Report of The Polytechnic-School Review Committee

March 2006

23 February 2006

Mr Tharman Shanmugaratnam
Minister for Education

1. In October 2005, you appointed the Polytechnic-School Review Committee to explore ways to enhance the learning experience of our secondary school students through a more applied approach.

2. The Committee drew on a wealth of feedback and information in formulating its recommendations. We sought the views of our stakeholders in education – principals, teachers and students from both the schools and the polytechnics, and parents. We also consulted employers, and engaged the universities in discussion. In addition, the Committee drew insights from studies of the education systems abroad.

3. In its deliberations, the Committee considered the current education landscape. There is now greater diversity and flexibility in the education system. Nonetheless, we can do more to better meet the needs and interests of some of our secondary school students who may benefit from a more applied education.

4. There are three main thrusts in our recommendations. First, we propose greater curriculum flexibility and choice for our students by introducing more applied modules as enrichment in the upper secondary curriculum. Second, we will introduce more applied subjects that can replace existing 'O' Level subjects. Third, we want to recognise student achievements and talent beyond the academic areas and broaden measures of success. To do so, we propose to introduce a Direct Polytechnic Admissions (DPA) Exercise similar to the Direct School Admission system available for entry to secondary schools and junior colleges.

5. However, even as we introduce greater differentiation and flexibility in the school curriculum, our fundamental philosophy that students should undergo a 10-year comprehensive and broad-based education remains unchanged. This ensures that students do not prematurely specialise, and gives them a strong foundation for further studies at the junior colleges or polytechnics.

6. The success of these recommendations lies in their implementation. We propose that the applied elective modules be introduced from 2007 while the applied subjects and the DPA in 2008. These initiatives will provide the foundation and experience for us to explore closer tie-ups with polytechnics. Over time, we can consider allow some students who are very clear on their desire for a polytechnic education to progress directly to the polytechnics without taking the GCE "O" Levels.

7. The Committee is grateful for the opportunity to undertake this review. We believe that these recommendations will add to the richness and diversity of school experience for our students, better cater to their needs and allow them to pursue their passions. We will also like to express our appreciation to the many individuals and organisations who have contributed to the work of the Committee. The Committee has completed its work, and we are pleased to present the Report for your consideration.

MR GAN KIM YONG
(CHAIRMAN)

MR ZAINUDIN NORDIN

LG(NS) LIM CHUAN POH

MISS SEAH JIAK CHOO

MS CHANG HWEE NEE

MR WONG SIEW HOONG

MS HO PENG

MR TANG TUCK WENG

MR LIM CHEE HWEE

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MR CHIA MIA CHIANG

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MR LIN CHENG TON

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MDM SIM AY NAR

MR VASUTHEVAN K
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MISS TAY LAI LING

2 March 2006

Mr Gan Kim Yong
Minister of State for Manpower & Education and
Chairman, Polytechnic-School Review Committee

Dear Kim Yong,

1. Thank you for your letter of 23 February 2006. I am pleased to inform you that the Government has accepted the recommendations of the Polytechnic-School Review Committee.

2. We have a robust education system, which provides a broad-based education for our students. We have been building on this strong foundation, by moving towards greater flexibility and choice in schools, and introducing new educational pathways. As part of this direction in education, your Committee was established to examine how we can better cater to students who are keen on being exposed to applied learning in our secondary schools.

3. The Committee's proposals to allow secondary schools and polytechnics to work together to introduce diverse curriculum offerings of an applied nature will give students greater room to discover their strengths and interests. They will also allow more secondary schools to take ownership of their curriculum, and to differentiate themselves in distinct niches of learning. They will add to a lively and varied school landscape.

4. The proposal for a Direct Polytechnic Admissions exercise is also a useful step forward. It will give the polytechnics greater flexibility to select students on a broader assessment of talents and abilities.

5. Successful implementation of the recommendations will rest on a close partnership between schools and polytechnics. The polytechnics have an important role to play in helping schools design modules and subjects that are challenging and useful. The Ministry of Education will commit the necessary resources to support these initiatives.

6. I would like to thank you and members of the Review Committee for a set of practical and worthwhile recommendations. They will add to the Government's efforts to nurture diversity, develop every talent and help every Singaporean reach his or her fullest potential.

Yours sincerely,

THARMAN SHANMUGARATNAM

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Executive Summary

Executive Summary

1. The Polytechnic-School Review Committee, chaired by the Minister of State for Education & Manpower Mr Gan Kim Yong, was formed in October 2005 to explore ways to enhance applied learning options in secondary schools.

2. The Committee has completed its review. Its findings and recommendations are presented in this report.

BACKGROUND

3. We have introduced greater diversity in the education system to better cater to the different strengths and interests of our students. This included the introduction of the Integrated Programme (IP)[1], the Sports School, NUS High School for Maths and Science and the upcoming Arts School[2]. We have also widened discretionary admission into secondary schools, JCs and universities with the aim of recognising a wider range of talents.

4. We are providing for greater choice in the curriculum in mainstream schools. Elective Modules (EMs) for Normal course students have been introduced to allow for more practical, hands-on learning and to expose students to possible courses of study at the ITE. Several secondary schools are also offering new subjects such as Drama, Computer Studies and Economics at the GCE 'O' level from 2006. JC students will benefit from a new broader and more flexible GCE 'A' level curriculum from this year, which will allow those with the talent and interest in particular areas to pursue them in greater depth.

Catering to Applied Learning Interests

5. Feedback from students indicates that many desire to be given more room to offer applied subjects in secondary schools. These include significant numbers of students who are eligible to go to JCs but choose to go to polytechnics[3]. There is also interest in applied learning among students who intend to take the academic pathway at the JC levels and beyond, but would like greater exposure to applied, hands-on and project-oriented approaches towards learning.

6. Several other countries recognise the value of providing elements of an applied education in secondary schools. In Switzerland, for example, close to 70% of the upper secondary cohort undergoes apprenticeship training in banking and industry. Sweden offers 17 national programmes to all their upper secondary students, of which 14 are applied in nature, enrolling about 80% of students. These

[1] The Integrated Programme caters to students who are clearly university bound. It allows them to skip the GCE 'O' level examinations, and creates more time and space for these students to engage in a broader range of learning experiences.

[2] These three schools are 'Specialized Independent Schools', designed to cater to special talents within our education system.

[3] Our polytechnics currently take in about 40% of each GCE 'O' level cohort. Among those who go to the polytechnics, about 30% (i.e. about 12% of the 'O' level cohort) are eligible to enter JCs but choose to go to polytechnics.

include areas such as Mass Communications, Auto Engineering, Health and Nursing and Hotel, Restaurant and Catering. In some top high schools in Japan, students are required to take at least one applied subject, to encourage them to go beyond being "book smart".

7. We believe that our students should continue to benefit from a 10-year comprehensive and broad-based education. A secondary school education should not be overly specialised, and should provide a good foundation in the fundamentals that prepare students for further studies at the JCs, polytechnics or ITE. In our secondary schools, all students are required to take a core of subjects comprising English Language, Mother Tongue Language, Mathematics, at least one Science subject, and at least one Humanities subject[4]. This core of subjects remains relevant for the future.

RECOMMENDATIONS OF POLYTECHNIC-SCHOOL REVIEW COMMITTEE

8. After considering feedback from students, parents and the educators, the PSRC recommends giving our secondary school students more opportunities to experience an applied approach to education. This will further enrich students' learning experience, help them to discover their strengths and interests in applied learning, and allow them to make more informed decisions on their future course of studies.

Recommendation One – Introduction of Advanced Elective Modules

9. The Committee recommends that the polytechnics be allowed to work with selected secondary schools to offer Advanced Elective Modules (AEMs) to upper secondary students in applied areas such as Online Entrepreneurship, Digital Media and Basic Electronics. The AEMs will not be part of the slate of subjects that students offer at GCE 'O' level examinations.

10. Currently, Elective Modules developed by the ITE are offered to Normal (Academic) and Normal (Technical) students to enhance their learning experience. These EMs, which last between 20 – 30 hours, have been popular with students, as they are effective in engaging them in hands-on learning in areas of interest to them.

11. The AEMs will differ from the existing EMs in that they will go into greater depth and rigour in their respective fields, and will be of a longer duration. Each AEM will comprise about 40 hours of contact time, of which practical content such as laboratory work, projects and presentations will typically make up about 50%. Depending on the nature of resources required, an AEM could be conducted within the secondary school involved or in a polytechnic campus.

12. To recognise students' efforts in taking AEMs, their participation and grades in AEMs will be considered by the polytechnics within the framework of their

[4] The core examinable subjects for Normal (Academic) students exclude a Science subject.

discretionary admissions[5]. The polytechnics will also consider if students could be given credit exemption for certain polytechnic modules where relevant.

13. As a start, the polytechnics could work with 10 to 15 secondary schools to develop a range of AEMs customised to suit the areas of focus and interests of the participating schools. The first AEMs could be offered from January 2007.

Recommendation Two – Introduction of New Applied Subjects at the GCE 'O' level Examinations

14. The current GCE 'O' level curriculum includes a few subjects of an applied nature, namely Design & Technology, Principles of Accounts, and Food & Nutrition.

15. The Committee recommends that the polytechnics work with a few schools to develop new applied subjects that students can choose from in lieu of existing GCE 'O' level subjects. The report refers to these as 'Applied Graded Subjects' (AGS). The new AGS will be equal in rigour and scope to a full GCE 'O' level subject[6]. Students will still be required to offer the five core subjects, to ensure that they continue to have a basic and broad-based foundation of academic knowledge.

16. The polytechnics can also decide to give students exemption from certain polytechnic modules if the relevant topics have been covered in the AGS.

17. We expect that AGS will initially be offered in 4 to 5 secondary schools. The subject areas being explored include Interactive Multimedia Development and Electronics. The polytechnics and schools intend to roll out some of these AGS in 2008. The polytechnics may expand their offerings subsequently if there is strong demand and interest from students, subject to the availability of teaching resources.

