

# Numbered Heads Together as a Tier 1 Instructional Strategy in Multitiered Systems of Support

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## Abstract

Federal mandates (Individuals With Disabilities Education Improvement Act, 2004; No Child Left Behind Act, 2001) require teachers to accommodate students with more diverse academic and behavioral needs in inclusive general educational settings. To assist general educators in meeting this instructional challenge, multi-tiered systems of support (MTSS) such as response to intervention (RtI) and positive behavior interventions and supports (PBIS) were established in schools nationwide. There is still a need, however, for classroom-based interventions with empirical support that are feasible to implement in whole-class settings and acceptable to teachers and students. Here, Numbered Heads Together (NHT), an alternative questioning strategy, is offered as a potentially effective Tier 1 intervention that can be used to improve student performance in general education classrooms. Extant research findings are described, procedures for using NHT in classroom settings are discussed, and future directions for research and practice are offered.

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Since the enactment of No Child Left Behind (2001) and the reauthorization of the Individuals With Disabilities Education Improvement Act (2004), general educators have assumed greater instructional responsibility for students with disabilities. By law, they are expected to use evidence-based or scientifically based practices to improve student outcomes (Heward, 2010; Spencer, Detrich, & Slocum, 2012). Yet most general educators do not know which practices are evidence based, receive few opportunities to use them in teacher preparation or professional development programs, and get little assistance and support in monitoring their impact on student performance (Begeny & Martens, 2006; Burns & Ysseldyke, 2009; Gable, Tonelson, Sheth, Wilson, & Park, 2012; Maheady, Smith, & Jabot, 2013). As the number of students with disabilities attending inclusive settings has increased, general educators have openly expressed reservations about their ability to meet these students' needs (Brownell, Adams, Sindelar, Waldron, & Vanhover, 2006; Rosenzweig, 2009).

To address the mounting instructional challenges and concerns confronting general and special educators, multi-tiered systems of support (MTSS) were developed (Harlacher, Sakellaris, & Kattelman, 2013). MTSS use evidence-based techniques that provide varying levels of intensity to increase the achievement of all students (Harlacher et al., 2013). Through varied tiers, differentiated instruction is provided to prevent academic and behavioral problems before reactive measures are put in place (Gamm et al., 2012). Two high-profile exemplars, response to intervention (RtI; Brown-Chidsey & Steege, 2005) and positive behavioral interventions and supports (PBIS) from the U.S. Department of Education's Office of Special Education Program (OSEP Technical Assistance Center for Positive Behavioral Interventions and Supports, n.d.) fall under the umbrella of MTSS. Both systems were designed to improve student outcomes by providing educators with access to and training in evidence-based practices and progress-monitoring systems to document the impact of selected services. It is in this context that Numbered Heads Together (NHT), a cooperative learning structure (Kagan & Kagan, 2009), is offered as a possible Tier 1 instructional practice.

NHT is an alternative teacher questioning strategy that actively engages all students simultaneously in collaborative, content-related discussions. All students write individual responses to each teacher question; share those responses in small, heterogeneous groups; and reach consensus. One member of each team is then selected randomly to provide the group's response. An emerging database of literature

suggests that NHT is more effective than the voluntary hand-raising practices that have dominated American education for decades (Haydon, Maheady, & Hunter, 2010; Hunter & Haydon, 2013; Maheady, Mallette, Harper, & Sacca, 1991; Maheady, Michielli-Pendl, Harper, & Mallette, 2006; Maheady, Michielli-Pendl, Mallette, & Harper, 2002). Teacher use of NHT can increase active student engagement, enhance interpersonal relationships, and improve student learning (Kagan & Kagan, 2009).

This article briefly describes the nature and purposes of MTSS. NHT is then offered as a potentially useful Tier 1 instructional practice for changing the way students respond to teacher questioning during class time. The extant research base on NHT is described, details are provided for using NHT in the classroom, and directions are offered for future research and practice.

