

**BIOTECHNOPRENEURSHIP:  
AN INTRODUCTION OF BIOTECHNOLOGY AND ENTREPRENEURSHIP  
PROGRAM  
IN ADDRESSING BEHAVIORAL PROBLEMS OF GIFTED CHILDREN  
FROM TUMBUH INCLUSIVE ELEMENTARY SCHOOL, YOGYAKARTA, INDONESIA**

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**Abstract**

Tumbuh Inclusive Elementary School is one of inclusive school at Yogyakarta that facilitates special needs student in their learning activity. The school creates Individual Educational Program (IEP) to gain special needs student competencies as their needs including gifted students. The school looks the importance of designing special program for gifted because they show some behavioral problem in daily activity at school such as tantrum; get bored easily, hiperactive, and emotional crisis. The aim of this program is to minimize the social impact of gifted children's behavioral problems towards the other children by conducting activities that stimulate their experience and knowledge in biotechnology and its implementation. The biotechnopreneurship program consists of activities that introduce the way of human being in processing food materials or environment which produces valuable products. The program decreased behavioral problem of gifted children because the superior cognitive capacity was balanced with soft and social skills. The program conducted for 9 gifted children with durations of 10 meetings which carried out biweekly for one and a half hour.

This research is one group post test only experiment design. Qualitative analysis has done to teacher's questionnaires to identify the effectiveness of the program. Qualitative analysis also has done to the student's log book and post test to observe everyday progress. The behaviors of the students influence to be better. Based on our observation, there is no clear linkage between the program activities in class activities. But, three students showed their influence to made conclusion during their experiment class activity. Two students assist the teachers in class and able to re-tell the experiment of biotechnopreneurship but they

couldnot remember the experiments detail. One student did not show any changing of his problem.

The follow up of this activities, we will lead this program to entrepreneurship by motivated the students to make their own biotechnology product as have been taught to them this semester. Then, they will sale those products to their classmate or in school fair.

**Keywords: biotechnology, inclusive education, gifted, behavioral problems.**

### **Introduction**

Nowadays, people's awareness of inclusive education has rapidly developed in Indonesia. More schools adopt the inclusion system which facilities normal children and also children with special needs. Children with superior intellectuality or usually called gifted children are also considered as the special need children, which require special treatment. Their superior intellectual capacity, which is shown by their broad knowledge and good problem solving skill, in fact is not optimally facilitated by the school. As consequences, in class, gifted children get bored easily and distracted because their aspiration and energy are not fully facilitated. Furthermore, they show some behavior problems.

In 1994 a world conference on special needs education took place in Salamanca, Spain. Almost 100 countries and many international organizations took part. A statement (subsequently referred to as the Salamanca Statement) was issued concerning the education of all disabled children. Delegates called for inclusion in mainstream schools of all children with SEN to become the universally accepted approach. The conference also proposed a framework for action which was underpinned by the principle that mainstream schools should accommodate all children, irrespective of their physical, intellectual, social, emotional, linguistic and other conditions. It also demanded that all educational policies should enable children to attend their local school, whether or not they had a disability. The Salamanca Statement was influential because it was the product of an international agreement from representatives of 92 nations. As a collective they called on governments worldwide to address a number of vital issues for the further development of inclusive education. All governments should adopt the following: a) Give the 'highest policy and budgetary priority' to improve education; b) services so that all children could be included, regardless of differences or difficulties; c) Adopt as a matter of law or policy the principle of inclusive education; d) Ensure that organizations of disabled people, along with parents and community bodies, are involved in planning decision making. The subsequent widespread publicity given to the Salamanca Statement acted as a stimulus to inclusive thinking in many countries, and greatly raised the profile of SEN in doing so (Gardner, 2009).

Indonesia government has several regulations as basic to conduct special education, they are: a) Section 32 UU no 20 year 2003 Sisdiknas that accommodates children with physical impairment, emotional problem, social problem, and giftedness, also students from left behind villages, disaster victims, and low economy; b) Section 5 UU No 20 Year 2003 Sisdiknas mentioned that every citizen has their own right to get qualified education, including children with characteristic as written at point a. Then, Indonesia government creates National Education Ministry Regulation No 70 Year 2009 about inclusive education for students with impairment and students with giftedness. There are 10 sections that arrange the practical framework until province and district level.

