16%; 26%). It is assumed that they did not understand well enough about

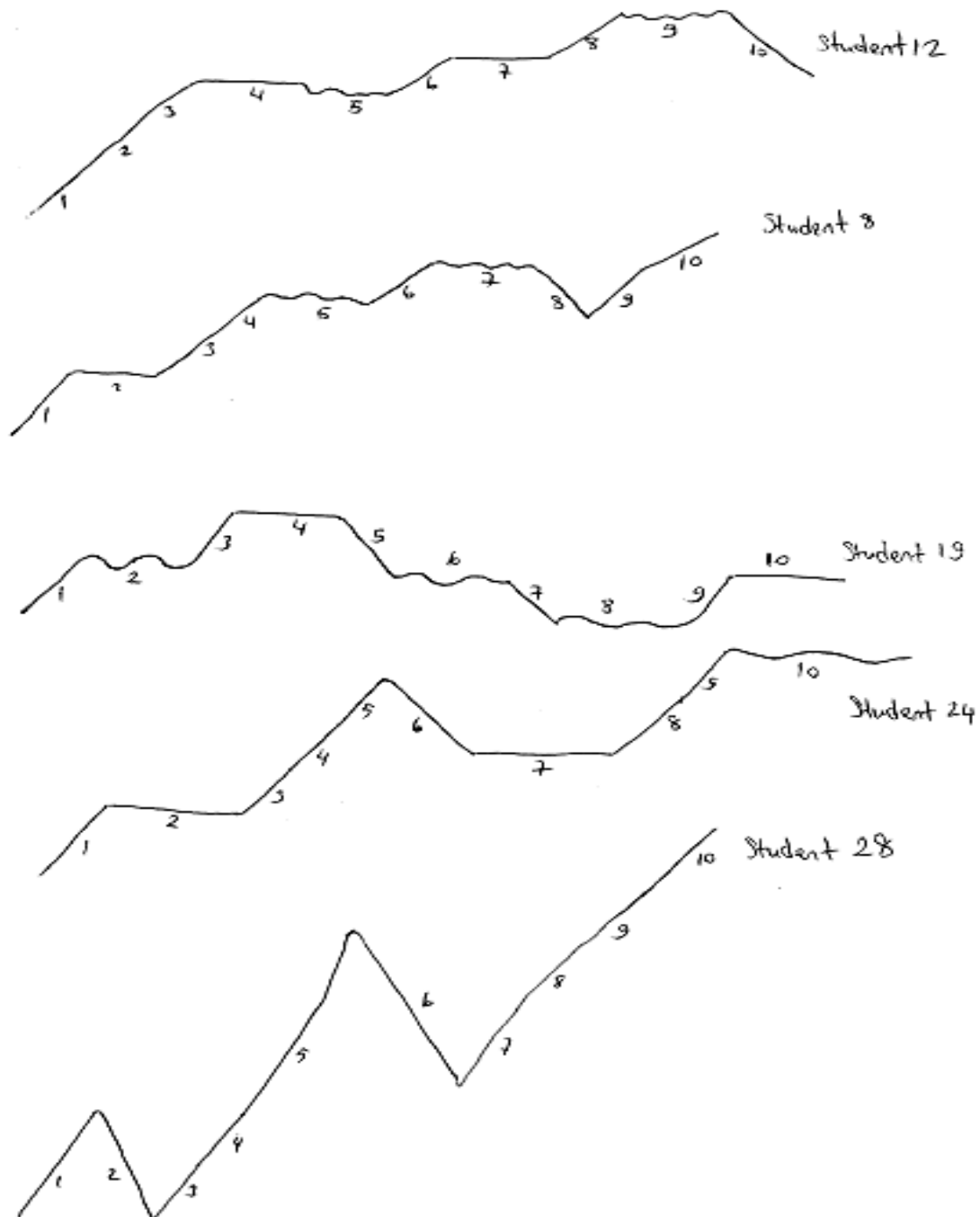
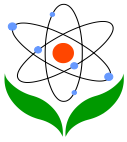


Item 6: The United States has 500 thousand tons of stored explosives (26%), and  
Item 7: Increasing of usage of enzymes in industry (34%).

**Table 2.** Percentages of the students' fortune lines about enzymes activity

Fortune Lines					
Item	Developing, Positive %	Changing, Variable %	Unchanging, Constant %	Worsening, Negative %	Expected Fortune Lines as Answer
Item 1	84	3	11	3	↗
Item 2	53	11	21	16	↘
Item 3	63	18	3	16	↗
Item 4	53	16	21	11	↗
Item 5	63	16	13	9	↗
Item 6	39	21	13	26	↘
Item 7	34	13	34	18	↗
Item 8	63	11	18	9	↗
Item 9	68	18	8	9	↗
Item 10	71	10	10	9	↗

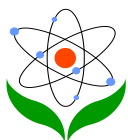
Figure 4 presents some striking examples of the students' fortune lines related to the Enzymes Activity.



**Figure 4.** Sample fortune lines indicating the students' views about the usage of enzymes in daily life

### Findings related to fortune lines technique questionnaire

The findings related to Fortune Lines Technique Questionnaire were summarized in Table III to show the students' views about fortune lines technique.