Recommendation Three – Introduction of Direct Polytechnic Admission

18. The Committee recommends that a Direct Polytechnic Admission (DPA) exercise be introduced, similar to the Direct School Admission (DSA) exercise[7] for secondary schools and JCs. The DPA Exercise could ride on the same processes as for the JCs, i.e. application will be open in May/June and the outcome released in August, before the GCE 'O' levels examinations.

19. Under the DPA, while students will continue to take their GCE 'O' level examinations, they will benefit from an early confirmation of a place in the polytechnics in the course of their choice. Allowing students to gain confirmed admission into the polytechnics early, before their 'O'-level results, will allow them to benefit from special programmes which will be offered by the polytechnics. For example, students could take up a special 10-week preparatory programme in the

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[5] Beginning 2006, up to 5% of students will be admitted by the polytechnics on a discretionary basis under the Joint Polytechnic Special Admissions Exercise (JPSAE) in March each year. This will allow a wider range of abilities to be considered for polytechnic admission.

[6] We expect that some of the applied subjects will be developed as an extension of the shorter Advanced Elective Modules (AEMs).

[7] Since 2004, selected schools have been allowed to admit a percentage of their students using their own set of merit-based and transparent criteria such as students with special talents. These include our government schools and independent schools.

polytechnics between January to March, covering modules such as Communications and Foundational Mathematics. The DPA will also give the polytechnics greater flexibility to assess students holistically, for example, based on evidence of their interests and aptitude in applied learning[8].

20. For a start, we target to have up to 500 students admitted under the DPA each year, or 100 per polytechnic. This is equivalent to about 2.5% of the polytechnics' annual intake, and will be in addition to the 5% of annual intake that the polytechnics can currently admit under the Joint Polytechnic Special Admissions Exercise[9] which takes place after the GCE 'O' level results. The DPA scheme can be expanded after the polytechnics have developed confidence in their direct admission procedures. MOE intends to start the DPA in May/June 2007 for admission to the polytechnics in 2008.

LOOKING AHEAD

21. In the long term, as the polytechnics and schools gain more experience, we can explore how some secondary schools can have closer tie-ups with polytechnics. This could include allowing some students who are very clear on their desire for a polytechnic education to progress directly to the polytechnics without taking their GCE 'O' level examinations. This will give schools greater latitude to develop a curriculum to meet the needs and interests of such students.

[8] In selecting the students through the DPA, polytechnics will ensure that the student will be able to cope with the rigours of a polytechnic education.

[9] Together with the 5% of students admitted after their 'O' level during the Joint Polytechnic Special Admissions Exercise (JPSAE) in March each year, this means that the polytechnics will be able to admit up to 7.5% of their intake on discretionary grounds.

CHAPTER 1

Introduction

Chapter 1: Introduction

TOWARDS GREATER DIVERSITY AND CHOICE

1. Our education system aims to provide our students with a balanced and well-rounded education, and to develop and nurture them to their full potential.

2. To achieve this, MOE has in recent years introduced various initiatives to bring about greater diversity and flexibility in the education system. As students have different strengths and interests, these efforts are aimed at allowing our students to develop their potential to the fullest and ensure that they are well-prepared for future challenges. Some of these initiatives include:

a. The setting up of the Sports School and the NUS High School for Maths and Science to cater to students with exceptional abilities in the sports and maths/sciences respectively and a third school, the Arts School, will be set up in 2008;

b. The introduction of Integrated Programmes (IP) in 12 schools to provide a seamless upper secondary and JC education for students. As students in the IP are not required to take the GCE 'O' level examinations, they are able to benefit from the time freed-up from examination preparation to enrich and broaden their educational experience; and

c. The introduction of Elective Modules to N(A) and N(T) students, to deepen their understanding of key concepts, stimulate their interests, and expose them to fields that they can pursue subsequently.

POST-SECONDARY EDUCATION OPTIONS

3. Today, our students enjoy a 10-year broad-based education in our primary and secondary schools, which gives them a strong foundation upon which to further their education. In addition, various non-academic programmes offered in the schools support students' development into well-balanced individuals.

4. After completing their secondary education, students may further their studies at the Junior Colleges / Centralised Institute, polytechnics, or the Institute of Technical Education. The JCs / CI provide a more academically oriented education, the polytechnics adopt a more applied approach towards learning, while the ITE prepares students with the technical knowledge and skills relevant to industry. There are currently 17 JCs, 1 CI, 5 polytechnics, and 1 ITE (3 colleges) in Singapore.

5. Admission into the various post-secondary education institutions is based on GCE 'O' or 'N' levels grades[10]. Every year, out of each GCE 'O' levels examination

[10] Applicants need to have L1R5 scores of at least 20 to be eligible for admission into JCs and an L1R4 of at least 20 for the CI. Applicants to the polytechnics will need to meet the minimum entry

cohort of about 34,000 students, close to 40% go on to study in the JCs / CI, while an approximately equal number are admitted to the Polytechnics.

A MORE APPLIED APPROACH TOWARDS LEARNING

6. While the current system where specialisation takes place at the post-secondary level has served us well, more could be done to help our students further develop their interest and talents, especially in the applied areas. We have already started Elective Modules (EMs) for students in the Normal courses to give them a taste of different vocational and technical education available at ITE. We can do more for students in the Special, Express and Normal (Academic) courses who may benefit from a more applied approach to learning, such as that provided in our polytechnics, at an earlier stage of their education.

7. There is a growing interest among our students for an applied education. This is evident in the following developments:

a. Increasing Numbers of JC-eligible Students Going to Polytechnics: In recent years, there have been an increasing number of students who did well in their GCE 'O' level (L1R5 ≤ 20) and were eligible for JCs/CI but chose to go to polytechnics. The proportion of GCE 'O' level students who were eligible for JCs but chose to progress to the polytechnics increased from 25% (4,400 students) in 2001, to 30% (6,300 students) in 2004. Most of these students desired a polytechnic education, as almost all of them chose a polytechnic course as their first posting choice in the Joint Admissions Exercise (JAE).

b. More Polytechnic Graduates Going to Universities: Increasingly, more students are also seeing polytechnic education not as an end in itself but as an attractive and viable route for progression to higher education. According to a survey conducted by MOE, about 40% of our recent polytechnic graduates either possess university degrees, or are currently pursuing further studies. The number of polytechnic graduates admitted to our local universities (NUS, NTU, SMU) in 2001 was 952. By 2005, this had doubled to 2046.

c. High Quality of Polytechnic Education: The polytechnics were set-up to train manpower in professional and technical areas to support Singapore's knowledge-based economy. Today, our 5 polytechnics have established themselves as world class institutions providing a wide range of high quality programmes with an applied learning focus for our students, whether their aspirations are to continue to higher education in universities, or to join the workforce.

8. While there is strong interest among students to pursue an applied pathway in education, the current secondary education system and curriculum may not fully cater to their needs. Today, our secondary school students study a broad-based

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requirements stipulated for the various polytechnic courses. For ITEs, they should have completed their GCE 'N' levels to qualify for National ITE Certificate (*NITEC)* courses.

curriculum comprising mainly academic subjects. They may also offer a small number of applied subjects, such as Design & Technology.[11]

9. Although our broad-based education has worked well in building a strong foundation for our students to pursue future work and studies, some students are keen on and will benefit from a more applied approach towards learning at an earlier stage of their education. By giving our secondary school students more opportunities to experience an applied approach to education, we will broaden their learning experiences and help them discover their strengths and interests, allowing them to make more informed decisions on their future course of studies and work.

EXPERIENCES IN OTHER COUNTRIES

10. Students have varying abilities, interests, and preferred learning styles. In catering to the different learning needs of our students, we need to adopt a more customised approach. Many other countries around the world also recognise the value of an applied education and the need to cater to the different types of learners in their societies, by incorporating professional and applied aspects in their education systems.

11. For example, many of the education systems in Europe provide students with the option to offer applied subjects from the age of 15, equivalent to Secondary 4 in Singapore. These subjects often include internships, apprenticeships or work attachment programmes. In Switzerland, close to 70% of the upper secondary cohort undergoes apprenticeship training in banking and industry. Sweden offers 17 national programmes to all their upper secondary students, of which 14 are applied in nature, enrolling about 80% of students. These include areas such as Auto Engineering, Health and Nursing and Hotel, Restaurant and Catering. In some top high schools in Japan, students are required to take at least one applied subject, to encourage them to go beyond being “book smart”.

12. In comparison, our students undergo a generally academic program in the first 10 years of formal schooling, and can only choose between an applied pathway in the polytechnics and an academically-oriented pathway in the Junior Colleges/Centralised Institute, after completing their GCE ‘O’ level examinations. There is scope to provide richer secondary school curriculum offerings and for selected secondary schools to offer curriculum niches in applied subjects.

POLYTECHNIC-SCHOOL REVIEW COMMITTEE

13. The Polytechnic-School Review Committee (PSRC), chaired by the Minister of State for Education & Manpower Mr Gan Kim Yong, was formed in October 2005. The Committee was tasked to explore ways to enhance applied learning options in secondary schools. The full list of Committee members is at Annex A. Its Terms of Reference are in Annex B.

[11] The other applied subjects include Principles of Accounts and Food & Nutrition.

REVIEW AND CONSULTATION PROCESS

14. In its study, the Committee examined the key features of the existing upper secondary and polytechnic education systems, working closely with secondary schools and the polytechnics. It also drew insights from visits and study of school systems in Sweden, Switzerland, France and the United States.

15. The Committee also consulted a wide cross-section of stakeholders in education, including principals, teachers, parents, students and polytechnic staff, through focus group discussions and soliciting feedback via online channels. Those surveyed felt that it was timely and appropriate to introduce more elements of applied learning into the secondary school curriculum, and expressed keen interest for more elective courses and subjects in applied areas. A summary of the key findings of the consultation process is at Annex C.

