Creating Effective Maths Worksheets

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Worksheets have been used in maths classrooms for a long time, much before the pandemic. There are some resource groups that teachers can subscribe to, which periodically share worksheets on various topics over emails. Worksheets are related to workbooks: the note to textbook writers at the beginning of NCERT syllabus for classes I-V states categorically that the 'class I and II books would be workbooks'. So, we can consider a workbook to be a collection of thoughtfully created and ordered worksheets. So, why are worksheets particularly popular in maths?

Simple drill and practice

One big reason for this popularity is that drill and practice and maths are inseparable. Most traditional maths pedagogies include a high dose of practice. Worksheets can not only achieve that easily, but they also carry some form of self-corrective features if they are designed with some creativity. Figure 1 is an example of how the colours can indicate if the answers are correct. A more interesting worksheet would be Figure 2, in which the sheet is split into many areas, each containing a sum. Once the sums are completed, and the areas coloured according to the given code, a picture emerges. If the sums are done incorrectly, the picture will be distorted, conveying that not all the answers are correct.

Exploration with something learned

While there is ample scope for creativity in the development of such worksheets, they offer very

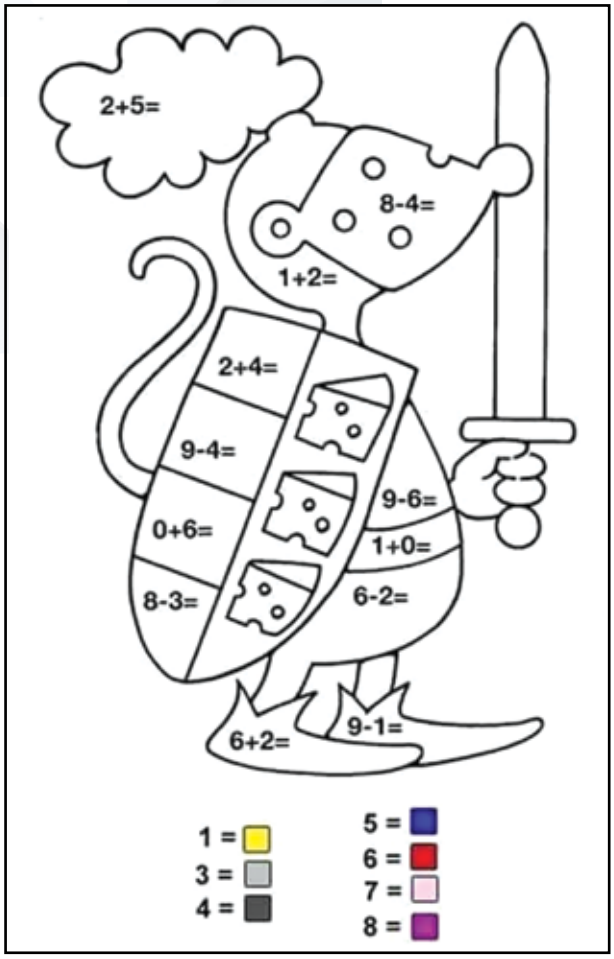

Figure 1. Colours indicate correct answers

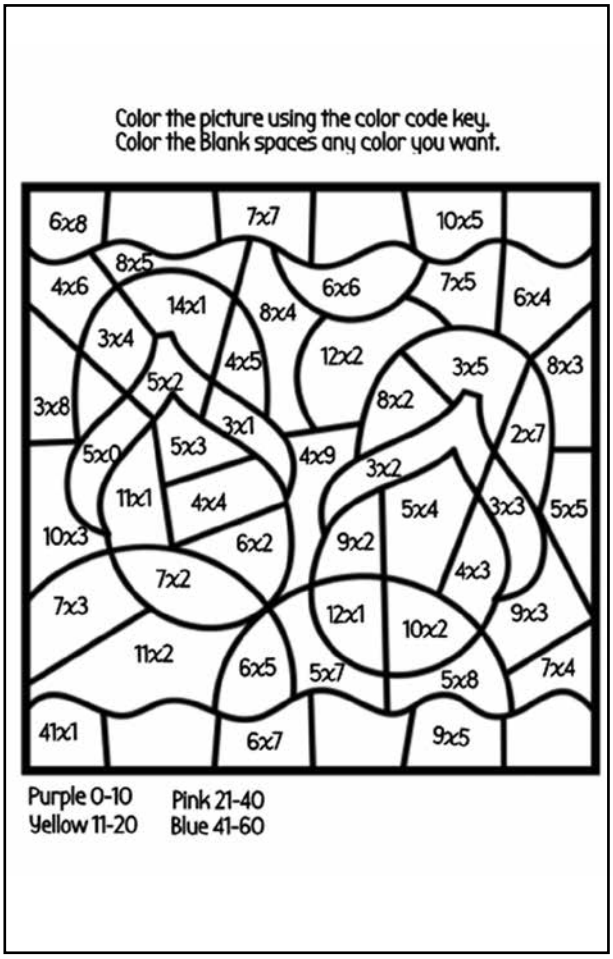

Figure 2. Source https://teachersherpa.com/

little beyond drill and practice to the learner. At the same time, even at this basic level of operation with single-digit numbers, a good worksheet will include operations with zero. A drill and practice worksheet can be made more interesting by including Multiple Choice Questions (MCQ) and matching. For children in classes I and II, MCQ can take the form of, (i) Colour the correct one, (ii) Circle the biggest/longest/…, (iii) Tick the smallest/shortest/ etc. Similarly, matching can include three-way matching with three columns and/or one column can have a few more entries so that the last pair is not an automatic match. Many such examples are included in the NCERT textbooks for classes I and II in particular (Figure 3).

In the beginning, particularly in class I, a lot of vocabulary related to measurement and spatial understanding has to be learnt – some are

