THE LEARNING APPROACH OF PREUNIVERSITY STUDENTS AND ITS RELATIONSHIP WITH THEIR PERFORMANCE IN MENDELIAN GENETICS

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Abstrak: Semakin ramai ahli pendidik serta pengkaji menganjur penggunaan secara meluas pelbagai strategi kognitif serta metakognitif dalam usaha untuk meningkatkan pembelajaran dan pemikiran pelajar. Efikasi pembelajaran pelajar sebahagiannya ditentukan oleh kebolehan mereka dalam menangani tuntutan kognitif serta konteks pembelajaran (Shuell 1986; Snowman 1986). Pelajar-pelajar yang boleh mengenal pasti secara jelas gol pembelajaran mereka lebih berkebolehan untuk mencapai kejayaan dan juga lebih berupaya untuk memantau kemajuan sendiri, dan dengan ini menjadi lebih berefikasi jika dibandingkan dengan rakan mereka yang tiada kebolehan tersebut. Sejauh mana pelajar boleh memenuhi syarat-syarat tersebut bergantung pada pendekatan mereka terhadap proses pembelajaran (Biggs 1985; Entwistle & Ramsden 1983). Kertas kerja ini akan membincang pendekatan pembelajaran yang digunakan oleh pelajar matrikulasi seperti pendekatan cetek, pendekatan mendalam dan pendekatan berorientasikan pencapaian dan hubungannya dengan pencapaian subjek dalam Genetik Mendel.

Abstract: Increasingly, more educators and researchers are promoting the wide use of cognitive and metacognitive strategies so as to enhance learning and reasoning in learners. Learning efficacies of learners are partly determined by their abilities in handling cognitive demands as well as learning contexts (Shuell 1986; Snowman 1986). Learners who can determine their learning goals clearly are able to achieve better success as well as be more capable of monitoring their own progress. In doing so, they are said to be efficacious compared to their counterparts who lack such capabilities. The extent to which a learner can fulfill such requirements would depend on the approach being adopted during the learning process (Biggs 1985; Entwistle & Ramsden 1983). This paper will discuss learning approaches undertaken by matriculation students such as surface approach, deep approach and achieving approach and its relationship with their performance in Mendelian Genetics.

INTRODUCTION

There seems to be a widespread assumption among many educators and school authorities that there exists a set of learning practices that if adhered to stringently by learners would undoubtedly guarantee them desirable outcomes. However, recent research have shown that this belief has not been proven correct (Tabberer 1984; Purdie & Hattie 1995). As a result, there is a change in the direction of research in education to now study other variables such as motivation and learning strategies (Marton & Saljo 1976), self-concepts (Purdie & Hattie 1995) and also learning approaches (Biggs 1985; Entwistle & Ramsden 1983; Novak & Gowen 1984). Learning efficacies of learners are partly determined by their abilities in handling cognitive demands as well as learning contexts (Shuell 1986; Snowman 1986). Learners who can determine their learning goals clearly are able to achieve success better and are also more capable in monitoring their own progress. In doing so, they are efficacious compared to their friends who lack such capabilities. The extent to which a learner can fulfill such requirements would depend on their approach towards their learning process (Biggs 1985; Entwistle & Ramsden 1983).

Biggs (1987) have proposed a model of learning which stated that the process of learning consists of motivational and strategic components. In other words, there exists two dimensions to the approach taken by learners which is motive and strategy. The strategy dimension refers to behaviour of learner undertaken when learning while the dimension of motive refers to personal aspects of learners such as aspiration, self-evaluation regarding academic performance and also self-concepts of abilities. The quality of learning depends on the strategies employed during the learning process and optimal results are obtained if the motive is congruent with strategies taken. Implied in this model is the assumption that the motive and strategy that learners take with them to the learning situation can be changed. This implication is important to faculty and teachers for after having determined the approach taken by the learners, instruction can now be designed and sequenced according to their needs. Learning approaches exhibited by learners, therefore, constitutes an important dimension to be examined further by researchers in their quest to understand issues related to learning.

