How Does Intrinsic Motivation Lead to Better Performance in Learning Organic Chemistry?

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Abstract

Intrinsic motivation concerns the degree to which the student perceives him/herself participating in a task for reasons such as challenge, interest, curiosity, and fulfillment. In contrast, extrinsic motivation concerns the degree to which the student perceives him/herself to be participating in a task for reasons such as grades, rewards, evaluation by others, and competition. This research project was designed to determine whether students in Organic Chemistry (CHM 203) who were more intrinsically motivated would have better performance than those who were less intrinsically motivated. We also determined the factors and their contributions to helping students learn Organic Chemistry. Our hypothesis is that students who take Organic Chemistry initially are extrinsically motivated and become more intrinsically motivated. Internalization must have occurred in order for the student to become more intrinsically motivated. Therefore, information about how students do/do not become internalized is important for educational purposes.
I. Introduction

The Self-determination theory (SDT) was proposed by Deci and Ryan in 1985. This theory is an approach to human motivation and personality that uses traditional empirical methods while employing an organismic metatheory that highlights the importance of humans’ evolved inner resources for personality development and behavioral self-regulation (Ryan, Kuhl, & Deci, 1997). The three needs that must be fulfilled in SDT are competence, relatedness, and autonomy. Competence is a feeling of having the right ability and skills to succeed. Autonomy is the experience of choice in the initiation, maintenance and regulations of behaviors, and the experience of connectedness between one’s actions and personal goal and values. Lastly, relatedness encompasses the need to feel securely connected to the social surrounding and need to experience oneself as worthy and capable of love. These three physiological are required for optimal functioning and well-being of an individual.

A subset to SDT is the organismic integration theory (OIT), which details the different forms of extrinsic motivation and the contextual factors that either promote or hinder internalization and integration of the regulation for these behaviors (Ryan and Deci, 2002). These factors include external regulation, introjected regulation, identified regulation, and integrated regulation. These factors are categorized as being most extrinsic to least extrinsic. It is important to help students proceed toward intrinsic motivation on the continuum beginning with external regulation. Based on our hypothesis which states that students are more extrinsically motivated towards taking Organic Chemistry, we believe that intrinsic motivation develops by means of internalization. OIT proposes that internalization is more likely to occur when there is a sense of relatedness and autonomy.
II. Methods

Subjects

The subjects were 21 college students (sophomores and juniors) taking Organic Chemistry (CHM 203) at the University of Rochester.

Procedure

A questionnaire was designed and given out during workshop after the second midterm of Organic Chemistry. The questionnaire consisted of four main questions.

Question 1 was proposed to determine whether the students were taking the class due to extrinsic motivation including Organic Chemistry as one of the requirements for their major, minor and cluster, or intrinsic motivation in other words, due to personal interest. This question was used to evaluate the initial motivation of students taking Organic Chemistry. We counted the total number of students who responded to each of the four options: major, minor, cluster and interest and divided it by the total number of students participated in the survey to obtain the distribution of major, minor, cluster and interest as initial motivation.

Question 2 was to determine how intrinsically motivated the students were towards the learning of Organic Chemistry. Eight questions were excerpted from the “Manual for the Use of the Motivated Strategies for Learning Questionnaire (MSLQ)” (Garcia, McKeachine, & Pintrich, 1991) shown in Table 1. Specifically, sub-questions (a), (c), (d) and (e) were extrinsic goal oriented and sub-questions, shown in the left column of Table 1, while (b), (f), (g), (h) were intrinsic goal oriented shown in the right column of Table 1.
<table>
<thead>
<tr>
<th>Extrinsic</th>
<th>Intrinsic</th>
</tr>
</thead>
<tbody>
<tr>
<td>I want to do well in this class because it is important to show my ability to my family, friends, or others.</td>
<td>In a class like this, I prefer course material that arouses my curiosity, even if it is difficult to learn.</td>
</tr>
<tr>
<td>The most important thing for me right now is improving my overall grade point average, so my main concern in this class is getting a good grade.</td>
<td>The most satisfying thing for me in this course is trying to understand the content as thoroughly as possible.</td>
</tr>
<tr>
<td>If I can, I want to get better grades in this class than most of the other students.</td>
<td>When I have the opportunity in this class, I choose course assignments that I can learn from even if they don’t guarantee a good grade.</td>
</tr>
<tr>
<td>Getting a good grade in this class is the most satisfying thing for me right now</td>
<td>In a class like this, I prefer course material that really challenges me so I can learn new things</td>
</tr>
</tbody>
</table>

Table 1. Extrinsic and intrinsic questions excerpted from MSLQ

The students were asked to rate the eight question on a scale of 1-7 (1 = least interested and 7 = most interested). For each student, we computed the total number of points from four intrinsic motivation and four extrinsic motivation questions, and calculated the percentage of intrinsic motivation to evaluate how intrinsically motivated the student was.