## MTSS

Extensive literature indicates that RtI and PBIS are effective in helping teachers address academic and behavioral challenges in contemporary classrooms (e.g., Berkeley, Bender, Peaster & Saunders, 2009; Chitiyo & Wheeler, 2009; Fuchs & Fuchs, 2006; Grigorenko, 2009; Hoyle, Marshall, & Yell, 2011; Landers, Courtade, & Ryndak, 2012; Sugai & Horner, 2009). Batsche et al. (2005) describe RtI as a framework that (1) provides high-quality instruction and interventions that address students' specific needs, (2) monitors student progress frequently to make decisions about changes in instruction or goals, and (3) uses student response data to make important instructional decisions. It is a student-centered formative assessment framework that uses preventative problem solving and evidence-based practices to address academic and behavioral difficulties among students with and without disabilities. RtI promotes a strong core curriculum, instruction linked to individual student needs, and a continuum of increasingly intense support services (Berkeley et al., 2009; Fuchs & Fuchs, 2006; Glover & DiPierna, 2007). The overarching expectation of a successful RtI framework is to offer the necessary support for the majority of the students to meet both academic and behavioral expectations. In addition to the foundation of support provided to all students within a classroom, more intensive levels of support are offered to smaller populations of students who do not respond to initial levels of treatment.

Similar to RtI, PBIS is also a problem-solving model designed to prevent inappropriate behavior by teaching and reinforcing

appropriate behavior (OSEP Technical Assistance Center for Positive Behavioral Interventions and Supports, n.d.). The PBIS process is consistent with core RtI principles, offers a range of interventions that are applied systematically and with fidelity, and provides behavioral supports of increasing intensity across three service delivery tiers: (a) Tier 1—primary, (b) Tier 2—secondary, and (c) Tier 3—tertiary. More intensive behavioral supports are provided as students proceed through successive tiers (Hoyle et al., 2011; Landers et al., 2012).

RtI and PBIS share many conceptual, procedural, and empirical characteristics (Sandomierski, Kincaid, & Algozzine, 2007; Sugai & Horner, 2009). They have common conceptual and empirical roots in applied behavior analysis, curriculum-based assessment, pre-referral intervention, data-based decision making, and team-based problem solving. RtI and PBIS also include universal screenings, a continuum of evidence-based practices, data-based decision making, and measures of intervention fidelity. Importantly, both share an overarching focus on prevention of learning and behavior problems.

Within Tier 1 of the MTSS structure, early intervention and identification allow for appropriate differentiated instruction to be implemented for most students to be successful (Gamm et al., 2012). It is assumed further that if teachers use practices with empirical support (i.e., evidence-based practices), then students are more likely to succeed academically and behaviorally (States, Detrich, & Keyworth, 2012). The goal at Tier 1, therefore, is to structure classrooms for academic and behavioral success and in so doing prevent many common learning and behavior problems.

Meta-analyses conducted by the National Reading Panel (2000) and National Mathematics Advisory Panel (2008) have identified practices with empirical support in both core areas. In addition, years of applied research have shown that student achievement is maximized when teachers (a) set clear and challenging goals, (b) provide students with multiple opportunities to respond, (c) deliver positive and constructive feedback, (d) monitor student progress regularly, and (e) make instructional adjustments as needed (Lignugaris/Kraft & Harris, 2014). Similarly, most inappropriate behavior is preventable by teaching students more appropriate academic, behavioral, and interpersonal responses initially. Doing so requires the use of similarly explicit instructional practices (Lane, Kalberg, & Menzies, 2009; Simonsen, Fairbanks, Briesch, Myers, & Sugai, 2008). Yet little is known about teachers' actual Tier 1 practices, the extent to which they have empirical support, and in fact, prevent learning and behavior problems. One area for fruitful empirical inquiry may involve teacher questioning strategies.

### **Teacher Questioning Strategy: Hand Raising and Student Responding**

Most teachers assess student understanding during instruction by asking questions of the whole class and calling on volunteers who raise their hands to respond. Gilbert (2010) discussed Dylan William's extensive research on hand raising and reported that it is a prevalent practice that is used often (i.e., high-incidence) across most, if not all, grade levels. This commonly used practice, however, may also be widening the achievement gap in our classrooms. William noted, for example, that only about one quarter of students raise their hands consistently in response to teacher-led questions, while the rest tune out. These data are consistent with earlier process-product research (Brophy & Good, 1986; Rosenshine & Stevens, 1986), other teacher questioning studies (Maheady et al., 1991; Maheady et al., 2002), and visits to general education classrooms. More troubling, however, is the fact that higher achieving students do more active responding than their lower performing peers under this practice (Hayling, Cook, Gresham, State, & Kern, 2008; Maheady et al., 2002). Students with disabilities and others at risk are less likely to participate in such content-related discussions (Lewis & Doorlag, 2006; Rich & Ross, 1989). If teachers cannot actively engage students, it is likely that the probability of improving their academic or behavioral performance is diminished. It is difficult to get all students to respond to teacher questions, at least when responding is voluntary. NHT may provide an appealing instructional alternative for doing so.

