ABSTRACT

Gifted and talented students are known as highly potential students, who always seek for challenging educational circle to ensure such students are able to make progress. Number of different reasons lead to gifted and talented students’ academic underachievement. Thus, there is a need to develop strategies for uplifting the underachieving gifted and talented students and the intervention plan. The intervention plan could differ from one gifted and talented student to another. This study examines gifted and talented students’ underachievement in Chemistry. In this study, both qualitative and quantitative studies were conducted. A survey was carried out involving 63 gifted and talented students from Pusat GENIUS@Pintar Negara. The data obtained was analysed using SPSS. The finding shows that gifted and talented students are interested in learning Chemistry, however continuous motivation from both peers and teachers plays a crucial role in leading towards success.

Keywords: Chemistry, Gifted, Intervention, Talented and Underachievement.

I. INTRODUCTION

A. Gifted Students and Underachievers

Underachievement among gifted students has no universal definition and occurs when a child’s performance is below their ability. Gifted students are a group of learners who are typically considered at risk for academic failure. Gifted students may tend to give up if they are not challenged in terms of intellect and may stop caring about learning in school (Fredricks et al., 2009). Studies have shown that underachievement may result from excessive absences from school, poor performance, disruptive behaviour, low self-esteem, family problems, poverty and inappropriate curriculum and content of the subject (Reis & McCoach, 2000).

Many children have never had a pleasant or meaningful exposure to science, and some children experienced fears of science, which are sometimes transferred to them by their teachers (Greco & Greco, 1987). Chowdury (2016) conducted a study about gifted education perspectives and creative insights with a particular focus on Chemistry and science, and discussed associated teaching, learning, pedagogies, curriculum developments and assessments in the context of gifted education. Based on this research, a teacher’s personality plays a dominant role in the development of students’ attitudes, values, and ethics. Hence, teachers may always be mindful of their professional developments, grasp the required knowledge and skills and be proactive participants in the areas of socio-scientific activities related to science and Chemistry. Thus, it is crucial for the schools and teachers to understand other cultures and create suitable environment where the students can gain skills and strategies that assist them to contribute their knowledge with wide range of social and cultural settings of human beings.

Gifted students need to be challenged based on their abilities and prior knowledge about the subject. Some gifted students can get bored and become difficult and uncooperative in lessons when they feel demotivated by the lack of demand in the tasks set. Many teachers rarely suspect
that classroom features, pedagogical style, or their own attitudes may influence powerfully on a student's ability to succeed, and connect with the school environment (Phelan et al., 1991). Therefore, we need to provide the most suitable educational program that meets the needs of gifted and talented students. Lang et al. (2005) carried out a study in Singapore that investigated teacher-student interactions, and gifted students’ attitudes towards Chemistry within the laboratory classrooms. The research revealed that the gifted students had more positive perceptions than the non-gifted students. Positive interaction between teacher and student is able to improve their perceptions and attitudes of gifted students towards Chemistry learning, and the enjoyment of Chemistry lessons can be significantly improved among the gifted students.

B. Factors Associated with Underachievement among Gifted Students

Underachievement differs from low achievement in which underachievement is characterized by the difference between the achievement of a student and the ability of what the students can or could achieve (Snyder et al., 2019). Research shows that underachieving gifted students have fixed mindset beliefs about intelligence and lower self-regulation or motivation compared with gifted achievers (Mofield & Parker, 2019). On the other hand, based on a study done by White, Graham and Blaas (2018), motivation, emotion, and students’ perceptions of school are common factors associated with underachievement among gifted students. Similarly, Obergriesser and Stroeger (2015) also observed that motivation, learning behavior, and emotions are identified as predictors of underachievement among the gifted students.