CHAPTER 2

Enriching our Secondary School Curriculum Through Advanced Elective Modules

Chapter 2: Enriching our Secondary School Curriculum through Advanced Elective Modules

BACKGROUND

1. Our secondary schools offer a robust GCE 'O' Level curriculum to prepare our students in their secondary years for a broad range of post-secondary options. While this has served us well, the secondary school curriculum could be enriched through providing more choices in applied learning. This could be done by leveraging on the extensive experience of our polytechnics to develop and implement elective modules with higher applied content for secondary schools.

2. Partnerships between schools and polytechnics have in recent years become an exciting feature of our education landscape. Our secondary schools have partnered our polytechnics to conduct a variety of interesting and meaningful learning activities and programmes for our students. These include seminars, camps, workshops, research programmes and competitions.

3. We will build on these linkages between schools and polytechnics to develop and offer 'Advanced Elective Modules' (or AEMs). These modules will be more rigorous than the existing enrichment activities but will not be as demanding as a full GCE 'O' level subject.

THE VALUE OF AEMS

4. Provide a Broader Range of Learning Experiences. The AEMs will provide broader learning opportunities for our students. Students who will eventually progress to the Junior Colleges will also benefit from such an exposure.

5. Provide Opportunities to Discover Interests. The AEMs will provide students the opportunity to 'test' out their inclinations towards more applied disciplines. Such opportunities enable students to have greater clarity of the range of post-secondary education and career options available to them.

6. Complement Core Curriculum. The AEMs will be designed to complement the core curriculum. For instance, students offering an Engineering AEM would begin to better appreciate the need to understand 'O' level Mathematics or Physics concepts. Similarly, students taking a Media and Design AEM will see the value of having strong language ability. They will therefore have a greater interest in foundation subjects and be more engaged in school.

7. Offer flexibility. Given that AEMs are not full subjects and are carried out over a shorter duration, students may offer a few AEMs in their upper secondary years. Students can choose a combination of AEMs either for greater breadth (taking subjects from different fields) or for greater depth (taking subjects from similar fields).

FEATURES OF AEMS

8. AEMs fulfil a niche between a full fledged subject and an enrichment programme, giving our students greater choice and flexibility in their educational experience. The AEMs' rigour and depth are greater than the usual enrichment programmes and yet provide some flexibility in the way it is delivered to students. Table 1 illustrates this layering of learning opportunities.

Table 1: Layers of Learning Opportunities for Greater Choice and Flexibility

GCE 'O' Level Subjects	At least 120 hours Typically examined in one sitting Rigorous curriculum for in-depth learning Subjects are developed through a rigorous and structured process
Advanced Elective Modules	Typically 40 hours On-going assessment and project work Less in-depth curriculum, focused on practical application of knowledge Advanced Elective Modules are developed in a rigorous but flexible process
Enrichment Programmes	Typically 5 to 16 hours Activity-based, e.g. camps and competitions Enrichment Activities are developed in an ad-hoc manner

9. Table 2 below provides some key features of a typical AEM.

Table 2: Key Features of Advanced Elective Modules

S/No.	Feature	Remarks
1.	Duration	Typically 40 hours of instruction time which can be conducted during curriculum hours, school holidays, in the afternoons on weekdays, weekends, or a combination. Each AEM will be conducted over a period of 3 to 6 months.
2.	Eligibility	All students in the upper secondary years.
3.	Content	More applied content that may complement and support existing GCE 'O' level subjects.
4.	Delivery	Varied delivery methods will be employed to enhance the learning experiences of students. Modules will have a high practical content, with students spending more time on projects and in the workshops or

S/No.	Feature	Remarks
		laboratories. Students will be expected to work in teams. They may also be required to make a presentation of their work towards the end of the module. In addition, industry visits, work attachments and project work will allow students to experience a more realistic work environment where teamwork is critical.
5.	Assessment	AEMs will be graded. The emphasis will be on continuous assessments and more authentic assessment approaches. These would be based on set assignments or projects, short tests and presentations.
6.	Location	The AEMs could be conducted either at schools or at the polytechnics, depending on the nature of the content area and the resource requirements of the module.
7.	Instructor	The AEMs would be taught by polytechnic lecturers in the initial years. School teachers could over time take over more of the instruction of the AEMs.

10. The AEMs offered may be grouped into the following main subject clusters, though they need not be restricted to these clusters:

a. Business and Humanities which would include modules on business administration, entrepreneurship and early childhood education;

b. Engineering which would include foundational engineering modules, building and environmental engineering;

c. Science and Mathematics which would include life and health sciences, and engineering mathematics;

d. Media and Design which would include mass communications, media design, arts; and

e. Information Technology, which would include web applications development and networking technologies.

11. Students will be allowed to offer up to a maximum of four AEMs within their upper secondary years, from any of the clusters above. This will help strike a balance in ensuring that students' workload remains manageable, while allowing students to benefit from study in a range of different disciplines, which will broaden their learning experience and help them ascertain interest in the subject areas.

12. An Academic Panel, comprising representatives from the five polytechnics and MOE officials, will oversee the development of the AEMs, to ensure that AEMs offered across the different polytechnics are of similar rigour and quality. The Panel will have the following roles:

a. to coordinate the AEMs to be offered to ensure that no modules are duplicated;

b. to moderate the depth and breadth of topics to be covered; and,

c. to ensure that standards and rigour of the assessments are maintained.

RECOGNITION OF AEMS

13. Recognition for Discretionary Admissions to the Polytechnics. Students' participation and performance in AEMs may be given additional consideration for discretionary admission to the polytechnics through the Joint Polytechnic Special Admissions Exercise (JPSAE) as well as the Direct Polytechnic Admission Exercise (DPA).

14. Credit Exemption for Polytechnic Modules. Students who have offered AEMs and have subsequently been admitted to a polytechnic may be granted credit exemption for some of the courses they have enrolled in. The credits to be exempted will depend on the relevance of the AEMs and the grades attained. This will be decided by the polytechnics.

15. Recognition in Holistic Report Card. Schools will also recognize students' efforts in completing an AEM by reflecting their participation and grades / marks of the AEMs in the Holistic Report Card which is a document that records students' performance in their secondary school education.

IMPLEMENTATION

16. The first AEMs are expected to be available to students from Jan 2007. In the initial years, we expect that the AEMs will be offered in about 10 to 15 schools. This will give the polytechnics and schools time to refine their implementation strategies and improve their approaches before offering the AEMs to more secondary schools. Some examples of proposed AEMs are in Annex D.

17. Once the polytechnics have acquired more experience with the AEMs and have a better sense which AEMs best benefit students and how AEMs can be best delivered, polytechnics can invite schools to partner them to mount customized AEMs for more schools or school clusters.

CHAPTER 3

Enriching our Secondary School Curriculum Through Applied Graded Subjects

Chapter 3: Enriching our Secondary School Curriculum through Applied Graded Subjects

BACKGROUND

1. While the introduction of Advanced Elective Modules (AEMs) will inject more diversity into the secondary school education, some students will be interested in pursuing applied subjects as full subjects in the formal curriculum. Today, there are only a small number of applied subjects that secondary school students can take, such as Design & Technology, Food & Nutrition, and Principles of Accounts.

2. We can address the needs of these students by introducing full subjects in applied disciplines at the upper secondary level, i.e. Applied Graded Subjects (or AGS). The introduction of AGS will enhance our curriculum offerings and provide more opportunities for our students to pursue their interests in areas currently available only in the polytechnics, such as media design and electronics. They will also expose students to possible future courses of study in the polytechnics, and help them make more informed decisions about their post-secondary education options.

FEATURES OF AGS

3. Applied Graded Subjects (AGS) will be introduced as new examinable subjects in applied disciplines, equivalent in rigour and scope to the existing GCE 'O' level subjects. AGS will be developed by the polytechnics in partnership with secondary schools and offered to upper secondary students. Students can offer the AGS in addition to the five core subjects, namely, English Language, the Mother Tongue Language (MTL), Mathematics, Combined Humanities and a Science subject[12], which are required to ensure that students have a strong foundation of core knowledge and skills.

4. The key features of AGS are provided in Table 3.

[12] The core examinable subjects for Normal (Academic) students exclude a Science subject.

Table 3: Key features of Applied Graded Subjects

S/No.	Feature	Remarks
1.	Duration	Similar to a GCE 'O' level subjects, each AGS will comprise at least 120 hours of instruction time, conducted over the upper secondary years.
2.	Eligibility	All Express and Normal (Academic) students in their upper secondary years[13].
3.	Content	The content of the AGS should be applied oriented. While there could be some overlap with existing GXE 'O' Level subjects, this should be no more than 25%.
4.	Delivery	A variety of teaching methods will be employed, for example, laboratory sessions, tutorials and lectures. There will be greater emphasis on experiential learning through practical, hands-on work such as laboratory sessions.
5.	Assessment	AGS would be examinable, similar to the GCE 'O' level subjects. The polytechnics will be the awarding agency. The assessment of the AGS would encompass a variety of modes including coursework, projects, presentations and written work, with a greater emphasis on continuous assessment. For example, a typical examination format for an AGS could comprise 60% coursework and 40% written paper; or 40% project work, 30% oral presentation and 30% written paper.
6.	Location	Depending on the nature of the subject and the type of equipment and facilities required, lessons may be conducted either in schools or at the polytechnics.
7.	Instructor	In the initial years, AGS will be taught by polytechnic lecturers or teaching staff recruited by schools or polytechnics. They need not be trained at NIE but they will be trained by the polytechnics. Over time, it is possible that some secondary school teachers could be trained to take over the instruction of certain AGS.

5. Polytechnics will partner with selected schools to develop AGS in specific niche areas of interest to the school, such as in the areas of Information Technology, Media, or Life Sciences. Examples of AGS are given in Annex E.

6. For further flexibility, polytechnics and schools could explore the option of allowing students to offer the AGS as an AEM in the first term of the Secondary 3

[13] As Normal (Technical) students do not offer 'O' level subjects, the AGS would not be applicable to them.

year. Students could try out the subject first as an AEM and interested students could then pursue the subject as a full AGS from the second term onwards.

