Preservice mathematics education:A report on the trial of a constructivist approach.

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In recent years there has been much research into the processes involved in learning, with particular emphasis being placed on examining the way in which learners' construct knowledge. The development and application of constructivist philosophy to the teaching and learning of mathematics as one method of exploring the process of learning has only occurred during the last decade (von Glasersfeld, 1987). Much has been written about the means of implementing these approaches within primary school classrooms, however, there has not been the same emphasis on exploring the actual application of such approaches with these classrooms. In discussing the use of constructivist approaches within classrooms, Gunstone and Northfield (1988, p.1) have stated that there is a need for teachers to be exposed to constructivist approaches in the process of learning how to implement them. In relation to teacher education "constructivism and conceptual change need to be considered in the same way for students, teachers and researchers". Teacher education programs need to model examples of constructivist teaching/learning approaches for participants. Both preñservice and inservice education programs need to allow teachers the opportunity to construct their own conceptions of the pedagogical knowledge required for˘˘˘˘-˘˘-˘˘˘ implementation within the classroom setting. Some examples of this being done within mathematics and science areas are: Ball (1988) who describes the use a constructivist approach with a group of preñservice mathematics teachers, while Baird and Mitchell˘˘˘˘˘˘˘˘˘˘˘˘˘˘˘˘˘˘˘˘ ˘˘˘ (1987), and Hand and Treagust (1991) describe the use of such approaches with inservice education for secondary teachers.

The importance of constructivist approaches to the teaching and learning of mathematics‹˘˘˘‹Œ˘˘’UŒlies in the emphasis placed on the individual actively exploring and constructing viable‹˘˘˘‹Œ˘.ãŒknowledge and then gaining experience with that knowledge through reflection. To‹˘˘˘‹Œ˘¢ËŒsupport this exploration an environment which is nonñthreatening as well as self‹ .PA
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‹Œ˘wwŒfulfilling needs to be created (Watts & Bentley, 1987). The setting up of such an‹˘˘˘‹environment allows learners ‹˘˘˘˘˘Ï˘˘˘˘˘˘‹ñ to be active rather than passive recipients of knowledge‹˘˘˘˘˘Ç˘˘˘˘˘˘‹Œ˘bvŒñ to write and talk about their mathematical experiences and beliefs, both past and‹˘˘˘‹present, through social interaction and reflective abstraction‹˘˘˘˘˘õ˘˘˘˘˘˘‹Œ˘ïUŒñ to take risks and explore mathematical concepts in the process of constructing‹˘˘˘‹understanding and developing their state of knowing.‹˘˘˘˘˘Õ˘˘˘˘˘˘‹Œ˘˘t]ŒThe development of a nonñthreatening learning environment allows the process of social‹˘˘˘‹Œ˘’UŒconstruction of knowledge to occur (Solomon, 1987).

Learners are to discuss and‹˘˘˘‹Œ˘˘ÃÃŒexpand on their own knowledge. In doing so they are required to defend their own ideas,‹˘˘˘‹and in the process begin to examine the validity of their own beliefs.‹˘˘˘˘˘˘˘˘˘˘˘˘‹‹˘˘˘˘˘c˘˘˘˘˘˘‹Œ˘.ãŒThis paper outlines a preñservice mathematics education course which was based on‹˘˘˘‹Œ˘E–Œconstructivist approaches to learning. An outline of the course structure and‹˘˘˘‹implementation procedure are given.‹˘˘˘˘˘|˘˘˘˘˘˘‹‹˘˘˘˘˘«˘˘˘˘˘˘ .PA
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˘–The Knowledge Base.–˘˘ .PA
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˘/‹Œ˘˘Í™Œknowledge ie. the methodology area required to teach primary school mathematics. Theø‹˘˘˘ ˘˘˘˘˘˘‹Œ˘@˘Œmathematics education course

used in the study was the first year compulsory subject‹˘˘˘‹Œ˘ôôŒfor preñservice primary teachers undertaking the Diploma of Teaching (Primary) at‹˘˘˘‹Œ˘˘˘ŒLaTrobe University College of Northern Victoria. Mathematics Education 1 is a 3 hour‹˘˘˘‹per week course consisting of a 2 hour workshop and a 1 hour tutorial.
‹˘˘˘˘˘˘˘˘˘˘˘˘‹‹˘˘˘˘˘æ˘˘˘˘˘˘‹Œ˘˘˘˘ŒThe area of mathematical subject matter knowledge addressed was Numeration. This topic‹˘˘˘‹Œ˘8„Œcovered such areas as number, operations, fractions, decimals, probability and‹˘˘˘‹Œ˘˘˘˘Œstatistics. The then recently released NSW Kñ6 Mathematics Program was the main core ‹˘˘˘‹Œ˘˘I$Œreference for the curriculum area of the course for several reasons including its ease of‹˘˘˘‹Œ˘LÃŒuse, concentration on sequential main ideas, language, examples of activities and‹˘˘˘‹Œ˘˘±;Œemphasis on manipulative aids. There were several short falls though especially in the‹˘˘˘‹Œ˘˘UUŒareas of Problem Solving, Creativity, Story Books, Calculators, Computers, Cooperative‹˘˘˘‹Œ˘˘˘˘ŒLearning activities. Many other resources were used to augment the course including the‹˘˘˘‹Œ˘ôŒthe Mathematics Curriculum and Teaching Program (MCTP, 1988), the Reality In‹˘˘˘‹Œ˘˘˘ŒMathematics Education Teacher Development Project (RIME, 1984,¿’¿89) project and‹˘˘˘‹Œ˘˘™™Œproblem solving material from the Australian Mathematics Education Program. (AMEP,‹˘˘˘‹Œ˘UŒ1983). Students were challenged with, and actively participated in, activities both as‹˘˘˘‹Œ˘˘Ìð‹Œindividuals and in groups. The intention was to allow students to develop and construct‹˘˘˘‹mathematical knowledge beginning from their own personal understandings of the topic.‹˘˘˘˘˘◊˘˘˘˘˘˘‹‹˘˘˘˘˘5˘˘˘˘˘˘‹Œ˘ªªŒThe pedagogical knowledge that is addressed in the first year of the course is centred on‹˘˘˘‹Œ˘ÏNŒintroducing subject matter to an individual or a small group. Such skills areas as‹˘˘˘‹Œ˘˘˘˘Œquestioning, observing, listening and discussing are introduced to the students. The skills‹˘˘˘‹Œ˘ÿùŒare practiced through the teaching of mathematic concepts both to peers and when on‹˘˘˘‹teaching practicum with individual children.‹˘˘˘˘˘N˘˘˘˘˘˘