### **NHT**

NHT is one of over 100 cooperative learning structures developed by Spencer Kagan and associates (Kagan & Kagan, 2009). Kagan's structural model is based on four basic principles: (1) positive interdependence, (2) individual accountability, (3) equal participation, and (4) simultaneous interaction. Like all Kagan structures, NHT requires teachers to break their classes into small, heterogeneous learning teams; provide students with structured opportunities to work collaboratively; and use common goal and reward structures to prompt and support positive interpersonal interactions. NHT was designed specifically to engage all students simultaneously in response to teacher questions and in so doing improve their academic performance (Maheady et al., 2006).

NHT has four primary components: (1) small, heterogeneous

learning teams; (2) structured roles within teams; (3) interdependent group contingencies; and (4) recognition for collective student effort. Specific procedural steps for using NHT with fidelity are included in Appendix 1. (For purposes of brevity, only the standard version of NHT is described here.) Initially, students are placed in small, heterogeneous learning teams, preferably with four members. Teams are formed systematically and are heterogeneous in terms of gender, ethnicity, and achievement (Kagan & Kagan, 2009). Typically they include at least one high-, one average-, and one low-performing student, who sit at common tables or desk "clusters" during teacher-led instruction.

Within teams, students follow structured roles and responsibilities. First, they are assigned numbers from 1 to 4. Next, each student is given a dry-erase board (i.e., response card), markers, and a cleaning cloth. When teachers direct questions to the class (e.g., "What will happen when we combine vinegar and baking soda?") students write down their responses and "belly up" their boards (i.e., hold cards close to their stomach). When all team members have written responses, they turn over their boards, "put their heads together" (i.e., share information, tutoring if necessary), agree on the best team response, and ensure that all team members know the answer(s). Teachers then *randomly* call a number from 1 to 4 (e.g., spin a spinner), and all students with that number must stand or raise their hands to respond. Teachers then pick one or all of those students to respond. Other students are then asked whether they agree with the responses (e.g., "How many number 4s agree?") and/or whether they can "add to" what was given. Teachers provide positive and/or corrective feedback, and students give one another "team cheers" for doing a good job. Boards are wiped clean until another question is asked and the same process is repeated.

Questions should not be limited to factual knowledge. Teachers can ask students to use information to solve problems, compare and contrast phenomena, provide applications, and/or analyze and summarize knowledge. NHT can be used at the beginning of class to activate students' prior knowledge, during class to maintain active student engagement and assess understanding, and/or at the end of lessons to review the most important big ideas. To facilitate implementation, an explicit instruction lesson plan for language arts (Archer & Hughes, 2011) is included (see Figure 1). The lesson plan shows how NHT was infused into a lesson from a previous investigation.