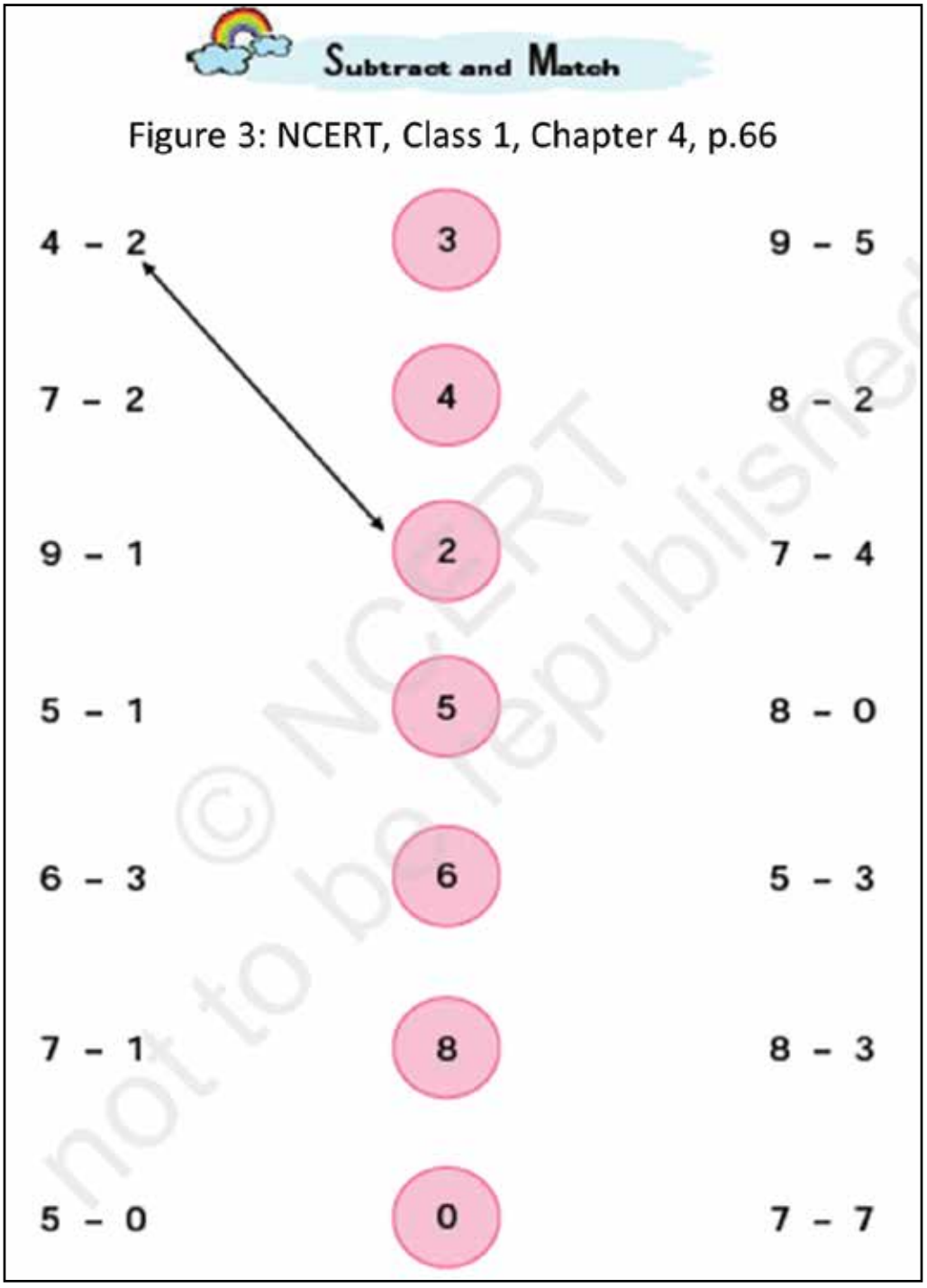

Figure 3: NCERT, Class 1, Chapter 4, p.66

Figure 3. Source NCERT, Class II, Chapter 4, p. 66

mentioned in Table 1. At this stage, the teacher will need to help the children wherever required. While worksheets (including pictures) are a good way to provide practice as well as assessment, one must remember that in primary classes, this experience may not be possible through a worksheet. *Longest-shortest* or *thicker-thinner* can be taught visually and therefore, through a worksheet. But heavier-lighter has to be *felt* first. Based on that primary experience, the worksheet can and should come as the next step. But without the primary experience, there is a possibility of developing a misconception that bigger is always heavier. So, care should be taken to avoid the same.

To develop a drill and practice worksheet with numbers, one must have a list of competencies that needs to be practised. Care should be taken to ensure that no resulting number is larger than what the learners have been exposed to. For example, at the class III stage, learners are taught numbers only up to one thousand. So, a sum of 748 + 509 would be inappropriate and may confuse the learner.

It is also highly recommended that one includes a few open-ended problems, that is, problems with multiple possible correct solutions (as well as some wrong ones) in the worksheet. Figure 4 provides an example of a set with open-ended questions. These kinds of arrangements also break the monotony of a drill and practice worksheet.

Such number worksheets can also nudge the learner into observing some properties of addition and multiplication – commutative, in particular (Figure 5). However, it is an inductive process, where one checks case-by-case, something that does not provide for generalisation or justification.

Table 1

Bigger smaller	Biggest smallest
Taller shorter	Tallest shortest
Longer shorter	Longest shortest
Thicker thinner	Thickest thinnest
Wider narrower	Widest narrowest
Heavier lighter	Heaviest lightest
Faster slower	Fastest slowest

Table 1. Early maths vocabulary

Interlinking different concepts

Some worksheets can help learners transit from addition to subtraction (Figure 6) and similarly, from multiplication to division. These are the great stepping-stones to reach the next concept while, at the same time, providing drill and practice. The *Ganit Bodh* series by *Digantar* is a great example of how concept-formation can be assisted by a thoughtfully sequenced and developed set of worksheets.

