UAEU College of Education

جامعة الإمارات العربية المتحدة
United Arab Emirates University

ملتقى الرياضيات، والعلوم والتقنيات التربوية
Mathematics, Science, & Educational Technology Forum

Mathematics Curriculum Documents as a Pedagogical and Professional Development Tool

وثائق منهج الرياضيات كوسيلة تربوية وأداة للتنمية المهنية

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مجلس أبوظبي للتعليم

Developing a strategy

تطوير الاستراتيجية

ADEC philosophy
فلسفة مجلس أبوظبي للتعليم

International benchmarking
المعايير العالمية

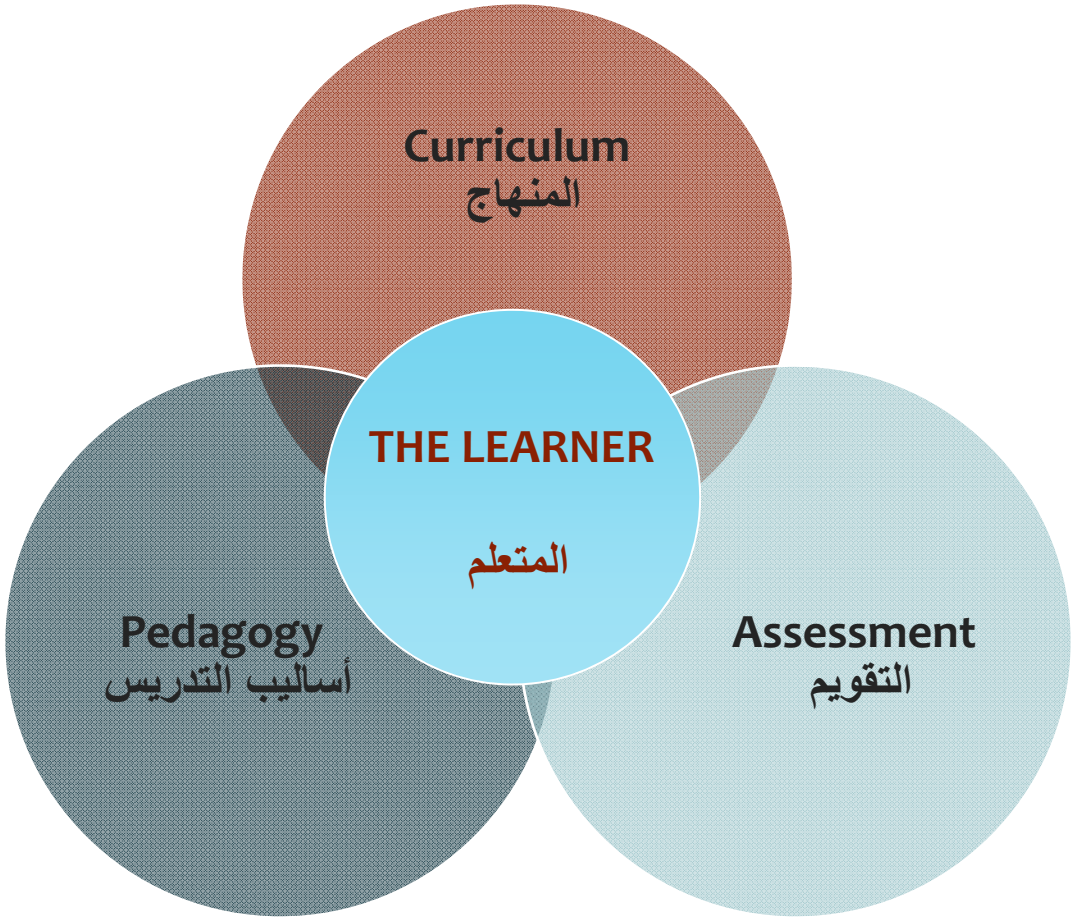
Best practice in education reform
أفضل الممارسات في إصلاح التعليم

Our context
السياق الخاص بنا

ADEC Mathematics Philosophy

فلسفة الرياضيات في مجلس أبوظبي للتعليم

What to teach
ماذا نُعلّم ؟



How to teach كيف نُعلّم ؟

How you know students have learned
كيف نتأكد أن الطلبة قد تعلموا ؟

International Benchmarking
المعايير الدولية

Singapore: سنغافورة

6 DATA ANALYSIS	
Pie charts	Include: • reading and interpreting pie charts, • solving 1-step problems using information presented in pie charts. Exclude use of degrees for calculation.