7. Similar to the development of AEMs, the Academic Panel (mentioned in the earlier chapter) will oversee the development of the new AGS, to ensure that AGS offered across the different polytechnics are of similar rigour and quality, and that the assessment modes and examination standards are consistent and comparable. Unlike the AEMs, MOE's Curriculum Development Committee will be the approving body for the AGS to ensure that they are comparable in rigour and scope to a full GCE 'O' level subject.

RECOGNITION OF AGS

8. Recognition for admissions to the JCs/CI and Polytechnics. We currently allow students to include up to two elective subjects in the computation of scores for admissions to our JCs / CI and Polytechnic.[14] As AGS are comparable in rigour and scope to the GCE 'O' level subjects, they will be recognised for admission to the JCs/CI and Polytechnics under the elective subjects of the L1R5 and ELR2B2 scoring formula. Students will be allowed to include their AGS grade in the computation of the L1R5 score as one of the elective subjects, or in the ELR2B2 score as one of the B2 subjects.

9. Credit Exemption for Polytechnic Modules. Students who have offered AGS and have subsequently been admitted to a polytechnic may be granted credit exemption for some of the courses they have enrolled in. The exemption will depend on the relevance of the AGS to the polytechnic module, and will be decided by the polytechnics.

10. Reflected in the School Graduation Certificate. Student's participation and results in the AGS will be recorded in the School Graduation Certificate issued by MOE, with the possibility of including them on the Singapore-Cambridge GCE 'O' Level Certificate issued by University of Cambridge International Examinations. The polytechnics will be listed as the awarding agency for the subject. Student achievement in the AGS will also be recorded in the School Graduation Certificate issued by MOE.

THE INITIAL YEARS AND BEYOND

11. The first AGS are expected to be offered to Secondary 3 students in 2008. This will give the polytechnics and schools time to refine the AGS based on their experience with the implementation of AEMs in 2007.

[14] L1R5 is used for admission into the 2-year JC course. It refers to First Language and 5 relevant subjects. The first three relevant subjects, depending on the JC course applied for (Arts or Science), could be a mix of Mathematics, Science and Humanities subjects. The remaining two are electives. ELR2B2 is used for admission into the Polytechnics. It refers to English Language, 2 relevant subjects for the polytechnic course applied for, and best 2 other subjects which could be elective subjects.

12. In the initial stages, we envisage that AGS will be offered in 4 to 5 secondary schools, which will partner closely with the Polytechnics to develop these new subjects. Polytechnics can scale up their offerings of AGS subsequently after they have gained sufficient experience and if there is strong demand and interest from students.

CHAPTER 4

Direct Polytechnic Admission Exercise

Chapter 4: Direct Polytechnic Admission Exercise

BACKGROUND – CURRENT POLYTECHNIC AND JC ADMISSIONS PROCESS

1. Currently, there are a number of admission exercises conducted by the polytechnics. The main one is the Joint Admissions Exercise (JAE) for fresh GCE 'O' level graduates applying to join the JCs/CI, ITE and polytechnics. In addition, for the polytechnics, the Direct Admissions Exercise (DAE) admits international students and ex-polytechnic students, while the Special Admissions Exercise (SAE) admits students into specific courses with special requirements and those with sports and other forms of course-related talents.

2. From 2006, the polytechnics will also hold a Joint Polytechnic Special Admissions Exercise (JPSAE), where up to 5% of their annual intake can be admitted based on special talents and aptitudes, rather than GCE 'O' level results alone. Following the introduction of the JPSAE, the SAE would be subsumed under the JPSAE.

3. The JPSAE would commence immediately upon the release of the GCE 'O' level results. This mirrors the discretionary admissions exercise for the universities, which also starts after the release of the A-level results. Each JPSAE applicant is allowed up to a maximum of 3 course-specific choices. The polytechnics have established their own respective selection criteria to ensure that only students who are able to cope with the rigours of a diploma education are admitted.

4. Since 2005, MOE has introduced the Direct School Admission exercise for Junior Colleges (DSA-JC). Under the DSA-JC exercise, JCs have the discretion to admit up to 10% of their JC1 intake. Students admitted under the DSA-JC will be offered confirmed places before they sit for their GCE 'O' level examinations.

DIRECT POLYTECHNIC ADMISSION (DPA) EXERCISE

5. The Committee recommends putting in place an additional pathway for progression to polytechnics, modelled along the lines of the DSA-JC. The objective of the Direct Polytechnic Admission (DPA) exercise would be to allow secondary school students who are clearly interested in a polytechnic pathway to obtain a confirmed place in a polytechnic course, before they sit for their GCE 'O' level examinations. Similar to the DSA-JC, these students will still sit for the GCE 'O' level examinations to ensure that they have the necessary foundation to cope with the rigours of a polytechnic diploma education.

6. Such an admissions exercise would benefit students who are clearly interested in, and have the aptitude for an applied education, which may not be fully reflected in their 'O' level examination results.

Eligibility Criteria

7. All final-year secondary students in the Express and N(A) streams would be eligible to apply for the DPA exercise.

8. Students must also demonstrate their interest and aptitude for a polytechnic education. Ideally, they should have offered at least one AEM or AGS. However, during the initial roll-out of the AEMs and AGS, some students might not have access to them. As such, this requirement would be phased in after AEMs and AGS become available in more secondary schools.

Selection Criteria

9. The polytechnics will design their own criteria to select students based a broader measure of merit beyond the single measure of their results at the national exams. Similar to the JPSAE and other discretionary admissions, the criteria will be transparent and merit-based.

10. The offers made by the polytechnics would be provisional, subject to students meeting certain basic minimum criteria decided by the polytechnics. This is to ensure that students selected will be able to cope with the rigours of a polytechnic education.

11. Students should also have attained a minimum passing grade in the core subjects relevant to their poly course for their school-based exams. For example, for Engineering courses, the core subjects are English, Maths and a Science subject. While academic competency is not the over-riding criterion for selecting students under the DPA exercise, this additional requirement is needed to ensure that students can cope with and complete their courses in the polytechnics.

12. Other selection criteria may include aptitude tests, Secondary 3 examination results, school recommendations, interviews, or immersion programmes[15].

13. Each polytechnic would be allowed to set up their own merit-based and transparent selection criteria within the broad parameters set out above, similar to what the existing DSA schools have put in place.

Application Process and Timeline

14. In line with the DSA-JC process, students could start applying to the polytechnics from May of their final secondary year. The application process would ride on the DSA-JC exercise so that students need not apply separately if they are interested in taking part in both the DSA-JC and DPA exercises. The exercise will

[15] For example, during the Secondary 4 June holidays, short-listed students could be invited to attend a one-week immersion programme in the polytechnic of their choice. This would give the polytechnics an opportunity to observe and evaluate the performance of the students, and also allow the students to ascertain that they would indeed be interested in a polytechnic education

take place based on the following timeline:

May - June: Students apply for the polytechnic courses of their choice.

June - July: Polytechnics will interview and make offers to selected students.

Late July: Students accepts DPA offer.

15. Under the combined DSA-JC and DPA exercises, each student could be allowed up to 3 course-specific choices (in any combination of polytechnics or JCs). For example, a student could apply for Hospitality and Tourism Management in Polytechnic "A" as his first choice, Electrical Engineering in Polytechnic "B" as his second choice, and JC "X" as his third choice.

16. Between June – July, the polytechnics and JCs would make offers to interested students, who would be required to confirm their offers by late July. As with the DSA-JC, students would not be allowed to withdraw and take part in the subsequent JAE once they have accepted an offer. This would be a fairer arrangement for other students, since it would prevent the DPA students from occupying places in the two separate admissions systems[16].

Enrolment Caps

17. For a start, the polytechnics should be given the flexibility to take in up to 2.5% of their annual intake through DPA, which is about 100 students per polytechnic on average. This is in addition to the existing 5% intake under the JPSAE.

18. Apart from the overall cap on intake, there will also be a course specific cap at 30% for each specific course, i.e. at least 70% of each course must remain available for students admitted after their GCE 'O' level results, i.e. during the JAE. This would ensure that students admitted through the GCE 'O' level route will continue to have access to popular courses despite the DPA.

SPECIAL POLYTECHNIC PREPARATORY PROGRAMME

19. Given that the DPA students would know in advance that they have confirmed places in the polytechnics and that these students have expressed clear interest in a polytechnic education, the polytechnics could put in place a special 3-month polytechnic preparatory programme before the start of the polytechnic term for the DPA students.

20. Such a special programme would serve to broaden students' learning experiences, orientate them better to the polytechnic environment, and help them build a stronger foundation in the polytechnic subjects.

[16] However, the polytechnics would consider appeals for changes of course within the same polytechnic.

21. The special programme could start in late January (similar to the start of the revised JC calendar when fully implemented in 2009), which would give the students a total of 12 weeks before the rest of the new intake admitted through the JAE join the polytechnics. The students could spend 10 weeks in the polytechnics with a 2-week break, during which they can have the option to join existing polytechnic students for overseas community service projects which are usually organised during this period of the year. During the 10-week period, the students could attend modules in areas such as communications skills and foundational Mathematics. As these DPA students in the special programme may have taken some modules required in the main diploma programme, they would have more curriculum space to be involved in more complex projects and enrol in advanced modules that would prepare them for further studies.

22. Annex F shows a possible curriculum for the polytechnic preparatory programme, based on an engineering-type course. The polytechnics could develop different curriculum for students enrolled in different courses, for example, mass communication students would undergo a preparatory course with a stronger focus on languages.

IMPLEMENTATION

23. We propose to start the DPA exercise in 2007 for admissions in 2008. This will also give the polytechnics a year to prepare the preparatory programme for these students, and also allow some of the students to take 1 or 2 AEMs in the first half of their Secondary 4 year.

LOOKING AHEAD

24. As we gain more experience with the DPA process, there is scope to enhance this pathway further. One way would be to allow certain students in this group to skip the GCE 'O' level examinations altogether, as long as they meet certain criteria. These could include students who have demonstrated strong school-based results as well as students who have done well in the AEMs and AGS and have shown strong, sustained interest in this more applied pathway.