In many such worksheets, the key idea is that since the task is self-evident, the learner has less to read. Often, there is a worked-out example at the beginning, illustrating what needs to be done. Also, it is expected that the learner does all the work in the worksheet itself. So, adequate space should be provided not only to write the answers but also to do some necessary rough work. If the worksheet occupies only one side of the page, then the back side can be used for rough work. Regardless of how it is planned, spacing and layout should be comfortable, convenient and clear. While the font size should be large enough for the learner, instructions for the facilitator could be included at the top or bottom of the worksheet in a smaller font.

Such worksheets do not have to be colourful. Simple line drawing works fine. Thus, they are not expensive to produce. *Ganit Bodh* by *Digantar* and *Khushi Khushi* by *Eklavya* are great examples of simple but effective worksheets, which not only provide drill and practice but do much more. While

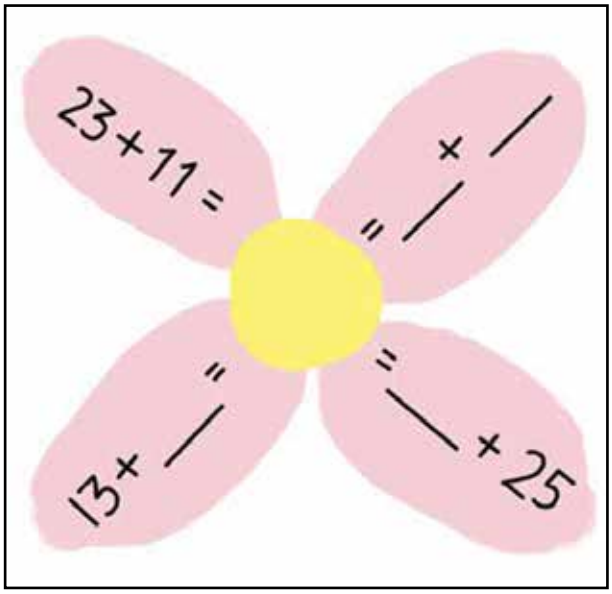

Figure 4. Source Sikkim maths textbook, class II, p. 54

Ganit Bodh builds up the concepts step by step, *Khushi Khushi* excels at linking various concepts and challenging the learner (Figure 7).

Addressing misconceptions

Worksheets need not be limited to just drill and practice. Let us consider the worksheet, *TearOut: Area-Perimeter* (link in References). It is for older children and therefore includes more text. It describes the parameters – unit length and unit area, and the dos and don'ts at the beginning. Then, the first couple of questions not only assess the basic understanding of the concepts of perimeter and area but are also open-ended questions, allowing the learner some degrees of freedom. In addition, these also ask the learner to observe and document his/her observations. Most importantly, they help the learner understand the difference between area and perimeter. Further questions build on these: illustrate how the perimeter in the