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˘–The Course Structure.–˘˘ .PA
˘ ˘–√˘Ä√ø<˘&˘˘˘˘Ù˘˘˘˘˘˘˘Ù˘˘˘˘˘˘˘ ˘˘˘˘˘&<Œ˘m∂ŒThis paper addresses a change in approach to the teaching of a first year mathematics<˘˘˘<Œ˘˘˘Œcourse which had previously been used at the college. In implementing a constructivist<˘˘˘<Œ˘˘ôôŒapproach there was a need to focus on a curriculum model to guide the adoption process.<˘˘˘<Œ˘§íŒAs such Driver and Oldham's (1986) model was chosen. In this model there are four<˘˘˘<Œ˘8„Œbasic steps which are used; determining students' conceptions, presenting conceptual<˘˘˘<Œ˘˘¿˘Œconflict for students to address, the promotion of conflict resolution via construction of<˘˘˘<Œ˘∫.Œnew knowledge, and revisiting old conceptions. Each of these four steps were<˘˘˘<Œ˘˘Ä˘Œimplemented and used for each of the three stages of the course. The three stages of the<˘˘˘<course were<˘˘˘˘˘˘˘˘˘˘˘<¡˘˘˘$˘˘¡Stage 1. ¡˘˘˘˘˘¡Empowering Students : Empowering Teachers<˘˘˘˘˘Ù˘˘˘˘˘˘<¡˘˘˘$˘˘¡Stage 2.¡˘˘˘"˘˘¡Getting Close to Learners.<˘˘˘ ˘˘ ˘˘˘˘˘˘<¡˘˘˘$˘˘¡Stage 3.¡˘˘˘"˘˘¡How do we Learn? How do we Learn Mathematics?<˘˘˘!˘˘ &˘˘˘˘˘˘<Œ˘∂€ŒThe overriding objective of the three stages in the course was to give students the<˘˘˘<Œ˘EŒopportunity to develop their cognitive and pedagogical knowledge of mathematics in a<˘˘˘<Œ˘˘≥3Œsupportive environment that will help strengthen their own confidence and selfñesteem<˘˘˘<when doing mathematics.<˘˘˘"˘˘ ?˘˘˘˘˘˘<<˘˘˘#˘˘ £˘˘˘˘˘˘ .PA
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˘–Three Stages of Mathematics Education Course–˘˘ .PA
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<Œ˘ÏNŒjudgemental support from peers and the lecturer. To achieve this the students were<˘˘˘<Œ˘]Œencouraged to communicate with the lecturer via their Dialogue Journal where they<˘˘˘<Œ˘˘ïUŒwere asked to write about prior experiences involving mathematics at primary school,<˘˘˘<Œ˘˘ƒÏŒsecondary school and in everyday life. Students were encouraged to participate in class<˘/˘˘ q˘˘}˘˘˘˘m˘˘˘˘˘˘˘˘˘˘˘˘˘˘˘˘ ˘˘˘ ˘/<Œ˘˘Í™Œdiscussions where they were given the opportunity to express their expectations of theø<˘˘˘<Œ˘ôŒcourse and reflect on their prior experiences and concerns about mathematics. <˘˘˘<Particular emphasis was placed on the Dialogue Journal as a confidential means of<˘˘˘<Œ˘˘Ë∫Œinteraction with the lecturer because from previous experience the students who enter<˘˘˘<Œ˘˘]Œthis primary teaching course predominantly have had negative feelings and beliefs about<˘˘˘<Œ˘˘†˘Œtheir ability to do mathematics. Thus the initial aim of

the course was to dislodge those‹˘˘˘‹Œ˘ã¢Œconcerns through activities that gave students the chance to see mathematics as‹˘˘˘‹Œ˘qŒsomething personally achievable, enjoyable and challenging. Students were given‹˘˘˘‹Œ˘˘–tŒopportunities to choose a variety of problems, centred on primary school mathematical‹˘˘˘‹concepts. The reason for using problem solving activities was to show:‹˘˘˘&˘˘ Ù˘˘˘˘˘˘‹¡˘˘˘$˘˘¡¿•/¿ that solutions to problems may be gained in various ways, ‹˘˘˘'˘˘î˘˘˘˘˘˘‹¡˘˘˘$˘˘¡¿•/¿ student conceptions and mathematical skill,‹˘˘˘(˘˘≠˘˘˘˘˘˘‹¡˘˘˘$˘˘¡¿•/¿ any pedagogical consequences.‹˘˘˘)˘˘Δ˘˘˘˘˘˘‹Œ˘ôŒCommunication via reflection through a ¿‘¿conference¿’¿ approach both during the activity‹˘˘˘‹Œ˘;Œand formally at the completion of the activity highlighted the thinking of the group,‹˘˘˘‹Œ˘UUŒcreated debate and raised concerns, which in turn presented the participants with a‹˘˘˘‹Œ˘v'Œconsensus of views or lead to future related activities. The students Dialogue Journal‹˘˘˘‹Œ˘∫.Œwas another mechanism used to continue discussions in a confidential and non‹

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‹Œ˘;Œthreatening way. During Stage 1 students were encouraged to investigate the extent of ‹˘˘˘‹Œ˘ÃÃŒtheir personal mathematical knowledge. This was addressed via students working‹˘˘˘‹Œ˘ffŒthrough some progressive achievement tests which gave feedback to the students‹˘˘˘‹Œ˘˘˘Œregarding their mathematical skills and understandings and gave directions for further‹˘˘˘‹mathematical development. ‹˘˘˘*˘˘fl˘˘˘˘˘˘‹In summarising stage one, the following main ideas and issues were addressed. ‹˘˘˘+˘˘ .PA
Ÿ˘˘˘˘˘˘‹¡˘˘˘$˘˘¡¿•/¿ Notions of what Mathematics is.‹˘˘˘,˘˘ .PA
Ú˘˘˘˘˘˘‹¡˘˘˘$˘˘¡¿•/¿ Students exploring, investigating and practising problem solving.‹˘˘˘-˘˘ ˘˘˘˘˘˘‹¡˘˘˘$˘˘¡¿•/¿ Mathematics as a creative activity.‹˘;˘˘.˘˘ $˘˘˘˘˘˘˘ $˘˘ä˘˘˘˘à˘˘˘˘˘˘˘˘˘˘˘˘˘˘˘˘˘ ˘˘˘ ˘;‹¡˘˘˘$˘˘¡Œ˘˘]Œ¿•/¿ Students using a variety of resources, eg. calculators, computers, story books,ø‹˘˘˘‹¡˘˘˘$˘˘¡audio visual material.‹˘˘˘/˘˘ M˘˘˘˘˘˘‹¡˘˘˘$˘˘¡¿•/¿ Communicating and representing mathematics in a variety of ways.‹˘˘˘0˘˘ ˘˘˘˘˘˘‹¡˘˘˘$˘˘¡Œ˘Í™Œ¿•/¿ Exploring and practising mathematics cooperatively as a group in a real or‹˘˘˘‹¡˘˘˘$˘˘¡social ¡˘˘˘˘˘¡context.‹˘˘˘1˘˘ ò˘˘˘˘˘˘‹¡˘˘˘$˘˘¡¿•/¿ Develop a personal mathematical understandings profile.‹˘˘˘2˘˘ ˘˘˘˘˘˘‹‹˘˘˘3˘˘ „˘˘˘˘˘˘ ˘˘˘˘˘‹√˘√Stage 2.¡˘˘˘˘˘¡Getting Close to Learners√√√˘Ä√‹˘&˘˘4˘˘ ¸˘˘˘˘˘˘˘ ¸˘˘˘Ø˘˘˘ ˘˘˘˘˘&‹Œ˘UUŒ√Ä√The second stage of the course was about exploring students understandings of the‹˘˘˘‹Œ˘¢ËŒpedagogical issues involved in the mathematical subject matter covered in the course. ‹˘˘˘‹Œ˘˘33ŒOne method used to achieve this with the students was by completing a school based Work‹˘˘˘‹Œ˘–tŒRequirement that was linked to the teaching practicums. Students exploration of‹˘˘˘‹Œ˘˘¢ËŒchildren¿’¿s understandings of mathematical concepts indicated the need for a diversity of‹˘˘˘‹Œ˘˘'bŒapproaches to teaching mathematics in the classroom. This was followed up with another‹˘˘˘‹Œ˘EŒWork Requirement, the Cooperative Group Project which allowed a small group of‹˘˘˘‹Œ˘˘ÏNŒstudents to investigate and research a particular