<p><b>Subject:</b> Language Arts    <b>Teacher:</b> Ms. Simmons    <b>Date:</b> Monday, October 22<sup>nd</sup>, 2014</p> <p><b>Total Number of Students/Total Number of Students with IEP(s):</b> 8/8 (Self-Contained Classroom)</p> <p><b>Lesson Title:</b> “Exploring the Non-Violent Teachings of Mahatma Gandhi and Martin Luther King Jr.”</p> <p><b>Standard:</b> CCSS.ELA-Literacy.RI.7.1: Cite several pieces of textual evidence to support analysis of what the text says explicitly as well as inferences drawn from the text.</p> <p><b>Objective:</b> The students will answer 10 text supported questions with a focus of analysis of main and secondary ideas with 80% accuracy in Numbered Heads Together groups.</p> <p><b>Materials:</b> Small hand held dry erase boards, dry erase markers, dry erasers, 1 dice, large dry erase board (accompanied by projector) or interactive white board, Microsoft PowerPoint, YouTube™ video community (<a href="https://www.youtube.com/watch?v=BaIg8l7w7qg">https://www.youtube.com/watch?v=BaIg8l7w7qg</a>), Document-based Questions for Reading Comprehension and Critical Thinking by D.J. Housel.</p>
<p style="text-align: center;"><b>Background Information</b></p> <p>Ms. Simmons is responsible for delivering Tier 1 (Multi-Tiered System of Supports) instruction to her self-contained classroom. The class is working on a unit that focuses on high-interest non-fictional stories. The objectives of the previous included understanding selected literature text and providing practice opportunities toward acquisition of the language arts materials. Ms. Simmons will continue to incorporate Universal Design For Learning (UDL) through use of technology and differentiated instruction through working with multi-skilled level cooperative learning groups in the Numbered Heads Together (NHT) activity. Prior to the NHT lesson students were placed in two heterogeneous skilled level groups.</p>
<p style="text-align: center;"><b>Anticipatory Set</b></p> <p>Gain students attention by showing three clips of peaceful non-violent demonstrations of civil rights from culturally popular cinematic movies.</p> <p>After the clips are presented to the students, Ms. Simmons will ask three questions directly related to the cinematic clips that would require students to use the skill of inference.</p>
<p style="text-align: center;"><b>Interactive Instruction</b></p> <p>Model and explain rationale of answers for previous three questions related to the three cinematic movie clips presented in the anticipatory set.</p>

*Figure 1.* NHT lesson plan. Based from the Haydon, Maheady, & Hunter (2010) study.

Table 1

Investigators	Maheady, Mallette, Harper, and Sacca (1991)	Maheady, Michiel-Pendl, Mallette, and Harper (2002)	Maheady, Michiel-Pendl, Harper, and Mallette (2006)	Haydon, Maheady, and Hunter (2010)	Hunter and Haydon (2013)
Settings	Third-grade social studies Small, urban, ethnically integrated district	Sixth-grade science class Small, urban, ethnically integrated district	Sixth-grade science class Small, urban, ethnically integrated district	Seventh-grade social studies (self-contained room for students with mild to moderate disabilities)	Eight-grade math (self-contained room for students with EBD)
Length of treatment (dosage)	18 sessions × 30 minutes = 540 minutes	11 sessions × 42 minutes = 462 minutes	29 sessions × 42 minutes = 1,218 minutes	22 sessions	14 sessions
Sample demographics /students	N = 20 10 male, 10 female, 11 Caucasian, 6 Hispanic, 3 African American, 6 students retained one grade level	N = 21 7 male, 14 female, 4 Caucasian, 15 Hispanic, 2 African American, 4 students identified with IEPs, 2 ELLs	N = 23 15 male, 8 female, 13 Hispanic, 10 Caucasian, 2 with IEPs, 8 ELLs	N = 3 2 male, 1 female, 3 African American, 3 with IEPs, IQ range of 70–93	N = 4 3 male, 1 female, 2 Caucasian, 2 African American, ages 12.5–13.11, identified with EBD
Teacher participants	Caucasian female 15 years teaching experience	Caucasian female 27 years teaching experience	Caucasian female 28 years teaching experience	African American male 10 years of teaching experience	Caucasian female 11 years teaching experience
Study design	Alternating treatments	Alternating treatments	A-B-BC-B-BC	Alternating treatments	Alternating treatments



Dependent variables	% correct on 10-item social studies quiz	% correct on a 10-item quiz	% correct on a 10-item quiz	10-item language arts quiz scores	10-item math quiz scores
	Student on-task behavior	Questioning event Recording system	Active student responding Social validity	Student on-task behavior	Student on-task behavior
Results: Quiz data	Increased class quiz scores; teacher-led = 68% versus NHT = 84%	Increased class quiz scores; WGQ&A = 73% versus NHT = 86% versus response cards = 86%	Increased quiz scores; WGQ&W = 72% versus NHT = 81% versus NHT+I = 89%	Increased language arts quiz scores; baseline = 42% versus NHT = 62%	Improved math computation quiz scores; baseline = 26% versus NHT = 72%
Results: On-task data	Increased on-task behavior; teacher-led = 39% versus NHT = 71%	Increased student responding; WGQ&A = 24% versus response cards = 81% versus NHT = 96%	Not assessed	Increased on-task behavior; baseline = 63% versus NHT = 96%	Increased on-task behavior; baseline = 48% versus NHT = 86%

*Note.* EBD = emotional behavioral disorders; IEP=Individual Education Program ; ELL = English language learners; NHT = Numbered Heads Together, NHT+I = Numbered Heads Together plus incentives; WGQ&A = whole-group question and answer.