25. It is likely that such a pathway would be best mounted by specific secondary schools and polytechnics so that a more customized curriculum and programme could be developed for these students even while they were in secondary school, thus freeing up more time and space for these students to broaden their learning experiences.

26. Another approach is to consider the setting up of a polytechnic 'high school' by one or two of our polytechnics to cater to students who prefer a more applied approach to learning. Students can also take polytechnic courses in addition to the main curriculum. This is not an uncommon practice in other countries. In the US, there are early and middle college high schools established by the community colleges with a customised curriculum to allow students to take college credits while earning their high school diploma. In Singapore, we already have the NUS High

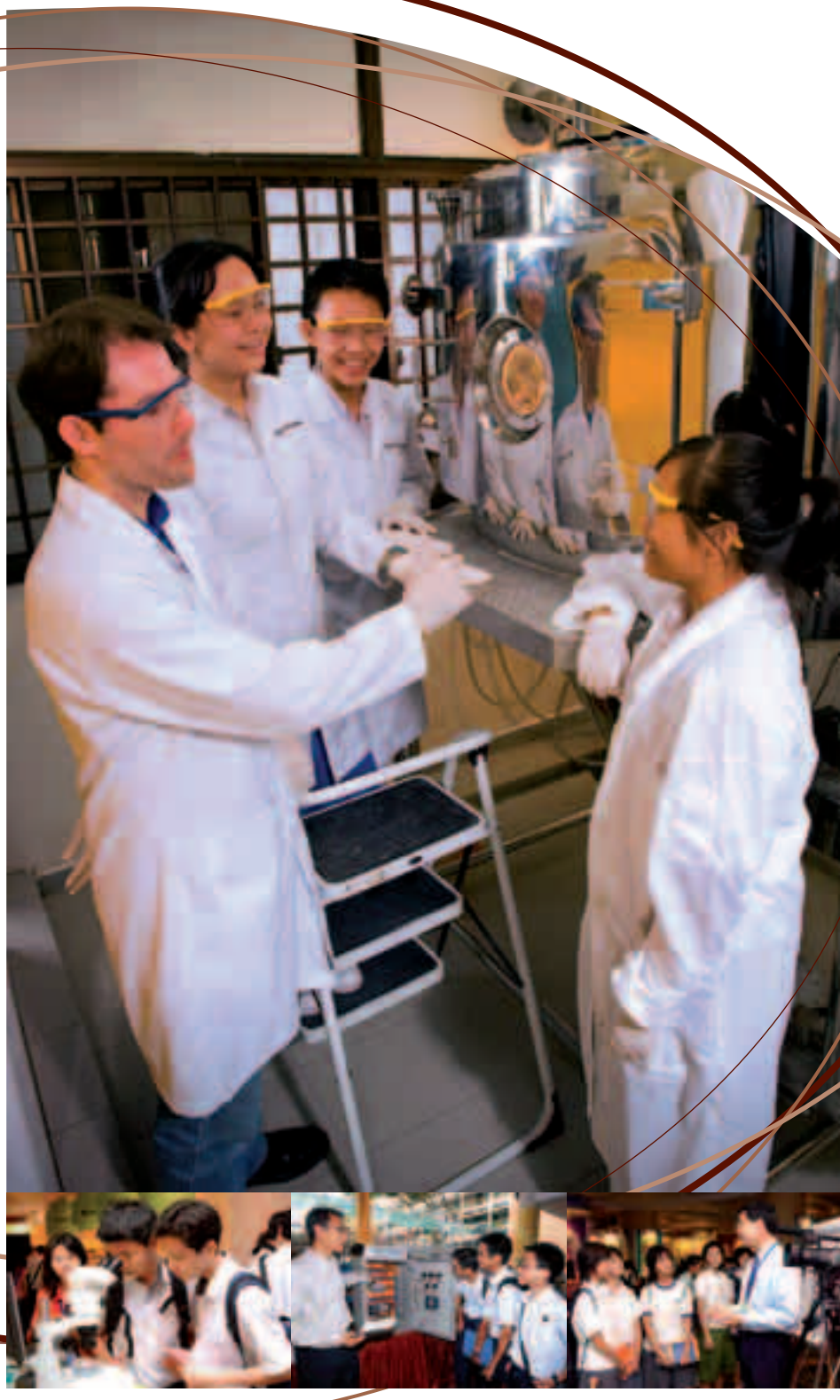
School of Mathematics and Science which allows the highly able students to take university courses.

27. One advantage of a polytechnic 'high school' is that it allows greater flexibility for the polytechnics to focus on curricular and pedagogical innovations from as early as secondary one to cater to students with clear intent on an applied education. They will still be offered a broad-based education, and be given the choice to take the GCE 'O'-Level examinations if they wish to.

28. These ideas should continue to be explored as additional ways to diversify the education landscape and provide more choice and flexibility for our students.

CHAPTER 5

Implementation



Chapter 5: Implementation

THE INITIAL YEARS

1. The implementation of the three recommendations of the Committee will be rolled out over the next two years as follows;

a. From Jan 2007, the first Advanced Elective Modules will be rolled out in about 10 to 15 schools which are opened to IP, Express and Normal (Academic) students;

b. By middle of 2007, the Direct Polytechnic Admission (for admission in 2008) will be offered to all secondary schools. Students will apply for places in the polytechnics based on a set of meritocratic and transparent criteria; and

c. From 2008, the first Applied Graded Subjects would be available in about 4 to 5 secondary schools where students could offer and use the subjects for the computation of their L1R5 or ELR2B2 scores for admissions to the JCs or polytechnics respectively.

RESOURCES

2. We will give the polytechnics and schools additional resources, based on the current funding framework for EMs, to enable them to offer AEMs and AGS to their students.

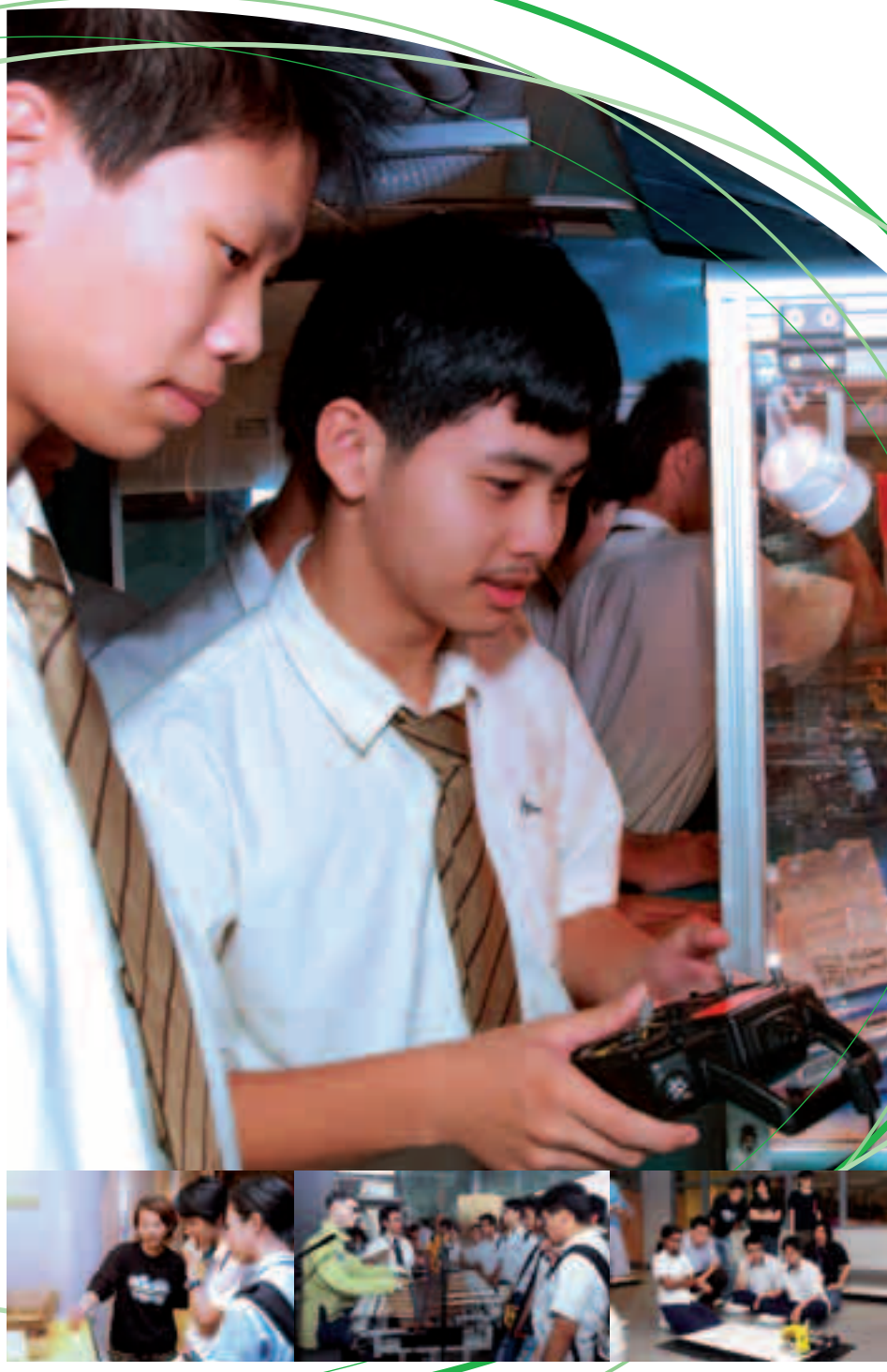
3. In terms of teaching resources, the AEMs and AGS will be taught by polytechnic lecturers or teaching staff with knowledge and experience in the subject area. The teaching staff may be recruited directly by polytechnics or schools. They will be trained by the polytechnics and need not have been trained at NIE. With more experience, it is possible that some secondary school teachers could be trained to take over the instruction of certain AGS

LOOKING AHEAD

4. As the polytechnics and schools gain more experience, they would expand their offerings to include more subjects and more schools. We expect some economies of scale to be reaped as more schools come on board to offer the AEMs and AGS. For example, these modules and subjects could be offered at the cluster level to enable more students from different schools to benefit from them.