✓ Clear specifications of what to include and exclude

✓ مواصفات واضحة لما يجب ضمّه أو استبعاده

International Benchmarking
المعايير الدولية

Ontario (Canada), Grade 6:

أونتاريو (كندا) ، الصف السادس

– solve problems that arise from real-life situations and that relate to the magnitude of whole numbers up to 1 000 000 (*Sample problem:* How would you determine if a person could live to be 1 000 000 hours old? Show your work.);

✓ **Sample problems showing good pedagogy – higher order thinking**

✓ **نماذج من المسائل تظهر أساليب التدريس الجيدة و التي تتطلب مستوى عاليا من التفكير**

International Benchmarking
المعايير الدولية

Ontario (Canada), Grade 6:

أونتاريو (كندا) ، الصف السادس

- represent, compare, and order fractional amounts with unlike denominators, including proper and improper fractions and mixed numbers, using a variety of tools (e.g., fraction circles, Cuisenaire rods, drawings, number lines, calculators) and using standard fractional notation (***Sample problem:*** Use fraction strips to show that $1\frac{1}{2}$ is greater than $\frac{5}{4}$.);

✓ **Use of manipulatives and visual representations**

✓ **استخدام الوسائل اليدوية و التمثيلات البصرية**

International Benchmarking

المعايير الدولية

Qatar, Grade 8:

دولة قطر ، الصف الثامن

7.7 Recognise that measurements are not precise (e.g. give the upper and lower bounds of a measurement recorded as 15 cm to the nearest centimetre).

15 pupils measured two angles.
Here are their results.

Use the results to decide what each angle is most likely to measure.
How did you decide?

Angle A

Angle measured as	Number of pupils
36°	1
37°	2
38°	10
39°	2

Angle B

Angle measured as	Number of pupils
45°	5
134°	3
135°	4
136°	3

The mass of a dolphin was reported as 170 kg, to the nearest 10 kg.
Write down a mass that might have been the actual mass of the dolphin.