mathematical concept. As part of this‹ˇˇˇ‹Œˇ;Œprocess they were then asked to document their research and present their findings to‹ˇˇˇ‹Œˇ[mŒtheir peers. This ¿‘¿Jig Sawing¿’¿ process enabled the students to research and develop a‹ˇˇˇ‹ŒˇÍ™Œrange of sequential curriculum material on a specific mathematical topic and teach a‹ˇˇˇ‹ŒˇÄˇŒselection of activities to other peer groups. Their findings and associated curriculum‹ˇˇˇ‹Œˇm∂Œmaterial was published and disseminated to all the other groups. Thus the main ideas‹ˇˇˇ‹explored in Stage 2 were: √√‹ˇˇˇ5ˇˇˇˇˇˇˇˇˇ‹√Ä√¡ˇˇˇ$ˇˇ¡¿●/¿ Understanding children as learners.‹ˇˇˇ6ˇˇsˇˇˇˇˇˇ‹¡ˇˇˇ$ˇˇ¡ŒˇÊfŒ¿●/¿ Learning and practising effective observation and listening skills in the‹ˇˇˇ‹¡ˇˇˇ$ˇˇ¡classroom.‹ˇˇˇ7ˇˇåˇˇˇˇˇˇ‹¡ˇˇˇ$ˇˇ¡¿●/¿ Methods of recording and storing information.‹ˇˇˇ8ˇˇœˇˇˇˇˇˇ‹¡ˇˇˇ$ˇˇ¡¿●/¿ Building and analysing student profiles.‹ˇ;ˇˇ9ˇˇ◊ˇˇˇˇˇˇˇ◊ˇˇäˇˇˇˇ£ˇˇˇˇˇˇˇˇˇˇˇˇˇˇˇˇ
ˇˇˇ ˇ;‹¡ˇˇˇ$ˇˇ¡¿●/¿ Using student profiles for curriculum design.ø‹ˇˇˇ:ˇˇˇˇˇˇˇˇˇ‹√√¡ˇˇˇ$ˇˇ¡√Ä√¿●/¿ Documentation of approaches used to teach a range of mathematical concepts.√√‹ˇˇˇ;ˇˇˇˇˇˇˇˇ
ˇˇˇˇˇ‹¡ˇˇˇ$ˇˇ¡√Ä√–ˇˇ ˇ .PA
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ˇ ˇ–√ˇ√Stage 3.¡ˇˇˇˇˇ¡How do we Learn? How do we Learn Mathematics?√ˇÄ√–ˇˇ ˇ .PA
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ˇ ˇ–On completion of Stage 2 of the course students had now gained some insights into the ‹ˇˇˇˇdˇˇˇdˇˇˇ
ˇˇˇˇˇˇ‹ŒˇˇffŒteaching and learning mathematics. In Stage 3 the emphasis was on the discussion of the‹ˇˇˇ‹Œˇ–tŒissues involved in educational research and students own experience that related to‹ˇˇˇ‹ŒˇUUŒeffective mathematical learning. The intention of this final part of the course was to ‹ˇˇˇ‹ŒˇÌ∂Œreflect on the previous two stages of the course and consider or analyse what was‹ˇˇˇ‹ŒˇààŒimportant to the student as a learner and as a learner in mathematics education. The‹ˇˇˇ .PA
ˇˇˇˇˇˇ‹main ideas explored in Stage 3 were:–ˇˇ ˇ .PA
ˇ–¡ˇˇˇˇˇ¡–ˇˇ .PA
ˇ ˇ–√√‹ˇ&ˇˇ>ˇˇdˇˇˇˇˇˇˇˇˇ·ˇˇˇˇˇˇˇ·ˇˇˇˇ ˇˇˇˇˇ&‹√Ä√¡ˇˇˇ$ˇˇ¡¿●/¿ The constructivist theory of learning‹ˇˇˇ?ˇˇˇˇˇˇˇˇ‹¡ˇˇˇ$ˇˇ¡¿●/¿ Observation and exposure to current research‹ˇˇˇ@ˇˇ2ˇˇˇˇˇˇ‹¡ˇˇˇ$ˇˇ¡¿●/¿ Observation and exposure to effective teacher craft‹ˇˇˇAˇˇKˇˇˇˇˇˇ ˇˇˇˇˇ‹¡ˇˇˇ$ˇˇ¡√√–ˇˇ ˇ .PA
ˇ–√Ä√√ˇ√‹ˇ&ˇˇBˇˇdˇˇˇˇˇˇˇdˇˇdˇˇˇ .PA
ˇˇˇˇˇ&‹Course Work Requirements√ˇÄ√–ˇˇ .PA
ˇ ˇ–‹ˇ&ˇˇCˇˇ}ˇˇˇˇˇˇˇ}ˇˇ}ˇˇˇ ˇˇˇˇˇ&‹√ˇ√1√√¡ˇˇˇˇˇ¡√Ä√The Dialogue Journal¡ˇˇˇˇˇ¡¡ˇˇˇ$ˇˇ¡(Ongoing requirementñStages 1,2,3)√√√ˇÄ√√Ä√‹ˇ&ˇˇDˇˇúˇˇˇˇˇˇˇúˇˇúˇˇˇ ˇˇˇˇˇ&‹Œˇˇ∂€ŒThe Dialogue Journal was a requirement that gave students a place to collect and reflect‹ˇˇˇ‹ŒˇˇˇˇŒon their ideas, thoughts or experiences that related to mathematics. The expectation was‹ˇˇˇ‹ŒˇùâŒthat the journal should be substantial in that substantiality is an indication of effort. ‹ˇˇˇ‹ŒˇˇùâŒStudents were encouraged to adopt a searching approach to the journal with entries that‹ˇˇˇ‹ŒˇïUŒgave thoughtful consideration and