### A Summary of the Literature on the Effects of NHT

NHT has been used in at least five empirical studies across two research groups (see Table 1). The first three investigations were conducted in a small urban, culturally and linguistically diverse school district in third-grade social studies and sixth-grade science classes. Using single-case research designs (i.e., alternating treatments and A-B-A-B variant), two teachers with over 15 years of experience compared the effects of NHT and a variant with a behavioral incentive package to those of their normal questioning practice (i.e., hand raising) and response cards. In third-grade social studies, student on-task rates almost doubled (i.e.,  $\times$  39% versus 71%) when NHT with a behavioral incentive package was used instead of hand raising, and quiz scores improved from a class mean of 68% to 84% (Maheady et al., 1991). Ninety percent of students preferred NHT over hand raising, and the teacher continued using it after the study ended.

The sixth-grade science teacher used NHT in two studies; the first compared the effects of NHT to hand raising and response cards (Maheady et al., 2002), while the second examined differential effects of NHT, with and without the behavioral incentive package, on student on-task rates and science quiz performance (Maheady et al., 2006). The former study found that both response cards and NHT produced higher on-task rates and science quiz scores than hand raising, while the latter reported that NHT produced a one-letter-grade improvement in science quiz scores over hand raising, and another grade-level improvement when behavioral incentives were added. Students preferred both NHT versions over hand-raising procedures and reported that they helped them learn class material better. Initial investigations were replicated and extended by a second research team (Haydon et al., 2010; Hunter & Haydon, 2013), who used NHT in self-contained special education classes. The first study compared the effects of existing practices to NHT, with and without a behavioral incentive package, on three students' on-task rates and language arts quiz scores. Results showed that both NHT versions produced higher on-task rates and improved academic quiz scores for all three students. Students increased on-task rates by over 30% and quiz scores by more than 20% under both NHT conditions. There were no clear differential effects for one NHT version over the other.

Hunter and Haydon (2013) then examined the effects of NHT, with and without a behavioral incentive package, on four students' math quiz scores and on-task behavior in a self-contained class for students with emotional behavioral disorders. Using an alternating-treatments design, they found that NHT with incentives produced the

highest on-task rates (94%) and math quiz scores (80%), followed by standard NHT (i.e., 64% correct and 76% on-task) and existing practices (i.e., 26% correct and 48% on-task). Again, students indicated a preference for both NHT versions over existing practices.

Collectively, the studies demonstrated that NHT with and without behavioral incentives was more effective than existing teaching practices in increasing students' on-task behavior and improving their academic performance across general and special education settings. All studies assessed fidelity of implementation and social validity and found that NHT was easy to implement and generally well liked by teachers and students. In another report, Kagan (2014) reported that the average effect size of the five NHT studies was .92 (strong effect) and consistent with previous meta-analyses conducted on cooperative learning.

### **NHT and Tier 1 Service Delivery**

Originally, RtI focused on early reading interventions primarily in lower grades (Fuchs & Fuchs, 2006). In recent years, however, RtI has spread to all academic content areas and behavior (Berkeley et al., 2009; Glover & DiPierna, 2007; Mellard, Stern, & Woods, 2011). As such, NHT use in language arts, math, social studies, and science takes on particular relevance. NHT may be an appealing and functional Tier 1 practice for preventing learning and behavior problems for other reasons as well.

First, NHT requires all students to respond actively in class rather than relying on only those who volunteer. This is a clear change in expectation for students from voluntary to routine responding. Second, all students must make written responses to each teacher question. This increases individual response opportunities and informs teachers of all student responses. Instead of basing instructional decisions (e.g., Do they understand?) on the responses of a few typically high-performing students, teachers get to see the range of student responses to each question. Third, by sharing responses before responding, all students (including those who do not know, are unsure, and/or are reluctant to respond) gain access to credible information. This is due in part to the use of mixed-ability teams. Since students gain access to requested information before responding, the procedure serves as a "pre-correction" and increases their probability of responding and doing so correctly. Fourth, NHT uses interdependent group contingencies that promote positive interpersonal interactions and improved attitudes toward school and peers (Kagan

& Kagan, 2009). Students encourage and recognize one another for good team responses.