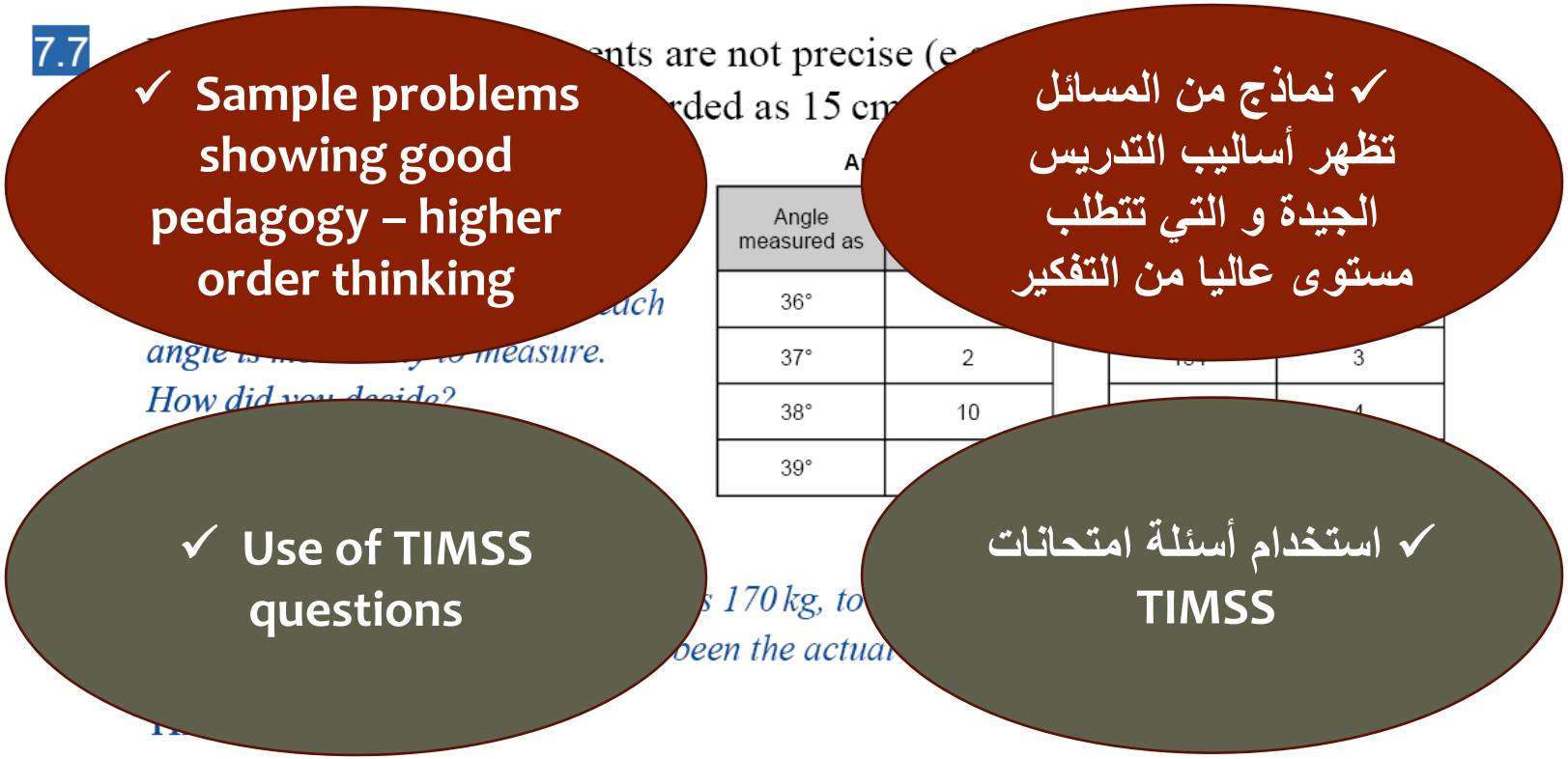
TIMSS Grade 8

International Benchmarking

المعايير الدولية

Qatar, Grade 8:

دولة قطر ، الصف الثامن



Conclusions

الخلاصة

- Curriculum documents can be more than just lists of content to cover.

- يمكن لوثائق المنهج أن تكون أكثر من مجرد قائمة المحتويات.

- Curriculum documents can be tools for promoting good **pedagogy**.

- يمكن لوثائق المنهج أن تكون أدوات لتعزيز **أساليب التدريس** الجيدة

Conclusions

الخلاصة

- Professional development = any “activities that develop an individual’s skills, knowledge, expertise and other characteristics as a teacher” (OECD, 2009)

- التنمية المهنية هي ” الأنشطة التي تطور مهارات الفرد و معرفته و خبرته و صفاته الأخرى كمعلم“ (منظمة التعاون الاقتصادي و التنمية ، 2009)

- Curriculum documents can be used as a **professional development** tool.

- يمكن استخدام وثائق المنهج كأداة **للتنمية المهنية**

Our Context

بالنسبة لنا

- Diverse international teaching force with different backgrounds / assumptions
- القوة العاملة في المدارس عالمية و متنوعة ومن بيئات وخلفيات مختلفة.
- Need for consistent, best-practice approach
- الحاجة إلى تطبيق أفضل الممارسات المناسبة .
- Need for teacher professional development
- الحاجة إلى عمل التنمية المهنية للمعلم .
- Education reform agenda
- أجندة إصلاح التعليم .

Best practice in education reform
أفضل الممارسات في إصلاح التعليم

- McKinsey Report (2010) – international synthesis of how to successfully improve education systems
- *"Prescribe adequacy, unleash greatness"*
- Early in reform, highly specific guidelines for teachers are needed to:
  - Improve teacher knowledge
  - Promote implementation of desired practices

- تقرير مكنزي (2010) – التركيبة العالمية لكيفية تحسين الأنظمة التعليمية بنجاح
- "تحديد الكفاءة و إطلاق العنان للتميز"
- البدء مبكرا في الإصلاح ، بحاجة لإرشادات للمعلمين بخصوص :
  - تحسين معرفة المعلم
  - تعزيز تنفيذ الممارسات المطلوبة

Developing a strategy

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Best practice in education reform
أفضل الممارسات في إصلاح التعليم

- Develop new documents with explicit **pedagogical** and **content** guidance for teachers.
- Be **explicit**, but not **prescriptive** – give examples and ideas.

- تطوير وثائق جديدة تحتوي على إرشادات واضحة للمعلم فيما يخص أساليب التدريس و المحتوى .
- كن واضحا و لكن ليس بأسلوب توجيهي. أعط أمثلة و أفكارا .