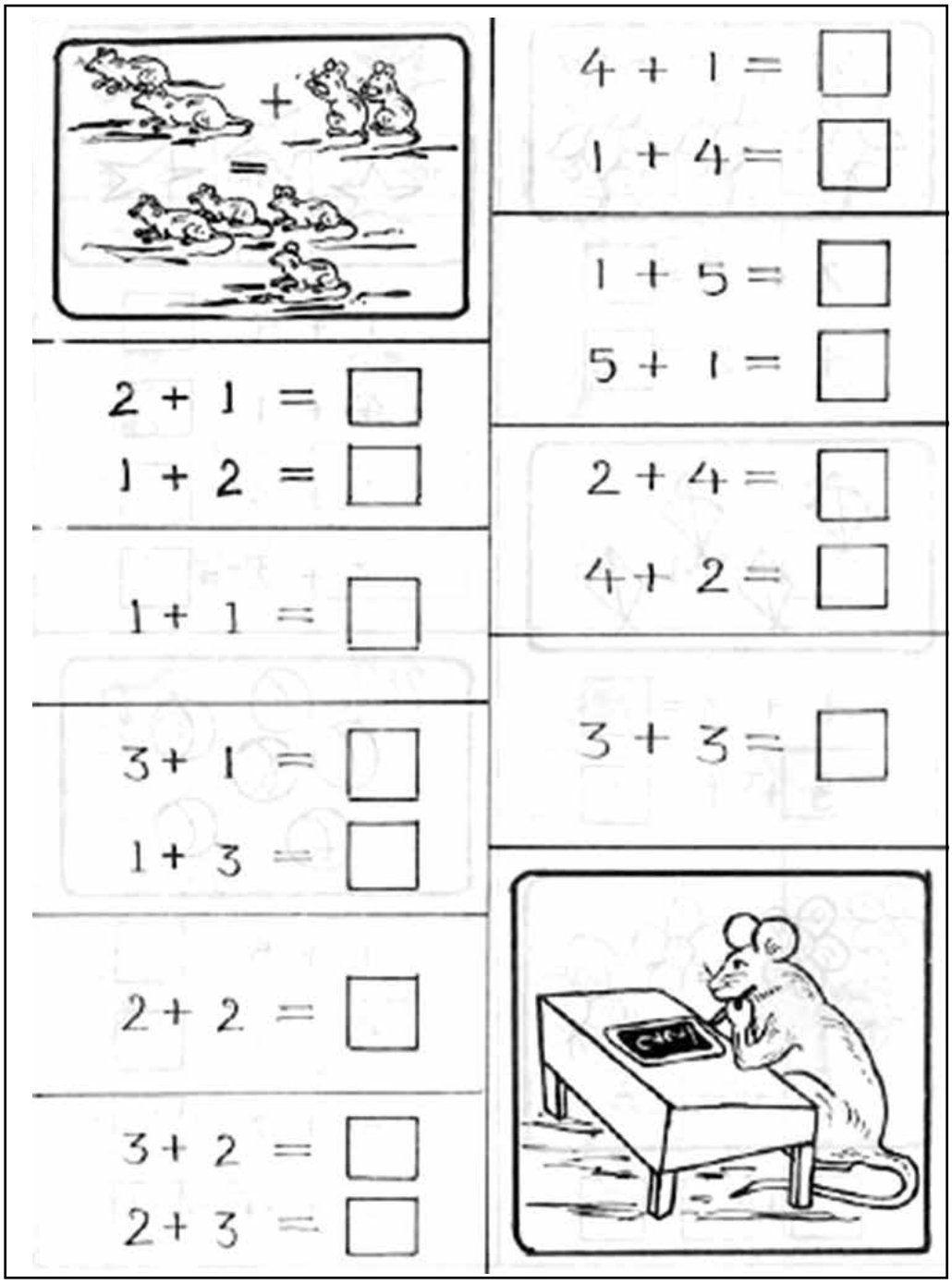

Figure 5. Source Ganith Bodh 3, p. 61

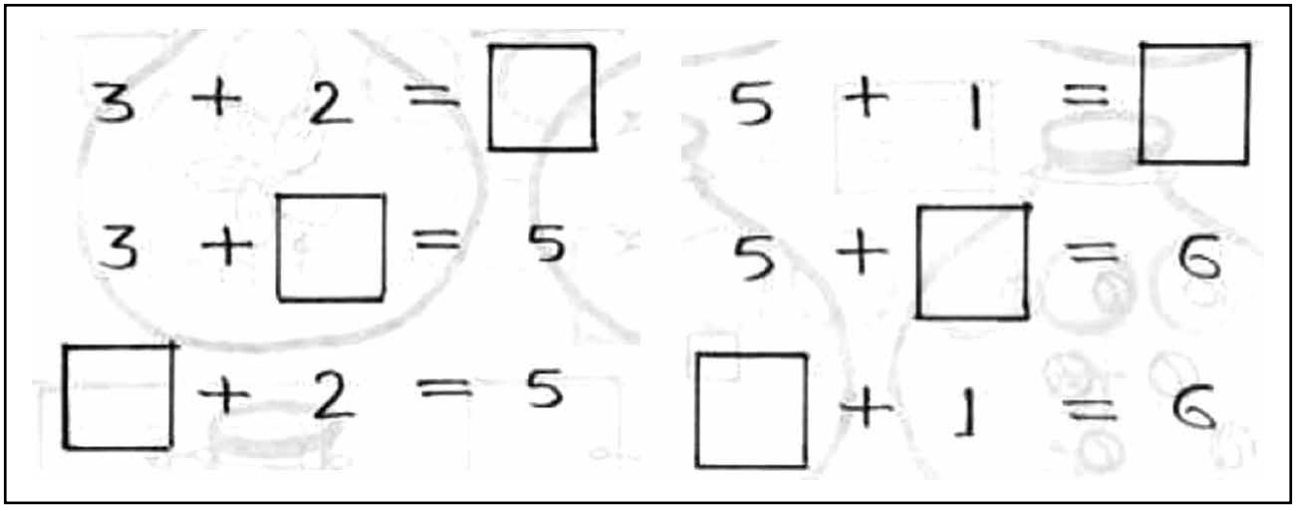

Figure 6. Source Ganith Bodh 3, p. 65

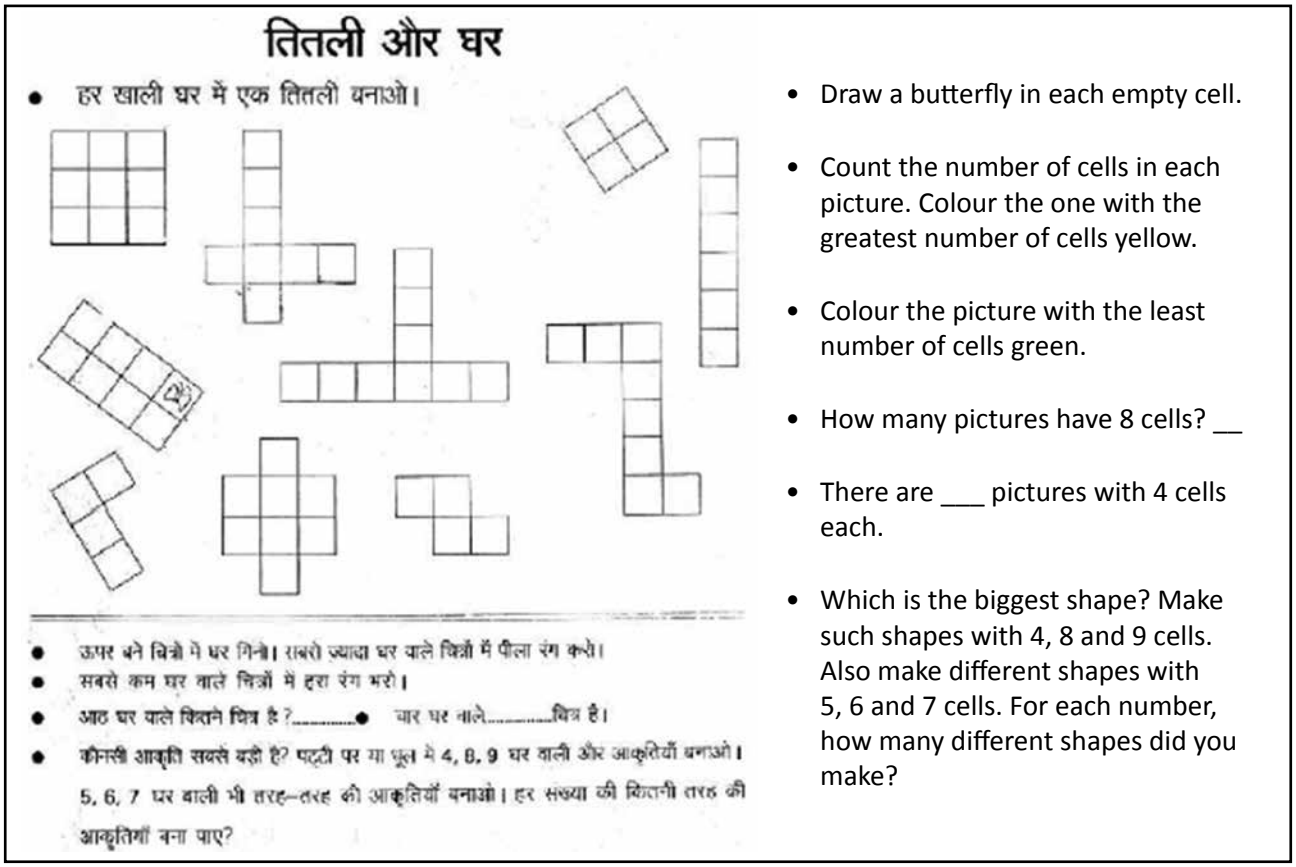

Figure 7. Source Khushi Khushi, Class II, p. 8

shape obtained as the difference of two rectangles, can be equal to or longer than that of the bigger rectangle. And the final task gets the learner to apply this knowledge to generate new shapes with the given specifications from an existing shape.

The goal of this worksheet is not only to eliminate the misconception that if the area reduces, then the perimeter also reduces and vice versa but to illustrate how one can be preserved while the other changes. It also shows how to increase the perimeter while reducing the area. Thus, a worksheet can focus on a misconception and go beyond that. This particular worksheet was inspired by (i) the *Education Initiative* video on misconceptions children have related to perimeter and (ii) a problem from the *Thinking Skills* pull-out.

So, as described in this article, worksheets can be used for a wide range of things. Last, but not least, they are useful for both formative as well as summative assessment as shown in textbooks and workbooks.