Home factors such as parenting practices, children’s electronic media consumption, family background and involvement can lead to underachievement issues (Abelman, 2007; Reis et al., 2005). Meanwhile, negative attitudes towards schooland teachers, negative environmental and perceptions structural aspects of schooling such as classroom climate, support, availability, and specialist programs all considered as school factors that give raise to underachiever (Abu-Hamour & Al-Hmouz, 2013; Figg et al., 2012; Reis et al., 2005; Ritchotte et al., 2014; Schick & Phillipson, 2009).

Besides that, individual factors also contribute to underachievers among gifted students. These individual factors include motivation, self-regulation, goal valuation, academic self-perception, academic self-concept, learning goal orientation, emotions, resilience, self-efficacy, task meaningfulness, negative self-concept, learning motivation, personal identity, and fine motor skill (Abu-Hamour & Al-Hmouz, 2013; Dixon et al., 2006; Figg et al., 2012; Obergriesser & Stroeger, 2015; Reis et al., 2005; Ritchotte et al., 2014; Schick & Phillipson, 2009; Stroeger et al., 2008).

C. Teachers’ Developmental Plan to Reverse Underachievement

Studies have highlighted that teacher’s poor knowledge in the field of subject significantly affects student’s learning performance (Okorie & Akubuilo, 2013). Based on the study done by Okorie and Akubuilo (2013), it is important to discover how knowledgeable teachers are about the Chemistry concept taught to students in the school. Therefore, one of the interventions to reverse the phenomenon of underachievement in Chemistry is via teachers’ developmental program. The education systems are rapidly transforming around the world in order to provide necessary skills to students with higher levels of intellectual abilities and talents (Gomendio, 2017). Thus, teachers play an important role in implementing the curriculum throughout the process of educational transformation. Also, studies suggest teaching quality is important in improving students’ academic performance (Lu et al., 2017).

Based on a study done in Peru, teacher subject knowledge significantly impacts student’s achievement (Metzler & Woessmann, 2012). Moreover, studies have shown that underachieving gifted students have low self-efficacy, low tolerance for failure and often suffer from anxiety. Also, they lack study skills and fail to set appropriate goals (Reiss & McCoach, 2000). Thus, gifted students are not able to develop their full potential due to the ineffective learning behaviors. Therefore, the achievements are lower than the expected abilities (Reiss & McCoach, 2000; Thummapan et al., 2013). In order to reverse the phenomenon, previous studies have investigated the effectiveness of self-regulated learning in improving the learning behaviors of gifted students (Reiss & McCoach, 2000; Eisenberg et al., 2009; Thummapan et al., 2013).

Other studies have also associated self-regulated learning with the regulations of self-behavior which involves the active control of time, study environment and peers (Reiss & Green, 2014). In addition, self-regulation learning is also closely related to the regulation of motivation so that students are able to control their emotion and adapt to the rapidly changing demands of a course (Reis & Greene, 2014). According to Reis and Greene (2014), teachers can help students to learn self-regulation using common instructional practices such as guiding students’ goal setting, promote collaborative learning, provide constructive feedback, conduct hands-on learning and integrate experiential learning activities in the classroom. Implementing these practices helps students to strategize their thoughts. Studies implies that self-regulation among gifted children shows positive outcomes in the aspects of academic performance, problem solving skills, reading comprehension, self-efficacy, and self-motivation (Eisenberg et al., 2009).

Parent’s involvement in the educational settings of gifted children is crucial in preventing underachievement. Underachievement is often identified in the school by the teachers via standardized tests and it is measured using a student’s giftedness (ability) and a student’s performance. Therefore, parent-teacher collaboration is important in order to understand the learning styles and preference of the gifted learner. Also, a joint assessment between teacher-parent will help to identify the root cause, conflicts, or problems within the educational setting (Smutney, 2004). According to Francoys Gagné’s Differentiated Model of Giftedness and Talent, four types of environmental catalyst which include milieu (culture, family), persons (mentors), provisions (programs, activities, or services), and events will have significant impact onto the development process of gifted students (Gagne, 2000) Thus, the collaboration of school teachers and parents will help to facilitate the positive
enrichment of gifted students and provide a solution for reversing underachieving behaviors.