First version – 2013-2014
2014 - 2013 النسخة الأولى

Learning Outcomes *Students learn to:*	Explanatory Notes
N1.7 Investigate, visually represent and describe factors and multiples up to 100	▪ Students need to develop a systematic approach for finding factors. ▪ Students should explore patterns of multiples (e.g. using a hundreds board). ▪ Students are not required to do HCF, LCM or factor trees.

Feedback and observations

الملاحظات و المشاهدات

- Explanatory notes were received very positively
- Curriculum documents (including ENs) were used in schools on a daily basis to guide teaching and learning
- Requests for even more support:
  - ✓ Extra explanation
  - ✓ Showing progression from grade to grade
  - ✓ What is NOT required

- تم تلقي الملاحظات التوضيحية بإيجابية.
- وثائق المنهج (بما فيها الملاحظات التوضيحية) تم استخدامها في المدارس بشكل يومي في العملية التعليمية .
- مطالب بدعم أكثر :
  - ✓ شرح أوفى .
  - ✓ إظهار التقدم من مرحلة إلى أخرى
  - ✓ ما هو غير مطلوب .

Revised version – 2014-2015

النسخة المعدلة - 2014 - 2015

	Mastered (Learning Outcome)	Developing	Emerging
6N1.4	Identify, visually represent and **explain** multiples and factors up to 100	Identify and visually represent multiples **and factors** up to 100	**Identify and visually represent multiples** up to 100

Explanatory Notes

- This is the first time the concepts of factors and multiples have been introduced.
- Students can find multiples using basic facts knowledge, skip counting and exploring patterns (e.g. on a hundreds board).
- Students need to develop a systematic approach for finding factors to ensure they find all the factors. A systematic approach could be noting that 1 is a factor of any number, then checking if the number divides by 2, 3, 4, and so on until they begin to encounter pairs of factors they have already discovered. For example, to find the factors of 18: 1 is always a factor. 18 divides by 2 – this gives 2 and 9 as factors. 18 divides by 3 – this gives 3 and 6 as factors. 18 does not divide by 4 or 5. 18 divides by 6 – this gives us a pair we have already found, so we know we are finished. The factors of 18 are 1, 2, 3, 6, 9, 18.
- When writing lists of factors, a 'square' factor should not be written twice. For example, the factors of 16 are 1, 2, 4, 8 and 16 (4 is not written twice).
- Students are not required to do highest common factor (HCF), lowest common multiple (LCM) or factor trees.
- Students should compare factors and multiples, to help clarify their understanding of the two related but different concepts.

Feedback and observations

الملاحظات و المشاهدات

- Again, teachers and curriculum reviewers responded very positively
- Documents used daily as ‘working documents’ in schools
- More consistency of practice
- Suggested pedagogical approaches used in schools
- No concerns about length of document / too much information

- مرة أخرى، كانت استجابة المعلمين و مراجعي المنهج إيجابية جدا .
- استخدمت الوثائق بشكل يومي في المدارس ’ كوثائق عمل ‘.
- تجانس أكثر في العمل.
- أساليب تدريس مقترحة تُستخدم في التعليم في المدارس .
- لا يوجد مخاوف من طول الوثيقة / أو من كثرة المعلومات .

Feedback and observations

الملاحظات و المشاهدات

Teachers asked us to:

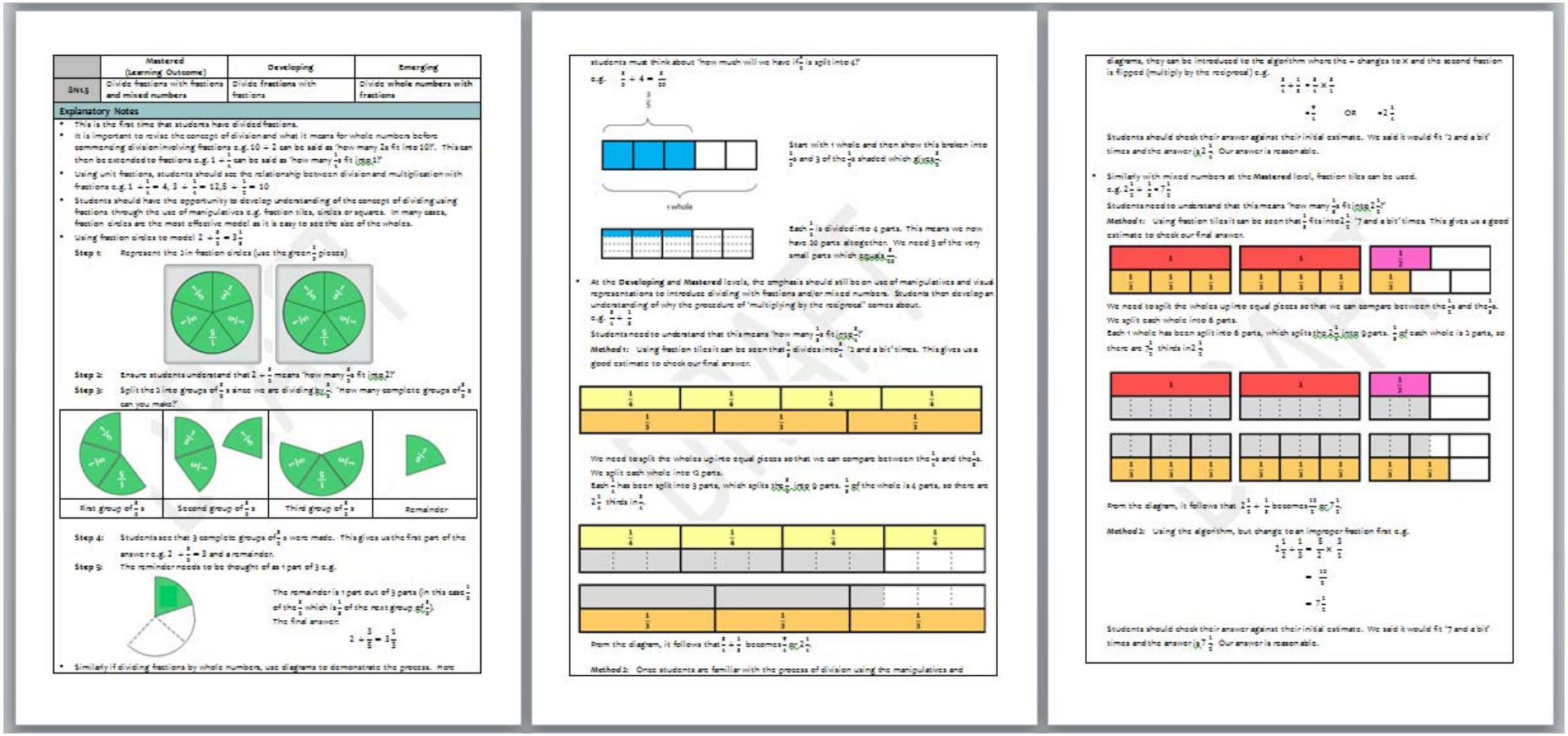
- More clearly describe the different E, D, M levels
- Specifically show the level of difficulty
- State ADEC terms (different countries use different terms e.g. BEDMAS / PEMDAS / BODMAS …)
- Bold important words
- Say what students had learned the previous year

طلب المعلمون الآتي :

- شرح مستويات الإنجاز- مبتدئ ، متقدم ، متقن – بشكل أوضح .
- إظهار مستوى الصعوبة بشكل محدد .
- تحديد المصطلحات المستخدمة في مجلس أبوظبي للتعليم . (حيث يتم استخدام مصطلحات مختلفة في كل دولة) مثلا : BEDMAS ، PEMDAS، BODMAS الخ .
- كتابة الكلمات الهامة بالخط العريض .
- تحديد ما تعلمه الطلبة في السنة السابقة .

Draft version – 2015-2016

المسودة – 2016 - 2015



	Mastered (Learning Outcome)	Developing	Emerging
SN1.5	Divide fractions with fractions and mixed numbers	Divide fractions with fractions	Divide whole numbers with fractions

Explanatory Notes

- This is the first time that students have divided fractions.
- It is important to revise the concept of division and what it means for whole numbers before commencing division involving fractions e.g. $10 \div 2$ can be said as 'how many 2s fit into 10?'. This can then be extended to fractions e.g. $1 \div \frac{1}{4}$ can be said as 'how many $\frac{1}{4}$s fit into 1?'
- Using unit fractions, students should see the relationship between division and multiplication with fractions e.g. $1 \div \frac{1}{4} = 4$, $3 \div \frac{1}{4} = 12$, $5 \div \frac{1}{2} = 10$
- Students should have the opportunity to develop understanding of the concept of dividing using fractions through the use of manipulatives e.g. fraction tiles, circles or squares. In many cases, fraction circles are the most effective model as it is easy to see the size of the wholes.
- Using fraction circles to model $2 \div \frac{1}{3} = 3\frac{1}{3}$

Step 1: Represent the 2in fraction circles (use the green $\frac{1}{3}$ pieces)

Step 2: Ensure students understand that $2 \div \frac{1}{3}$ means 'how many $\frac{1}{3}$s fit into 2?'