reflection to issues raised in the course and gleaned‹ˇˇˇ‹Œˇ*™Œfrom
students own personal experiences with mathematics. It was anticipated
that the‹ˇˇˇ‹Œˇbv Œjournal should contain a collection of relevant
material in the form of articles, ideas,‹ˇˇˇ‹Œˇ–tŒillustrations, concerns
or topical issues with commentary on how it relates
to‹ˇˇˇ‹Œˇ*™Œmathematics education. The student was asked to consider the
personal implications of‹ˇ/ˇˇ}ˇˇ}ˇˇˇˇΩˇˇˇˇˇˇˇˇˇˇˇˇˇˇˇˇˇ ˇˇˇ
ˇ/‹Œˇˇ I$Œmathematical issues raised during the course by both the
lecturer and other students. Itø‹ˇˇˇ‹Œˇˇ IŒwas expected that students
engage themselves in the process and be willing to write
about‹ˇˇˇ‹Œˇˇ j™Œhow their beliefs and feelings about mathematics,
mathematics education or any aspects‹ˇˇˇ‹of it.
‹ˇˇˇEˇˇμˇˇˇˇˇˇ‹Œˇˇ IŒPerhaps the most important feature of the dialogue
journal is that it was confidential and‹ˇˇˇ‹Œˇ±;Œinteractive between the
lecturer and the student. Students were able to submit
their‹ˇˇˇ‹Œˇˇƒ ÏŒjournal when needed with the understanding that the
lecturer would write back to them‹ˇˇˇ‹making comments, answering
questions or giving feedback regarding the entries.‹ˇˇˇFˇˇ
ˇˇˇˇˇˇ‹Œˇˇ±ŒThe Dialogue Journal was a mechanism that facilitated the
sharing of thoughts and beliefs‹ˇˇˇ‹Œˇˇã¢Œregarding the course and
feelings towards mathematic teaching and learning between
the‹ˇˇˇ‹Œˇˇƒ ÏŒstudent and lecturer. The role of the lecturer encompassed
a positive interrogative and‹ˇˇˇ‹ŒˇÄˇŒinteractive approach which will
encourage a searching learning student and
reflective‹ˇˇˇ‹practitioner.‹ˇˇˇGˇˇnˇˇˇˇˇˇ‹‹ˇˇˇHˇˇÎˇˇˇˇˇˇ
ˇˇˇˇˇ‹√ˇ√2√√¡ˇˇˇˇˇ¡√Ä√The Number Investigation
Assignment¡ˇˇˇ"ˇˇ¡¡ˇˇˇ$ˇˇ¡(Stage 1)√√√ˇÄ√√Ä√‹ˇ&ˇˇIˇˇˇˇˇˇˇˇˇˇˇ^ˇˇˇ
ˇˇˇˇˇ&‹Œˇˇƒ ÏŒTo give students the opportunity to investigate an everyday
situation, theme or idea and‹ˇˇˇ‹Œˇ∫.Œpresent a written report on the
associated mathematical concepts. The activity is‹ˇˇˇ‹ŒˇÌ∂Œstructured in
such a way to show students that Mathematics is ¿‘¿real¿’¿ and common
to‹ˇˇˇ‹Œˇˇ ÓÓŒeveryday situations. An intrinsic aim is to also show that
in various situations we use‹ˇˇˇ‹Œˇ≥3Œmathematical concepts in everyday
occurrences often without realizing it and without‹ˇˇˇ‹relating it to
school mathematics. ‹ˇˇˇJˇˇˇˇˇˇˇˇ ˇˇˇˇˇ‹√ˇ√‹ˇ&ˇˇKˇˇ≥ˇˇˇˇˇˇˇ≥ˇˇ ˇˇˇ
ˇˇˇˇˇ&‹3√√¡ˇˇˇˇˇ¡√Ä√School Based
Assignment¡ˇˇˇˇˇ¡¡ˇˇˇ$ˇˇ¡¡ˇˇˇ$ˇˇ¡¡ˇˇˇ$ˇˇ¡¡ˇˇˇ$ˇˇ¡(Stage
2)√√√ˇÄ√√Ä√‹ˇ&ˇˇLˇˇÃˇˇˇˇˇˇˇÃˇˇ&ˇˇˇ ˇˇˇˇˇ&‹Œˇˇˇˇ ŒThe School Based
Assignment was a curriculum activity which was carried out during
the‹ˇˇˇ‹Œˇˇ Œsecond week of the students first school practicum. The
purpose of the assignment was to‹ˇˇˇ‹Œˇˇ™™Œgive students the opportunity
to to gain some insights through observation and
listening‹ˇˇˇ‹ˇUUŒregarding the nature of childrens thinking, and some
awareness of the range of‹ˇ/ˇˇ0ˇˇäˇˇˇˇÿˇˇˇˇˇˇˇˇˇˇˇˇˇˇˇˇˇ ˇˇˇ
ˇ/‹ŒˇÄˇŒunderstandings which children of the same age or grade have of a
particularø‹ˇˇˇ‹Œˇˇÿù Œmathematical concept or procedure. The activity
was undertaken with a small group of‹ˇˇˇ‹ŒˇÏNŒchildren (4ñ6 children) in
which the child was given 3ñ4 problems and asked to‹ˇˇˇ‹Œˇˇ IŒrepresent or
describe their understandings of what was required. The role of the
student‹ˇˇˇ‹Œˇv'Œwas to check the childs ability to describe the

situation through the collection of‹˘˘˘‹Œ˘Ä˘Œinformation regarding the childs mathematical language, symbolic representations