Counselling intervention is one of the strategies used to reverse underachievement (Reis & Greene, 2014). Counselling plays an important role in understanding the family background of a student and changing the dynamics that contribute to a student’s underachievement. Counselling can be conducted as individual counselling or group counselling which solely aims to help students to decide whether success is valued as a desirable goal. Besides that, research also shows that there is a positive impact on students’ education and personal development by conducting school counselling intervention (Parveen & Khan, 2014). Students show improvement in the classroom via classroom guidance along with individual and small-group counselling. Also, previous study conducted on counselling highlights that counselors are able to help underachievers by identifying the underlying issues, assist them via counselling and consequently analyze the effect of counselling on academic achievement (Parveen & Khan, 2014).

Apart from a counsellor, a mentor also plays an important role on gifted underachieving students. The mentorship approach on the reversal of underachieving behaviors is quite promising as it helps students to have the freedom to build a relationship with someone they trust. Studies also have shown that mentorship is an effective way in reversing underachievement in young men (Hébert & Olenchak, 2000). Also, another study shows those underachievers become highly productive when they are motivated and mentored (Kim, 2008). Thus, the gifted students are able to display a very high level of excellence with the help of mentors.

II. METHODOLOGY

A. Participants

The participants of this study were 63 gifted and talented students from Pusat GENIUS@Pintar Negara. The age group of the participants are 17 years old. All the 63 gifted and talented students were involved in the survey. However, for the interview, only 8 students who scored below the average was selected in order to further explore underachievement issues which had been identified in the document analysis and survey.

B. Document Analysis

Documents have been used as a source of data in many research reports and journal articles (Bowen, 2009), and careful selection of documents is important to provide validity for qualitative content analysis (Bryman, 2012). For the purpose of this analysis, the documents collected include the results of the students from Foundation 1 until Foundation 3 (2017-2019). The data obtained was analyzed using descriptive analysis and Greenhouse-Geisser correction via SPSS 21.

C. Survey

The close-ended responses survey questions were adapted based on a survey instrument used by Tayyaba et al. (2017). The conceptual framework proposed by Kanapathy et al. (2021) provided the basis for the preparation of the survey instrument. Face validity is defined as the deliberation of the level to which a measure reflects what it aims to measure based on the objectives of the assessment (Nunnally & Bernstein, 1994). Thus, face validity was used to determine the validity of the survey, where the experts in the field of Chemistry education, gifted education and survey construction appraised the survey before distributing it to the participants. The survey instrument of this study consists of five main sections: Section A: demographic variables (name, gender, age); Section B: interest towards Chemistry (8 items); Section C: individual attributes (5 items); Section D: institution commitment (6 items) and Section E: profession selection (5 items). Levels of agreement and disagreement were measured using a five-point Likert scale with the following denominations: Strongly Agree (SA), Agree (A), Neutral, Disagree (D) and Strongly Disagree (SD). The SPSS 21 software was used to perform descriptive analysis and Spearman correlation analysis.

D. Interview

Semi-structured interviews were carried out in order to further explore issues which had been identified in the survey. Four underachieving gifted and talented students were interviewed. For anonymity, the students are represented as student A, student B, student C and student D. The students’ consent was obtained before the commencement of data collection. The importance of feedback from each student was foregrounded to encourage their participation. The goal of the interview was outlined using an interview protocol to each student. However, students were also encouraged to share opinions emerging throughout their interviews. With the interviewees’ consent, the interviews were recorded. A maximum of 15 minutes was allocated for each interview session.

During the interview, each student was asked to explain or provide feedback on Chemistry academic self-perception, attitudes towards teachers and motivation in learning Chemistry. All interviews were transcribed verbatim. Based on the interview, the issues highlighted by the students were analyzed and coded thematically. Some of the parts of the data were analyzed by means of descriptive analysis.