5. By then, our secondary school education landscape will be richer and our students will have more choices and be able to discover their strengths and interests in applied areas.

Annexes



Annex A

Composition of the Polytechnic-School Review Committee

CHAIRPERSON	
Mr Gan Kim Yong	Minister of State for Education and Manpower
MEMBERS	
Political Representative	
Mr Zainudin Nordin	Member, Government Parliamentary Committee, Education
Ministry of Education Representatives	
LG(NS) Lim Chuan Poh	Permanent Secretary, Education
Miss Seah Jiak Choo	Director-General of Education
Ms Chang Hwee Nee	Deputy Secretary (Policy)
Mr Wong Siew Hoong	Director, Schools
Ms Ho Peng	Director, Curriculum Planning and Development
Mr Tang Tuck Weng	Director, Planning
Mr Lim Chee Hwee	Director, Higher Education
Polytechnic Representatives	
Mr Low Wong Fook	Principal, Singapore Polytechnic

Mr Chia Mia Chiang	Principal, Ngee Ann Polytechnic
Mr Boo Kheng Hua	Principal/CEO, Temasek Polytechnic
Mr Lin Cheng Ton	Principal/CEO, Nanyang Polytechnic
Prof Low Teck Seng	Principal/CEO, Republic Polytechnic
School Representatives	
Mr Chua Chor Huat	Principal, Ngee Ann Secondary School
Mdm Sim Ay Nar	Principal, Xinmin Secondary School
Miss Tay Lai Ling	Principal, Swiss Cottage Secondary School
Mr Vasuthevan K Ramamurthy	Principal, Bishan Park Secondary School
SECRETARIAT	
Mr Lau Peet Meng	Deputy Director, Planning and Management Information
Miss Genevieve Chye	Assistant Director, Humanities & Aesthetics
Miss Lee Shiao Wei	Assistant Director, Planning and Management Information
Ms Wang Li-Sa	Senior Head Policy, Higher Education
Mr Andrew Tan	Planning Officer
Miss Beatrice Chong	Planning Officer

Annex B

Terms of Reference

The Terms of Reference for the Polytechnic-School Review Committee are:

a. To study the value and feasibility of putting in place a new applied and practice-oriented pathway in secondary education catering to the needs of students with the appropriate interest and ability.

b. In the context of (a), to consider the feasibility of the following two options:

i. Offering relevant applied and practice-oriented subjects and elective modules, mounted in the secondary schools or the polytechnics, to enrich the secondary school curriculum; and

ii. Establishing a closer link between selected secondary schools and polytechnics so that students with suitable abilities can progress to these polytechnics without having to sit for the GCE 'O' level examinations.

c. To study other local and foreign models that can contribute to an applied and practice-oriented pathway in secondary education, and provide a value proposition for secondary students to opt for a Polytechnic education, which will better engage our students and offer them more choices.

Annex C

Consultation Process and Key Findings

CONSULTATION PROCESS

1. As part of its consultation process, the committee conducted a series of Focus Group Discussion sessions with a broad cross-section of our stakeholders including students, teachers, principals, parents and industry leaders. We also engaged a diverse range of students including those who are currently in the secondary schools, polytechnic students as well as university students who were from the polytechnics.

2. The Committee also consulted a wider audience of teachers, Heads of Departments and Principals on the recommendations of the Review Committee via online channels.

KEY CONSULTATION FINDINGS

3. On the whole, participants felt that providing a broader range of options to enrich our secondary school curriculum as well as a more applied pathway would bring many advantages to our education landscape.

4. Participants were supportive of enriching our upper secondary curriculum with applied modules and subjects. They also noted that there was a need to maintain a broad-based education for our students, even as we provided for more applied options and pathways to cater to our diverse student needs. Participants also provided their views on an earlier proposal surfaced to the Committee, of allowing secondary school students to proceed directly to the polytechnics without having to take their GCE 'O' level examinations.

INTRODUCING APPLIED MODULES AND SUBJECTS

Advanced Elective Modules

5. There was strong support for the Advanced Elective Modules (AEMs). Participants felt that the AEMs would be a useful innovation to more formally provide support for initiatives to provide secondary school students with a broader range of learning experiences.

6. It was also noted that the availability of the AEMs would provide broader learning opportunities for students as well as allow them to explore their interests and gain a more in-depth feel for an applied education. This will enable students to make more informed decisions about their post-secondary education pathways at the end of their secondary education.

7. Suggestions were also made for the selection criteria for the AEMs to take into account factors other than academic achievement, such as passion, interest and commitment of the students.

8. While there were concerns about workload of students, many students also said they would be prepared to make time for the modules if they were interested in and passionate about the topics. They also said it would be helpful if some form of recognition was given for their completion of the AEM such as certification or subsequent module exemptions at the polytechnics.

9. There were also some concerns about where AEMs would be conducted. While some preferred the AEMs to be conducted within the school campuses to reduce transport time, others noted that it was useful for the AEMs to be conducted at the polytechnics to provide students with greater exposure to a polytechnic environment as well as to the more specialized facilities and equipment at the polytechnics.

Applied Graded Subjects

10. Students consulted expressed broad support for the Applied Graded Subjects (AGS) and many indicated that they would take them up if it was relevant for them. They welcomed the flexibility to use the subject for computation for admissions to JC and the Polytechnics. Students also noted that this was one way in which a more applied pathway could be created by allowing students to offer a hybrid of the GCE 'O' level examinations and the more applied AGS.

11. The participants noted that there was a need to maintain standards for the AGS to ensure parity between the AGS developed by different polytechnics, as well as with the GCE 'O' level subjects.

A MORE APPLIED PATHWAY

Direct Polytechnic Admission Exercise

12. There was general consensus that the Direct Polytechnic Admission (DPA) Exercise would be attractive to students who desired a polytechnic education. Participants welcomed the wider range of selection criteria for students including special talents and achievements under the DPA Exercise.

13. Participants also felt that a pre-polytechnic programme for DPA students would be useful and attractive, as it would better prepare them for a polytechnic education. They were supportive of the programme including bridging and foundational polytechnic modules, and suggested that the programme also provide opportunities for personal and leadership development.

Proceeding to the Polytechnics Directly without taking the GCE 'O' Level Examinations

14. The Committee also sounded out participants on an earlier proposal to allow upper secondary students to gain entry to the polytechnics, without taking the GCE 'O' level examinations.

15. Many participants felt that polytechnic-bound students would continue to

benefit from taking the GCE 'O' level examinations as it was a useful milestone qualification for students, and was widely used by employers and other post-secondary education institutions, locally and overseas. They were concerned that if students did not do well at the polytechnics after skipping the GCE 'O' level examinations, they would have no qualifications to fall back on. Students also agreed that they would prefer to continue taking the GCE 'O' level examinations, as this would give them greater flexibility.

16. The participants were also of the view that the proposal would need to have a sufficiently strong value proposition in order to be attractive to students, such as allowing students to graduate with enhanced qualifications.

17. Overall, the participants felt that students and the general public would need more time to accept the idea of progressing directly into the polytechnics without taking the GCE 'O' level examinations. The proposal could be considered in the future as students gain greater understanding and exposure of an applied education pathway, through taking the AEMs and AGS.

Examples of Advanced Elective Modules

SINGAPORE POLYTECHNIC

Fundamentals of Entrepreneurship

This module introduces students to the essential principles of entrepreneurship. Students will learn the process of business ideas generation and selection. They are expected to work in teams to produce a simple business plan based on the selected business idea.

Creative Game Design

This module aims to foster an awareness and appreciation for the innovative and creative processes that lie behind successful game design. Students will learn the complete game design cycle, ranging from conceptualisation, drafting, and story boarding to game prototyping and play testing. The module also provides an overview of past and current successful game genres and discusses future trends and directions in game design. Students are expected to work in teams to come up with an original game concept. They will also have the opportunity to get hands-on experience in aspects of game design using a game engine.

Introduction to Food Innovation

This module gives students an understanding of the product development process in the food industry. Emphasis will be on the application of their knowledge of foods and food processing in the design of new products. With the knowledge gained in the research, management processes and technological developments relevant to effective food product development, students will work in teams to plan and execute a food product development project.

Electronic Design and Development

This module aims to equip students with practical skills such as electronic components identification, correct wiring methods, prototyping, soldering and use of DC power supply and multi-meter. Students will use these skills to work on mini-projects designed to reinforce their knowledge of electronics.

Gene Explorer

The module introduces students to the world of DNA and genes. Principles governing the flow of genetic information and gene manipulation will be taught. The module also gives students an appreciation of the career prospects in the biotechnology and life science industry.

Designing Cartoons and Animation for Games

This module introduces students to the design principles of cartoons and animations for 2-D games. The module starts with analysing the successful usage of cartoons and animations to produce engaging games over the last decade. Students will learn how to draft cartoons as well as how to use various software tools to re-produce these cartoons in digital form. Students will learn the principles of 2-D sprite animation and will be given an opportunity to load these animations in pre-prepared games to test and optimize them.

Design Communication

This module teaches students to translate conceptualized ideas into graphic language. They will be introduced to the various forms of graphic presentations, from quick sketches to the application of computer drafting software. Students will have the opportunity to use these tools to solve open-ended problems.

Creative Modelling

This module teaches students the fundamentals of solid modelling. Basic, advance and editing commands are covered so that models can be changed during and after the modelling process. Students are also taught how design ideas can be realized through Rapid Prototyping.

Creating Your Own Mobile Applications for Mobile Phones/PDA

This module aims to familiarise students with the mobile computing world. It introduces concepts and features of mobile devices and in-trend programming techniques used to build applications running on mobile devices. The module shows them, through a hands-on approach, how to create their first mobile application using programming tools for mobile devices as well as simple animated GIFs / expressions for their mobile devices.