Inclusive education according to the Minister of National Education Regulation (*Permendiknas*) No. 70 year 2009 is defined as an education system that provides opportunities to all students with SEN and special talents and/or intelligence to have access to education or learning in an educational environment together with other students. In its application, inclusive education aims to provide as many opportunities as possible to students with SEN and develop education that recognizes diversity and non discriminatory towards all students with physical, emotional, mental and social limitations as well as those student with special talents and/or intelligence so they can receive quality education according to their needs and abilities (Aznam, 2012).

Significant momentum has also been built in Indonesia, especially in Yogyakarta has responded with the creation of regulations specifying inclusion. These regulations include Provincial Education Plan (PERDA) approved on 12 May 2011 and plans to create a provincial regulation on inclusive education are underway. Yogyakarta municipality already has a local regulation establish in 2008 and regent regulation on inclusive education are planned for the district of Gunung Kidul, Bantul, and Kulon Progo. The provincial government created several regulations specifying inclusion such as a Provincial Education Plan and a provincial regulation on inclusive education. Education authorities have worked together with the parliament and Planning and Development Agency (Badan Perencanaan Daerah) to budget funds for accessibility in schools. Furthermore, the provincial education authority has taken steps to revitalize the inclusive education resource center in the province and plan for the establishment of 5 further sub-centers at the district level.

In recent years, a focus on individual student needs has set the stage for tailoring educational interventions to address issues of students who are not working up to educational proficiency standards outlined in the No Child Left Behind (NCLB) legislation (Robertson, 2012). Luckily, this change also opens the door to meeting the needs of students who are not working to their potential in the classroom. Unfortunately, these same students spend the majority of their school days in regular education classrooms without

modifications or accommodations to the curriculum. In addition, research indicates that gifted students allowed working on additional material instead of maintaining the pace of the rest of the class actually performed better on end of the year testing in math and science than gifted controls that did not pursue additional work. Further, the gifted students who engaged in independent study performed no differently in other subject areas. The implication is that one method of improving student math and science performance is to allow for accelerated and/or enriched curricula.

Tumbuh elementary school is an inclusive school that located at Yogyakarta, Indonesia under Yayasan Edukasi Anak Nusantara (YEAN). The school starts the learning activity at 2005. Now they have already 3 elementary schools and 1 junior high school with all 425 students.

The vision of Tumbuh Inclusive School is children grow as lifelong learners, have respect for diversity and local wisdom, love the mother land and show awareness to be part of universe. Tumbuh Inclusive School has deep philosophy in learning that school must be fun for both students and educators; students and educators must enjoy learning as a life long journey; and students have sense of belonging to the learning. In conducting learning program, Tumbuh Inclusive School uses national curriculum KTSP (Kurikulum Tingkat Satuan Pendidikan) and also Cambridge Curriculum as enrichment. They also design Individual Education Program (IEP) for special need students.

Differentiation of the curriculum represents the baseline strategy for dealing with an identified SEN. The approach has been defined as 'teaching things differently according to observed differences among learners' (Westwood, 2006). It is important to note that differentiation in the curriculum is one of the bases of effective generalist teaching. It has assumed significant importance in SEN, it remains applicable across the entire curriculum and at every level of the achievement spectrum. Fundamentally, therefore, it represents recognition that learners are individuals. It is derived from a number of pedagogical approaches, notably those of task analysis, curriculum monitoring and review, pupil grouping, and learning and teaching styles. Differentiation is a relatively straight forward term to define; most teachers will agree that, because it relates to an input process output model of teaching, it is not easy to put into practice (Philip, 2009).

Giftedness has been conceptualized in a number of different ways over time, and by different authorities. Depending on the expert you ask (and at what point in time you ask that individual), you may hear giftedness characterized in a number of different ways. Sternberg and Davidson (2005) published a second edition of their book *Conceptions of Giftedness*, some 20 years after it was initially published and asked contributors to answer the following questions: "what is giftedness, how does your conception of giftedness

compare with other conceptions, how should gifted individuals be identified, how should gifted individuals be instructed in school and elsewhere, and how should the achievement of gifted individuals be assessed?" (Sternberg & Davidson, 2005, p. ix).