Language, look and accessories

It is important to indicate what the learner should know beforehand, that is, the prerequisite knowledge to fill in worksheets. While worksheets for younger children (class I and II) should not be text-heavy, older children (classes IV and V and older) can be expected to read and follow instructions. The language should be simple, crisp and unambiguous. It is a good idea to test out a worksheet and check if it is conveying what the creator intends to. If necessary, one should add a diagram or an example to clarify things further.

While for class IV and upwards, the font size can be regular; for the primary classes, it should be bigger. For older children, layout etc. are not very important, especially because they may solve the worksheet in their notebooks. However, the stages should be distinct, especially if the worksheet builds up (for example, Low-floor, high-ceiling or LFHC).

A worksheet can be accompanied by accessories. For example, some of the initial subtraction tasks in *Ganit Bodh* requires learners to place buttons or pebbles at the designated spots and then remove some to get the answers (Figure 8), the *TearOuts* are based on dot sheets and sometimes interlocking cubes. Ideally, a worksheet should be just 1-2 pages long. Therefore, it must focus on a specific topic, rather, a specific aspect of some topic.

Limitations of worksheets

So, is there anything that a worksheet cannot do? Yes, there are limitations to worksheets. Note that a worksheet is essentially textual material with some diagrams/pictures printed on paper or seen on a screen (mobile, laptop etc.). It can provide direct experience of 1D (length, distance, perimeter) and 2D (area) but not of 3D (volume and capacity). So, experience with 3D and solid shapes must take place before worksheets can be used to harness maths concepts further. Unless the learner is able to visualise solid shapes and map them on 2D figures, worksheets will not be of much help. Thus, developing a conceptual understanding of capacity/volume and developing an intuitive sense for it, is difficult through worksheets alone. Similarly, worksheets are not sufficient to provide full exposure to all possible situations involving size and weight. That needs to be done separately (see the teacher pages for *Measurement* in the Sikkim class I textbook).