LEARNING APPROACH

The theory underlying learning approaches has conceptualised learning as a composite of motivational and strategic dimensions known as surface, deep and achieving that categorises the important differences in how learners learn (Biggs 1987). This matter represents a learner's general orientation towards the learning process which has been found to be quite stable across various situations. The

surface, deep and achieving approaches to learning and its subscales of motive and strategies for each approach are described below.

Surface approach is composed of both surface motive and surface strategy. Surface motive includes the acquisition of only minimal conditions where the learner will strive only to pass and nothing more than that. The learner who utilises surface strategy will only focus on discrete elements but will not make the effort to integrate knowledge thus exhibiting rote learning (Kember & Leung 1998). Learners who employ a dominantly surface approach to learning often feel bored, dissatisfied or dislikes learning.

Deep motive and deep strategies are the composites of deep approach. Deep motive is the deep intrinsic interest in whatever is learned so that competencies can be developed in that subject matter. Its strategy is to gain meaning in whatever is learned through extensive readings and also to make connections between new input with the relevant prior knowledge. Deep strategy also includes making connections between evidence and conclusions (Kember & Leung 1998). This kind of approach will more often than not produce high levels of understanding towards a certain task as well as bring about positive feelings.

The achieving approach is composed of achieving motive and strategies. The motive here is to enhance the ego and feelings of self-esteem by competing to score the highest marks irrespective of whether the subject matter is of interest or not. The strategies include careful planning of the learning periods, carrying out all required readings as well as to make certain that all materials and conditions needed for success are at hand. In other words, a learner that exhibits the achieving approach is an examplary student. This kind of approach if coupled with the deep approach frequently results in excellent performance as well as a high academic self-concept (Biggs 1987).

GENETICS LEARNING

The learning of genetics is confronted with a host of problems and a lot of research has been done to arrest the problems involved so that success can be achieved by a majority of students. Misconceptions or alternative frameworks forms a serious issue and this matter arose due to many factors including instruction and information gotten from textbooks (Stewart & Van Kirk 1990; Stewart & Dale 1989; Stewart 1983; Smith & Good 1984). The main difficulty in acquiring the correct concepts in genetics is due to the fact that the concepts are in a large part comprised of theoretical concepts which are abstract in nature and not descriptive (Lawson 1995). The concept of "gene" in itself is theoretical and needs to be understood by way of the correct acquisition of other concepts such

as heredity, trait, the combination of genes that can produce a certain phenotype as well as the theory that connects phenotype to genotype (Lawson 1995).

Problem-solving in genetics generally requires the use of mathematical procedures which compounded the problems. The need to use probability concepts which is abstract has contributed towards learning difficulties in genetics (Longden 1982; Radford & Bird-Stewart 1982). Hackling and Treagust (1984) have also reported that learners tend to perceive the phenotypic ratios of 3:1 and 9:3:3:1 in mono and dihybrid crossings are fixed even though the numbers of off-spring are small. Kinnear (in Cho Kahle & Nordland 1985) reported that learners perceive the ratio concept to mean absolute values and not in terms of probability. This shows that, learners are still not clear about the role of chance events in the process of heredity. Gipson, Abraham and Renner (1989) reported that the scores for reasoning attained during problem solving in genetics is related directly to the learners' intellectual level. Due to this, they have maintained that learners must have developed their intellect to the level of formal-operational or be able to reason at the hypothetical-deductive level in order to succeed in Mendelian Genetics.

However, the failure of a majority of learners at university level to exhibit the use of higher-order reasoning strategies such as the identification and control of variables, probabilistic thinking, correlational thinking, proportional thinking as well as combinatorial thinking have been extensively reported (Lawson, Nordland & De Vito 1975; Chiappetta 1976; Gipson, Abraham & Renner 1989). Studies carried out by Sharifah (1999, 2000) have reported that only 16.67% matriculation students of Universiti Sains Malaysia are able to reason at the hypothetical-deductive level and among those undergoing a postgraduate Diploma of Education only 14.8%. Similar findings by Syed (2000) reported that only 19% of matriculation students studying at MARA Colleges can reason at the formal level. Sharifah (2003) concluded that failure to do well in preuniversity genetics was largely due to the inability of the students do reason at the hypothetical-deductive level.

