
Socio-Environmental Learning Model

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Abstract

This paper examined the socio-environmental factors that affect learning based on the concept that students learn best in a mutually supportive environment where they have contact with effective teachers. The main goal was to develop a learning model taking into consideration the underlying factors that affect optimum learning. The factors were [1] the average number of effective teachers per student, [2] amount of contact time between the students and effective teachers, and [3] the amount of time spent for studying per student. A simulation was done to imitate the real-life interaction between the students and effective teachers using the AIDS model from the NetLogo software—a multi-agent programmable modeling environment. In the model, the virus was translated as ‘effective teachers’ and the infection caused by the virus as the ‘learning gained’ by the students. Results show that the average learning rate a student acquires is 84% when there is a [1] greater number of effective teachers a student is in contact with, and [2] high amount of study time, even if the student has a low amount of contact time with effective teachers. It proposed that when students are exposed to effective teachers at a high rate then these students are able to receive optimal learning.

Keywords and phrases: socio-environmental learning model, NetLogo software, effective teachers, factors, optimal learning

Introduction

Psychologists assert that humans are social creatures by nature and that it is but natural that they in general like to interact, share ideas and observe how others behave in certain ways. Allwright and Hanks (2009) proposed that students are social beings who learn and develop best in a mutually supportive environment. Learning across individuals has social aspects attached to it. The first idea on social learning is by Bandura (1977) who proposed that behavior is learned from the environment through observational learning, that is, by observing the behaviors of others, people develop similar behaviors. This means that learning could be shaped by a social context

such an environment that is well designed so that learning opportunities are created. So how can this be applied to teaching? One essential concept drawn from this principle is teachers who serve as good role models. Being a model, the teacher teaches by ‘personal example’ to oversee, guide, or direct. Other concepts drawn from social learning theory include confidence building and constructive feedback, to name some. In this study, we define an effective teacher as one having the ability to create learning environments that [1] increase motivation to learn, [2] recognize individual differences across students, [3] adapt of wide-ranging pedagogies dependent on the learners,

[4] provide feedback, and [5] help build student self-confidence. Further, effective teachers are who are able to transfer learning to students Kolb (1984), Lavy (2010), Darling-Hammond (2010), and Stronge (2011).

Transfer of learning is conveying the knowledge or skill from the teacher and acquisition of the knowledge or skill by the learner. The optimum acquisition of knowledge and skill depends on the learning model employed in the teaching and learning process. In fact several literatures suggest that learning models serve as guides. For instance, Sugiyanto (2008) asserts that a learning model is a framework that describes a systematic procedure in organizing learning experiences to achieve specific learning objectives and serves as a guide for learning. Learning is a complex process and can be influenced by several factors (Noe & Schmitt, 1986; Baldwin & Ford, 1988; Rouiller & Goldstein, 1993; Ford & Weissbein, 1997). In this study however, we focused primarily on social learning.

Social learning, according to Bandura (1977), is about learning by observing the behaviors of others and the outcomes of those behaviors. This means that when students come in contact with effective teachers, learning takes place. In fact, several models arise from effective teaching. For instance, the study of Vassileva (2008) focused on the design of new social learning in context to support the learners in contact with the right persons. Finding “what is right” means the “content” needed by the learner together with the pedagogies that fit their learning styles. On the other hand, Del Rosario (2010) used the STSE model—an effective teaching model which focused on the sociocultural perspective of the learners. These models suggest that optimal learning could be achieved when students come in contact with effective teachers more often. In this present study, we assume that optimal learning could be achieved when the learning rate is at least 85%. Thus, the agent-based model of NetLogo was used in the context of this assumption. Furthermore, data used in this study were gathered through a simulation process.