and‹˘˘˘‹Œ˘IŒapplication of the concept. The student was then required to present a report detailing‹˘˘˘‹Œ˘±;Œtheir observations and findings. The reports were then compiled in a class document‹˘˘˘‹which demonstrated the diversity of childrens understandings and procedures used.‹˘˘˘M˘˘Â˘˘˘˘˘˘ ˘˘˘˘˘‹√˘√‹˘&˘˘N˘˘:˘˘˘˘˘˘˘:˘˘˘·˘˘˘ ˘˘˘˘˘&‹4¡˘˘˘˘˘¡The Cooperative Group Project¡˘˘˘˘˘¡¡˘˘˘$˘˘¡¡˘˘˘$˘˘¡¡˘˘˘$˘˘¡(Stage 2 & 3)√√√˘Ä√√Ä√‹˘&˘˘O˘˘S˘˘˘˘˘˘˘S˘˘˘˘˘˘˘ ˘˘˘˘˘&‹Œ˘˘ê˘ŒThe purpose of this Project was for a group of students to read the Number strand from‹˘˘˘‹Œ˘¢ËŒthe NSW Kñ6 Mathematics program and select a substrand (ie. Numeration, Addition,‹˘˘˘‹Œ˘˘ ˘ŒSubtraction, Multiplication, Division, Fractions and Decimals) for further investigation‹˘˘˘‹Œ˘$íŒby the group. The expectation was that this group then became ¿‘¿experts¿’¿ on that‹˘˘˘‹Œ˘UŒparticular substrand. The strategy that was employed to undertake this project was‹˘˘˘‹Œ˘ã¢Œbased on the ¿‘¿Jigsaw Model¿’¿ in the Cooperative learning (Dalton, 1988) teaching‹˘˘˘‹Œ˘6€Œstrategy. Each group was asked to provide the following in their report: 10 activities‹˘˘˘‹Œ˘˘DDŒfor each Main Idea of the substrand, the activities should be selected from a broad range,‹˘˘˘‹Œ˘EŒfor example ñ Problem Solving, Story Books, Writing, Estimation, Cooperative group‹˘˘˘‹Œ˘˘˘Œproblems, Outdoor Investigations, Calculator or Computer activities. Each report was‹˘˘˘‹Œ˘I$Œpublished and exchanged with other groups. As part of the assignment each group was‹˘˘˘‹Œ˘˘˘˘Œalso required to present their report and findings to their peers, in which they conducted‹˘˘˘‹Œ˘˘˘Œa forum on their mathematical area including the main ideas involved and selected‹˘˘˘‹Œ˘˘Ä˘Œactivities. During this reporting back stage of the assignment students were encouraged‹˘˘˘‹to actively participate in the discussion and the activities.‹˘˘˘P˘˘l˘˘˘˘˘˘‹Œ˘6€ŒDuring the second school practicum in Stage 3 of the course students were required to‹˘/˘˘„˘˘ä˘˘˘˘Û˘ ˘ ˘˘˘˘˘˘˘˘˘˘˘˘˘˘ ˘˘˘ ˘/‹Œ˘˘Œselect an activity from their assignment, trial it with a small group of chidren and writeø‹˘˘˘‹a report on their observations. ‹˘˘˘Q˘˘„˘˘˘˘˘˘‹‹˘˘˘R˘˘>˘˘˘˘˘˘ ˘˘˘˘˘‹√˘√5¡˘˘˘˘˘¡The Negotiated Project¡˘˘˘ ˘˘¡¡˘˘˘$˘˘¡¡˘˘˘$˘˘¡¡˘˘˘$˘˘¡¡˘˘˘$˘˘¡(Stage 3)√√√˘Ä√√Ä√‹˘&˘˘S˘˘W˘˘˘˘˘˘˘W˘˘˘K˘˘˘ ˘˘˘˘˘&‹Œ˘˘6€ŒThe purpose of the Negotiated Project was to give students the opportunity to develop and‹˘˘˘‹Œ˘Ä˘Œuse their mathematics education knowledge to carry out an extended independent‹˘˘˘‹Œ˘˘;Œinvestigation of problems, situations or issues in mathematics. As part of the procedure‹˘˘˘‹Œ˘˘±Œstudents were required to complete a Work Contract in which they ¿‘¿negotiated¿’¿ the terms‹˘˘˘‹Œ˘˘˘Œand procedures for their investigation with the lecturer. This contract provided the‹˘˘˘‹Œ˘UŒbasis for student self assessment and lecturer evaluation. Suggestions as to the‹˘˘˘‹Œ˘UŒapproaches that might be undertaken were discussed with the class, they included such‹˘˘˘‹ideas as:‹˘˘˘T˘˘p˘˘˘˘˘˘‹¡˘˘˘$˘˘¡¿•/¿ A Research Project‹˘˘˘U˘˘8˘˘˘˘˘˘‹¡˘˘˘$˘˘¡Œ˘ƒÏŒ The emphasis in the Research Project was placed on the identification of a‹˘˘˘‹¡˘˘˘$˘˘¡Œ˘EŒproblem and the

collection, collation and interpretation of raw or primary data‹ˇˇˇ‹¡ˇˇˇ$ˇˇ¡Œˇˇ…$Œrather than a review of literature. The presentation was not confined to a piece‹ˇˇˇ‹¡ˇˇˇ$ˇˇ¡of written work and may have included the use of audioñvisual material.‹ˇˇˇVˇˇQˇˇˇˇˇˇ‹¡ˇˇˇ$ˇˇ¡¿•/¿ Learning a new mathematics skill‹ˇˇˇWˇˇµˇˇˇˇˇˇ‹¡ˇˇˇ$ˇˇ¡Œˇˇ€mŒIn this type of project students would undertake to learn, or attempt to learn, a‹ˇˇˇ‹¡ˇˇˇ$ˇˇ¡new or unfamiliar mathematical skill or mathematical procedure.‹ˇˇˇXˇˇŒˇˇˇˇˇˇ‹¡ˇˇˇ$ˇˇ¡¿•/¿ Investigation of Literature, Film, Song, Computer applications in mathematics.‹ˇˇˇYˇˇˇˇˇˇˇˇ‹¡ˇˇˇ$ˇˇ¡Œˇˇ6€ŒStudents undertaking this type of activity would develop a piece of work in one or‹ˇˇˇ‹¡ˇˇˇ$ˇˇ¡Œˇ–tŒmore of the above modes to demonstrate and explore ideas concerning creative‹ˇˇˇ‹¡ˇˇˇ$ˇˇ¡issues raised in the course.‹ˇˇˇZˇˇˇˇˇˇˇˇ‹¡ˇˇˇ$ˇˇ¡¿•/¿ Information collection and presentation.‹ˇˇˇ[ˇˇdˇˇˇˇˇˇ‹¡ˇˇˇ$ˇˇ¡Œˇ™™ŒThis activity gives students the opportunity to assemble some practical‹ˇˇˇ‹¡ˇˇˇ$ˇˇ¡Œˇˇv'Œinformation related to one or more issues raised in the course. The presentation‹ˇ/ˇˇñˇˇä‹ˇˇˇˇ ˇ ˇˇˇˇˇˇˇˇˇˇˇˇˇˇ ˇˇˇ ˇ/‹¡ˇˇˇ$ˇˇ¡Œˇ§íŒcould be in the form of a collection of posters, a catologue and reveiw ofø‹ˇˇˇ‹¡ˇˇˇ$ˇˇ¡Œˇˇí‹Œappropriate films or videos, making