Current studies in genetics learning have been making a change in direction. As a result of new understandings in learning, "conceptual ecology" of the learner is significant as it gives a more holistic representation of the interactions occuring between context and the environment, thereby factors which are non rational have begun to attract the attention of researchers. Lawson and Worsnop (1992) have looked into the intuitive and reflective beliefs of learners on their performance in genetics and evolution and, Lawson and Weser (1990) have also looked into similar aspects. In the Malaysian context, Sharifah (2002, 2003) have looked into epistemological beliefs of learners as well as conflict in the learning of Mendelian Genetics.

Learning approaches of learners proves to be an equally crucial variable to be studied so that educators and instructors can benefit from the findings and design instruction accordingly so as to make the learning of Mendelian Genetics more dynamic and less problematic.

PURPOSE OF STUDY

This study was done to answer the following questions:

1. Which of the learning approach or subscales of it (motive and strategy) show a strong relationship with achievement scores in Mendelian Genetics.

2. Are there differences in the learning approaches or subscales of it (motive and strategy) between high-achieving and low-achieving students?

METHODOLOGY

The sample consists of matriculation students (N = 236) undergoing the life sciences program at one Kolej Matrikulasi, Ministry of Education Malaysia. Two hundred and thirty-six students representing 2 intact lecture groups were chosen randomly from several existing lecture groups. Learners were categorised into high-achieving and low-achieving groups based on their performance in the Biology paper for Semester 1. Students attaining grades A, A- and B+ were categorised as high-achieving while the rest were categorised as low-achieving.

Learning Process Questionnaire (1987)

The original version of the questionnaire constructed by Biggs (1987) will produce scores on 3 motive and 3 strategy subscales and together will result in scores for the learning approach comprising of both motive and strategy. The 3 learning approaches, namely (1) surface, (2) deep and (3) achieving is each made up of 6 items on motive and 6 items on strategy resulting in 36 items altogether. This questionnaire is in the form of a Likert scale with 5 responses ranging from "this statement is never true or seldom true for me" worth 1 point to "this statement is always true of me" worth 5 points. The score for each kind of learning approach would be the total score coming from its motive and strategy scales. The distribution of items for the subscales of surface, deep and achieving learning approach are given in Table 1.

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Table 1. Distribution of items in Learning Approach Questionnaire

Subscales	Item nos.
Surface motive	1, 7, 13, 19, 25 and 31
Deep motive	2, 8, 14, 20, 26 and 32
Achieving motive	3, 9, 15, 21, 27 and 33
Surface strategy	4, 10, 16, 22, 28 and 34
Deep strategy	5, 11, 17, 23, 29 and 35
Achieving strategy	6, 12, 18, 24, 30 and 36

The original questionnaire in English was translated into bahasa Melayu (Mardiana & Sharifah 2003) had been checked and edited by a bahasa Melayu expert for proper use of language. The bahasa Melayu version was then promptly back translated into the English language and further checked to ensure that the essence of the items remained. The reliability coefficient of this questionnaire was found to be 0.7530 (N = 229).

Mendelian Genetics Post Test

This is a paper and pencil test and administered to all the subjects. The items of the test consisted of problems involving both mono and dihybrid crosses in Mendelian Genetics based on the syllabus prepared by the Ministry of Education for Matriculation and Higher Certificate of Education (STPM). There were a total of 7 problems consisting of 17 small parts altogether to be answered in 1½ hours. A pilot study was done on 60 matriculation non-target students to obtain its reliability coefficient. The reliability index was found to be 0.7096.

RESULTS

Table 2 shows the correlation between subscales and scales of the learning approach and scores on Mendelian Genetics test. The results show that all the subscales and scales correlated significantly with each other. However, scores on Mendelian Genetics test showed a significant correlation with only deep motive and achieving motive.