Step 3: Split the 2 into groups of $\frac{1}{3}$s since we are dividing by $\frac{1}{3}$. 'How many complete groups of $\frac{1}{3}$s can you make?'

First group of $\frac{1}{3}$s	Second group of $\frac{1}{3}$s	Third group of $\frac{1}{3}$s	Remainder

Step 4: Students see that 3 complete groups of $\frac{1}{3}$s were made. This gives us the first part of the answer i.e. $2 \div \frac{1}{3} = 3$ and a remainder.

Step 5: The remainder needs to be thought of as 1 part of 3 e.g.

The remainder is 1 part out of 3 parts (in this case $\frac{1}{3}$ of the $\frac{1}{3}$ which is $\frac{1}{3}$ of the next group of $\frac{1}{3}$).

The final answer:

$$2 \div \frac{1}{3} = 3\frac{1}{3}$$

- Similarly if dividing fractions by whole numbers, use diagrams to demonstrate the process. More

students must think about 'how much will we have if $\frac{1}{2}$ is split into 4?'

e.g. $\frac{1}{2} \div 4 = \frac{1}{10}$

Start with 1 whole and then show this broken into $\frac{1}{2}$s and 1 of the $\frac{1}{2}$s shaded which equals $\frac{1}{2}$.

Each $\frac{1}{2}$ is divided into 4 parts. This means we now have 10 parts altogether. We need 1 of the very small parts which equals $\frac{1}{10}$.

- As the **Developing** and **Mastered** levels, the emphasis should still be on use of manipulatives and visual representations to introduce dividing with fractions and/or mixed numbers. Students then develop an understanding of why the procedure of 'multiplying by the reciprocal' comes about.

e.g. $\frac{1}{4} \div \frac{1}{3}$

Students need to understand that this means 'how many $\frac{1}{3}$s fit into $\frac{1}{4}$?'

Method 1: Using fraction tiles it can be seen that $\frac{1}{3}$ divides into $\frac{1}{4}$ 'a and a bit' times. This gives us a good estimate to check our final answer.

We need to split the wholes up into equal pieces so that we can compare between the $\frac{1}{4}$s and the $\frac{1}{3}$s.

We split each whole into 12 parts.

Each $\frac{1}{4}$ has been split into 3 parts, which splits the $\frac{1}{3}$s into 4 parts. $\frac{1}{3}$ of the whole is 4 parts, so there are $1\frac{1}{4}$ thirds in $\frac{1}{4}$.

From the diagram, it follows that $\frac{1}{4} \div \frac{1}{3}$ becomes $\frac{3}{4}$ or $1\frac{1}{4}$.

Method 2: Once students are familiar with the process of division using the manipulatives and

diagrams, they can be introduced to the algorithm where the ÷ changes to × and the second fraction is flipped (multiply by the reciprocal) e.g.

$$\frac{1}{4} \div \frac{1}{3} = \frac{1}{4} \times \frac{3}{1}$$

$$= \frac{3}{4} \quad \text{OR} \quad = 1\frac{1}{4}$$

Students should check their answer against their initial estimate. We said it would fit '1 and a bit' times and the answer is $1\frac{1}{4}$. Our answer is reasonable.

- Similarly with mixed numbers at the **Mastered** level, fraction tiles can be used.

e.g. $2\frac{1}{2} \div \frac{1}{3} = 7\frac{1}{2}$

Students need to understand that this means 'how many $\frac{1}{3}$s fit into $2\frac{1}{2}$?'

Method 1: Using fraction tiles it can be seen that $\frac{1}{3}$ fits into $2\frac{1}{2}$ '7 and a bit' times. This gives us a good estimate to check our final answer.

We need to split the wholes up into equal pieces so that we can compare between the $\frac{1}{2}$s and the $\frac{1}{3}$s.

We split each whole into 6 parts.

Each 1 whole has been split into 6 parts, which splits the $\frac{1}{2}$s into 3 parts. $\frac{1}{3}$ of each whole is 2 parts, so there are $\frac{1}{2}$ thirds in $2\frac{1}{2}$.

From the diagram, it follows that $2\frac{1}{2} \div \frac{1}{3}$ becomes $\frac{15}{2}$ or $7\frac{1}{2}$.