Differentiation of the curriculum for gifted students is the best way to optimize their potential. Usually gifted students have high interest in science and technology. One of the themes in recent science and technology is biotechnology. Biotechnology is a sample of modern science which provides teachers with a context to show how teams of scientist, technologist, and social scientist work together. It also provides opportunities for students and teachers to explore and critically debate and dilemmas in ethical issues that arise during the process (Phoenix in France, 2007). Furthermore the social and political issues arising from the practice of biotechnology provide a rich context to link science with the life world of the students.

Biotechnology has been a part of human history for thousands of years and perceived as an indicator of prosperity and development (Kwon, 2012). This study was improving the quality of our daily lives such as food, health, fuel, and environment. The growing impact of biotechnology globally and nationally over the past few decades has promoted the need for elevating general biotechnology literacy levels in all populations (Kwon, 2012).

Etymologically, biotechnology means "the study of tools from living things", combining the Greek words "bio" (living organism or life), "techno" (art, skill, system or tool), and "logos" (speech, study of) (Wells on Kwon 2012). We can conclude that biotechnology is any technique that uses living things (organism or part of organism such as enzyme, gene) to make or modify products, improve them, or develop them for specific uses.

Indonesian people recognized local biotechnology such as fermentation for long time. Tempe, tape, yogurt, kefir, salty eggs, pickled vegetables are local cuisine as biotechnology product. Modern biotechnology is central to human innovation and our future. Public knew about genetic modified organism (GMO), but they did not have enough scientific knowledge to understand it. There is a tension about the GMO. As biotechnology develops to molecular genetics, began a large gap between scientists with general public. Communities with limited understanding about biotechnology and science have to deal with conflict between commercial and politic.

Moses, 2003 said that people became confused by conflicting statements for and against; the more so as a number of food and other health scares had recently gained great prominence. Faced with conflicting claims for the new products, especially those involving

food for which there was no perceived urgency and anyway there were plenty of other options, the safest cores seemed to be maintain a healthy distance.

Again, Moses, 2003 explained that the problem of disseminating information exists at two levels: addressing the adult electors of today and ensuring that the voters of tomorrow have a good grasp of important issues through the normal processes of educating children and young people.

Biotechnopreneurship is a program that we set up to introduce biotechnology to children. We hope with this program 9th gifted students from Tumbuh Inclusive School can be an agent to biotechnology to public and they can figure their behavior as their difficulties to learn in class. This program is aimed to minimize the social impact of gifted children's behavioral problems towards the other children by conducting activities that stimulate their experience and knowledge in biotechnology and its implementation. The biotechnopreneurship program consists of activities that introduce the way of human being in processing food materials or environment which produces valuable products. This program was a pilot project which have been evaluated and considered as alternative activities that facilitate the needs of the students in the inclusive school setting.

The biotechnopreneurship program contains an introduction of microorganism, concept of fermentation, preservation of foods and generic laboratory equipments workshop.

## **MATERIALS AND METHOD**

To gain the best practice in inclusive education and facilitating gifted students, Tumbuh Inclusive Elementary School in Yogyakarta – Indonesia creates biotechnopreneurship program. The principal and its center for studies on inclusive education did this process:

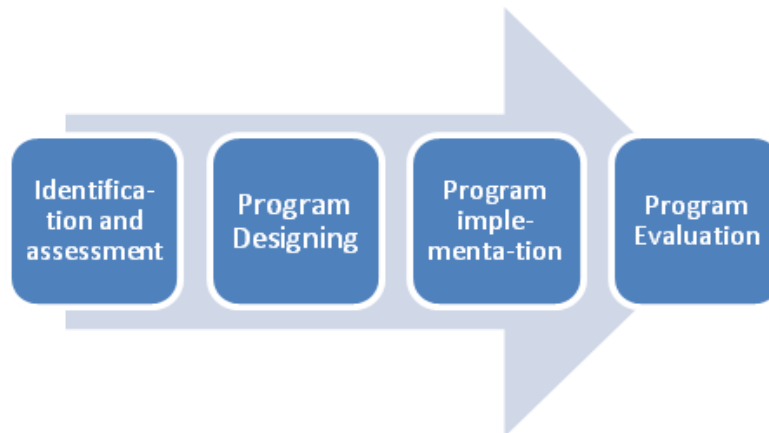


Fig 1 Research Design

The identification and assessment process was done by teacher recommendation and the IQ testing. From this process, Tumbuh Elementary school has 9 gifted students, but 1 student has to move to Australia so he only joined 3 sessions. Then Head of Schools and principals did corporation with biotechnology mentor to conduct this program. They designed *biotechnology for young learner program* to be implemented in second semester academic year 2012-2013. At the end of the program, they will evaluate all of the process to get do the next program.

Table 1 Data of students with their behavioral problem

Student Initial	Grade	Behavioral problem
DN	3th	Tantrum, emotional crisis
FL	4th	Get bored easily, low confidence to explain a result and make conclusion
RF	3th	Get bored easily, hiperactive
NN	6th	Low confidence
AW	6th	-
WL	3th	low confidence
RK	3th	Attention deficit, hiperactive
AR	3th	Talk active, bossy, tantrum
RN	6th	-

The program conducted for 9 gifted children with durations of 10 meetings which carried out biweekly for one and a half hour.

The introduction of biotechnology was begun with fermentation of yogurt and built generic microscope from web cam. The theme of this semester was preservation. We introduced the concept of preservation of their samples or their foods.

We prepared module to guide the experiment because we used inquiry based learning model. The students were guided with a problem or question, then we arranged an experiment (explanation the experiment), the students collected the data and we got them with post test. The teacher observed them during the experiment.

Biotechnopreneurship schedule was provided in table 2:

Table 2: Biotechnopreneurship schedule

• Meeting	• Day and Date	• Theme
• 1	• Thursday, • 10 January 2013	• Yogurt and meranti seeds preservation
• 2	• Friday, • 11 January 2013	• MIRA: Microscope in a Rush (generic microscope from web cam)
• 3	• Friday, • 25 January 2013	• Technique of herbarium
• 4	• Friday, • 08 February 2013	• Insectariums
• 5	• Friday, • 22 February 2013	• Bio plastic
• 6	• Friday, • 08 March 2013	• Fermentation war: microbe that blow balloon
• 7	• Friday, • 05 April 2013	• Tape: fermented cassava
• 8	• Friday, • 19 April 2013	• Sweeten fruits: diffusion-osmosis
• 9	• Friday, • 03 May 2013	• Salty Eggs: the way we preserved foods
• 10	• Friday, • 17 May 2013	• The bouncy eggs

## RESULTS AND DISCUSSION

To obtain research data, observations and teacher's questionnaire were conducted. Observations were done at biotechnology class every two weeks. Observation guideline was constructed based on the scientist attitude such as concentration, work in tidy, observation skill, scientific questioning, and constructing hypothesis. Questionnaire was fulfilled by the teachers that the gifted students are studying in their class. The teachers wrote the differences of student's attitude before and after the program. The questionnaire type is open question to gain qualitative data about student's attitude in the class.

Inquiry is the process initiated by the learner or the teacher which moves the learner from his or her current level of understanding to a new and deeper level of understanding. Tumbuh Inclusive School uses inquiry as approach in learning process with using six main units of inquiry that children explore along the school year. They are who we are, Diversity,



Indonesia, Our Earth, Technology and Innovation, and Entrepreneurship. The main units are implemented into certain topic of inquiry based on the curriculum competencies and concerning the recent issues. Then, these inquiry themes are deducted into learning method. The learning methods are wondering and questioning, experimenting, researching & seeking information, collecting data and reporting findings, deepening understanding through the application, making and testing hypothesis, and elaborating on solutions to problems.

This program has been running 9 times out of 10 meetings scheduled. A major theme in this semester is preservation. Logbook as scientific journal has been introduced in the first meeting. Based on our observation, students did not realize the importance of logbook as experiment record. They wrote down their observation during experiment if the teacher said so.