audioñvisualmaterials, mathematical games‹ˇˇˇ‹¡ˇˇˇ$ˇˇ¡ŒˇUUŒor activities, interviewing children or adults regarding their attitudes towards‹ˇˇˇ‹¡ˇˇˇ$ˇˇ¡mathematics or writing and illustrating childrens mathematical story books. ‹ˇˇˇ\ˇˇ}ˇˇˇˇˇˇ‹¡ˇˇˇ$ˇˇ¡¿•/¿ Extended essay.‹ˇˇˇ]ˇˇ#ˇˇˇˇˇˇ‹¡ˇˇˇ$ˇˇ¡Œˇ'bŒStudents in this activity could choose to write on a current issue or ideology‹ˇˇˇ‹¡ˇˇˇ$ˇˇ¡concerning mathematics education in the form of an essay.‹ˇˇˇ^ˇˇ<ˇˇˇˇˇˇ‹‹ˇˇˇ_ˇˇnˇˇˇˇˇˇ‹ŒˇˇÄˇŒThe above suggestions were presented to students for their consideration and as possible‹ˇˇˇ‹courses of action rather than prescriptions.‹ˇˇˇˇˇˇá‹ˇˇˇˇˇˇ‹‹ˇˇˇaˇˇπˇˇˇˇˇˇ .PA
ˇˇˇˇˇˇ‹√ˇ√–ˇˇ ˇ .PA
ˇ–Student impressions of the course‹ˇ&ˇˇbˇˇ“ˇˇˇˇˇˇˇˇ“ˇˇˇˇˇˇ
ˇˇˇˇˇˇ&‹Œˇˇj™Œ√ˇÄ√–ˇˇ .PA
ˇ ˇ–An overview of student impressions of the course were gained by combining information‹ˇˇˇˇÒˇˇ2ˇˇˇ ˇˇˇˇˇˇˇˇ‹Œˇ*™Œfrom three sources (i) the Dialogue Journal, (ii) through student interviews and also‹ˇˇˇ‹Œˇ™™Œfrom the lecturers own reflections and observations in the form of fieldnotes made‹ˇˇˇ .PA
ˇˇˇˇˇˇˇˇ‹Œˇâÿ‹Œduring the course.√ˇ√–ˇˇ ˇ .PA
ˇ– –ˇˇ .PA
ˇ ˇ–√ˇÄ√After compiling the information gained from the above sources it‹ˇˇˇˇ<ˇˇ}ˇˇˇ ˇˇˇˇˇˇˇˇ‹Œˇâÿ‹Œbecame obvious that students impressions of the course could be categorised into two‹ˇˇˇ‹significant areas (i) ownership and (ii) involvement. ‹ˇˇˇcˇˇÒˇˇˇˇˇˇˇˇ‹‹ˇˇˇdˇˇçˇˇˇˇˇˇˇˇ‹ŒˇUUŒThis course reduced students¿'¿ anxiety toward mathematics resulting in increased ‹ˇˇˇ‹Œˇ≥3Œconfidence and willingness to undertake mathematical problems. This increase in‹ˇˇˇ‹Œˇ@ˇŒconfidence resulted in the students becoming more willing to be involved in discussing ‹ˇˇˇ‹Œˇàà‹Œand

expressing their beliefs and views with others in the group. Students
were now<˘˘˘<Œ˘j™Œready to take ownership and responsibility for their
learning whilst also displaying a<˘˘˘<Œ˘˘ïUŒgreater preparedness to
interact with their peers and the lecturer about their concerns<˘˘˘<and
often fear of subject. <˘;˘˘e˘˘¶˘˘˘˘˘˘˘<˘˘}˘˘˘(˘˘˘˘˘˘˘˘˘˘˘˘˘˘˘˘ ˘˘˘
˘;<Œ˘˘∂€ŒThe second significant factor was that as students became more
powerful and willing toø<˘˘˘<Œ˘ôŒtake ownership within the learning
environment, their participation in the course<˘˘˘<Œ˘¢ËŒbecame more
intense. Students were readily taking the opportunity to
express<˘˘˘<Œ˘˘;Œthemselves in the classroom or through writing in their
journal about issues relating to
<˘˘˘<Œ˘ƒÏŒtheir beliefs, values and concerns with mathematics. They were
able to see the<˘˘˘<Œ˘DDŒapplication of mathematics in the real world,
and in fact began to report on their own<˘˘˘<self exploration of this
real world view in their own time.<˘˘˘f˘˘e˘˘˘˘˘˘<<˘˘˘g˘˘˘˘˘˘˘˘<Œ˘ÊfŒThis
interplay between ownership and participation was significant in the
learning<˘˘˘<Œ˘˘ffŒprocess which students were involved. The value of
the course for students has been the<˘˘˘<Œ˘""Œrealization that there is a
need for them to be actively involved in their own learning.
<˘˘˘<Œ˘˘m∂ŒThe need to translate this active involvement to the classroom
situation is the next stage<˘˘˘<in the development of this
course.<˘˘˘h˘˘-˘˘˘˘˘˘<<˘˘˘i˘˘™˘˘˘˘˘˘ .PA
˘˘˘˘˘<–˘˘ ˘ .PA
˘–√˘√References<˘&˘˘j˘˘√˘˘˘˘˘˘˘√˘˘^˘˘˘ ˘˘ ˘˘˘&<Œ˘˘@˘Œ™–˘ .PA
˘˘˘˘˘˘˘ .PA
–´√˘Ä√–˘˘ .PA

˘ ˘–AMEPñAustralian Mathematics Education Project, (1983). √√Teacher
Tactics for Problem<˘˘˘˘,˘˘}˘˘˘ ˘˘ ˘˘˘˘<Solving.√Ä√ Curriculum
Development Centre: Canberra.√√√˘√√Ä√<˘&˘˘k˘˘,˘˘˘˘˘˘˘Ô˘˘ä˘˘˘ ˘˘
˘˘˘&<√˘Ä√<˘&˘˘l˘˘¸˘˘˘˘˘˘˘¸˘˘ó˘˘˘ ˘˘ ˘˘˘&<Œ˘˘˘˘ŒBall, D.L. (1988) ¿“
¿Unlearning to Teach Mathematics.¿”¿ √√For the Learning of
Mathematics√Ä√.<˘˘˘<Vol. 8, Issue 1. Canada.<˘˘˘m˘˘
˘˘˘˘˘˘<<˘˘˘n˘˘#˘˘˘˘˘˘<Œ˘ÏNŒBaird, J.R. & Mitchell, I.J. (Eds) (1987).
√√Improving the quality of teaching and<˘˘˘<learning√Ä√. Melbourne,
Monash University Printery. <˘˘˘o˘˘0˘˘˘˘˘˘<<˘˘˘p˘˘J˘˘˘˘˘˘<Œ˘˘Í™ŒDalton,
J. (1985). √√Adventures in Thinking. Creative Thinking and Cooperative
Talk in<˘˘˘ ˘˘ ˘˘˘˘<small groups.√˘√√Ä√√˘Ä√ Thomas Nelson:
Melbourne.<˘&˘˘q˘˘W˘˘˘˘˘˘˘d˘˘˘˘˘˘ ˘˘ ˘˘˘&<<˘˘˘r˘˘q˘˘˘˘˘˘<Œ˘˘¢ËŒDriver, R.