Method 2: Using the algorithm, but change to an improper fraction first e.g.

$$2\frac{1}{2} \div \frac{1}{3} = \frac{5}{2} \times \frac{3}{1}$$

$$= \frac{15}{2}$$

$$= 7\frac{1}{2}$$

Students should check their answer against their initial estimate. We said it would fit '7 and a bit' times and the answer is $7\frac{1}{2}$. Our answer is reasonable.

Feedback and observations

الملاحظات و المشاهدات

- Feedback still very positive
- Small number of concerns about length but many requests for more
- Request for even more examples, especially using manipulatives
- Request for more clarification of maths concepts
- Request for new section on key vocabulary in each unit

- الملاحظات ما زالت إيجابية .
- يوجد بعض المخاوف عن الإطالة و لكن الكثيرون يطالبون بالمزيد .
- طلب وجود أمثلة أكثر و خاصة باستخدام الوسائل اليدوية .
- طلب توضيح أكثر لمفاهيم الرياضيات .
- طلب وجود قسم جديد للمفردات الرئيسة في كل وحدة .

Quotes from the field

مقتطفات من الميدان

- "The explanatory notes have been extremely helpful during the planning stage of my lessons. It provided me with specific details and ideas on what I can do to support students when I teach a specific learning outcome."

  – *Teacher*

- "لقد ساعدتني الملاحظات التوضيحية بشكل كبير أثناء مرحلة التخطيط للدروس . لقد زودتني بتفاصيل و أفكار محددة لما يمكن أن أقوم به لدعم الطلبة عندما أقوم بتدريس مخرج تعلم محدد . "

  أحد المعلمين

Quotes from the field

مقتطفات من الميدان

- "The reason the notes are helpful for me is that the outcomes give you a little idea but not enough detail about ***how*** you need to teach that. What methods should I use for multiplication? What vocabulary words should I use / not use? What words have they used before?"

  – *Teacher*

- "إن السبب في كون هذه الملاحظات مفيدة بالنسبة لي هو أن المخرجات تعطيك فكرة بسيطة ولكن غير مفصلة بشكل كاف عن **كيفية** تدريس نقطة معينة . ما هي الطرق التي يجب أن أستخدمها في شرح عملية الضرب ؟ ما هي المفردات التي يجب أن أستخدمها / أو لا أستخدمها ؟ ما هي المفردات التي قاموا باستخدامها من قبل ؟ "

  أحد المعلمين

Quotes from the field

مقتطفات من الميدان

- "There are lots of good examples of how to use the manipulatives. I use these a lot in my teaching and it helps the girls understand the mathematical concepts."

  – *Teacher*

- "يوجد الكثير من الأمثلة الجيدة عن استخدام الوسائل اليدوية . أقوم باستخدام الكثير منها في التدريس ، حيث تساعد الطالبات على فهم المفاهيم الرياضية . "

  إحدى المعلمات

Quotes from the field

مقتطفات من الميدان

- "I always look for the notes that say *'In Grade 5, they learned … In Grade 7, they will learn …'* and so it tells me the gap that I need to fill this year in Grade 6."

  – *Teacher*

- "أنظر دائما إلى الملاحظات التي تبدأ بـ *'لقد قام الطلبة في الصف الخامس بتعلم ..... سوف يتعلم الطلبة في الصف السابع .... '*

  تساعدني هذه الملاحظات على إيجاد الفجوة التي يجب ملؤها في الصف السادس هذا العام . "

  أحد المعلمين

Quotes from the field

مقتطفات من الميدان

- "Whenever I was unsure exactly what was required from my students to achieve a learning outcome on a specific level, I used the explanatory notes as a guide."

  – *Teacher*

- "عندما لا أكون متأكدا تماما مما هو مطلوب من الطلبة لتحقيق مخرج تعلم بمستوى محدد ، أقوم باستخدام الملاحظات التوضيحية كدليل . "

أحد المعلمين

Quotes from the field

مقتطفات من الميدان

- "During my first year of teaching in the NSM, the explanatory notes helped me to plan assessment opportunities to check my students' understanding of the mathematics."

  – *Teacher*

- "خلال عامي الأول في تدريس النموذج المدرسي الجديد ، ساعدتني الملاحظات التوضيحية على التخطيط للتقويم حتى أتحقق من فهم الطلبة للرياضيات . "

أحد المعلمين

Quotes from the field

مقتطفات من الميدان

- "Every single time I go into schools to work with teachers, we look at what the curriculum document says. The documents give them so many good ideas that they can take straight into their teaching."