Table 2. Correlation between scales and subscales of learning approach with scores on Mendelian Genetics

	Surface motive	Deep motive	Achieving motive	Surface strategy	Deep strategy	Achieving strategy	Surface approach	Deep approach	Achieving approach	Genetics score
Surface motive	1.00									
Deep motive	0.304**	1.00								
Achieving motive	0.357*	0.445**	1.00							
Surface strategy	0.223**	-0.142*	0.097	1.00						
Deep strategy	0.166*	0.607**	0.322**	-0.202**	1.00					
Achieving strategy	0.224**	0.354**	0.366**	-0.114	.378**	1.00				
Surface approach	0.786**	0.106	0.291**	0.778**	-0.021	0.072	1.00			
Deep approach	0.257**	0.880**	0.422**	-0.194**	0.912**	0.409**	0.042	1.00		
Achieving approach	0.338**	0.473**	0.769**	-0.028	0.426**	0.876**	0.200*	0.499**	1.00	
Genetics score	0.055	0.138*	0.133*	-0.111	-0.026	0.005	-0.035	0.056	0.072	1.00

Table 3. Mean and standard deviation of scales and subscales of learning approach of high and low achievers

	High/Low	N	Mean	Std. Deviation	Std. Error Mean
Surface motive	High	162	23.3395	3.6631	0.2878
	Low	73	22.8219	3.9593	0.4634
Deep motive	High	162	23.5926	3.0043	0.2360
	Low	73	22.7260	3.2372	0.3789
Achieving motive	High	162	23.3642	4.4145	0.3468
	Low	73	22.3151	3.5350	0.4137
Surface strategy	High	162	15.5556	3.5263	0.2771
	Low	73	17.2466	3.8253	0.4477
Deep Strategy	High	162	21.4383	3.4352	0.2699
	Low	73	20.1507	3.7404	0.4378
Achieving Strategy	High	162	22.7284	5.9793	0.4698
	Low	73	20.3699	4.0774	0.4772
Surface Approach	High	162	38.8951	5.5422	0.4354
	Low	73	40.0685	6.3799	0.7467
Deep Approach	High	162	45.0309	5.7758	0.4538
	Low	73	42.8767	6.2114	0.7270
Achieving Approach	High	162	46.0926	8.5319	0.6703
	Low	73	42.6849	6.4612	0.7562

Significant at 0.05

Table 4. T-tests of scales and subscales of learning approach for high and low achievers

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means				
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference
Surface motive	Equal variances assumed	.599	.440	.977	233	.329	.5176	.5296
	Equal variances not assumed			.949	129.629	.344	.5176	.5455
Deep motive	Equal variances assumed	.001	.974	1.997	233	.047	.8666	.4339
	Equal variances not assumed			1.941	129.976	.054	.8666	.4464
Achieving motive	Equal variances assumed	.542	.462	1.788	233	.075	1.0491	.5868
	Equal variances not assumed			1.943	170.985	.054	1.0491	.5399
Surface strategy	Equal variances assumed	.873	.351	-3.313	233	.001	-1.6910	.5105
	Equal variances not assumed			-3.212	129.225	.002	-1.6910	.5265
Deep Strategy	Equal variances assumed	2.246	.135	2.586	233	.010	1.2876	.4979
	Equal variances not assumed			2.504	128.810	.014	1.2876	.5143
Achieving Strategy	Equal variances assumed	1.418	.235	3.063	233	.002	2.3585	.7701
	Equal variances not assumed			3.522	196.594	.001	2.3585	.6697
Surface Approach	Equal variances assumed	2.821	.094	-1.432	233	.154	-1.1734	.8196
	Equal variances not assumed			-1.358	122.935	.177	-1.1734	.8644
Deep Approach	Equal variances assumed	1.863	.174	2.584	233	.010	2.1542	.8336
	Equal variances not assumed			2.514	130.197	.013	2.1542	.8570
Achieving Approach	Equal variances assumed	1.351	.246	3.041	233	.003	3.4077	1.1207
	Equal variances not assumed			3.372	179.921	.001	3.4077	1.0105

Significant at 0.05

Table 3 shows the means and standard deviations for both scales and subscales of the learning approach. Students from the high-achieving group recorded a higher mean in all subscales and scales except for surface strategy and surface approach. In this area the low-achieving group recorded a higher mean of 17.25 for the subscale on surface strategy compared to only 15.56 for the high-achieving group and also the scale for surface approach of 40.07 compared to 38.89 by the high-achievers.