& Oldham, V. (1986). A constructivist approach to curriculum
development<˘˘˘<in science. √√Studies in Science Education. 13√Ä√
107ñ121.<˘˘˘s˘˘~˘˘˘˘˘˘<<˘˘˘t˘˘ò˘˘˘˘˘˘<Œ˘é8ŒGunstone, R.F. & Northfield,
J.R. (1988). √√Inservice Education: some
contructivist<˘˘˘<Œ˘Ä˘Œperspectives and examples√Ä√. Paper presented at
the annual meeting of the American<˘˘˘<Educational Research Association,
New Orleans.<˘˘˘u˘˘●˘˘˘˘˘˘<<˘˘˘v˘˘Ã˘˘˘˘˘˘<Œ˘ÃÃŒHand, B. & Treagust, D.
(1991). √√From teachersñasñtechnicians to teachersñas< .PA
˘ .PA
<Œ˘UUŒfacilitator√Ä√.√√A study of a professional development initiative

involving teaching for‹˘/˘˘Ê˘˘Å˘˘˘$L˘ .PA
˘ .PA
˘˘˘˘˘˘˘˘˘˘˘˘˘ ˘˘˘ ˘/‹Œ˘Ä˘Œconceptual change√Ä√. Annual meeting of the special Interest Group, Subject Matterø‹˘˘˘‹Œ˘é8ŒKnowledge and Conceptual Change, of the American Educational Research Association,‹˘˘˘‹Chicago.‹˘˘˘w˘˘Ÿ˘˘˘˘˘˘ ˘˘ ˘˘˘‹–˘˘ ˘ .PA
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–´¿ ˘˘¿In order to give preservice teachers the opportunity to develop their understanding of‹˘˘˘˘"fi˘˘˘4˘˘˘ ˘˘˘˘˘˘‹Œ˘™™Œhow we learn and how we learn mathematics a mathematics education program was‹˘˘˘‹Œ˘E–Œdeveloped along the lines of the radical constructivist philosophy of learning advocated‹˘˘˘ ˘˘˘˘˘˘‹Œ˘˘±Œby von Glasersfeld (1987)√√ see (Pateman p. 27) √Ä√The radical constructivist maintains as‹˘˘˘˘#˘˘˘m˘˘˘ ˘˘˘˘˘˘‹Œ˘˘ôôŒan important element the idea of an active knower and that the ¿'¿existence¿'¿ of ¿'¿objects is‹˘˘˘‹Œ˘˘Ä˘Œthe result of our own constructive coordinations of experiential data and our subsequent‹˘˘˘‹Œ˘qŒprojection of these coordinations into an ¿" ¿outside¿"¿ world¿'¿.(von Glasersfeld, 1987,‹˘˘˘‹p.102 in Pateman

p27)‹˘˘˘¶˘˘"fi˘˘˘˘˘˘ ˘˘ ˘˘˘‹™–˘ .PA
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–´‹˘&˘˘ß˘˘#v˘˘˘˘˘˘˘#v˘˘˘Ã˘˘˘ ˘˘ ˘˘˘&‹¡˘˘˘$˘˘¡Œ˘˘]ŒFor the constructivist, structures are constituted out of the knower¿'¿s activity as‹˘˘˘‹¡˘˘˘$˘˘¡Œ˘«Œhe or she coñordinates experiential particles. for the knowing organism,‹˘˘˘‹¡˘˘˘$˘˘¡Œ˘˘˘Œ¿'¿reality¿'¿ is a set of invariant patterns of coñordination. Both the raw material‹˘˘˘‹¡˘˘˘$˘˘¡Œ˘˘˘˘Œand the cognitive structures which establish the organism¿'¿s reality are inside the‹˘˘˘‹¡˘˘˘$˘˘¡cognising system.¡˘˘˘˘˘¡‹˘˘˘®˘˘#É˘˘˘˘˘˘‹¡˘˘˘$˘˘¡¡˘˘˘$˘˘¡¡˘˘˘$˘˘¡¡˘˘˘$˘˘¡¡˘˘˘$˘˘¡¡˘˘˘ $˘˘¡¡˘˘˘$˘˘¡¡˘˘˘$˘˘¡(Pateman, 1989, p.27)‹˘˘˘©˘˘#ƒ˘˘˘˘˘˘ ˘˘˘˘˘‹™–˘ .PA
˘˘˘˘Ä˘˘ .PA
–´‹˘&˘˘™˘˘#–˘˘˘˘˘˘˘#–˘˘'˘˘˘ ˘˘˘˘˘&‹Œ˘]ŒThe importance od the constructivist approach to the teaching and learning of‹˘˘˘‹Œ˘;Œmathematics lies in the emphasis it places on the learner

being actively searching out‹˘˘˘‹Œ˘˘˘Œknowledge and gaining experience with that knowledge through reflective abstraction. ‹˘˘˘‹Œ˘™™ŒThe predominant thought of the course is to aid mathematical discovery and invention‹˘˘˘‹Œ˘˘„éŒthrough creative, nonñthreatening and selfñfulfilling means. While other philosophies‹˘˘˘‹Œ˘±Œview mathematics as something known and preñdetermined the aim of this course is to‹˘˘˘‹Œ˘˘ôôŒallow students to develop their own mathematical knowledge and understandings through‹˘˘˘‹learning experiences that require them to be ‹˘˘˘´˘˘#‰˘˘˘˘˘˘‹‹˘˘˘¨˘˘˘$|˘˘˘˘˘˘‹Œ˘Nƒ¿•/¿ active not passive learners in a supportive environment that seeks to raise self‹ .PA
˘ .PA
‹esteem, ownership, confidence and commitment to learning.‹˘˘˘≠˘˘$è˘˘˘˘˘˘‹Œ˘˘v'Œ¿•/¿ questioning and able to write and talk about their mathematical experiences views and‹˘˘˘‹Œ˘ôôŒbeliefs both past and present through social interaction and reflective abstraction‹˘˘˘‹(dialogue journal) ‹˘˘˘Æ˘˘$µ˘˘˘˘˘˘‹Œ˘¿˘Œ¿•/¿ to takeñrisks and explore mathematical concepts with a view of developing their‹˘˘˘‹Œ˘UUŒunderstandings, synthesise the knowledge gained and eventually apply that information‹˘˘˘‹in a new situation.‹˘˘˘Ø˘˘$Ó˘˘˘˘˘˘ ˘˘˘˘˘‹‹˘Q˘˘∞˘˘%'˘˘˘˘˘˘˘%'˘˘}˘˘˘˘%'˘˘}˘˘˘&•˘˘˘˘˘˘˘˘˘˘˘˘˘˘˘˘˘ ˘˘˘ ˘ ˘˘˘˘˘Q‹√˘√First Year Mathematics Education Course√˘Ä√ø‹˘&˘˘±˘˘%J˘˘˘˘˘˘˘%J˘˘˘˘˘˘˘ ˘˘˘˘˘&‹1. √√Knowledge Base√Ä√‹˘˘˘≤˘˘%]˘˘˘˘˘˘‹Œ˘˘ƒÏŒThe mathematics education course used in this study is a first year compulsory subject‹˘˘˘‹Œ˘t]Œfor preñservice teachers undertaking the Diploma of Teaching (Primary) at La Trobe‹˘˘˘‹Œ˘˘íIŒUniversity College of Northern Victoria. Mathematics Education 1 is a 3 hour per week‹˘˘˘‹Œ˘ÏNŒ(2hr Workshop, 1hr Tutorial) course, the predetermined focus of the first year of‹˘˘˘‹Œ˘EŒmathematics education is Numeration which covers the areas of Place Value, the‹˘˘˘‹Œ˘ôŒOperations, Fractions, Decimals, Probability and Statistics. The intention of the‹˘˘˘‹Œ˘˘âÿŒmathematics education course is to give the student the opportunity to start from where‹˘˘˘‹Œ˘∫.Œthey are