Online Entrepreneurship

This module aims to provide students with an understanding of the fundamental concepts of selling on the web. Students will be introduced to web technology, web architecture, different revenue models, web site usability concepts, electronic payment, and security issues pertaining to online business. Students will be challenged to identify business opportunities that can be exploited using web technology.

NGEE ANN POLYTECHNIC

Microbiology

This module introduces the student to the world of microbes. Students learn to visualize these using microscopes and other means. They learn to tell the microbes apart and learn to distinguish ‘friend’ from ‘foe’. This module is pitched at a level suitable for secondary school students with no prior knowledge in this subject area.

There will also be more guidance given by lecturers and senior students acting as mentors.

Electronic Product Design

The objective of this module is to cultivate students' interest in electronic product design. It is achieved through putting students through a small-scale electronic product design and construction cycle. It also aims to imbue in students the traits of exploration, creativity and entrepreneurship.

Get Real with Business

Students will learn to run a business event and discover the fundamentals of business. Through this fun and hands-on approach, students will have an overview of business principles such as economics, organizational structures, accounting, finance, marketing, human resource, business IT and entrepreneurial concepts and issues.

Discovering Tourism

This exciting module provides an excellent insight into the various sectors in the tourism industry, e.g. theme parks, resorts, hospitality, and food and beverage. Students will also have hands-on experience in designing travel itinerary and brochures to promote Singapore as a unique tourist destination. Students will acquire a general understanding of the dynamics and workings of the tourism industry.

The Art of Animation

This module provides the students a gist of what animation is. The language of animation transcends cultural barriers and bridges the divide between art and technology. The students will be treated to a general understanding of the principles and techniques of animation and develop simple classical animation and transform them to digital forms.

TEMASEK POLYTECHNIC

3D Modelling and Animation using Cinema 4D

This module provides learners with an understanding of the concept and theory of 3D modelling, animation and rendering. This module is an instructor-led workshop involving lectures and hands-on sessions. The objective of the module is to teach and facilitate working in the 3D space. The module covers theory and practice, as well as an understanding of the workflow and the fundamentals of how digital 3D models and animation are produced. The approach is to work through the features and techniques while working and building on a single project.

Water Technology

This module examines water as an essential for life. It highlights the sources of water in nature, the technology in processing of water including waste water, quality of

water in terms of chemical, physical and microbiological standards and uses of water in everyday life.

Electronic Prototyping

This module introduces the use of hand tools and standard laboratory equipment for the construction of electronic prototypes. Learners are required to identify basic electronic components and be proficient in the use of standard laboratory equipment, soldering and de-soldering techniques. They are also required to construct simple prototypes using Vero board and wire wrapping. Learners are required to construct an electronic project thus putting into practice the knowledge acquired.

NANYANG POLYTECHNIC

Foundation in Food Science

This module introduces students to the world of food science and some interesting less known facts about the food we eat, how it is made and prepared for the consumer. Through a hands-on practical approach, students are introduced to some of the fundamental concepts of food science such as the basic properties of food, food microbiology and sensory evaluation. This module complements and enhances the syllabus currently taught to students in the Food & Nutrition subject.

Product Design and Prototyping

This is an applied module. It aims to equip the students with hands-on experiences in the creation of three-dimensional free-form modelling. The concepts and applications of various rapid prototyping techniques are also introduced to the students. The coverage equips the students with some of the fundamental skills in Computer-Aided-Design for Product Design.

Electrical and Electronics Principles

Through an applied and hands-on approach, this module aims to equip the students with a good understanding of the fundamentals of electricity and electronics. The topics covered include basic circuit laws & theories and the working principles of electronic components such as diodes, transistors and operational amplifiers. Illustrations with applications of electricity & electronics in our daily life are used to enthuse the learning interest of the students and enhance their understanding. This module complements and helps reinforce relevant topics in O-level Design & Technology and Physics subjects.

Developing Multimedia-rich Web Contents

In the Internet world, it is critical to design informative and interesting websites that attract surfers and customers and sustain their interests. In this module, students learn how to create engaging websites or presentations rich with video, graphics and animation. They build a good foundation in multimedia development by learning design principles, digital imaging, sound capture and editing, video editing and production, animation techniques as well as interactive design, through hands-on exercises and case studies. Software tools such as Adobe Photoshop, Macromedia

Flash and Ulead Video Studio are used to illustrate the various techniques for creating these digital media.

REPUBLIC POLYTECHNIC

Teaching Computers to Work for You

This module will provide students an introduction to how computers can be made to do useful 'work' for students. Students will be introduced to commonly used tools, such as the spreadsheet, and be taught a highly interactive, easy-to-learn programming language called Python. This module reinforces that information technology is easy to learn and use, and how students can teach (program) a computer to do useful things.

Mathematical Modelling

This module introduces students to mathematical modelling of various physical phenomena and biological processes. Students will build models using Microsoft Excel spreadsheets to simulate complex processes using 'time-lapsed' calculations and numerical approximations. Graphical representations and user interface elements will allow students to interact with the models and better understand the processes being simulated. Students will be able to apply creative thinking skills as well as mathematical and scientific concepts in developing and improving their simulations.

Computer Animation Basics

This module introduces the concepts of computer animation to students. It covers various aspects of animation, from basic animated graphics to more elaborate 2D and 3D animation. Through attending this module students will learn what is required to generate visually pleasing animation, and gain a better understanding of what is required to create complex animation such as what is seen at the movies.

Introduction to Cognitive Processes

This module aims to introduce to students cognitive processes and problem-solving. Through attending this module, students will appreciate what it is like to be a reflective learner, through stimulating creative thinking, critical thinking, innovation and quality reasoning. Students will also acquire investigative skills related to engineering, technology and the sciences.

Examples of Applied Graded Subjects

AGS: INTERACTIVE MULTIMEDIA DEVELOPMENT

Questions to which students can seek for answers

What is multimedia?
How do I develop a multimedia application?
How was the “Lion King” interactive CD-ROM developed?
How do I develop interactive multimedia content to showcase my group of buddies?

What is the module about?

Objective: This module provides students with a good foundation in the art and science of interactive multimedia development. In this module, students will learn the fundamentals of interactive multimedia and be engaged in the design and production process of developing interactive multimedia applications. Students will develop a solid understanding of new media related design principles and apply them in developing multimedia applications. The module provides students with the opportunity to learn various tools and technology relating to the different elements of multimedia: text, graphics, audio, animation, and video. Through working with these tools, students are expected to develop an understanding of how such technology can be applied in industry settings. This module provides an excellent foundation for further education in multimedia and animation.

Developmental & Experiential: This will be a very interesting and engaging hands-on experiential module where the students will actively and interactively participate to develop an interactive media-rich application (internet, CD-ROM, etc). They will work in teams while having fun exercising their creativity and at the same time, appreciating the beauty of digital media.

How is the module taught?

This is a highly interactive and practical module where students work in teams to explore the concepts, tools, techniques and principles behind interactive multimedia applications. The classes will be interspersed with short concept presentation, demonstrations, hands-on projects and in-class sharing and critiquing. Students will be given plenty of room to exercise their creativity and think out of the box. Students will be given hands-on exposure to digital media development tools during the practical sessions to analyze, design, create and develop interactive media-rich applications. The students will also learn soft skills of independence, time management, nurturing creativity, experimentation, team work and project organization skills.

How will students be assessed?

This module will be assessed by both coursework (60%) and examinations (40%). It is envisaged that coursework component will include an assignment project and continuous assessments. Students will be required to complete a project assignment which requires them to apply the knowledge and skills gained to create interactive multimedia applications with well designed interfaces. In addition, students will be assessed through continuous assessments in their class activities which may include presentations, discussions, exercises and other class work. Students will sit for a final examination that will be set based on the topics and concepts learnt in the module.

Coursework	60%
Examinations	40%

Total	100%

What specifically will students learn?

	Indicative Topics
1)	Introduction to Interactive Multimedia
2)	Multimedia Development Process – Concept, Design & Production
3)	Basic Architecture of Multimedia Application
4)	Digital Visual Design – Principles, Guidelines and Techniques
5)	Digital Storytelling
6)	Animation Basics
7)	Creating Interactive Multimedia Applications – Technology, Tools, and Techniques
8)	Future of Multimedia

What polytechnic modules can students be exempted from?

Exemptions from the following polytechnic modules can be considered upon successful completion of this module and admission to the polytechnic:

DIPLOMA	MODULE
Multimedia & Animation (MMA)	Visual Interface & Information Design
Information Technology	Elective module
IT (Mobile Computing)	Elective module
Business Information Technology	Elective module
Engineering Informatics	Elective module

What can students look forward to after the module?

If students discover a huge interest in the subject area after completion of the module, they can look forward to furthering their studies in the following specialized areas:

AREAS OF SPECIALIZATION	POSSIBLE CAREER OPTIONS
Multimedia / Digital Media Development	Fusion Artist Interactive Media Designer Interactive Media Developer 3D Character Animator

AGS: CELL & MOLECULAR BIOLOGY

Questions to which students can seek for answers

The basic unit of life is the cell. We are all made of trillions of cells. What is a cell made up of and how do these trillions of cells work together?
What is the potential of stem cells?
How does the Human Genome Project impact me?
What is Frankenstein Food?
How do I genetically modify organisms?

What is the module about?

This module introduces the student to the cell and its workings. It starts with a macro overview of the cell and its composition and events that take place in the cell. After the foundation is laid, the student examines the workings of the cell at the molecular level i.e. at the DNA level. Cell mutation and genetic engineering is also discussed.

This module is pitched at a level suitable for secondary school students with no prior knowledge in this subject area. There will also be more guidance given by lecturers and senior students acting as mentors.

How is the module taught?

This module is taught via lectures, practical lessons and tutorials. There is a lot of hands-on. Practical lessons will include visualization of chromosomes and cloning of genes.

What are the facilities available?

Real time PCR machines, protein analysis equipment

Who will teach the module?

Highly qualified polytechnic lecturers with rich industry experience will teach the module. These lecturers could be assisted by secondary school teachers and senior polytechnic students who will act as mentors to the secondary school students.