The first meeting we introduced to students the way to preserved meranti seeds and preserved milk as yogurt. We introduced to them that there was a microorganism had spoiled the milk but it still could be eaten. One of the students (DN) refused to join with the group and run. But, when he knew that his friends made yogurt in the kitchen by themselves, he was keen to join. This student has behavior problem tantrum. He grew up in a violent household. His teacher gave up by his tantrum behavior in class. But, in this program, he was only once run and back to the class in the first meeting.

Second meeting we got Dr. Marc D from Lifepatch. He taught students to built generic laboratory equipment from simple tools. The students built microscope from web cam and observed microorganism. They named the organism they saw by the generic microscope with *bubuflufu* or *microflea bubuflufu*, actually we observed water bug.



Fig 2 Students and mentors built generic microscope

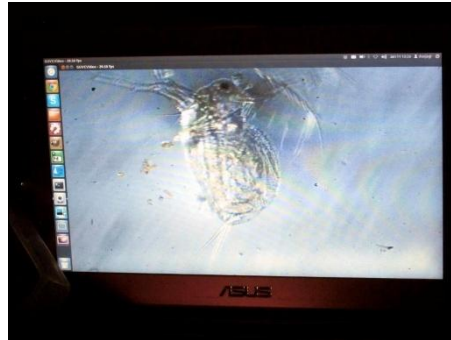


Fig 3 'Microflea bubuflufu' (water bug observed with generic microscope)

In this meeting, the students followed all the activity nicely. They contributed to finished their previous activities that had been hold yesterday, made yogurt. They also did their post test by draw their microorganism observed by generic microscope and named it.

Students' high interest in biotechnology and science are very high. They could understand and completed the difficult task of fermentation or built generic equipment quickly and well managed. We taught them about the generic equipment as their curiosity of biotechnology was high. Biotechnology represents an important field for the development of new educational tools. While the activities are very brief and simple its value of clearly visualizing and illustrating the basic techniques of biotechnology concepts cannot be disputed (Antiparmak and Yazici, 2010).

The third meeting, the students practiced to made herbarium. Herbarium is a method to preserved botanical samples. The samples were taken from the garden. The students looked for leaves with different shapes and edges. RK, RF, and DN took this opportunity to go out other activities such as played football or picked fruits and flowers. Once they got back to the laboratory, they started did their herbarium sheet. They improved their sheet by painted them with colorful paint.

The fourth meeting, the students learned to made an insectariums preserved. This method was more complicated than herbarium. They had to killed the insect by injected the insect with alcohol. The boys were very interested with this technique, but the girls became stressful. AR escaped twice from laboratory as frightened with the insects. RK improved his worked by poured a lot of alcohol in his insects' box, so the insect became spoiled the day after. Their herbarium and insectariums was displayed at Tumbuh Inclusive School open house. As the entrepreneurship program, they will make preserved sample to be sold in school fair.

The fifth meeting, students learned to preserved seeds and flower used resin. This technique was called bio-plastic. This activity was interesting and there were no students left their worked incompletely. Some students made more than one sample.

The students learned to prove single cells creatures involved in the fermentation process. We conducted an experiment proving the microbial by 'Microbes that blow the balloon' experiment. Yeast is a single celled fungus that converted glucose into alcohol and carbon dioxide in the microaerophilic conditions. The students witnessed the gas produced by the yeast by observed at the balloon inflated. They recognized that fermentation was occurred by the flavor of the sugar liquid changed into fermented flavor like tape. We observed that FL and RK have interested with this theme. FL wrote in his logbook about the time after time of gas formation. This is FL's written about the time of gas formation during fermentation:

*4 menit sudah mulai mengembang*

*7 menit sudah berdiri*

*10 menit sudah agak besar*

*30 menit sudah besar*

(4 minutes: the balloon has blown)

(7 minutes: the balloon have raised)

(10 minutes: the balloon have increased in volume)

(30 minutes: the balloon increased bigger that before)

This program was not connected with their curriculum and lesson. FL teacher observed that by this program, FL increased her confidence to explain something and helped her classmates. FL already knew the experiments steps. But after join this program, FL understood the experiments steps, more enthusiastic in science experiment lesson and good to drag a conclusion.

