Country Reports

Japan

1.1 Relevant Policy

In Japan, the school curriculum is set and regularly revised by the Ministry of Education, Culture, Sports, Science and Technology; detailed explanatory booklets are published for each subject area and level, including mathematics.[1] Mathematics is one of five core subjects studied by students. These core subjects account for 70% of students' compulsory education.[2] Japanese school days are also longer than the worldwide average.[3] These factors mean that students spend comparatively longer studying mathematics at secondary school level than students in other countries.

Japan has consistently been one of the highest performing countries in mathematics education worldwide; 95% of students complete the high school qualifications that are used as a measure of mathematics performance.[4] Japan's performance is attributed to high quality teaching, family support, coherent and challenging curriculum, logical development of the academic programme and teacher autonomy with respect to delivering the curriculum.[5] While there was a slight dip in performance between 2003-2006 following Japan's third education reform (*yutori*), results improved by 2009, especially in the area of '*open ended higher order thinking skills*'[6]. This improvement followed a return to a clearly delineated curriculum and away from the briefly implemented practice of greater student autonomy within the curriculum.[7]

1.2 Institutions and Courses

General System

In Japan, compulsory education comprises elementary school (six-12 years of age) and lower secondary school (12-15 years of age)[8]. Since 2010, both primary and lower secondary school has been free for all students.[9] Funding is also available to help less well-off families to pay for education in private high schools.[10] At post-compulsory level, students may choose to attend an upper secondary school, a technology college or specialised training college.[11] Entry to upper secondary school (15-17 years of age; graduation typically at 18 years of age) is determined by report cards and test scores obtained at lower secondary level.[12] Some students also attend night, or '*cram*', schools (*Juku*) to help prepare for entrance exams.[13] Learners may choose from three course routes: general, (academic), specialised (vocational) and integrated (mixed).[14]

Tertiary level education is offered by a number of different institutions; these include graduate schools, universities, junior colleges, specialised training colleges and technical colleges.[15] In 2008, there were approximately 3.7 million students enrolled on tertiary level courses; 48% studied at university, while 29% were enrolled on practical or vocational courses.[16] In recent years, universities have come under increasing pressure to ensure that graduates are equipped with the necessary skills for work in new and changing labour markets.[17] In addition, falling population levels mean that schools and tertiary institutions now have to compete for students.[18]

Vocational Courses

---

[1] http://www.oecd.org/japan/46581091.pdf
[2] http://www.oecd.org/japan/46581091.pdf
[3] http://www.oecd.org/japan/46581091.pdf
[4] http://www.oecd.org/japan/46581091.pdf
[5] http://www.oecd.org/japan/46581091.pdf
[6] *OECD Economic Surveys: Japan* and http://www.oecd.org/japan/46581091.pdf
[7] http://www.acola.org.au/PDF/SAF02Consultants/SAF02_STEM_%20FINAL.pdf
[8] http://www.mext.go.jp/english/introduction/1303952.htm
[9] http://www.mext.go.jp/english/introduction/1303952.htm
[10] http://www.mext.go.jp/english/elsec/1303524.htm
[11] http://www.mext.go.jp/english/introduction/1303952.htm
[12] http://www.nuffieldfoundation.org/sites/default/files/Values_and_Variables_Nuffield_Foundation_v__web_FINAL.pdf
[13] http://www.nuffieldfoundation.org/sites/default/files/Values_and_Variables_Nuffield_Foundation_v__web_FINAL.pdf
[14] http://www.mext.go.jp/english/introduction/1303952.htm
[15] *OECD Economic Surveys: Japan*
[16] *OECD Economic Surveys: Japan*
[17] *OECD Economic Surveys: Japan*
[18] *OECD Economic Surveys: Japan*

Courses at technology colleges typically run for five years; learners may also undertake a further two years' study to obtain a higher level qualification.[19] Specialised training colleges and schools provide practical vocational and technical education directly tailored to the needs of employers.[20] Most of these institutions are privately controlled with close links to industry; as a result, some institutions even guarantee jobs for students that successfully complete their course of study.[21] Just over 600,000 students attend specialised training colleges.[22]

In general, the Japanese vocation education and training system maintains a clear focus on skills required by industry.[23] Since 2005, this has included a dual education system that offers two days a week on-the-job training and three days a week study at a school or college.[24] It is estimated that up to 80% of secondary level graduates from vocational schools and colleges find employment.[25]

Established in 1961, the *Kosen* system of vocational schools and colleges is designed to train young students with an aptitude for mathematics and science in the skills necessary to become engineers[26]. Since 1961 approximately 300,000 students have graduated from *Kosen* institutions; entry remains highly competitive[27]. Courses comprise both theoretical schooling and workplace training; students are encouraged to develop skills relevant for engineering, for example, building robots, writing software and making test diodes[28].