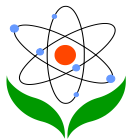
**Table 3.** Percentages of the students' fortune lines about enzymes activity

Theme	Sub-theme	%
Thoughts	We can express our thoughts very well, shortly and clearly.	48
	We can express our thoughts by lines instead of writing on sheets./A good technique.	36
	We can express things that we couldn't express by this technique.	5
	An enjoyable technique.	5
	An understandable technique	5
	I don't think anything.	1
Positives	We can express our thoughts easily.	38
	Things that couldn't be expressed by writing and speaking can be expressed.	16
	It is a practical and understandable technique.	15
Negatives	Expression is limited./A number of lines are not enough to express ourselves.	31
Efficiencies	Efficient.	59
	Less efficient.	6
	Inefficient.	29
	People can express themselves in better way by writing.	6

As seen in Table 3, when the students were asked about their thoughts regarding Fortune Lines Technique, all of them had positive reactions apart from one (S17). For example, S11 said *"I don't think anything about these lines because I don't know why I perform these lines."*

Most of the students expressed their thoughts very well, shortly, and clearly (%48) and said fortune lines were a very good technique (%36). Three students explained: *"It is a useful way to graph our thoughts."*(S5); *"I think it is an enjoyable technique and it expresses our thoughts very well."* (S23); *"... we can express our thoughts by simply drawing instead of writing"* (S9).

When students were asked about the positive and negative features of fortune lines, most of them described the positive features. Most of them said they could express their thoughts by using this technique (%38). For example, S13 said *"People can*



*explain feelings and thoughts in a short and practical manner*". Additionally, some students expressed the limits of this technique (%31). For example, *"The fact that there are only four lines is not enough to express our thoughts"* (S19).

When asked how efficient this technique was for expressing their emotion, feelings, and thoughts, most of them said it was enough to express their thoughts (Efficient, %59). For example, *"... I can explain my feelings and thoughts very well in a short way ..."* (S12). Some students believed that this technique was only a little effective (%6) or was ineffective (%29). For example: *"It facilitates us even if it is not completely effective. It is not efficient because it doesn't refer to which aspects are good and which are bad."* (S10). S26 said it was ineffective, and explained, *"We can't express ourselves very well because there are twelve lines."*

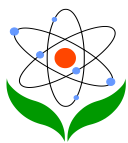
## Discussion and Conclusion

Fortune lines technique used for determining students' attitudes, satisfaction, understanding level, and thoughts is a complimentary technique to the traditional measurement and assessment techniques such as writing composition and true-false tests (Bahar et al., 2010; Rush, 1998, cited in White & Gunstone, 1998).

This current research has examined the views of students regarding the usage of enzymes in daily life using fortune lines technique as well as their perceptions of fortune lines technique itself. This study was not aimed to explore and explain the students' understanding of enzymes in detail using the fortune lines technique, but rather their perceptions of their own understanding.

The expected fortune lines of the researchers were all developing fortune lines except for Items 2 and 6 related to enzymes. Most of the students drew developing fortune lines for Items 1, 9, 10, and it could be perceived that the students had better understandings about Items 1, 9, 10 compared with the other items. Although Items 3, 4, 5, 8 were a moderate level, it could be perceived that the students did not understand well enough about Items 6 and 7. A possible reason could be that the teacher conducted the course only using PowerPoint and this may not be efficient enough (Sinan, 2007). Additionally, the subject of enzymes is difficult and includes abstract concepts (Kurt, 2013). It is also believed that students have some misconceptions about enzymes (Kurt, 2013; Linenberger & Bretz, 2012; Selvi, & Yakışan, 2004; Sinan, et. al., 2006). In short, perceptions of the students regarding





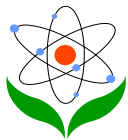
the usage of enzymes in daily life may have affected their drawings of fortune lines negatively.

Models and information technology such as videos and simulations related to enzymes may help to convert abstract concepts into concrete ideas. Additionally, enzymes can be taught through laboratory work in secondary education. Thus, it is believed that the inefficiencies and misconceptions among the students regarding the topic can be remediated.

White and Gunstone (1998) stressed that detailed data can be obtained about learning levels of students in a short time using this technique at the beginning and/or at the end of the learning processes. Students can complete this technique in a short time and possibly enjoy mapping their own fortune lines. Additionally, class discussion can be facilitated using the fortune lines drawn by students and discussing the possible reasons for variations in each student's fortune lines.

As seen in the data from the Fortune Lines Technique Questionnaire, all students had positive reactions to fortune lines technique except for one student. Most of the students indicated that fortune lines expressed their thoughts very well in a short and concise manner. Thus, this technique was enough to express their thoughts. However, a few of students said it was not enough to express their thoughts or since it had limits. Reasons for this could be that the Fortune Lines Technique is new and different technique for students, and they may have problems in adapting to this technique. Some students may have difficulties reflecting on their own thoughts by drawing lines or may be unwilling to draw lines. By implementing fortune lines technique in more activities in classes, students may become more familiar with it, which may eliminate these initial issues. In other words, because fortune lines technique is a new form of assessment, there may be some problems to overcome. Further testing of fortune lines technique may reveal more issues that need to be addressed in future studies.

Finally, in future studies fortune lines technique can be used as a complimentary measurement tool in addition to conventional measurement and assessment techniques in classrooms (Bahar et al., 2010). It can be used throughout different levels of education. Data collected by fortune lines technique can be enriched by other techniques such as interviews and tests (Feteris, 2008; White & Gunstone, 1998).

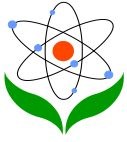


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