We introduced how amazing some microorganism did in our live and how they gave very much advantages. In the present study, before we did the experiment, the students have asked about their perception concerning the microorganism. All the students in this program defined microorganism as harmful. That opinion and perceptions were relevant with Karadon dan Sahin research in 2010. They found that 53 % of the students in 17 different primary school defined microorganism as dirt pollutant, and harmful. Most of students think that the risks of microorganisms are more than their benefits, and they stated that they feel bad when they hear the word microbe or microorganism. After we have done the fermentation experiment, students understood that there was microorganism that gave more benefits than the risks. WL explained it to her parents at home after this program.

The students learned about local fermentation by made tape (fermented cassava) in the seventh meeting. They did post test briefly. The tape they had made was good and tasty. Their parents and teachers tasted the tape they made.

We introduced the concept of diffusion and osmosis cell, the main concept in food preservation, by design an experiment to made sweetened fruits, salty eggs, and bouncy

eggs. We also made a post test and the students managed to do it well. In the eighth meeting, we made sweetened fruit (zalaca and papaya).

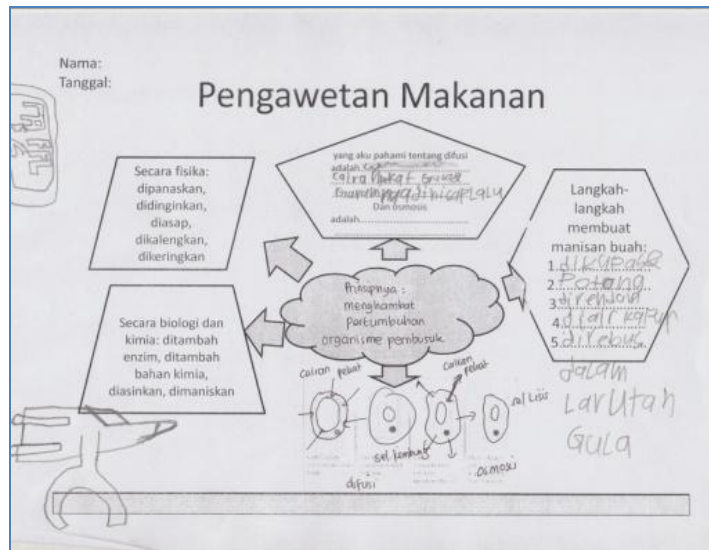


Fig 4 Students' post test about diffusion and osmosis

The students made salty eggs in ninth meeting. That was the last meeting we have done, once meeting left.

Temporary evaluation until the ninth meeting has done. From questionnaires filled by the classroom teachers, interview with parents, and observation mentors, we got feedback from the influence of this program for gifted children behavior. Their influence does not related with lesson but their habits in the classroom during class activity. For NN, FL, and WL this program increases their knowledge of science and biotechnology especially microorganism. They are more confidence to drag conclusion in their experiment and understand about experiment step. AW and RN left the program in fourth meeting because AW had to move to Australia and RN got his national exam (UAN). RK and AR showed their interest in this program and presented it in the class but they missed about the scientific step of the experiment. DN was difficult children. Normally in his class, DN could not notice the order from his teacher. But, in this program, DN almost did not show this attitude. He could understand an order, he followed the module's step of the experiment, and he did his task well. Unfortunately, DN had to left this program because his family problem. Not only this program, DN had left the class and did home schooling program. And last student, RF didnot show any change in his behavior.

## Conclusion

Biotechnopreneurship as pilot program of Tumbuh Inclusive School for gifted students showed a good result. The behaviors of the students influence to be better. Based on our observation, there is no clear linkage between the program activities in class activities. But, three students showed their influence to made conclusion during their experiment class activity. Two students assist the teachers in class and able to re-tell the experiment of biotechnopreneurship but they cannot remember the experiments detail.

The follow up of this activities, we will lead this program to entrepreneurship by motivated the students to make their own biotechnology product as have been taught to them this semester. Then, they will sale that product to their classmate or in school fair.

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