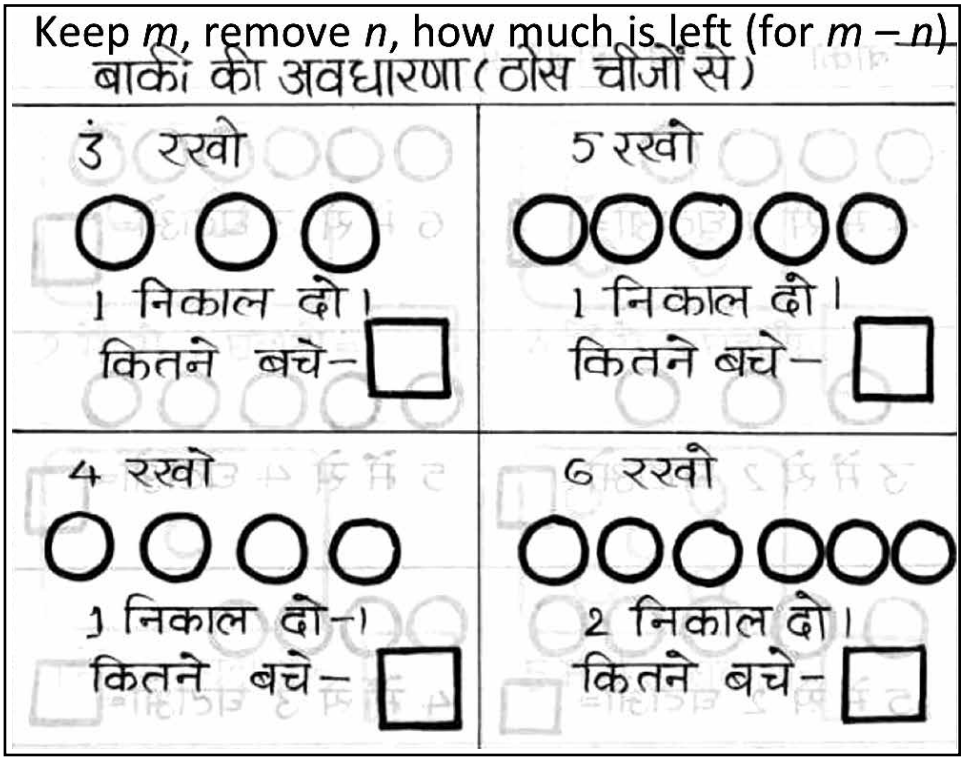

Figure 8. Source Ganit Bodh 3, p. 67

References

NCERT syllabus for Class 1-5

NCERT Math-magic textbooks for Class 1-5: https://ncert.nic.in/textbook.php

Sikkim mathematics textbooks:

Class I: https://online.fliphtml5.com/iuwdn/pfdo/#p=1

Class II: https://online.fliphtml5.com/iuwdn/kgob/#p=1

Class III: https://online.fliphtml5.com/iuwdn/hsdm/#p=2

Class IV: https://online.fliphtml5.com/iuwdn/ifaw/#p=1

Class V: https://online.fliphtml5.com/iuwdn/pjgl/#p=1

Khushi Khushi: https://www.eklavya.in/books/eklavya-books-pdf (Primary Education Programme)

Ganit Bodh, Digantar

Area-perimeter TearOut, At Right Angles: http://publications.azimpremjifoundation.org/2032/1/Terout_fun%20with%20dot%20sheets.pdf

Misconception: Perimeter: https://www.youtube.com/watch?v=zYiw_EfIQNE

Thinking Skills Pullout, At Right Angles: http://publications.azimpremjifoundation.org/1709/1/20_Teaching%20thinking%20skills%281%29.pdf

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