Conceptual Framework

Social cognitive theory suggests that learning is taking place when learners are observing someone else demonstrating a behavior to be learned which in turn creates a mental image of that behavior. Bandura (1977) asserts that most human behavior is learned through observation from others; that one forms an idea how new behaviors are performed and that on later occasions this coded information serves as a guide for action. Further, learning occurs from a selected environment structure where teacher-student interaction is taking place. The selection and creation of environments affect the reciprocal interplay between personal, behavior and environmental factors (Bussey et al., 1999). Hence, when students work closely with effective teachers they are able to practice the modeled behaviors, and then they receive feedback and reinforcements from their teachers. These teachers are able to create an environment where student’s attention, retention, reproduction, and motivation have occurred. In this study, we develop a learning model interplaying the variable on learning and its underlying socio-environmental factors. The relationship between the variables is shown in Figure 1 below.

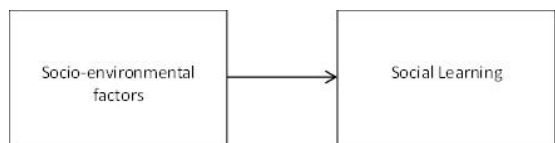


Figure 1. Socio-environmental learning model

Objectives

The purpose of this paper was to develop a socio-environmental learning model. Specifically, it sought to:

1. Determine the socio-environmental factors that affect learning
2. Generate an equation model for optimum transfer of learning
3. Propose a learning theory involving the socio-environmental factors of the model

Delimitation

This study is delimited to the learning model based on the agent-based model of the NetLogo software through data simulation.

Methodology

This study investigated the effects of socio-environmental factors in learning employing factorial design. Three factors were considered as predictors of learning that were associated with the parameters of NetLogo software. The first factor was the average number of effective teachers per student. Teachers create learning environments such that optimal learning is achieved. It is assumed that there is sufficient amount of learning received by each student when they are engaged with effective teachers. That is to say, for each school year, each student must be in contact with more effective teachers in their respective classes. It follows that the greater number of effective teachers, the greater learning is acquired. The second factor was the amount of contact time or periods with the effective teachers. We considered the contact time as the time of the learning process when a student is engaged with effective teachers. Contact periods may occur in the classroom or may be during consultation periods. In the classroom, it is assumed that there is significant amounts of “transfer of learning” since students were engaged with effective teachers. The third factor is the amount each student spent on study time. We assume that lessons presented in the classrooms should be reinforced with sufficient review and extensive research on the part of the students outside of the classroom. Study time however is flexible for each student. All the three factors were translated to adhere to the parameters and the underlying assumptions of the NetLogo software simulation.

NetLogo: Translation of the Factors

We translated our factors so that they would fit in with the parameters of the borrowed model from the NetLogo software—a multi-agent programmable modeling environment. This

software contains wide-ranging models where one of them is the AIDS model. It simulates the sexual transmission of a population. This model examines the emergent effects of the aspects of an individual's sexual behavior. The factors were translated in the AIDS model so that the context would be set in accordance to the socio-learning model. In particular, the virus is translated as “effective teacher”, and the infection caused by the virus is the “learning gained”.

The (real-life) interaction between the students and effective teachers was imitated through a computer simulation. The parameters in the NetLogo software were adjusted so that each of the three factors has two levels as high or low. The parameters of the model in the NetLogo software have been extensively described from the NetLogo models library which can be found in the software itself. For the number of effective teachers, values from 1 to 5 are considered low while values from 6 to 10 are considered high. For the amount of contact time, below 150 weeks is considered low and above 150 weeks is considered high. In the NetLogo, the factor ‘contact time’ was reversed with ‘non-contact time’. The factor on ‘study time’ was also reversed to ‘non-study period’ so that zero contact time is considered high and above zero is considered low.

The AIDS model fits this study in certain ways. Specifically, the infection of the virus was translated as the ‘transfer of learning’ as a result of students’ contact with effective teachers. Hence the virus is the ‘effective teachers’ and the way the students are engaged with them are its effects. The parameters defined in our model are as follows: [1] the average number of effective teachers per student, [2] the amount of non-contact time between the effective teacher and the student, and [3] the amount of non-study period of a student.

The model simulates the transfer of learning by subjecting the learner to have contact with effective teachers while considering his non-study periods. The assumptions are: [1] the

greater the amount of time the learner is in contact with effective teachers, the greater the learning; and [2] the greater the amount of time for non-study periods the lesser the learning. The learning model examines the effect of four aspects of social and environmental behavior of a learner.