  – Education Advisor

- "في كل مرة أقوم فيها بزيارة إحدى المدارس للعمل مع المعلمين ننظر إلى ما تقوله وثيقة المنهج . تزود الوثائق المعلمين بالكثير من الأفكار الجيدة التي يمكنهم استخدامها مباشرة في التعليم . "

- مستشار تربوي

Quotes from the field

مقتطفات من الميدان

- "When the teachers refer to the documents, they know much more clearly exactly what they should teach. They're not having to ask me to explain what the learning outcomes mean."

  – *Education Advisor*

- "عندما يرجع المعلمون إلى الوثائق فإنهم يدركون بوضوح أكبر ما يجب عليهم تدريسه . و عندها لن يطلبوا مني في كل مرة شرح معنى مخرجات التعلم ".

- مستشار تربوي

Quotes from the field

مقتطفات من الميدان

- “All the teachers think it’s amazing. When they arrive in the country, they get the document and they know exactly what they have to do. They say they’ve never had a document giving them so much help.”

  – *Education Advisor*

- ”يعتقد جميع المعلمين أنها رائعة . عندما يصلون إلى الدولة يحصلون على هذه الوثيقة و يعرفون تماما ما يجب عليهم فعله . يقولون بأنهم لم يحصلوا على وثيقة تساعدهم بهذه الطريقة من قبل . “

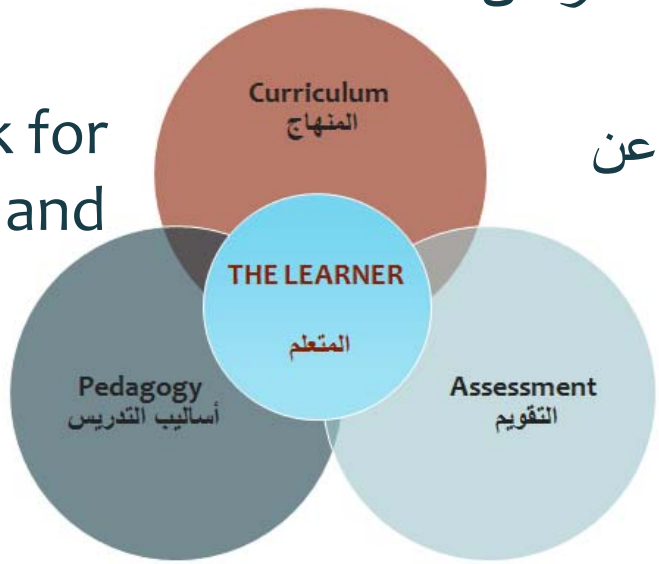
  - مستشار تربوي

‘Take-home’ messages

رسائل

- Curriculum and pedagogy should not be separated.
- There is more than one pedagogical approach to teaching the same content.
- Some are more effective than others!
- We all need to look for different methods and try to use the best ones available.

- يجب عدم الفصل بين المنهج و أساليب التدريس .
- يوجد أكثر من أسلوب لتدريس المحتوى نفسه .
- بعض هذه الأساليب فعال أكثر من غيره.
- يجب علينا جميعا البحث عن طرق مختلفة و استخدام الأفضل منها .



‘Take-home’ messages

رسائل

- Don’t make assumptions about what your teachers ‘know’ and do:
  - Content
  - Pedagogy

- لا تفترض مسبقا ما يعرفه المعلمون أو يقومون بعمله :
  - المحتوى
  - أساليب التدريس

Questions?

الأسئلة

References

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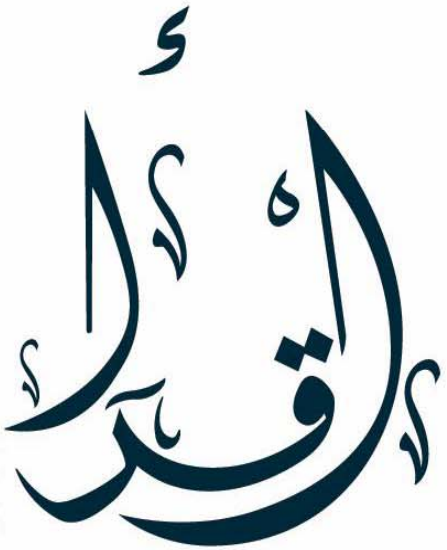
Thank you
شكرا



Iqraa