III. RESULTS AND DISCUSSION

A. Document Analysis

Table I represents the analysis of students’ results. The examinations were conducted four times yearly from 2017 to 2019. The analysis shows that the lowest mean, 69.79 with the highest variation 13.86 was obtained for the November examination in 2017. However, for the year 2018, lowest mean value was 60.27, with the variation of 16.45. While for the year 2019, November examination shows the lowest mean value, 73.97 with the value of standard deviation 15.02. Overall, for examinations conducted from 2017 till 2019, the mean scores were found to be higher in March and August, respectively compared to May and November examinations. This is due to the May and November examinations being the midterm and final examinations, respectively, where these two examinations cover more chapters.
The Greenhouse-Geisser correction is used to assess the change in a continuous outcome with three or more observations across time or within-subjects. Greenhouse-Geisser correction was conducted to assess whether there were differences between the mean score of the four examinations. Table II shows the Greenhouse-Geisser correction analysis for tests of within-subjects effects. Results indicated that students did score the four examinations differently, F(2.62, 431.91)=46.07, p<0.001.

Table III shows the Greenhouse-Geisser correction analysis for tests of within-subjects contrasts. Based on the analysis, there was a significant linear trend observed, where F(1, 165)=32.17, p<0.001. However, this finding was qualified by the significant cubic trend, F(1, 165)=116.74, p<0.001, reflecting the higher score in August than May.

B. Document Analysis

Document Analysis Gifted and Talented Students’ Characteristics

The gifted and talented students’ demographic characteristics are presented in Table IV. The age group of gifted and talented students of this study was 17 years, with females as the dominant gender (n=33, 50.8%). In terms of ethnicity, 88.9% were Malay, 6.3% were Chinese, 3.2% were of other races and only 1.6% were Indian. Fig. 1 shows the gifted and talented students towards learning Chemistry. The highest level of interest was shown in the statement “I like my Chemistry class” with a mean value of 4.10, and “if I go into higher society, I will feel proud of being a Chemistry student.” (3.90). On the other hand, the gifted and talented students ascertained that Chemistry oriented jobs are dry and boring, with lowest mean value (2.05). It was also noticeable that the gifted and talented students continuously make an effort to learn Chemistry because others expect it of me (3.43). The finding of this study shows that the gifted and talented students have high motivation and involvement in learning Chemistry. Students also show a positive perception on jobs related to Chemistry.
Fig. 1. Analysis of gifted and talented students on interest towards Chemistry.

The analysis of individual attributes reveals that the gifted and talented students enjoyed doing Chemistry experiments, where the highest mean value was obtained (4.62). The second highest level of agreement was shown for “The more I learn in Chemistry, the interesting it becomes” (4.10). The gifted and talented students show the least response on “Theories in Chemistry cannot be changed or questioned” (2.94) as shown in Fig. 2.

Fig. 2. Analysis of gifted and talented students on individual attributes.

The analysis of institution commitment showed the range of agree to strongly agree for most of the questionnaire items. Analysis of institution commitment also reflects that the gifted and talented students were glad about their Chemistry teachers’ performance and tools used as a medium of teaching.

Additionally, the gifted and talented students’ profession selection related to Chemistry was observed as shown in Fig. 4. Most of the students are found to be agree that “Chemistry oriented jobs are becoming popular day by day” with a mean value of 3.79 and the second highest positive response was towards earning a handsome salary (3.75). Although the gifted and talented students would like to have a profession based on Chemistry (2.92), they do not really support that to teach us a topic, with the mean value 4.33. Analysis of institution commitment showed the range of agree to strongly agree for most of the questionnaire items. Analysis of institution commitment also reflects that the gifted and talented students were glad about their Chemistry teachers’ performance and tools used as a medium of teaching.

Fig. 3. Analysis of gifted and talented students on institution commitment.
Chemistry has a very limited professional scope (2.46) and teaching is the only profession they can join after learning Chemistry (2.25).