Concept Map of the Model

NetLogo AIDS Model	Learning Model
<ul style="list-style-type: none"> HIV (+) infected 	<ul style="list-style-type: none"> Learned. This means that a successful transfer of learning (at a right amount of content and learning outcomes) has taken place.
<ul style="list-style-type: none"> HIV (-) not infected 	<ul style="list-style-type: none"> Not Learned
<ul style="list-style-type: none"> Number of people. 	<ul style="list-style-type: none"> Number of students who received learning from effective teaching. We assume that learning received from effective teachers is at least 85%. The more effective teachers a student is in contact with, the more likelihood that the student received learning.
<ul style="list-style-type: none"> Average coupling Tendency. General likelihood member of population has sex (max of 10). 	<ul style="list-style-type: none"> Number of effective teachers per student. The higher the number of effective teachers per student, the more likelihood the student learns. An average of 6 or more effective teachers per student is considered high. 10 effective teachers is considered maximum per student.
<ul style="list-style-type: none"> Average commitment (in weeks) 	<ul style="list-style-type: none"> Amount of non-contact time periods of students with effective teachers. This 'contact' involves a learning engagement or activity. The higher the amount of non-contact time periods with effective teachers of a student, the lesser the learning. An average of 150 weeks is considered low.
<ul style="list-style-type: none"> Average condom use (assumed as 100% protection) 	<ul style="list-style-type: none"> The amount of non-study periods (time) of each student. A non-study time period involves the absence of study time. The higher the amount of non-study time period, the lesser the learning.
<ul style="list-style-type: none"> Frequency of Testing (per year) 	<ul style="list-style-type: none"> The average frequency of a student to get tested with successful 'transfer of learning' resulting from learning engagement with effective teachers.

Linear Modeling

In the model, the response variable was 'learning'. The factors include 'effective teacher', 'non-contact time', 'non-study period, and the

interactions. The interaction effects include [1] Effective teacher and non-contact time, [2] Effective teacher and non-study period, [3] Non-contact time and non-study period, and [4] Effective teacher and non-contact time and non-study period. All factors have two levels high or low. The simulation was carried out using various combinations of factor levels, Each run was recorded and then analyzed through general linear modeling procedures.

Results

Table 1 presents the result of the simulation using the parameters that were set at the start. The result shows that a student is able to acquire learning by an average of 84% when a learner comes in contact with an average of six effective teachers. Similarly, a student is also able to acquire 84% rate of learning when there is a high amount of study time, even if the student has a low amount of contact time with effective teachers. Further, there is an average of 85% acquisition of learning even if the the non-contact time with highly effective teachers is low and the non-study period is either high or low. Thus, the results suggest that even if there is variation in the non-study periods across students and low contact time with highly effective teachers the students are still able to acquire high rate of learning. On the other hand, when both the number of effective teachers and the non-study period is low given that the non-contact time is high, on the average, the transfer of learning is less than 5%. Moreover, transfer of learning is also low when the number of effective teachers is low even if non-contact time and non-study period are high.

Table 1. Data Simulation Results

		Factor A (The number of effective teachers per student)			
		Low		High	
Factor B (Non-contact time)	Low	High	Low	High	
	Low	4.00	12.00	80.33	10.00
4.55		8.33	83.33	7.33	
3.33		13.00	87.00	8.61	
5.00		9.33	83.33	9.33	
3.00		7.67	85.67	11.67	
High	5.56	9.00	86.33	7.00	
	4.00	6.30	86.00	8.00	
	4.00	4.33	84.67	6.00	
	4.33	3.60	86.10	11.67	
	4.67	8.00	90.00	8.33	

Results from Analysis of Variance

Table 2. The ANOVA Table

Source of Variation	DF	Adj SS	Adj MS	F	p-value
Effective teacher	1	13640.50	13640.50	3696.11	0.000
Non-contact time	1	92.70	92.70	25.12	0.000
Non-study period	1	36.20	36.20	9.81	0.004
[1]*	1	5855.40	5855.40	1586.61	0.000
[2]*	1	3.90	3.90	1.05	0.314
[3]*	1	23.80	23.80	6.45	0.016
[4]*	1	42.60	42.60	11.53	0.002
Error	32	118.10	3.70		
Total	39	46166.10			

The interaction effects:

- [1]*-Effective teacher and non-contact time.
- [2]*-Effective teacher and non-study period.
- [3]*-Non-contact time and non-study period.
- [4]*-Effective teacher and non-contact time and non-study period.