NHT may also appeal to teachers because it promotes simultaneous and equal participation in the classroom. All students write responses at the same time, and everyone shares their responses with team members. Team discussions stay focused on improving everyone's understanding because students cannot predict who will respond for the team. NHT is also flexible and easy to use in multiple content areas (e.g., language arts, social studies, and science) and with different question types (e.g., factual, comparative, and evaluative). Finally, NHT has embedded components of explicit teacher expectations and procedures, which are core Tier 1 PBIS components (Shepherd & Linn, 2015).

### **Future Research and Practice**

Despite its demonstrated success, more research is needed on the effects of NHT. To date, empirical evidence has been collected primarily by two research teams. There is need for additional replications across geographic locations, age/grade levels, setting types (e.g., general, special, and alternative education), outcome variables, and independent researchers. Future studies should also examine the impact of NHT for longer durations, use explicit generalization and maintenance measures, and tease out the relative contributions and costs and benefits of a behavioral incentive package. It might also be interesting to examine NHT effects on specific student populations such as those with other health impairments such as attention deficit hyperactivity disorder as well as physical and communicative disabilities. The NHT strategy might be especially useful for students with more severe physical or communication disabilities who participate in cooperative learning groups within inclusive environments. Because each group is allowed time to discuss questions as a small group and because every group member may be randomly called on to answer the teacher's question, students without disabilities or with more moderate disabilities are required to ensure that a student with more significant disabilities also understands and can present the group's answer as all group members are accountable. In addition, this group time allows students with assistive physical and/or communication needs the time necessary to record their answers on an assistive communication device, ensuring their full participation.

Future research should observe directly the interactions among NHT team members and examine other interpersonal student

outcomes (e.g., attitudes toward school and subject matter, interpersonal interaction patterns, and peer acceptance). Another interesting research agenda might integrate NHT procedures into teacher preparation methods and/or classroom management coursework. Future teachers might be given structured opportunities to use these practices in applied field experiences before working independently in their own classrooms.

While researchers grapple with empirical and dissemination issues, teachers can collect their own practice-based evidence to see what effects NHT has on class performance. Do more students participate (i.e., write responses) when NHT is used instead of hand raising? What is the nature and tone of team discussions? Does everyone share responses, and are interactions positive and supportive? How is student academic performance affected, if at all, when students use NHT? Does NHT appear to prevent any academic or behavior problems? These are but a few of the unanswered questions about NHT.

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Appendix 1

Fidelity Checklist for Using Numbered Heads  
Together in the Classroom

Teacher: \_\_\_\_\_

School: \_\_\_\_\_

Time Session Begins: \_\_\_\_\_

Date: \_\_\_\_\_

Observer: \_\_\_\_\_

Time Session Ends: \_\_\_\_\_

General Directions:

After observing the class session for a minimum of 20 minutes, check **Yes** next to each item that was present during your observation. Check **No** if a particular activity was not present during your observation. Add anecdotal comments as deemed necessary!

Instructional Activities	Yes	No
1. Students are seated in small, heterogeneous teams.		
2. Students in teams are numbered 1–4.		
3. Teacher-led, whole-group instruction occurs.		
4. Teacher asks knowledge-based questions to entire class and provides “think time.”		
5. Pupils write down answers and belly up boards.		
6. All students turn over boards.		
7. Students put heads together.		
8. Students share individual responses.		
9. Teacher says, “How many number __ know the answer?”		
10. <i>All</i> designated students respond (e.g., raise hands, raise response boards, respond in unison responding, or use hand gestures).		
11. Teacher picks student(s) to respond and checks with others for agreement.		
12. Teacher asks whether any team members disagree or can expand on answers.		
13. Teacher provides positive or corrective feedback to class.		
14. Students wipe off boards to prepare for next question.		
15. Teacher transitions to next instructional activity.		
<i>Subtotal</i>	____ / 15 =	____ %

Anecdotal Comments:

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