Question 3 asked the student to rate own performance level in the class within a scale of 5 (1 being poor performance and 5 being excellent performance).
We grouped students into performance range 1-1.9, 2-2.9, 3-3.9 and 4-5, and calculated the mean and standard deviation of intrinsic motivation percentile for students in each performance range. We plotted percentage of intrinsic motivation vs. performance level and attempted to find the relationship between these two quantities.

Lastly, question 4 was devoted to determine the contribution of factors towards their learning in Organic Chemistry within a scale of 1-5 (1 being least helpful, 5 being most helpful): class lecture, reading textbook, attending workshop, going to Center for Excellence in Teaching and Learning (CETL), attending Wednesday graduate students’ Q&A session, extra-help from the workshop leaders (including review sessions, meeting individually), external actors (parents) and student interaction (peer group learning). We calculated the mean and standard deviation of each factor that helped students’ learning in Organic Chemistry.

III. Results

A. Item analyses of Initial motivation to take Organic Chemistry

Question 1 of the questionnaire was used to determine if students were intrinsically or extrinsically motivated to take Organic Chemistry. Shown in FIG.1, 86% of the 21 students took the course to complete a major. 9% of the students took the course to complete a minor, followed by 5% for interest and 0% for cluster.
B. Analyzing factors that help student learn Organic Chemistry

Question 4 was used to determine what factors helped the students in learning Organic Chemistry and to what extent. Shown in FIG.2, Workshop ranked the highest with an average of 4.8 out of 5. External actors (parents) ranked the lowest with an average of 1.3. The second highest ranked factor is extra-help from TA with an average of 3.8.
C. Relationship between Intrinsic motivation and performance level

The percentage of intrinsic motivation was plotted against the performance level. As seen in FIG.3, as the performance range increased, the percentage of intrinsic motivation also increased. Although a definite correlation could not be concluded, the results indicated that there was some level of positive correlation between how intrinsically motivated a student is and their performance level in class.
IV. Discussion

The results analyzed from the survey supported our hypothesis that students transitioned from extrinsic motivation to intrinsic motivation through internalization of motivation. In general, we have found that the more intrinsically motivated the students were, the better performance they had in Organic Chemistry. We also evaluated various factors that might have helped students’ learning in Organic Chemistry. This could also be an indication to the contribution of each factor in internalization. Among those, attending Workshop was the most helpful factor and external actor (parents) was the factor that contributed least, rated by the students. This shows that Workshop setting best internalizes the extrinsic motivations of the students.

In a teaching and learning environment, it is imperative to promote activism/participation as well as to motivate students during their learning process. The Workshop program for Organic
Chemistry at the University of Rochester is designed to allow students to work together once a week for the entire semester. Each Workshop consists of about 10 students and one student leader (teaching assistant). The time period of a Workshop lasts from 1-2 hours given on the material covered. During Workshop, the students solve Organic Chemistry problems in a small group that they can contribute their knowledge to. At the same time, students build a sense of relatedness and feeling of connection to the social surrounding due to repetitive meetings each week. Thus, workshop incorporates the components of competence, autonomy, and relatedness together which are the three physiological needs to be satisfied for intrinsic motivation as proposed by Deci and Ryan in the Self Determination Theory (SDT). As expected, students ranked Workshops being more helpful in comparison to other factors such as external actors or Q&A session.

In addition, Halliman et al. states that there are three determinants of learning – the quantity and quality of instruction, student motivation, and academic climate – are interrelated (2003). The strength of an academic climate is dependent on the quantity and quality of instruction, and both of these factors influence student motivation. When these factors co-vary in a way that fosters learning, students are provided with rich educational opportunities and experiences, and they are most likely to attain high achievement. When one or more of these determinants of learning is weak, student performance is expected to suffer. This further supports our evidence of the Workshop setting. The Workshops foster student motivation, academic climate, and quantity and quality of instruction (dependent upon the teaching assistant). When students have strong motivation to succeed and work with peers in a friendly environment, they improve their performance level and engagement in learning Organic Chemistry.
Another research by Hayamizu had studied the four types of motivation: external, introjected, identified, and intrinsic (1997). The main purpose of the study was to construct a scale to measure these four types of motivation for academic achievement and then to examine its validity. According to the study, Hayamizu determined that introjected motivation is seen where individuals just begin to internalize the reasons for their actions. In contrast, the individuals with identified motivation arrive at the deep level of internalization because their behaviors are valued by themselves. This study shows that as students transition from one motivational factor to the next, internalization into intrinsic motivation is observed. Likewise, students in Workshops are also observed to transition from extrinsic to intrinsic and develop better enjoyment, interest, and satisfaction of the material studied. Therefore, internalization is an imperative process towards enhancement of a student’s learning process.

Our study shows the positive relation between intrinsic motivation and performance level and the factors that contribute to the internalization process. However, further research must be done to determine how the factors contribute to the internalization process. Also future work would include taking a larger sample size, using better methods to evaluate student’s performance as well as monitoring progress throughout the course.
References