Model summary: $r^2 = 99.74\%$

Table 3. Coefficients of the Model: Test of Significance

Term	Coefficient	SE Coefficient	T-value	p-value
Intercept	3.976	0.85913	4.63	0.000
Effective teacher	73.866	1.21499	60.79	0.000
Non-contact time	6.090	1.21499	5.02	0.000
Non-study period	-3.806	1.21499	-3.13	0.004
[1]*	-68.442	1.71825	-38.83	0.000
[2]*	-1.758	1.71825	-1.02	0.314**
[3]*	4.364	1.71825	-2.54	0.016
[4]*	8.252	2.42998	3.39	0.002

**not significant

Discussion

The linear regression equation reveals all factors that affect learning. The factor ‘number of effective teachers per student’ has the greatest influence in learning. All factors of the model and the interaction between factors are significant, except for the interaction between ‘average number of effective teachers per student’ and ‘non-study period’. This implies that the teacher had most likely very little influence over the amount of time the students spent in studying. In fact, effective teachers are of great help especially in encouraging their students to understand the importance of placing a huge amount of study time in their works in order to do well. So when there is variation in study among students, it could suggest that they have

difficulty with their priorities. However, this might not be always true for most students. Hence, this non-effect needs to be deleted in the final model.

The results also suggest that there is much influence of an effective teacher over the learning of students. Obviously, the ‘teacher factor’ is an important factor in learning. This result conforms with the claim of Kolb (1984) and Stronge (2011) that effective teachers are the key to transfer learning. This implies that the higher the number of effective teachers a particular student is engaged with, the higher the amount of learning is received by that student. This further suggests that schools might consider the enhancement of faculty to increase their capability.

This result is in accordance with the Kentucky Department of Education description of Highly Effective Teacher. Some of these characteristics support teaching and learning outside classroom setting. One characteristic of an effective teacher is creating a learning environment where students are active participants as individuals and as members of a collaborative group, and two, effectively allocates time for students to engage in hands-on experiences, discusses and processes content, and makes meaningful connections which can be done outside the classroom setting and beyond the class schedules.

It is also important to note that 99.74% of the variability in the learning model can be explained by the independent variables such as average number of effective teachers per student, non-contact time, and non-study periods and their interactions. This implies that 99% of the variability (explained variance) of the independent variables has been accounted for in the model. Further, almost all the data from simulation fall within the linear model. The model shows that the average number of effective teachers per student greatly influences the acquisition of knowledge and transfer of learning. Furthermore, the model shows that

increasing the non-study period will decrease learning.

On the other hand, increasing the non-contact time still contributes to the increase of learning. This implies that effective teachers do not confine teaching and learning in the four corners of the classroom. As mentioned by Lakatos and Borsos (2011), e-learning and distance learning are some of the effective teaching methods for knowledge transfer. Thus, effective teachers must employ strategies for optimum transfer of learning.

Conclusion

The socio-environmental factors we have taken into consideration indeed affect learning. The number of effective teachers per student, amount of contact time between the student and the effective teachers, and the amount of study time of students account for 99% of the variability of learning in the model. In the learning process, students acquire learning at an average of 84% when they are engaged with effective teachers. The greater the number of effective teachers per student, the greater is the amount of learning received. Further, students still receive high learning rate even if there is a low contact time between them and the teachers. Hence, when students are more exposed to effective teachers employing effective methods of learning, then there is a greater likelihood that these students receive optimal learning.

Recommendation

Since the study used data resulting from the simulation process of the NetLogo software, it is recommended that a parallel study will be done using actual data to better appreciate the use of the software.

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