The results of the t-tests showed a significant difference on the means for subscales surface strategy, deep strategy and achieving strategy as well as means for deep and achieving approaches for both high and low-achieving groups.

DISCUSSIONS

Correlational statistics have revealed several patterns consistent with what can be expected that is the surface strategy has an inverse relationship with deep strategy (−0.202**) and achieving strategy (−0.114). This means that when the learner increasingly utilises surface strategies he or she will use less and less deep and achieving strategies in the learning process. However, all three surface, deep and achieving strategies have shown a significant correlation to each other. The means for the three subscales recorded values which are very similar to one another (see Table 1). This suggests that learners posess all the three kinds of motives at nearly the same level and not any particular one as a dominant motive.

The scale of surface approach has a significant relationship with the achieving approach (0.200**) but not with deep approach (0.042). However, the deep approach had a significant relationship which was quite considerable with achieving approach (0.499**). The correlational statistic suggests that the deep perspective can be differentiated quite clearly from the surface perspective but the achieving perspective could not be differentiated clearly from the achieving approach.

Looking from the perspective of performance on their tests on Mendelian Genetics, the scores showed a significant relationship with the deep motive subscale (0.138*) as well as achieving motive (0.133*) but not with surface motive. This suggests that learners with an intrinsic interest towards genetics subject matter and also those that desire high marks in this test will be the ones that will be more successful. Interestingly, however, the scores in the genetics test did not show any significant relationship with any of the strategy subscales even though problem solving requires the utilisation of powerful learning strategies.

Looking from the perspective of high and low-achieving groups, the results of the t-tests showed that both groups differ in both aspects of strategy subscale and approach scale. Both the high and low-achieving groups did not show any significant difference in means from the motive subscale. However, as expected the high-achieving group utilised more deep and achieving strategies from the low-achieving groups and that this difference in means was significant. The low-achieving group was found to utilise more surface strategies (mean of 17.25) than those from the high-achieving group (mean of 15.55) and this difference was significant.

Overall, the high-achieving group used more deep and achieving approaches than those from the low-achieving group and that this difference was significant. Nevertheless, learners from the high-achieving group as do the low-achieving

group do employ surface approach as the difference in means between them was found to be not significant.

CONCLUSIONS

In general it can be concluded that matriculation students do not possess any one of the motives that is surface, deep and achieving as a dominant motive when engaged in the process of learning. The means from these scores displayed a value of mean which was higher than the midpoint that is 23.00 for all three motives (maximum score = 30.0). The same findings were recorded for high and low-achieving groups. The groups did not show any difference when looking from the motive perspective meaning that motive was not a strong indicator in their learning experience. This unexpected finding is worrisome and should be taken seriously by the lecturers for matriculation students are selected ones based on their excellent performance in the National Exams and the presence of surface motive is clearly not a desirable learning trait to bring to the university learning experience. Through several test–retest studies, Biggs (1987) have reported that the subscales of motive and strategy are relatively stable but they can be changed making this a challenge for matriculation lecturers.

Nevertheless, matriculation students exhibit strategies and approaches of learning which are quite clear when seen from the perspective of high and low-achieving groups. Obviously, the high-achievers displayed more deep strategies which made success easier to attain such as described in item 5 "While I am studying, I often try to think of how useful the material that I am learning would be in real life", item 11 "In reading new material, I am often reminded of material I already know and see the latter in new light".

The approach taken by high-achievers are also those that are more desirable gravitating towards the deep and achieving. Needless to say, they too engage in surface approach in much the same degree as the low-achievers. This suggests that students in the high-achieving group will employ all kinds of strategies they know in order to attain good grades.

Studies by Drew and Watkins (1998) have detected that academic self-concept will influence learning approach dan thus students' performance. Learners with a high self-concept will choose to employ deep strategies but not surface strategies (Drew & Watkins 1998; Watkins & Hattie 1990) thus interventions such as attribute enhancement are useful to bring about more positive self-concepts.

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