A chemistry-based profession will help me to earn a handsome salary. (3.75)

Chemistry oriented jobs are becoming popular day by day. (3.79)

Only teaching is a profession which I can join after learning chemistry. (2.25)

I would like to have a profession based on chemistry. (2.92)

Table V shows the correlations between the variables. The correlation was investigated using the Spearman correlation coefficient. Results revealed that there was a positive relationship between the interest towards Chemistry and individual attributes, with $r=0.476$, $p=0.006$. This indicates that the students' interest towards Chemistry is associated with individual attributes such as higher academic self-perception. However, there was a significant and weak relationship between students' interest towards Chemistry and their profession selection with $r=0.345$, $p=0.006$. Moreover, a significant and weak positive correlation also was observed between individual attributes with institution commitment ($r=0.307$, $p=0.015$) as well as profession selection ($r=0.292$, $p=0.020$). Nevertheless, their knowledge and attitude do not affect their behaviour to act positively towards the sustainable development concept.

**TABLE V: CORRELATION BETWEEN THE VARIABLES**

<table>
<thead>
<tr>
<th>Interest towards Chemistry</th>
<th>Individual attributes</th>
<th>Institution commitment</th>
<th>Profession selection</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pearson Correlation</td>
<td>1</td>
<td>0.476**</td>
<td>0.135</td>
</tr>
<tr>
<td>Sig. (2-tailed)</td>
<td>0</td>
<td>0.292</td>
<td>0.015</td>
</tr>
<tr>
<td>Institution commitment</td>
<td>0.476**</td>
<td>1</td>
<td>0.307*</td>
</tr>
<tr>
<td>Sig. (2-tailed)</td>
<td>0.015</td>
<td>0.020</td>
<td>0.015</td>
</tr>
<tr>
<td>Prof. selection</td>
<td>0.345</td>
<td>0.292</td>
<td>0.104</td>
</tr>
<tr>
<td>Sig. (2-tailed)</td>
<td>0.006</td>
<td>0.020</td>
<td>0.020</td>
</tr>
</tbody>
</table>

**.** Correlation is significant at the 0.05 level (2-tailed).

**.** Correlation is significant at the 0.01 level (2-tailed).

Fig. 4. Analysis of gifted and talented students on profession selection.

Table V shows the correlations between the variables. The correlation was investigated using the Spearman correlation coefficient. Results revealed that there was a positive relationship between the interest towards Chemistry and individual attributes, with $r=0.476$, $p=0.006$. This indicates that the students’ interest towards Chemistry is associated with individual attributes such as higher academic self-perception. However, there was a significant and weak relationship between students’ interest towards Chemistry and their profession selection with $r=0.345$, $p=0.006$. Moreover, a significant and weak positive correlation also was observed between individual attributes with institution commitment ($r=0.307$, $p=0.015$) as well as profession selection ($r=0.292$, $p=0.020$). Nevertheless, their knowledge and attitude do not affect their behaviour to act positively towards the sustainable development concept.

C. Students Perception on Learning Chemistry

Based on the survey analysis, generally the students are interested in learning Chemistry. However, there are some factors which cause the students to score lower in their Chemistry subject which leads them to be categorized as underachievers. Thus, four underachieving students from this study were interviewed on Chemistry academic self-perception, attitudes towards teachers and motivation to understand in depth from their point of view.

Generally, all the students give positive feedback about learning Chemistry. From the Chemistry academic self-perception, the students feel excited and having fun in learning Chemistry. However, student B and student C said that they are only sometimes able to do Chemistry questions on their own and most of the time they need help from their friends and teachers. Moreover, all the interviewed students highlighted that fear of failure causes them to perform poorly even though their friends, teachers, and social environment appreciate their skills and abilities. Moreover, student C and student D show their disappointment by saying that their hard work and effort always disappoint them when it comes to Chemistry examination although getting A’s is like a reward after trying hard to understand and learn Chemistry. In a nutshell, fear of failure and self-doubt about their capability of achieving success among underachieving gifted and talented students leads them to face challenging situations.