1.3 Practice and Pedagogy

The mathematics curriculum is highly demanding but has a narrow focus on mastering fundamental mathematical concepts; students often acquire a deeper knowledge and understanding in these areas of mathematics than secondary students in other countries.[29] Mathematics lessons are not generally streamed; instead the focus is on providing a uniform education experience.[30] Teaching is approached through empirical, problem-solving activities with students encouraged to provide mathematical reasoning in response to a specific 'problem'.[31] The aim is to develop students critical thinking skills rather than to lead them directly to the right solution.[32] The American Institutes for Research cites the Japanese model of close collaborative practice among mathematics teachers to develop lessons plans as an example of high quality professional development.[33]

Further factors that contribute to the high level of mathematics understanding and knowledge achieved by school students include:

- Cultural values: traditional approaches in mathematics teaching succeed because of the cultural conditions that support, for example, parental expectations and '*a culture that highly values success in mathematics*'.[34]
- Emphasis on overall student development: teachers focus on developing students' personal qualities, for example, working cooperatively, in conjunction with achieving specific mathematical outcomes. Student effort is also prioritised over innate ability.[35]
- The Japanese numerical system: in the Japanese number system there are fewer number names to remember, for example, ten-three (13) and three-ten (30) are more easily remembered and distinguished and also more closely match the Arabian numeral system of tens and units. This means that from an early age the base 10 structure is more transparent and children can, according to the Nuffield Foundation, progress more easily '*from counting methods to strategic mental approaches*'.[36]
- Out-of-school tutoring: almost two thirds of eighth grade students receive private tutoring in mathematics outside school time. It is claimed that this tutoring complements the more conceptual teaching in Japanese schools by providing repetition.[37]

---

[19] http://www.mext.go.jp/english/introduction/1303952.htm
[20] *OECD Economic Surveys: Japan*
[21] *OECD Economic Surveys: Japan*
[22] *OECD Economic Surveys: Japan*
[23] http://www.cedefop.europa.eu/EN/Files/9012_en.pdf
[24] http://www.cedefop.europa.eu/EN/Files/9012_en.pdf
[25] http://www.cedefop.europa.eu/EN/Files/9012_en.pdf
[26] http://www.kosen-k.go.jp/english/education-system.html
[27] http://www.kosen-k.go.jp/english/education-system.html
[28] http://www.kosen-k.go.jp/english/education-system.html
[29] http://www.oecd.org/japan/46581091.pdf
[30] http://www.nuffieldfoundation.org/sites/default/files/Values_and_Variables_Nuffield_Foundation_v__web_FINAL.pdf
[31] http://www.oecd.org/japan/46581091.pdf
[32] http://www.oecd.org/japan/46581091.pdf
[33] http://www2.ed.gov/about/offices/list/ovae/pi/AdultEd/numlitrev.doc
[34] http://www.nuffieldfoundation.org/sites/default/files/Values_and_Variables_Nuffield_Foundation_v__web_FINAL.pdf
[35] http://www.nuffieldfoundation.org/sites/default/files/Values_and_Variables_Nuffield_Foundation_v__web_FINAL.pdf
[36] http://www.nuffieldfoundation.org/sites/default/files/Values_and_Variables_Nuffield_Foundation_v__web_FINAL.pdf
[37] http://www.nuffieldfoundation.org/sites/default/files/Values_and_Variables_Nuffield_Foundation_v__web_FINAL.pdf

- High quality textbooks: the standard of textbooks is monitored and all textbooks must achieve official approval. Textbooks are also more commonly used in Japan than other countries.[38]

A recent debate in the teaching and learning of mathematics in VET schools and colleges focuses on whether mathematics should be taught as a separate study or directly integrated into vocational training, taught by subject specialists. In 2007, a study conducted at the Wakayma National College of Technology concluded that '*the ability of electrical engineering students for mathematics improved dramatically with increasing the ratio of mathematics classes by the electrical engineering staff*'. One reason cited for these findings was the high level of motivation among subject specialists to support and improve student ability.[39]

A recent Japanese study focused on the benefits of using real-life situations to support student learning for abstract mathematical concepts. Two specific concepts were explored as part of the study: differential equations and the Fourier series. Fifth-year students the Fukui National College of Technology (where case studies were conducted) were asked, for example, to use differential equations in order to establish demographic trends in selected countries. The focus was not on teaching mathematics - that is on solving differential equations - but on how useful differential equations can be to explore real-life situations. Tools such as graphing calculators and personal computers were used to enable exploration. Student feedback was largely positive, especially with regard to the the use of practical, real world examples to aid learning.[40]

1.4 Key Points of Learning

The mathematics curriculum is highly demanding but has a narrow focus on mastering fundamental mathematical concepts; students often acquire a deeper knowledge and understanding in these areas of mathematics than secondary students in other countries.

Teaching is approached through empirical, problem-solving activities with students encouraged to provide mathematical reasoning in response to a specific 'problem'. The aim is to develop students critical thinking skills rather than to lead them directly to the right solution.

The American Institutes for Research cites the Japanese model of close collaborative practice among mathematics teachers to develop lessons plans as an example of high quality professional development.

Further factors that contribute to the high level of mathematics understanding and knowledge achieved by school students include cultural values, an emphasis on overall student development, the Japanese numerical system, out-of-school tutoring and high quality textbooks.

[38] http://www.nuffieldfoundation.org/sites/default/files/Values_and_Variables_Nuffield_Foundation_v__web_FINAL.pdf

[39] http://ieeexplore.ieee.org/xpl/articleDetails.jsp?reload=true&arnumber=6654410&punumber%3D6636319%26sortType%3Dasc_p_Sequence%26filter%3DAND%28p_IS_Number:6654377%29%26pageNumber%3D2

[40] http://dme.colorado.edu/fius/tsubokawa-presentation-rme4.pdf