mathematicaly at and encourage them to construct their own mathematical‹˘˘˘‹knowledge.‹˘˘˘≥˘˘%p˘˘˘˘˘˘‹‹˘˘˘¥˘˘&˘˘˘˘˘˘‹2. √√Pedagogical Base√Ä√‹˘˘˘µ˘˘&.˘˘˘˘˘˘‹ŒˇI$ŒThe course is an attempt to move away from the previous course which aimed at‹˘˘˘‹Œˇ˘m∂Œpreparing students to be teachers of mathematics with the content being set and taken as‹˘˘˘‹ŒˇÄˇŒa body of knowledge which the student is expected to transmit in the most efficient‹˘˘˘‹ŒˇEŒmanner possible in future classrooms. The purpose of this mathematics education‹˘˘˘‹Œ˘˘˘˘Œcourse is to give intending teachers the opportunity to experience and consider that there‹˘˘˘‹Œˇ@ˇŒmay be other ways to think about mathematics teaching and how children learn‹˘˘˘‹Œˇ˘I$Œmathematics. The intent is to model the constructivist approach to learning based on the‹˘˘˘‹Œ˘˘ÏNŒresearch of theorist such von Glasersfeld. The pedagogical focus of the course explores‹˘˘˘‹and examines the skills involved in questioning, observing and listening to others.‹˘˘˘∂˘˘&A˘˘˘˘˘˘‹‹˘˘˘∑˘˘&Ï˘˘˘˘˘˘‹creative skills to write about, to explore, to talk about to take risks. ‹˘˘˘∏˘˘&˘˘˘˘˘˘˘‹¡˘˘˘$˘˘¡‹˘˘˘π˘˘'˘˘˘˘˘˘˘‹Œˇ'bŒIn recent years there has been much research into the processes involved in learning,‹˘˘˘‹ŒˇDDŒplacing a particular emphasis on what is going on in the learner¿’¿s mind. The learner‹˘˘˘‹Œˇ6€Œattempts to relate new knowledge to what is already known. One model developed to‹˘˘˘‹ŒˇÄˇŒrepresent this process is that of the ¿‘¿concept map.¿’¿ These maps show linkages, or‹˘˘˘‹Œ˘˘bvŒpotential linkages between fragmentary bits of knowledge. As the linkages are made, the‹˘˘˘‹concept takes on greater meaning. ‹˘˘˘∫˘˘'%˘˘˘˘˘˘‹The purpose of using the concept map approach was two fold: ‹˘˘˘ª˘˘'ó˘˘˘˘˘˘‹ŒˇPˇŒ(a) Focus on how we learn. ñ Concept mapping allows us through a variety of‹˘˘˘‹Œ˘˘˘Œinteractive experiences to improve on our understandings of a concept in a gradual and‹˘˘˘‹continuous way. ‹˘;˘˘º˘˘'™˘˘˘˘˘˘˘'_˘˘Ü˘˘˘#»˘˘˘˘˘˘˘˘˘˘˘˘˘˘˘˘ ˘˘˘ ˘;‹ŒˇŒ(b) As an evaluation tool. (i) For the educator to gain an understanding of where theø‹˘˘˘‹Œ˘˘Ìø∂Œparticipants are conceptually at for planning and evaluation reasons. and (ii) For the‹˘˘˘‹participants to self evaluate and monitor their own conceptual/cognitive progress. ‹˘˘˘Ω˘˘'Û˘˘˘˘˘˘‹In

both cases learning needs to build on present understandings. ‹˘˘˘æ˘˘(,˘˘˘˘˘˘‹‹˘˘˘ø˘˘(?˘˘˘˘˘˘‹Œ˘˘˘Œthe teaching and learning (cognitive and pedagogical) of mathematics a constructivist‹˘˘˘‹approach to learning was developed to facilitate for experience a program‹˘˘˘¿˘˘(R˘˘˘˘˘˘‹‹˘˘˘¡˘˘(x˘˘˘˘˘˘‹Course Work Requirements‹˘˘˘¬˘˘(ã˘˘˘˘˘˘‹Journal‹˘˘˘√˘˘(û˘˘˘˘˘˘‹Œ˘˘xxŒThe intention of the journal is to give students a place to collect ideas and, to reflect and‹˘˘˘‹Œ˘˘j™Œconsider such thoughts... thoughts thinking active students prepared to search and think‹˘˘˘‹Œ˘˘ôôŒand learn to be creative to be personal and emotional about their past experiences with‹˘˘˘‹mathematics ‹˘˘˘ƒ˘˘(±˘˘˘˘˘˘‹Œˇ'bŒa resource bank, vehicle to convey or share thoughts and beliefs regarding the course,‹˘˘˘‹ŒˇôôŒtheir personal feelings towards mathematic teaching and learning with the facilitator.‹˘˘˘‹Œˇ™™ŒThe role of the facilitator needs to encompass a

positive interrogative and interactive‹ˇˇˇ‹approach which will encourage a searching learning student. to (interactive)‹ˇˇˇ≈ˇˇ(˝ˇˇˇˇˇˇˇ‹the reflective practitioner‹ˇˇˇΔˇˇ)Iˇˇˇˇˇˇˇ‹Number Investigation‹ˇˇˇ«ˇˇ)\ˇˇˇˇˇˇˇ‹ŒˇˇƒÏŒTo give students the opportunity to investigate an everyday situation, theme or idea and‹ˇˇˇ‹ŒˇùâŒfind the associated mathematical concepts. The activity is structured in such a way to‹ˇˇˇ‹ŒˇˇˇŒshow students that Mathematics is real and common to everyday situations. An intrinsic‹ˇˇˇ‹ŒˇˇíIŒaim is to also show that in various situations we use mathematical concepts in everyday‹ˇˇˇ‹occurrences often without realizing it and without relating it to school mathematics.‹ˇˇˇ»ˇˇ)oˇˇˇˇˇˇˇ‹‹ˇˇˇ…ˇˇ)Œˇˇˇˇˇˇˇ‹Cooperative group project ‹ˇˇˇ ˇˇ)·ˇˇˇˇˇˇˇ‹social interaction‹ˇˇˇÀˇˇ)Ùˇˇˇˇˇˇˇ‹‹ˇˇˇÃˇˇ*ˇˇˇˇˇˇˇ‹School Based Assignment‹ˇˇˇÕˇˇ*ˇˇˇˇˇˇˇ‹actively finding out what a student knows‹ˇˇˇŒˇˇ*-ˇˇˇˇˇˇˇ‹‹ˇˇˇœˇˇ*@ˇˇˇˇˇˇˇ‹Negotiated Project‹ˇˇˇ–ˇˇ*Sˇˇˇˇˇˇˇ