Attitude towards Chemistry is crucial and fuels interests towards learning Chemistry in order to obtain good academic achievement in science education especially in secondary schools (Abulude, 2009). Student A, Student C and Student D agreed that they show a good attitude toward Chemistry teachers and Chemistry lessons. However, Student B prefers to be quiet in class due to weak knowledge and enjoys listening and asking help from friends. All the interviewed students showed good discipline in engaging and completing Chemistry work with their own effort. Moreover, all the students have a strong belief that they will increase their GPA by giving strong commitment and effort in Chemistry.

Student’s achievement is dependent on the way of thinking, feeling and behaviour of students. In this case motivation becomes the background for someone to obtain a high achievement (Mokhtar et al., 2013). Student B and Student C are highly motivated to learn Chemistry. However, student A highlighted that Chemistry is an interesting subject to learn but not for the examination purpose. Besides that, all the students agreed that written assignments help them to learn and motivate them to explore the facts about Chemistry. When doing the assignment, Student B prefers to give maximum effort, however, student C states that he prefers to refer to peer groups to have the motivation to complete the assignment.

D. Underachieving Gifted and Talented Students Intervention Plan

The level of underachievement among the gifted and talented students is caused by internal and external factors. As educators, underachievement caused by external factors could not be changed. However, underachievement caused by internal factors could be changed. Fig. 5 shows the synthesis of the findings of this study, showing the strategies for intervention plan for underachieving gifted and talented students.
By internal factors, underachieving gifted and talented students could be helped by their friends and teachers by providing a trajectory for improvement. The progress of underachieving gifted and talented students also highly depends on the accomplishment of the roles and responsibilities carried out by the friends and teachers. Underachieving gifted and talented students strongly need motivation and peer support to complete their task and continue to perform in Chemistry subjects. This was further supported by Rule (2006), stating that peer coaching is an effective method for identifying and tackling the needs of underachieving gifted and talented students. ‘Understanding’ to overcome feelings of loneliness and isolation, ‘acceptance’ in order to overcome the fear of failure and to feel more self-confident by peers are the key factors to carry the underachievers towards success.

Moreover, underachieving gifted and talented students’ performance in Chemistry can be enhanced with right pedagogical approach, positive interaction or relationship with students, small group discussion and individual intensive class by the teachers. Teaching underachieving gifted and talented students can be more difficult than teaching students who are performing well. As highlighted by Sharp and Clemmer (2015), in terms of pedagogical approach for gifted and talented students, differentiated instruction playing a crucial role. However, for underachieving gifted students, individualised instruction, attention, and feedback is advised to create interest in learning Chemistry. Teachers are also required to build a positive interaction or relationship with the underachieving gifted and talented students in order to continuously motivate and bring the perception that the teachers are always there to coach them to achieve good grades in Chemistry. Moreover, small group discussion is advised for medium underachievers while individual intensive classes are encouraged for below medium achievers. Small group discussion and individual intensive class for underachievers, able to provide a great attention, positive feedback, and support to the academically underachieving gifted and talented students. It should be noted that underachievement could be overcome with the help and belief of the friends and teachers towards underachieving students.

IV. CONCLUSION

As a conclusion, underachievers among the gifted and talented students are categorized as a heterogeneous group, who exhibit a great variability with unique interest and abilities. There are various factors, which influence underachievement among the gifted and talented students. Gifted and talented students need to be continuously motivated to nature their potentials to the fullest. Thus, a right intervention plan is needed in order to reduce the number of underachievers among the gifted students. Identification of underachievers and implementation of intervention plan at the upper secondary level is too late to reverse their academic underachievement. Interventions designed to increase the academic achievement of gifted and talented underachievers need to be started as early as lower secondary school. Since academic underachievement is a complex process, individualized intervention plans need to be developed in order to improve academic underachievement of the gifted and talented students.

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Authors declare that they do not have any conflict of interest.

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