How will students be assessed?

Examination:	40%
Continuous assessment:	60%
• Practical and Theory Test:	20%
• Practical Worksheets & Laboratory Skills:	20%
• Scientific / Creative Presentation:	20%

What specifically will students learn?

No.	Topics
1	Structure of Matter (2 hours)
2	Chemical Bonds (2 hours)
3	Biological macromolecules - Carbohydrates, Lipids, Proteins, Nucleic Acids(4 hours)
4	Introduction to Cells (2 hours)
5	Cell membranes (2 hours)
6	Cell Organelles eg nucleus, mitochondria etc (4 hours)
7	Structure and analysis of DNA (4 hours)
8	DNA replication and problem posed (4 hours)
9	Storage and expression of genetic information (4 hours)
10	Regulation of gene expression in bacteria and bacteriophages (4 hours)
11	Gene mutation and DNA repair (4 hours)
12	Recombination and mapping in bacteria and bacteriophage (4 hours)
13	Recombinant DNA technology (20 hours)

Practical Sessions (3 hours for each session, 51 hours in total)

No.	Topics
1	Good laboratory practice
2	Chemical reactions in cells
3	Microscopy – use of the light microscope
4	Study of cell organelles
5	Transport mechanisms across membranes
6	Cell specialisation and differentiation
7	Mitosis – cell division
8	Agarose gel electrophoresis – separation of DNA fragments
9	SDS-PAGE analysis of proteins – separation of proteins
10	Plating/titering of bacteriophage
11-13	Bacteriophage , DNA miniprep – cleaning up of DNA
14	Transformation of *E.coli* competent cells – introducing DNA into bacteria cells
15	Checking for successful recombinants ie those that have taken up the DNA
16	Polymerase chain reaction – to make many copies of DNA
17	Practical Exam

Tutorials (9 hours)

What polytechnic modules can students be exempted from?

Exemptions from the following polytechnic modules can be considered upon successful completion of this module and admission to the polytechnic:

DIPLOMA	MODULE
Biomedical Science Biomedical Laboratory Science Biotechnology	Cell Biology, Advanced Cell & Molecular Biology

Where will classes be conducted?

This module has to be conducted in NP as molecular biology laboratory facilities are needed.

What can students look forward to after the module?

If students discover a huge interest in the subject area after completion of the module, they can look forward to furthering their studies in the following specialized areas:

AREAS OF SPECIALIZATION	POSSIBLE CAREER OPTIONS
Molecular Biology	Research & Development, Industry, Teaching
Cell Development	Research & Development, Scientist, Teaching
DNA Technology	Research & Development, Industry, Teaching, Forensic Science

AGS: FUNDAMENTALS OF ELECTRONICS

Why learn electronics?

Electronic devices and systems pervade every aspect of our daily life. They can be found everywhere, from home appliances, entertainment systems, computers and mobile phones to MRT control systems and biomedical equipment.

What is the module about?

This module enables students to embark on a journey into the exciting world of electronics. Students will acquire a fundamental knowledge of electronics and understand its applications. With great emphasis placed on hands-on work, students will be able to apply the knowledge gained in building simple electronic systems.

The objective of this module is to provide students with the foundation in electronic engineering. It will unveil the mysteries of electronics through introducing students to electronic circuit theories and devices operating principles.

This module is pitched at secondary school students with no prior knowledge in electronics. It uses daily electronic application examples to bring about student learning.

How is the module taught?

This module is taught through project-based learning approach with a total of 140 contact hours. Simulation packages will be introduced to reinforce concepts and empower the students to explore the subject on their own.

Students will design and construct a series of mini-projects encompassing various electronic functions. These mini-projects serve as the building blocks, with which students can investigate and integrate them into different possible applications.

What are the facilities available?

- Electronic test and measurement instruments
- Electronic fabrication laboratories
- Computer aided design and simulation packages

Who will teach the module?

This module will be taught by experienced full-time lecturers from the polytechnic. These lecturers will be assisted by secondary school teachers and senior polytechnic students who will act as mentors to the secondary school students.

How will students be assessed?

Students are assessed through a judicial mix of coursework (60%) and examination (40%).

What specifically will students learn?

S/N	Scope
1.	Fundamentals of Electricity and Electronics
2.	Electronic Components and Circuit Theory
3.	Electromagnetism and Its Applications
4.	Electronic Devices and Applications
5.	Electronic Test & Measurements
6.	Computer Aided Design & Simulation
7.	Electronic Design & Circuit Construction

What polytechnic modules can students be exempted from?

Exemptions from the following polytechnic modules can be considered upon successful completion of this module and admission to the polytechnic:

DIPLOMA	MODULE
• Diploma in Biomedical Engineering • Diploma in Electronic and Computer Engineering • Diploma in Electrical Engineering • Diploma in Internetworking & Communications • Diploma in Mechanical Engineering • Diploma in Mechatronic Engineering	Electrical Technology

What can students look forward to after the module?

If students discover a huge interest in the subject area after completion of the module, they can look forward to furthering their studies in the following specialized areas:

AREAS OF SPECIALIZATION	POSSIBLE CAREER OPTIONS
Aerospace Electronics Biomedical Engineering Computer Engineering Electronic Engineering Electrical Engineering Mechatronic Engineering	Technical Sales & Servicing Maintenance Research & Development Manufacturing & Production Support

AGS: CREATIVE 3D ANIMATION

Why learn 3D animation?

The rapid proliferation of digital technology throughout the film, internet, computer games and graphics design and visualisation industries is creating a growing demand for trained people with creative skills, visual expertise and knowledge in the area of 3D animation.

What is the module about?

This subject provides learners with the fundamental knowledge and technical capability to create a 3D animation movie.

Learners will be equipped with a broad background knowledge of the material used in 3D computer animation together with the skills required to create personal animation for independent films. The subject takes a hands-on practical approach in a team-based studio environment, using a project-oriented learning methodology.

This module is targeted at secondary school students with no prior knowledge of computer animation.

How is the module taught?

This module is taught using a project-based learning approach within a total of 140 contact hours. Learners progress through a combination of activities designed to nurture their creative talents. Laboratory/studio sessions, team discussions, brain-storming sessions, self-directed and project-based learning activities are used to actively engage learners.

These activities culminate finally in the learners' own independent animated production where they pool together all the elements of their learning to bring their stories to life through moving images.

What are the facilities available?

- State-of-the-art 3D Media Studio
- Dual-processor capable 3D workstations powered by industry-leading state of the art AMD 64-bit Opteron processors. These machines allow the pooling of the computing power via net rendering services to allow the scheduling and rendering of complex animation scenes
- Modelling and animation software
- Video Editing software

Who will teach the module?

This module will be taught by experienced full-time lecturers from the polytechnic. These lecturers will be assisted by secondary school teachers.

How will students be assessed?

Students will be assessed based on continuous assessment, project outcomes and examination.

What specifically will students learn?

∘ Introduction to Animation ∘ Film Theory & Scripts ∘ Storyboarding ∘ Perspectives ∘ Character Design ∘ Background Design ∘ Animation Technique ∘ Concepts of 3D ∘ Software user interface ∘ Creating models using primitives, polygons and splines ∘ Creating and apply shaders and textures	∘ Applying Deformers ∘ Using Emitters ∘ Scene Lighting & creating light objects ∘ Creating Camera Objects ∘ Lightings & Post Effects ∘ Dynamics ∘ Creating Xpressions ∘ BodyPaint ∘ Character Modelling & Animation ∘ Scene Composition ∘ Rendering still image and animation ∘ Integration with video editing software

What polytechnic modules can students be exempted from?

Students who have successfully completed this module can, upon admission to the polytechnic, be considered for exemption from modules of similar nature in various diploma courses or from some elective Cross-Disciplinary Subjects.

Annex F

Possible Curriculum for the Polytechnic Preparatory Programme (Engineering Courses)

10-Week Study Programme	Remarks
Creative & Applied Thinking Skills[+] (30 hours) This module introduces analytical, critical and creative thinking skills to help students develop a more open and inquiring mind. Students will be challenged to think out-of-the box by exploring a broad range of creative solutions to problem solving and product innovation.	This is a general studies module. At the end of the course, students are expected to produce an innovative product that could be submitted for the *Tan Kah Kee* Young Inventor's Competition.
Communications Toolkit[+] (30 hours) This module provides an integrated platform for facilitating communication skills. Students will get to develop speaking, writing, reading and presentation skills. Through this process, students will also acquire information literacy skills.	This module strengthens students' skills in English and communications.
Foundational Mathematics[*] (30 hours) This will strengthen the students foundational knowledge of mathematics with an emphasis on application to everyday problems.	
Engineering Physics[*] (30 hours) Through various hands-on applications, students will learn to appreciate physics and engineering mechanics.	Work-shop environment. Students will design rockets, model racing cars, electronic melody makers, organic battery, etc. and learn the application of physics in a fun way.
Team Building Programme This is a 3-day 2-night team-building camp. The emphasis will be on team building, adventure and inculcating in them the importance of team work which is especially important in poly courses.	This could be conducted overseas.

Individual & the Community[+] (30 hours) This is a national education module that exposes students to the dynamic interaction between sociological and psychological theories of the individual, family and society, and community issues. Students will critically examine the values that they hold, develop a deeper understanding of themselves and the community, as well as recognise the impact that they can make on society.	Students who have indicated and interest in participating in a community service overseas, will also use this module as a time to plan their activities. They will then conduct their community service during their 2 week vacation.
Industrial Visits (once a week)	Field trips to industries and key installations are important for students to have a better understanding of the Singapore economy and how they can fit into this after they graduate.

[*] Foundational Mathematics and Engineering Physics will serve as bridging modules to prepare them for Year 1.

[+] Students, who successfully complete Creativity & Applied Thinking Skills, Individual & the Community, and Communication Toolkit, will be exempted from these modules in Year 1. This will provide them with more opportunity to either take on advanced modules, or participate in the many other activities in the polytechnic so as to develop their leadership and entrepreneurial skills.